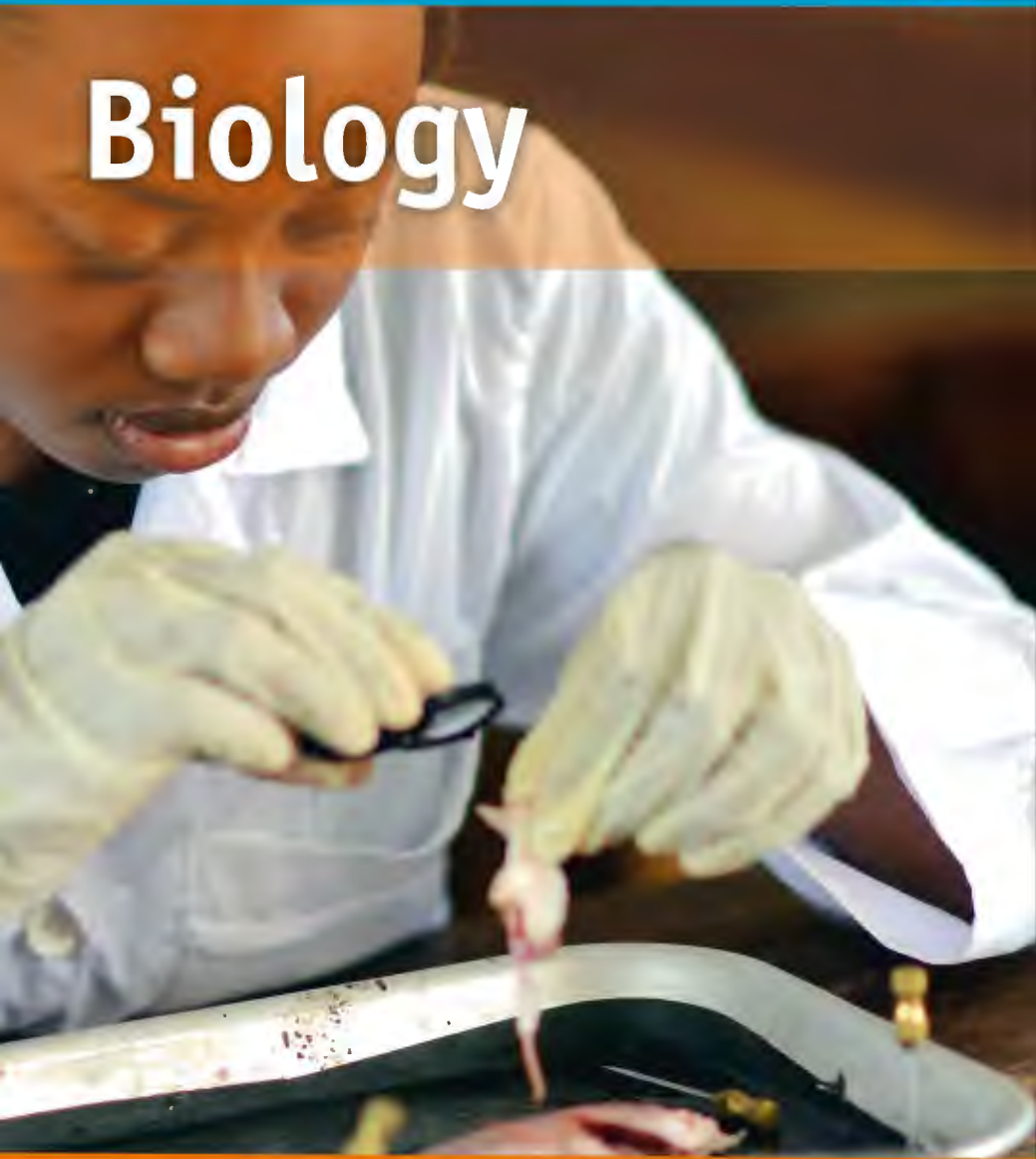
Caribbean Examinations Council

Biology



CAPE® PAST PAPERS

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TEST CODE **02107010**

FORM TP 2005170

MAY/JUNE 2005

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 1 – PAPER 01

$1\frac{3}{4}$ hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. Candidates must attempt ALL questions in this paper.
2. Answers are to be written in the spaces provided in this answer booklet.
3. EACH question is worth 10 marks.
4. The use of silent non-programmable calculators is allowed.

1. (a) Table 1 below is constructed to show the constituents and types of bonding in THREE saccharides. Complete Table 1 below.

TABLE 1: BONDING IN THREE SACCHARIDES

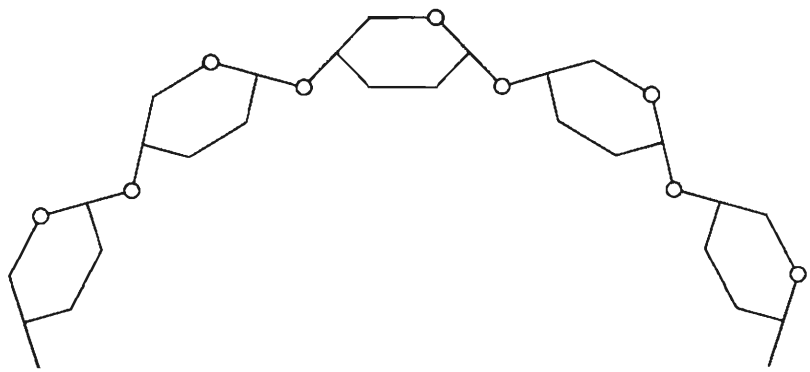
Saccharide	Constituent monomers	Precise type of bonding
Sucrose		
Glycogen		
Cellulose		

[3 marks]

(b) The diagrams in Figure 1 below show portions of two polysaccharides.

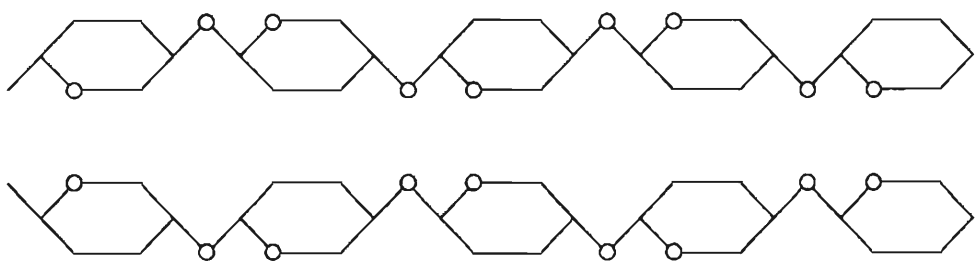
On EACH diagram, draw ALL the hydroxyl groups (– OH) on carbon number two of EVERY monomer.

(i) Glycogen:



[1 mark]

(ii) Cellulose:



[1 mark]

Figure 1. Two polysaccharides A and B

GO ON TO THE NEXT PAGE

(c) (i) Circle the groups involved in hydrogen bonding between the two adjacent polysaccharide chains in cellulose in Figure 1. **[1 mark]**

(ii) Suggest TWO ways in which the structure of glycogen supports its functions.

_____

_____

_____

_____

[2 marks]

(d) With reference to the structures shown in Figure 1, suggest why glycogen is soluble in water and cellulose is not.

_____

_____

_____

_____

_____

_____

[2 marks]

Total 10 marks

2. (a) Table 2 below is designed to show differences between prokaryotes and eukaryotes.

Complete Table 2 to detail the differences in size and structure between prokaryotes and eukaryotes.

TABLE 2

STRUCTURAL DIFFERENCES BETWEEN PROKARYOTES AND EUKARYOTES

Feature	**Prokaryote cells**	**Eukaryote cells**
Approximate size		
Nuclear Structure		
Structure of DNA		
Energy generating structures		
Ribosomes		

[5 marks]

(b) State THREE features possessed by

(i) animal cells but NOT plant cells.

Feature: _____

_____

Feature: _____

_____

Feature: _____

_____

(ii) plant cells but NOT animal cells.

Feature: _____

_____

Feature: _____

_____

Feature: _____

_____

[3 marks]

(c) The Benedict's test is used to confirm the presence of a reducing sugar in solution. If a solution contains ONLY a non-reducing sugar, what modifications must be made to the Benedict's test procedure to reveal the presence of the non-reducing sugar?

_____

_____

_____

_____

[2 marks]

Total 10 marks

3. (a) State why it is necessary for enzymes to be present in living organisms.

[**2 marks**]

(b) The anti-cancer drug methotrexate targets the enzyme dihydrofolate reductase. The activity of the enzyme dihydrofolate reductase is very high in some tumour cells.

Suggest whether methotrexate would be effective in curing tumours and give ONE reason for your answer.

[**2 marks**]

(c) Diisopropylphosphorofluoriate (DIPF) reacts with the hydroxyl group of the amino acid serine at an enzyme's active site, preventing the use of this side chain in catalytic reactions. DIPF is classified as a nerve gas and can cause death.

Deduce the type of inhibition that is occurring.

[**1 mark**]

(d) The enzyme succinate dehydrogenase is found in all mitochondria, and catalyses the conversion of succinate to fumarate. Oxaloacetate is similar to succinate but when this compound binds to the enzyme, no reaction occurs. In a mixture of succinate and oxaloacetate, when oxaloacetate moves out of the active site of succinate dehydrogenase, the enzyme is free, once again, to catalyse conversion of succinate to fumarate.

Deduce the type of inhibition occurring.

[**1 mark**]

(e) In EACH graph in Figure 2 below, one line represents a catalysed reaction while the other represents an uncatalysed reaction.

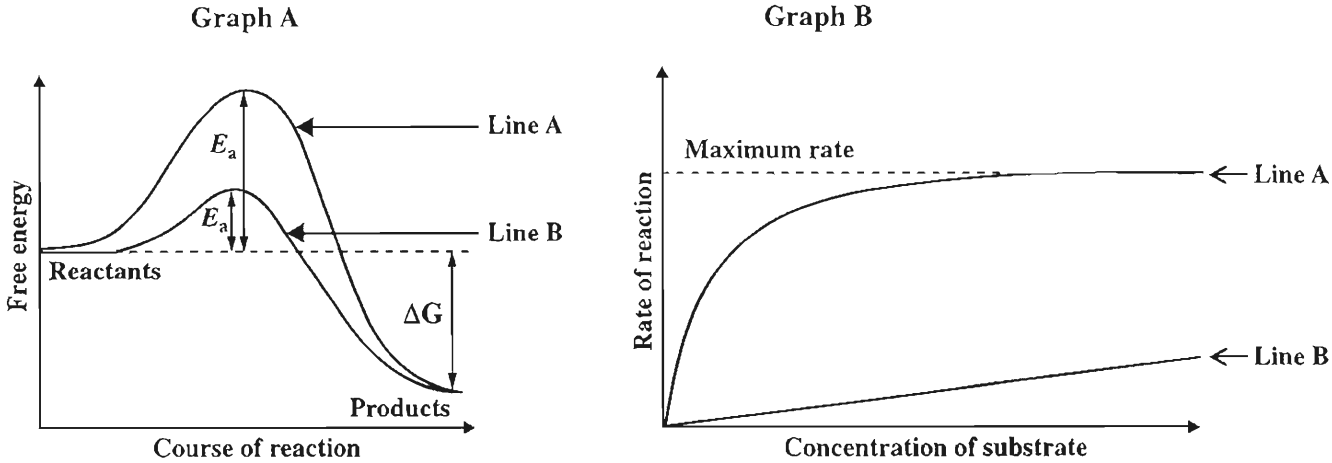


Figure 2. Catalysed and uncatalysed reactions

(i) a) Examine Graph A in Figure 2. Which graph line represents the enzyme catalysed reaction?

Enzyme catalysed reaction: Line _____

[1 mark]

b) Give ONE reason for your answer to (i) a) above.

_____

_____

_____

[1 mark]

(ii) a) Examine Graph B in Figure 2. Which graph line represents the enzyme catalysed reaction?

Enzyme catalysed reaction: Line _____

[1 mark]

b) Give ONE reason for your answer to (ii) a) above.

_____

_____

_____

[1 mark]

Total 10 marks

GO ON TO THE NEXT PAGE

4. (a) Briefly outline the process by which chromatids condense to one tenth of their original length.

_____

_____

[1 mark]

(b) Name the FOUR nucleotide bases that are found in DNA.

_____

_____

[2 marks]

(c) The drug dideoxycitidine is a nucleoside made with 2′, 3′ dideoxyribose sugar. This sugar does not have OH^- groups on the 2′ and 3′ positions. Consider the structure of a strand of DNA and explain why this drug would stop DNA replication.

_____

_____

_____

[2 marks]

(d) Figure 3 shows two stages, A and B, of a biological process that occurs in living cells.

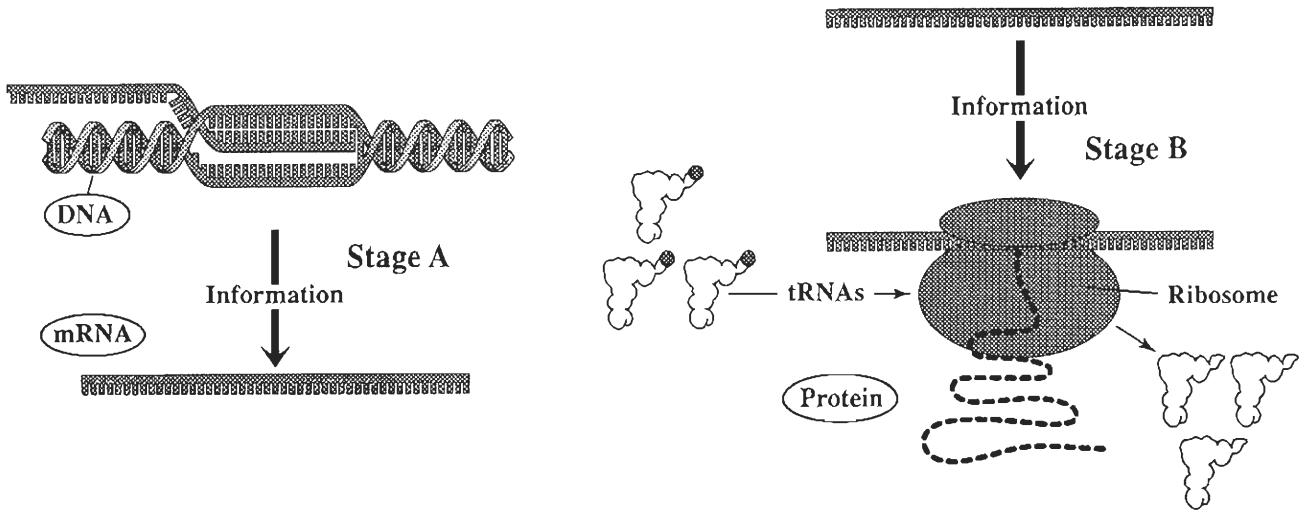


Figure 3. A biological process occurring in living cells

(i) Name the stages A and B of the process occurring in Figure 3.

Stage A _____

Stage B _____

[2 marks]

(ii) Outline the process occurring at Stage A in Figure 3.

_____

_____

_____

[3 marks]

Total 10 marks

5. Study Figure 4 showing a post-fertilization carpel.

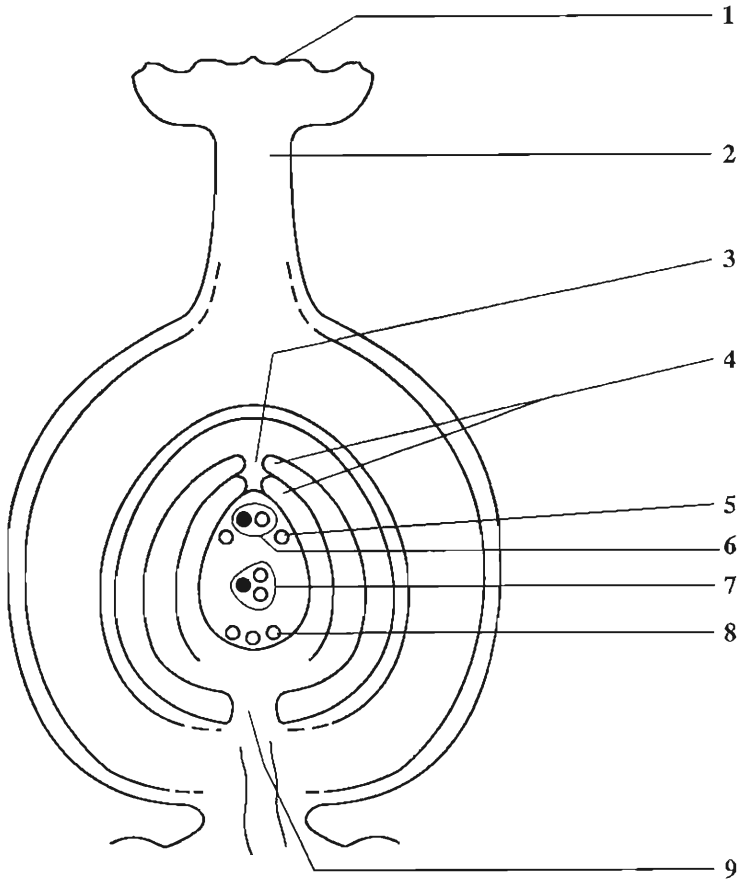


Figure 4. A post-fertilization carpel

(a) Identify the structures labelled 1 to 9 in Figure 4 above.

1 _____ 5 _____

2 _____ 6 _____

3 _____ 7 _____

4 _____ 8 _____

9 _____

[3 marks]

(b) State the contributions of the structures labelled 3 and 4 in Figure 4 to the establishment of the next generation.

(i) Label No. 3 _____

_____

_____

[2 marks]

(ii) Label No. 4 _____

_____

_____

[1 mark]

(c) In the plant structure shown in Figure 4, a 'double fertilization' occurs. State the names of the FOUR nuclei which contribute to the double fertilization.

_____

_____

_____

[2 marks]

(d) Compare the development of the zygote with that of the fertilized endosperm cell, in relation to:

(i) The future differentation of tissue

_____

_____

_____

_____

[1 mark]

(ii) The location of food storage

_____

_____

_____

_____

[1 mark]

Total 10 marks

6. Figure 5 shows a foetus in its eighth week of pregnancy.

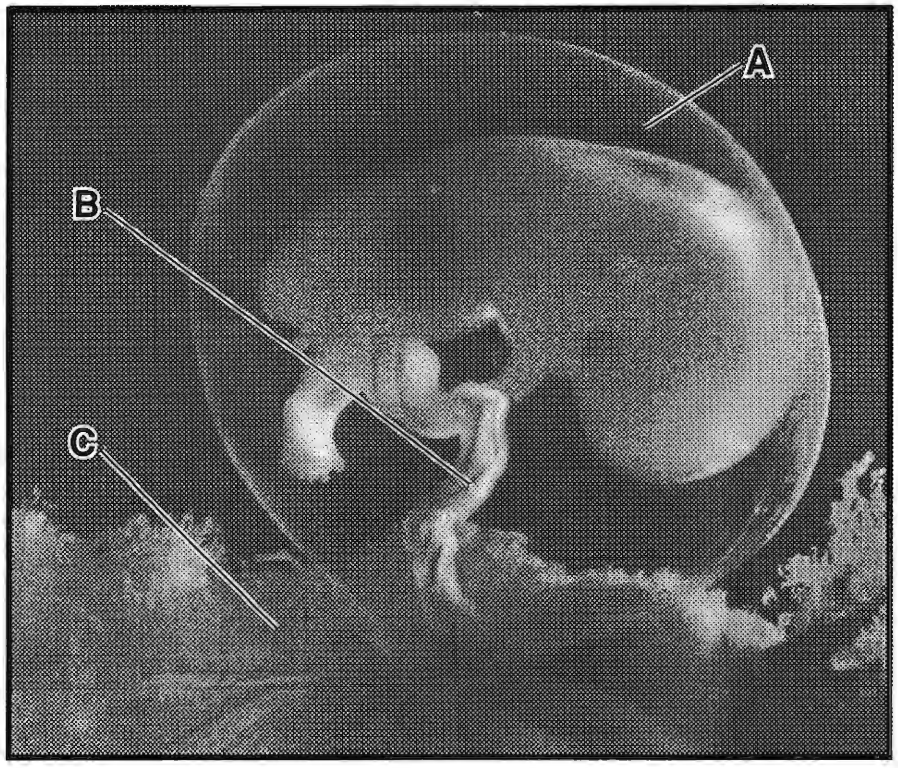


Figure 5. Foetus in the eighth week of pregnancy

Biology of Life on Earth.
J. Audesirk, G. Audesirk, Prentice Hall

(a) (i) Name the cavity, labelled A in Figure 5, in which the foetus is developing **and** state its function.

[3 marks]

(ii) Name the structure labelled B in Figure 5 **and** describe its function.

[3 marks]

GO ON TO THE NEXT PAGE

(iii) Identify the structure in Figure 5 which acts as an endocrine organ.

_____

[1 mark]

(b) Describe the effect on her unborn child when a woman drinks excessive quantities of alcohol.

_____

_____

_____

_____

_____

[2 marks]

(c) Explain why the placenta is not an effective barrier against substances that can harm the foetus.

_____

_____

_____

[1 mark]

Total 10 marks

7. (a) State TWO ways in which the process of meiosis increases rearrangement of the chromosomal material before it reaches the poles of the cell.

_____

_____

_____

_____

_____

_____

[2 marks]

(b) Down's Syndrome is an example of a mutation.

(i) What type of mutation is involved in Down's Syndrome?

_____

[1 mark]

(ii) State how this mutation is caused.

_____

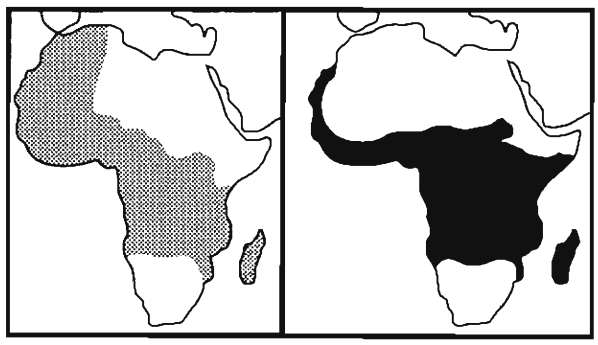
_____

_____

[1 mark]

(c) Sickle cell anaemia is caused by a mutation in the haemoglobin gene. The normal alleles are AA, the lethal sickle cell alleles are SS, and the heterozygote, which shows mild sickling, is AS. The sickle cell allele has been established in the African population for thousands of years, alongside the disease malaria.

The maps of Africa in Figure 6 show the distribution of sickle cell disease and malaria, prior to the 1950s, when mosquito eradication programs began.



Sickle Cell Disease Malaria

Figure 6. Distribution of two diseases

Following the mosquito eradication programs in Africa, the incidence and distribution of malaria were reduced.

What effect would this reduction in the cases of malaria have on the incidence and distribution of sickle cell disease, and why?

[4 marks]

(d) Between 1650 and 1850, African populations were established in the Caribbean. Some of the territories had endemic malaria and some did not. The present-day frequencies of sickle cell (SS, AS) and the normal gene (AA) have been calculated, and the results are expressed in Table 3.

TABLE 3: FREQUENCIES OF TWO DISEASES

Malaria present in territory			**Malaria absent in territory**		
Territory	**Alleles**		**Territory**	**Alleles**	
	SS or AS	**AA**		**SS or AS**	**AA**
Honduras	164	541	St. Vincent	65	683
Suriname	35	137	Barbados	64	848

Use the figures in Table 3 to determine the ratio of sicklers (SS and AS) to normal (AA) in the malaria-present territories in comparison with the malaria-absent territories. How do they compare?

[2 marks]

Total 10 marks

8. (a) Give TWO reasons why classification systems are important.

[2 marks]

(b) Figure 7 below shows eight carefully preserved prehistoric specimens discovered by a student. These specimens must be classified.

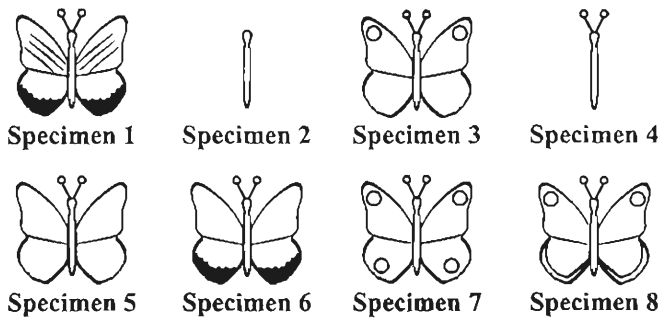


Figure 7. Butterfly specimens

(i) Select TWO features that could be used to classify the prehistoric specimens in Figure 7.

[2 marks]

GO ON TO THE NEXT PAGE

(ii) Using your knowledge of hierarchy in classification systems, arrange the specimens in evolutionary order from original ancestor to descendents. Use specimen numbers to illustrate your answer. DO NOT draw the specimens.

ORIGINAL ANCESTOR

DESCENDENTS

[4 marks]

(c) Name the five kingdoms of the 'Five-Kingdom Classification System'.

_____

_____

_____

_____

_____

[1 mark]

(d) Explain what is meant by the term 'dichotomous key'.

_____

_____

_____

[1 mark]

Total 10 marks

GO ON TO THE NEXT PAGE

9. (a) By means of named examples, distinguish between:

(i) Biome and Biomass

[2 marks]

(ii) In situ and ex situ conservation methods

[2 marks]

(b) Give TWO reasons why it is more difficult to store frozen embryos than frozen sperm.

[2 marks]

(c) There are fewer than 250 white (albino) tigers on earth and they all live in zoos or reserves. Captive breeding programs are used between the network of tiger sanctuaries.

(i) Give TWO reasons why white tiger populations in the wild have become so low.

_____

_____

_____

_____

_____

[2 marks]

(ii) Describe TWO objectives of the 'captive breeding programs' used between the network of tiger sanctuaries.

_____

_____

_____

_____

_____

[2 marks]

Total 10 marks

END OF TEST

TEST CODE **02107020**

FORM TP 2005171

MAY/JUNE 2005

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 1 – PAPER 02

$2\frac{1}{4}$ hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of NINE questions.
2. Section A consists of THREE questions. Candidates must attempt ALL questions in this section and should spend no more than 30 minutes on this section. Answers to this section MUST be written in this question paper answer booklet.
3. Section B consists of SIX questions. Candidates must attempt THREE questions in this section, ONE question from EACH module. Answers to this section MUST be written in the answer booklet provided.
4. The use of silent non-programmable calculators is allowed.

SECTION A

You must attempt ALL THREE questions in this section. You should NOT spend more than 30 minutes on this section.

1. The rates of enzyme catalysed reactions can be influenced by the pH at which they occur. Table 1 shows the relative reaction rates for salivary amylase and arginase at different pH values.

(a) On the graph grid provided, plot a graph of the relative rates for BOTH salivary amylase and arginase. **[6 marks]**

TABLE 1: REACTION RATES FOR TWO ENZYMES

pH values	Relative reaction rates	
	Salivary amylase (units)	Arginase (units)
4.5	2.2	0
5.0	5.0	0
5.5	8.0	0.2
6.0	13.0	1.0
6.5	17.0	4.0
7.0	18.0	7.0
7.5	16.0	9.0
8.0	11.0	11.8
8.5	6.0	13.5
9.0	2.0	16.0
9.5		18.0
10.0		17.8
10.5		15.0
11.0		14.0

(b) Using the graph, determine the optimal pH for

(i) arginase activity _____

[1 mark]

(ii) salivary amylase activity _____

[1 mark]

(c) Compound X is a substrate that has two parts, Part 1 and Part 2. Part 1 can be digested ONLY by arginase and Part 2 ONLY by salivary amylase. Both enzymes are required for the complete digestion of compound X.

Determine the optimal pH at which BOTH of these enzymes together digest compound X.

_____

[1 mark]

(d) Name TWO factors, in addition to pH, that can affect an enzyme's catalytic activity.

_____

[1 mark]

Total 10 marks

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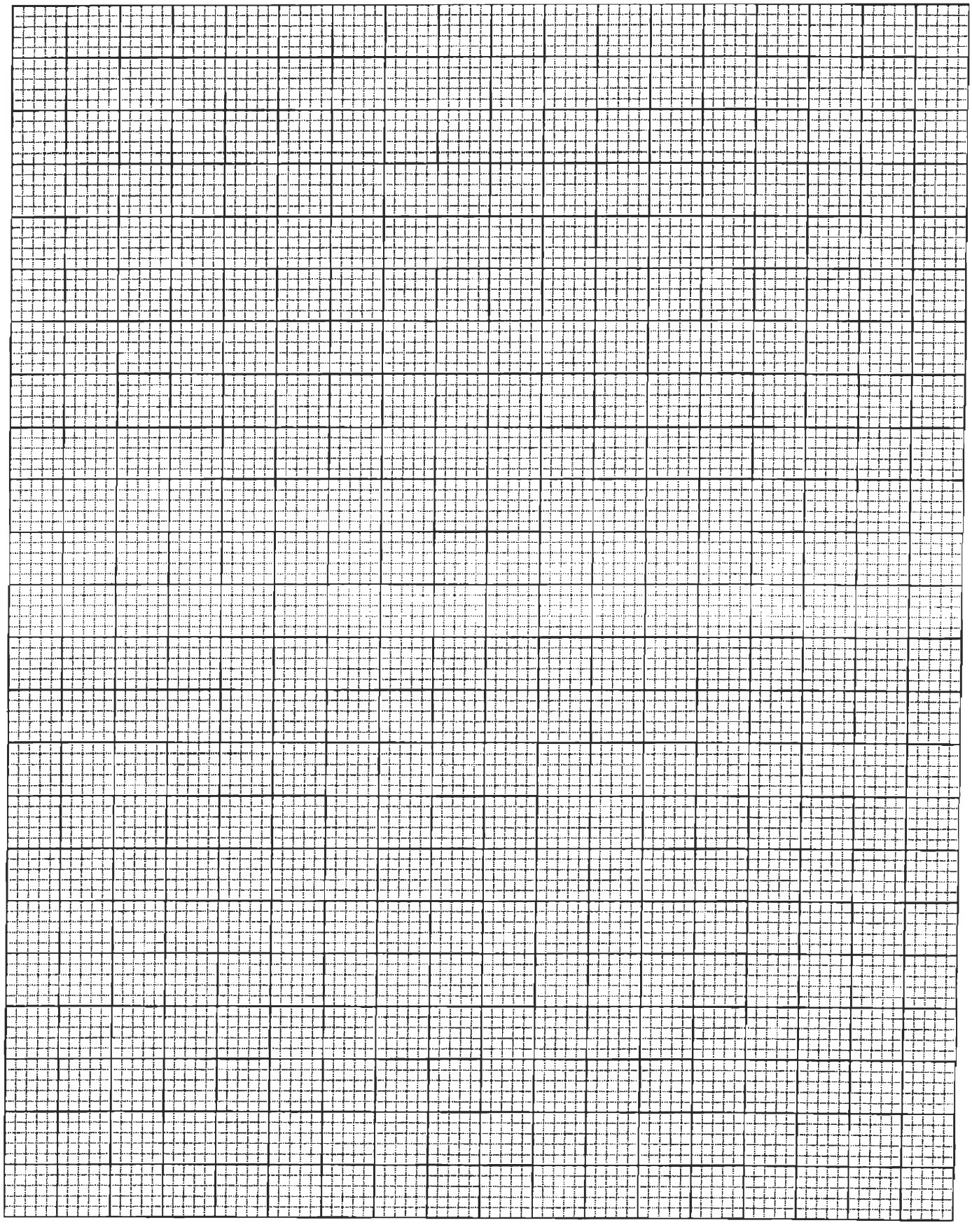


GO ON TO THE NEXT PAGE

2. (a) Consider the following hormones:–

(F) Follicle Stimulating Hormone

(L) Leutenizing Hormone

(O) Oestrogen

(P) Progesterone (when not pregnant)

Write the circled symbol for EACH hormone on the graph in Figure 1 at the exact day where the hormone is at its maximum concentration during the menstrual cycle. (You may sketch in the graph lines to assist you if you wish.)

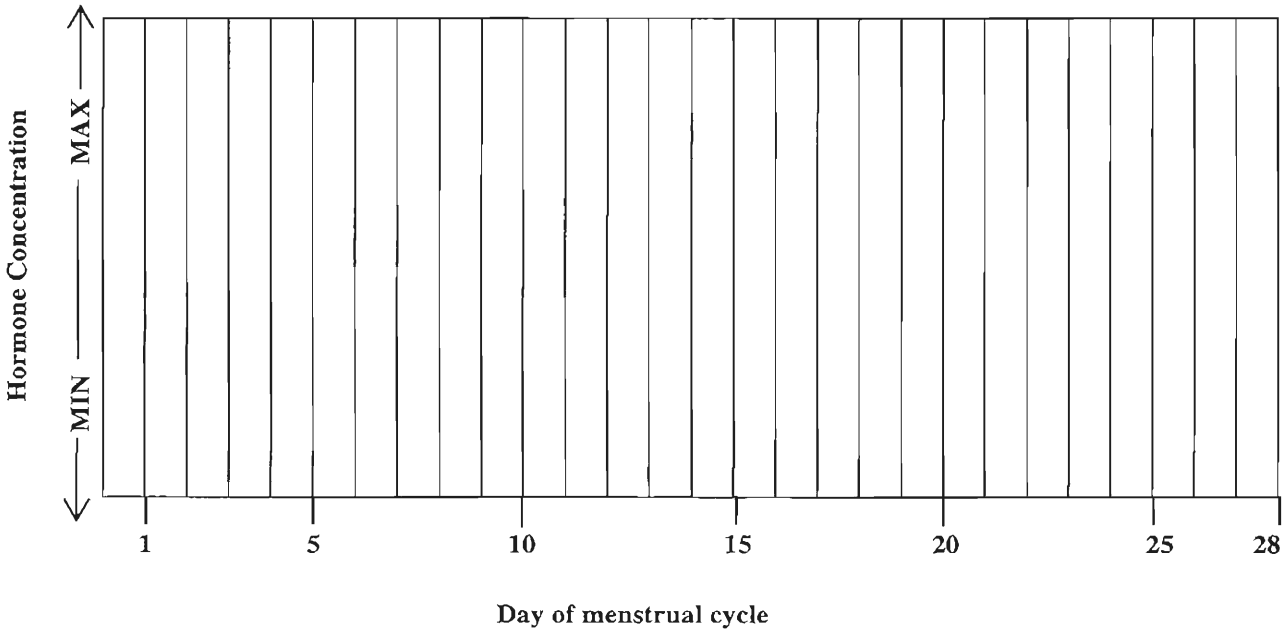


Figure 1. Hormone at its maximum concentration

[3 marks]

(b) Figure 2 is a microscopic section of a human ovary.

Figure 2. Section of a human ovary

Histology Colour Atlas of Microscopic Anatomy, 3rd Edition. Sobotta/Hammerson Urban and Schwartzenberg Inc.

(i) In the space provided below, at a magnification of 0.5, draw a plan diagram of the ovary in Figure 2 to show the distribution of the major tissues.

[3 marks]

GO ON TO THE NEXT PAGE

(ii) Identify structures 1 to 6 in Figure 2.

1: _____ 2: _____

3: _____ 4: _____

5: _____ 6: _____

[3 marks]

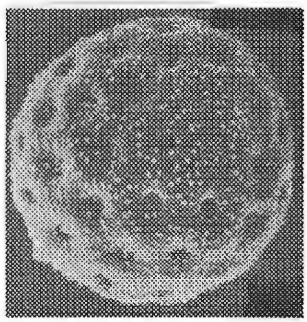
(c) If the length of the human ovary is 3.5 cm, what is the magnification of your drawing in (b) (i)?

_____

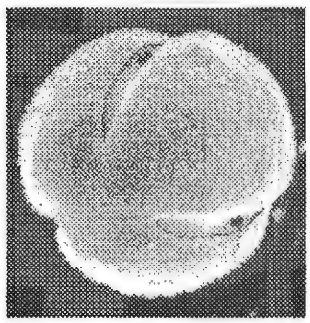
[1 mark]

Total 10 marks

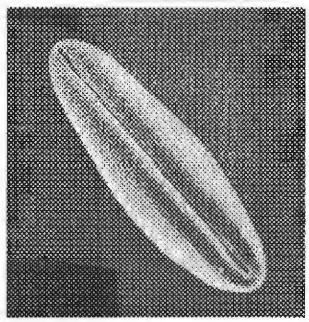
3. Figure 3 below consists of five scanning electronmicrographs of angiosperm pollen grains, showing aperture types and surface features.



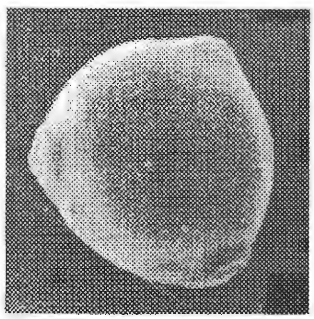
Chenopodium oahuense
Many pores
Diameter: 14 μm



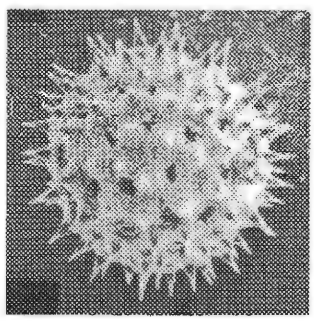
Scuevola glabra
Three pores three slits
Diameter: 33 μm



Magnolia grandiflora
One slit
Diameter: 34 μm



Cucumis sativus
Three pores
Diameter: 55 μm



Ipomea wolcottiana
Many pores
Diameter: 55 μm

Plant Systematics: A Phylogentic Approach, 2nd Edition.
W. Judd et al. Sinauer Associates Inc.

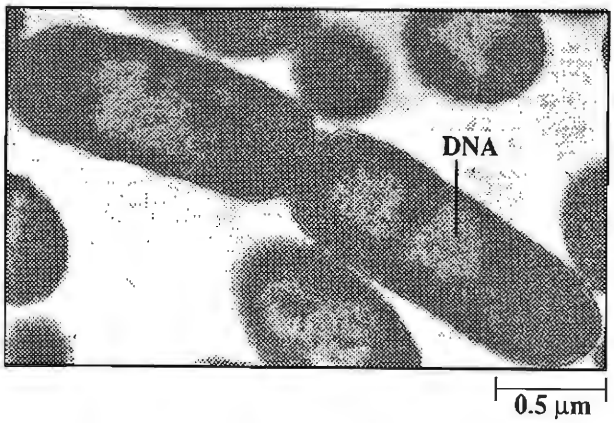
Figure 3. Angiosperm pollen grains

(a) Using any feature of the pollen grains shown in Figure 3, create a set of dichotomous keys to distinguish between the plants by means of their pollen grains.

[3 marks]

(b) The five-kingdom classification system consists of the kingdoms: Monera, Protoctista, Fungi, Plantae and Anamalia.

Using your knowledge of the distinguishing features of the kingdoms and clearly stating which features have been used, determine to which kingdom EACH of the cells in Figure 4 belongs.



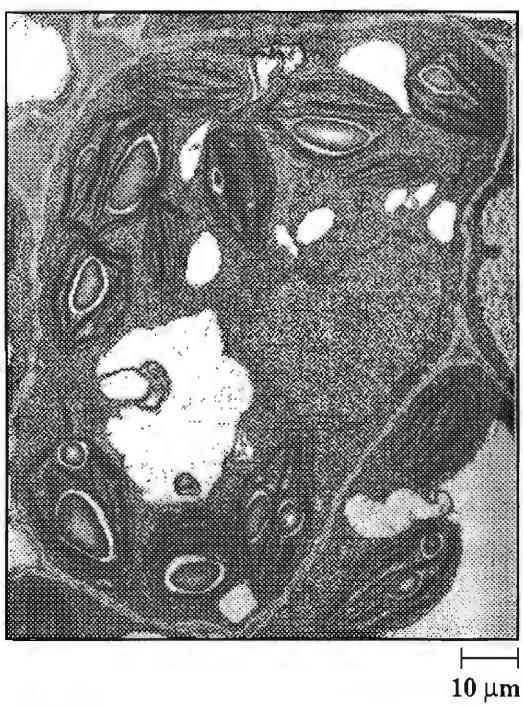
Kingdom _____

Features _____

_____

_____

_____



Kingdom _____

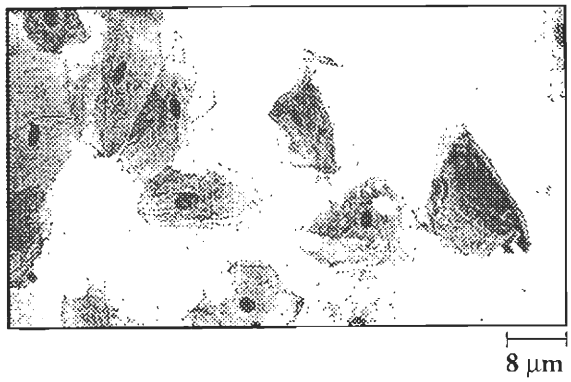
Features _____

_____

_____

_____

Biology of Plants, 6th Edition.
P. Raven, R. F. Evert, S. Eichhorn.
W. H. Freeman and Co/Worth Publishers



Kingdom _____

Features _____

_____

_____

_____

CXC Biology, 3rd Edition.
L. Chinnery et al.
Cambridge University Press

Figure 4. Three types of cells

[6 marks]

(c) Classification systems are hierarchical in nature.

List the SEVEN categories used in modern classification, starting with the broadest and proceeding to the narrowest category.

_____

_____

_____

_____

_____

_____

_____

[1 mark]

Total 10 marks

SECTION B

You must answer THREE questions in this section. Answer ONE question EACH from Modules 1, 2 and 3. You MUST write your answers in the answer booklet provided.

MODULE 1

Answer EITHER Question 4 OR Question 5.

4. (a) Draw a large, labelled diagram to show the structure and composition of the fluid mosaic membrane.

Describe the function of FOUR of the labelled structures. **[8 marks]**

(b) Red blood cells, separated from the blood, are placed in fluid on slides A and B. A contains distilled water and B contains molar salt solution. After 20 minutes, all the cells in A burst and those in B are small with wrinkled membranes.

Discuss the processes involved and give reasons for these results. **[6 marks]**

(c) Discuss the mode of operation of primary pumps for moving ions in and out of cells. **[6 marks]**

Total 20 marks

5. (a) Describe the structure and function of EACH of the following:

(i) Endoplasmic reticulum

(ii) Golgi apparatus

(iii) Nucleus

(iv) Chloroplasts

(v) Mitochondria **[10 marks]**

(b) With reference to the resolving power of the light microscope, and the electron microscope, explain the use **and** importance of microscopes in biology. **[4 marks]**

(c) Examine the following list of structures:

Flower
Mammalian skin
Xylem

Clearly indicate if EACH structure in the list is an organ or a tissue. Give TWO reasons for EACH choice. **[6 marks]**

Total 20 marks

MODULE 2

Answer EITHER Question 6 OR Question 7.

6. (a) Give the names of THREE hormones which control sperm production. State the origin and effect of EACH. **[3 marks]**

(b) Describe the meiotic sequence which occurs in spermatogenesis in the primary spermatocyte from Prophase I to late Anaphase I. **[7 marks]**

(c) (i) What structural features or conditions of the female reproductive system must sperm overcome in order to reach from the vagina to the fertilization site? **[2 marks]**

(ii) The contraceptive methods in current use have been devised through a knowledge of the processes which normally ensure fertilization.

For EIGHT contraceptive methods, comment on the structural or physiological means by which they prevent fertilization. **[8 marks]**

Total 20 marks

7. (a) Describe the stages of mitosis and indicate clearly how this process ensures that EACH daughter nucleus receives a full set of chromosomes. **[10 marks]**

(b) Nerve cells in the adult human central nervous system and heart muscle cells remain in interphase while epidermal cells of the skin divide frequently.

With reference to the **functions** of mitotic cell division in the lives of organisms:

(i) Discuss why damage to the heart and the nervous system (for example, during a stroke) is dangerous. **[2 marks]**

(ii) Suggest the effects that would occur if mitosis in skin epidermis were blocked. **[2 marks]**

(c) Explain the degree of genetic variability that occurs among asexually reproducing organisms, self-fertilizing organisms and bisexual (male and female) organisms. Give reasons for the degree of genetic variability that occurs. **[6 marks]**

Total 20 marks

MODULE 3

Answer EITHER Question 8 OR Question 9.

8. (a) Using ONE example of epistasis, explain how **and** why the F_2 phenotypes of a dihybrid cross might fail to show the normal 9 : 3 : 3 : 1 ratio for the two characters.

[10 marks]

(b) The χ^2 test (chi-squared test) is a method used to estimate the probability that the difference between observed results (O), and expected results (E), is due to chance alone.

Plants grown from smooth seeds, (SS dominant) were crossed with plants from wrinkled seeds, (ss recessive). The F_1 progeny were all Ss. The F_2 generation produced 90 smooth seeds and 22 wrinkled seeds.

(i) Show how you would set out a table to apply the formula:

$$\chi^2 = \Sigma \left(\frac{(O - E)^2}{E} \right)$$

to find the value of χ^2 where O is the observed and E the expected result.

[6 marks]

(ii) Once χ^2 is known, how would you use a table of χ^2 values to determine the probability that the difference between observed and expected results is due to chance alone? **[4 marks]**

Total 20 marks

9. (a) (i) Describe the THREE types of natural selection. **[6 marks]**

(ii) Explain how environmental factors can act as forces of natural selection.

[4 marks]

(b) (i) A single species of brown cats lives in a relatively homogeneous habitat. An earthquake causes a canyon to be formed which splits the habitat into two parts, dividing the cats into two populations. Environmental pressures cause the emergence of white cats in one population. Sediments gradually fill in the canyon and the two populations of cats now share the same habitat again but they cannot interbreed.

Identify the TYPE of speciation that occurred **and** indicate the mechanisms that contributed to it. **[5 marks]**

(ii) A single species of green tortoise occupies a homogeneous habitat. Climate change causes the formation of two distinctly different habitats that are still in the same general region. Environmental pressures in the two habitats lead to the emergence of brown tortoises in one habitat and green tortoises in the other. The green and brown tortoises cannot now interbreed.

Identify the type of speciation that occurred **and** indicate the mechanisms that contributed to it. **[5 marks]**

Total 20 marks

END OF TEST

TEST CODE **02207010**

FORM TP 2005172

MAY/JUNE 2005

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 2 – PAPER 01

1 $\frac{3}{4}$ hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. Candidates must attempt ALL questions in this paper.
2. Answers are to be written in the spaces provided in this answer booklet.
3. EACH question is worth 10 marks.
4. The use of silent non-programmable calculators is allowed.

1. (a) Define the term 'anaerobic respiration'.

[1 mark]

(b) Distinguish between the two types of fermentation.

[2 marks]

(c) After a 100 m race, runners may experience discomfort and fatigue in their muscles and may breathe deeply or pant.

(i) Name the chemical that causes the discomfort in the runners' muscles.

[1 mark]

(ii) Explain why it may be necessary for the runners to breathe deeply and pant.

[1 mark]

(d) Sparkling wines, for example champagne, are bottled while the yeast is alive and fermenting, thereby trapping the fermentation products in the bottle. Bakers yeast in bread dough causes it to rise.

Name the fermentation product that causes the bread to rise and the champagne cork to pop.

[1 mark]

(e) In cyanide poisoning, cyanide attacks the enzyme that transfers electrons from the respiratory electron transport chain to O_2.

Explain why it is not possible to survive cyanide poisoning by using anaerobic respiration alone.

_____

_____

_____

[2 marks]

(f) Respiration occurs in all living cells, but at different rates.

Explain why respiration occurs at different rates. Use ONE example to illustrate your answer.

_____

_____

_____

[2 marks]

Total 10 marks

2. Figure 1 is a simplified outline of the respiratory pathway.

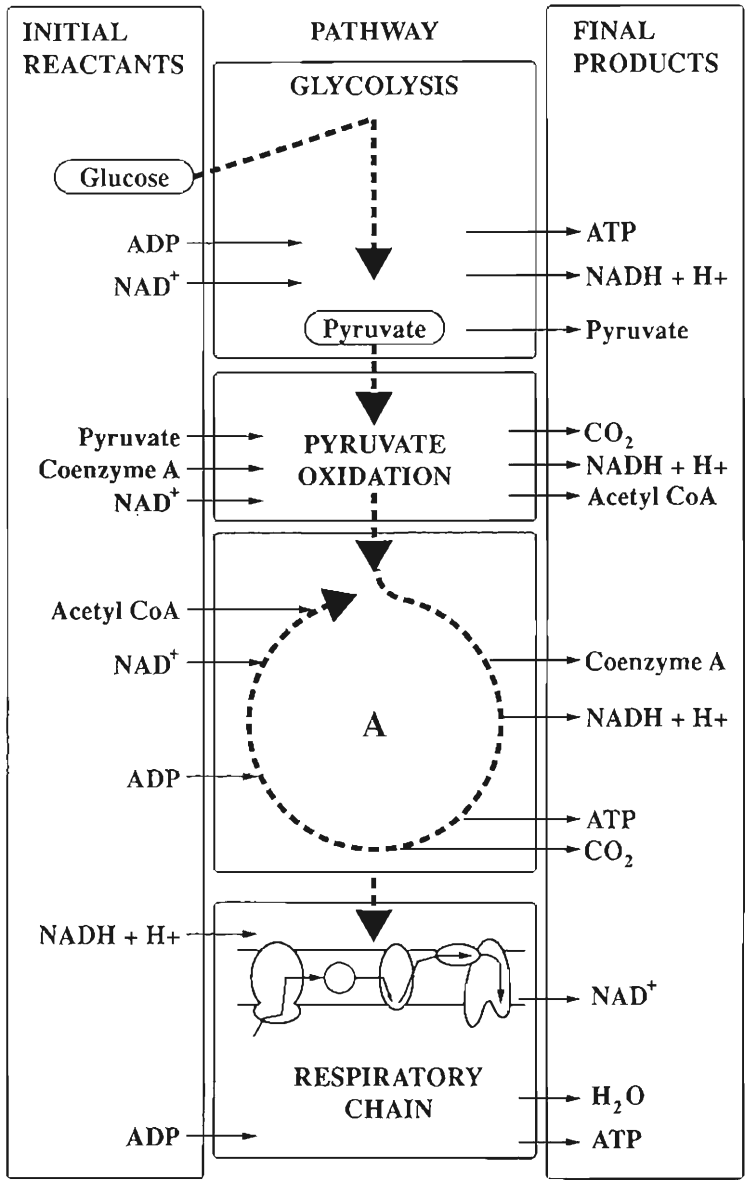


Figure 1. Outline of the respiratory pathway

(a) On Figure 1, indicate with a clear, bold arrow where O_2 will enter the pathway.

[1 mark]

(b) Name the cycle labelled A in Figure 1.

_____

[1 mark]

(c) Name the THREE pathways in Figure 1 that do not function if O_2 is NOT available.

[3 marks]

(d) Name the organelle in the cell in which the reactions shown in Figure 1 occur.

[1 mark]

(e) ATP synthase is a specific channel protein that synthesises ATP. Name the specific molecule or ion that must flow through the channel of this protein for ATP to be synthesized.

[1 mark]

(f) Define the term 'metabolism of a cell'.

[1 mark]

(g) Explain why metabolic pathways need to be linked or coupled together in the cell.

[2 marks]

Total 10 marks

3. Figure 2 below is a diagram of the nitrogen cycle.

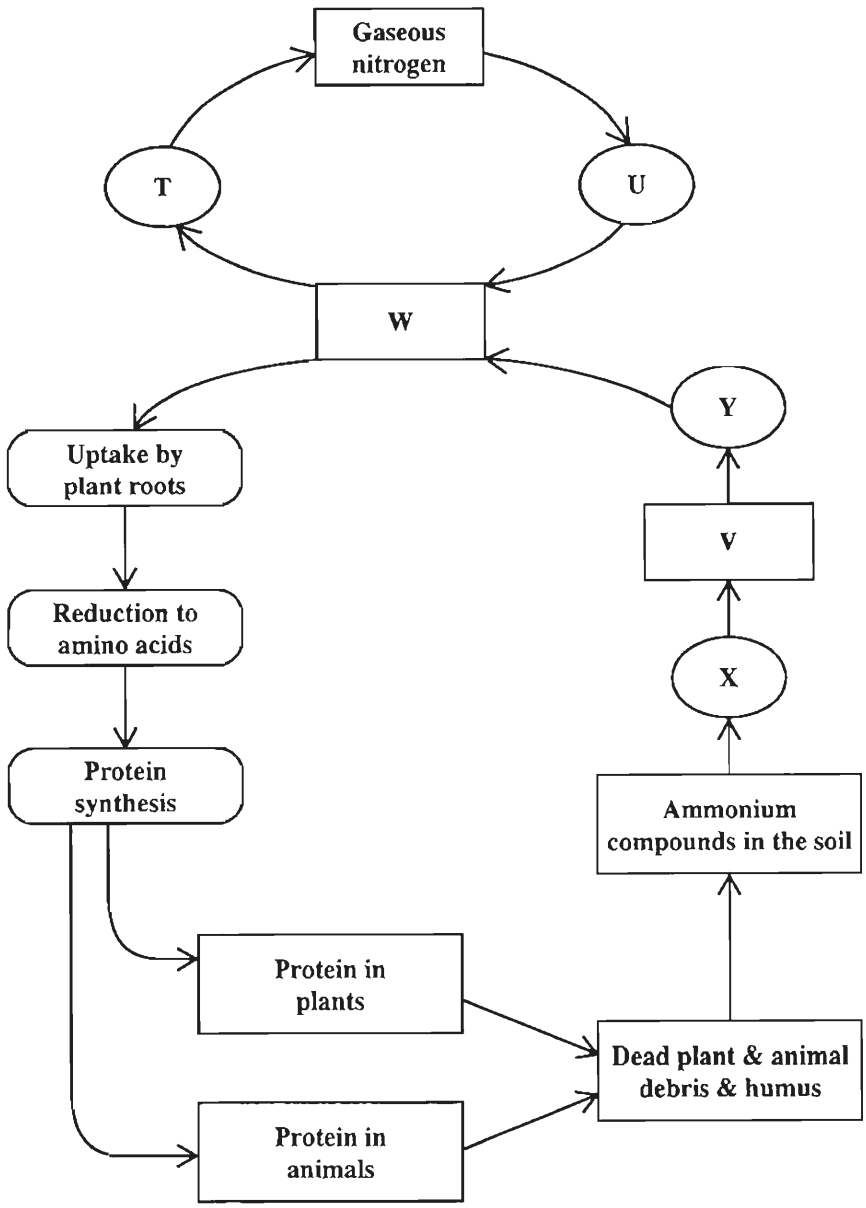


Figure 2. The nitrogen cycle

Use Figure 2 to answer questions (a) to (e).

(a) State the names of the **bacteria** acting at X and Y.

(i) X: _____

(ii) Y: _____

[1 mark]

GO ON TO THE NEXT PAGE

(b) Give the names of the ions labelled V and W.

(i) V: _____

[1 mark]

(ii) W: _____

[1 mark]

(c) Identify the bacteria operative at T and U.

(i) T: _____

[1 mark]

(ii) U: _____

[1 mark]

(d) State ONE other process by which gaseous nitrogen is converted to nitrates.

_____

[1 mark]

(e) Minerals are absorbed by primary producers, and passed up the trophic levels of the food chains. They are eventually returned to the soil in approximately the same concentration, due to the action of decomposers.

Does energy circulate through the trophic levels in the same way? Give reasons to support your answer.

_____

_____

_____

_____

_____

_____

_____

_____

[4 marks]

Total 10 marks

4. Figure 3 is a scanning electron micrograph showing the anatomical basis for kidney function.

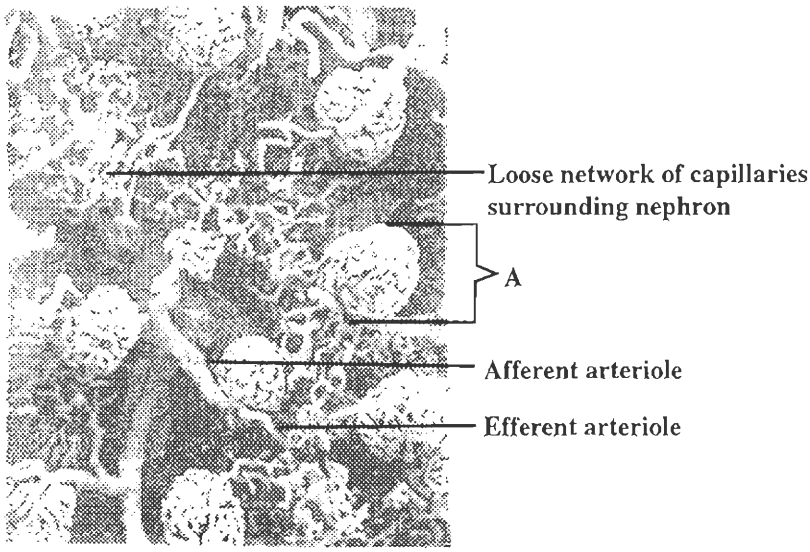


Figure 3. Scanning electron micrograph of part of a kidney

Life: The Science of Biology, 6th Edition.
W. K. Purves et al. Sinauer Associates, Inc.

(a) (i) Name the structure labelled A in Figure 3.

_____

[1 mark]

(ii) Briefly describe how A functions.

_____

_____

_____

[1 mark]

(b) The graph in Figure 4 shows how the glomerular filtration rate is affected by changes in arterial pressure.

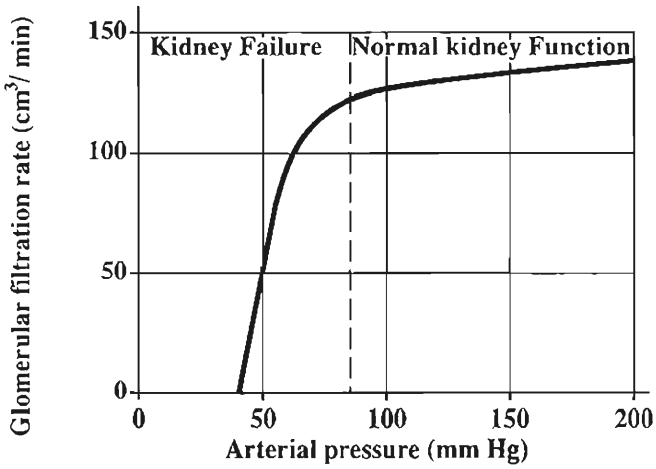


Figure 4. How glomerular filtration rate is affected by arterial pressure.

Life: Science of Biology, 6th Edition.
W. K. Purves et al. Sinauer Associates, Inc.

(i) Using the graph in Figure 4, determine the range of arterial pressure over which a kidney functions NORMALLY.

_____

[1 mark]

(ii) From the graph in Figure 4, estimate the maximum glomerular filtration rate.

_____

[1 mark]

(iii) With reference to the graph in Figure 4, give ONE reason for kidney failure.

_____

_____

[1 mark]

(c) Inulin is a carbohydrate molecule that is filtered in the glomerulus but is NOT secreted NOR re-absorbed by the renal tubules. One single dose of inulin was injected into an animal's blood stream and the rate of urine production of the animal was found to be 1 cm^3 per minute.

(i) State the function of the renal tubules.

_____

_____

[1 mark]

(ii) Suggest, giving ONE reason, whether inulin would be

a) excreted in the animal's urine

_____

_____

[1 mark]

b) maintained in the animal's blood over a prolonged period.

_____

_____

[1 mark]

(iii) Suggest how the glomerular filtration rate can be determined using inulin.

_____

_____

_____

_____

[2 marks]

Total 10 marks

5. (a) During the resting potential, there is a potential difference of approximately 70 mV between the inside and the outside of the axon membrane, with the inside being negative in relation to the outside.

Explain the role of membrane pumps and diffusion gradients in creating this potential difference. Refer to both anions and cations in your answer.

[4 marks]

(b) Figure 5 below shows activity along an axon.

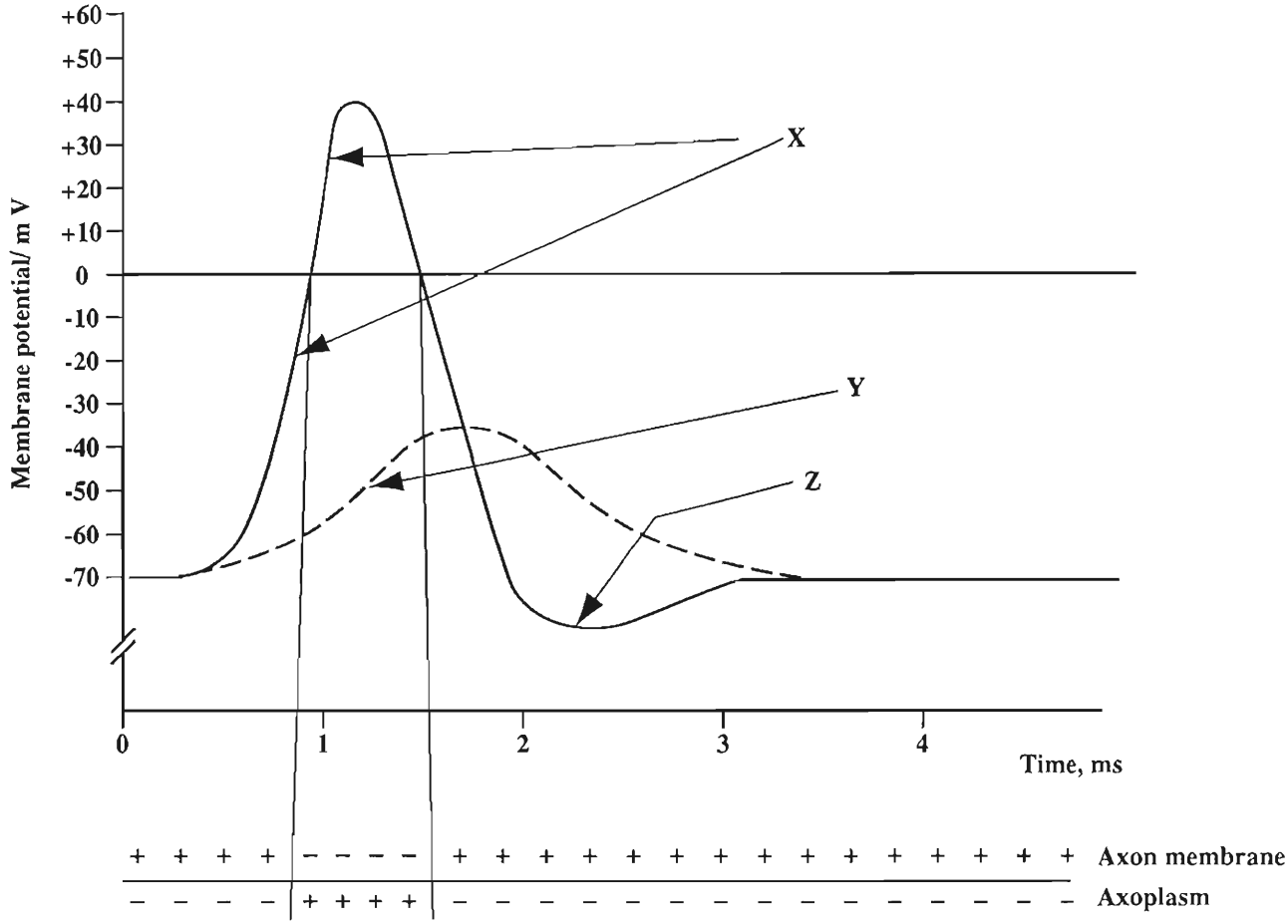


Figure 5. Activity along an axon

Study Figure 5 and answer questions (b) (i), (ii) and (iii).

(i) Describe the event occurring at X **and** suggest how this event is affected by lack of oxygen.

_____

_____

_____

_____

_____

_____

[2 marks]

(ii) Describe the activity occurring at X.

_____

_____

[1 mark]

(iii) Suggest what causes the reading of –90 mV at Z.

_____

_____

_____

[1 mark]

(c) Suggest the benefit of saltatory conduction in myelinated nerve fibres.

_____

_____

_____

_____

[2 marks]

Total 10 marks

6. (a) Figure 6 below depicts pancreatic cells in the ilets of Langerhans.

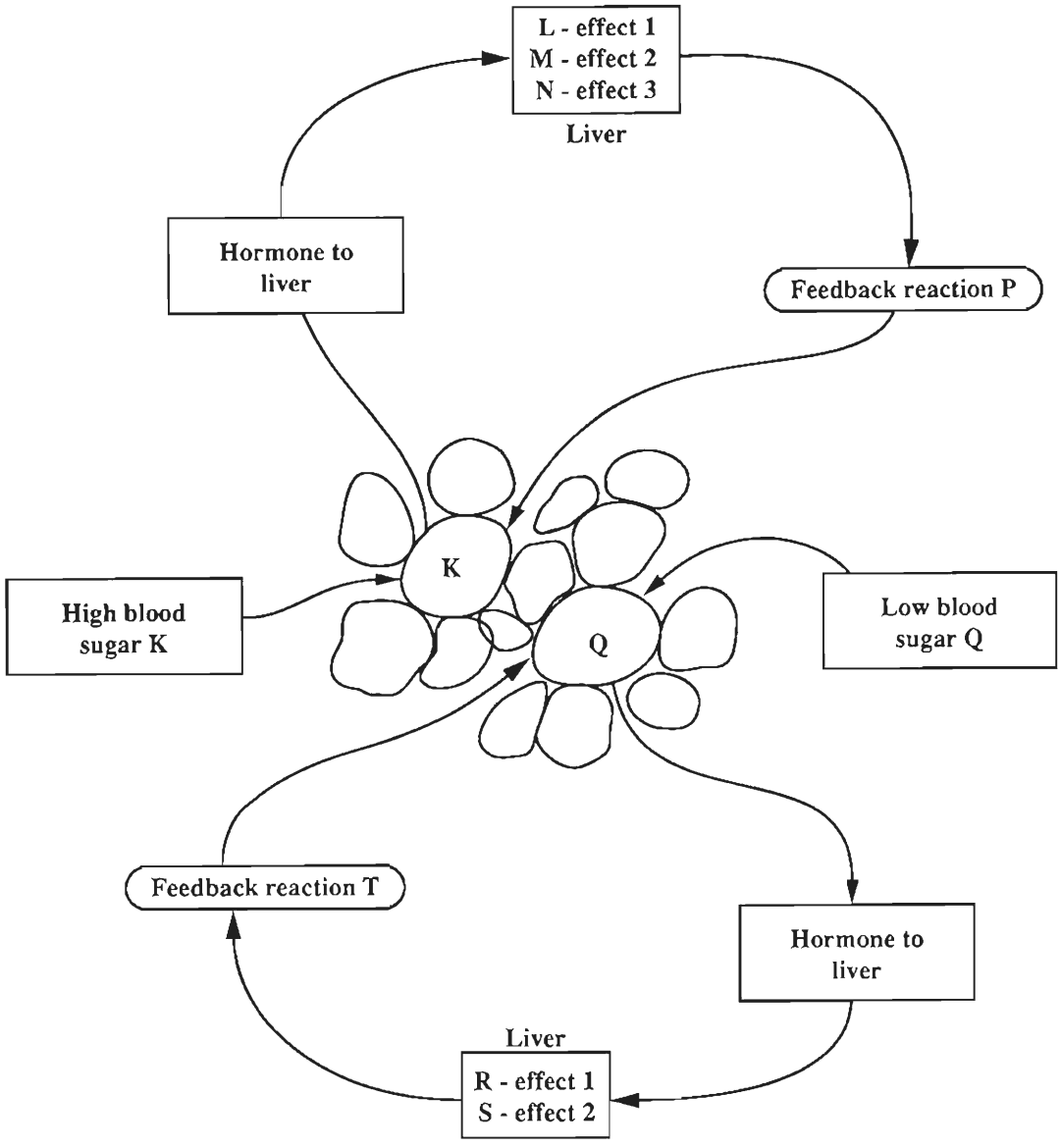


Figure 6. Feedback processes in pancreatic cells

Study Figure 6 and answer questions (i) to (iv) in question (a).

(i) Identify cells K and Q.

Cell K: _____

Cell Q: _____

[1 mark]

(ii) State the effects identified by L, M and N.

Effect at L: _____

_____

Effect at M: _____

_____

Effect at N: _____

_____

[2 marks]

(iii) State the effects at R and S.

Effect at R: _____

_____

Effect at S: _____

_____

[1 mark]

(iv) Give the approximate adjusted concentration of glucose in the blood at P and T.

Concentration at P: _____

Concentration at T: _____

[1 mark]

(b) When bunches of bananas are harvested, all the fruits are generally at the same stage of ripeness. It is much more expensive to harvest mangoes, as the fruits on a tree are at slightly different stages of ripening. How can the growers and shippers overcome this problem?

_____

_____

_____

_____

_____

_____

_____

[2 marks]

(c) Complete Table 1 by describing THREE differences between co-ordination effected by the endocrine system and the nervous system.

TABLE 1

DIFFERENCES BETWEEN ENDOCRINE AND NERVOUS SYSTEMS

Endocrine System	Nervous System
1.	1.
2.	2.
3.	3.

[3 marks]

Total 10 marks

7. (a) Figure 7 shows an immunoglobulin molecule.

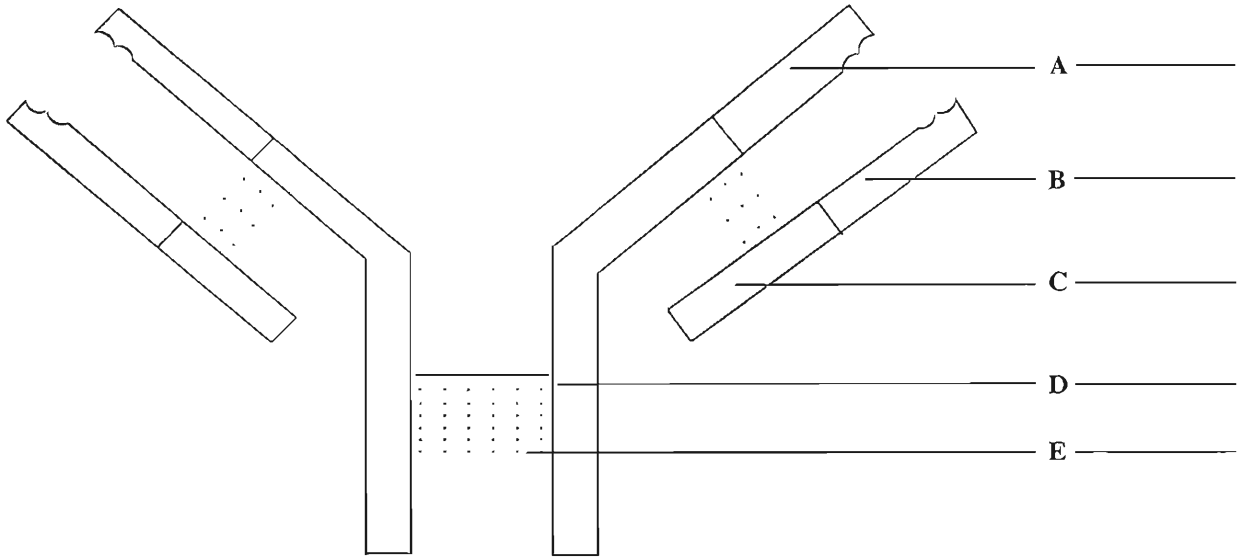


Figure 7. An immunoglobulin molecule

(i) Examine the immunoglobulin molecule in Figure 7 and complete the labels A to E. **[3 marks]**

(ii) CIRCLE the antigen binding site on the immunoglobulin molecule in Figure 7. **[1 mark]**

(b) The major histocompatibility complex (MHC) encodes proteins that present antigens to the immune system's T cell receptors. In human organ-transplant surgery, MHC molecules are important because the proteins produced by the MHC are specific to each individual. They act as antigens if transplanted into another individual.

Explain why **twins** can accept organs from each other and **parents** can accept organs from their **children**.

_____

_____

_____

_____

_____

_____

[3 marks]

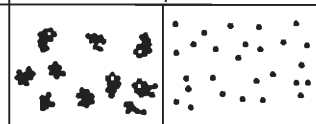
(c) The method used in laboratories to determine blood groups involves the mixing of blood of unknown type with anti-A or anti-B antibodies.

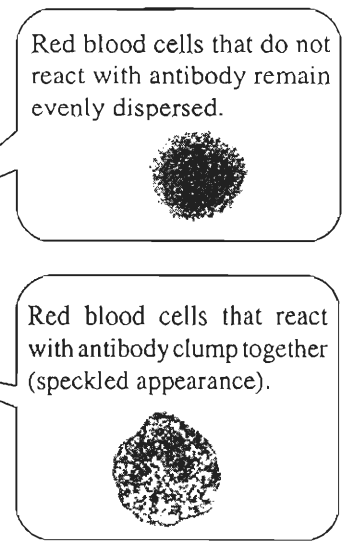
Table 2 below shows ABO blood reactions when anti-A and anti-B antibodies are mixed with blood of different blood groups. Red blood cells that react with antibodies clump together and the blood appears speckled. Red blood cells that do not react with antibodies remain evenly distributed.

(i) Study and complete Table 2 by writing 'CLUMPED' or 'EVENLY DISPERSED' in the boxes a) to d).

TABLE 2

ABO BLOOD REACTIONS

Blood type of cells	**Genotype**	**Antibodies made by body**	**Reaction to added antibodies**	
			Anti-A	**Anti-B**
A	I^AI^A or I^AI^O	Anti-B		
B	I^BI^B or I^BI^O	Anti-A		
AB	I^AI^B	Neither anti-A nor anti-B	a)	b)
O	I^OI^O	Both anti-A and anti-B	c)	d)



Life: The Science of Biology, 6th Edition.
W. Purves et al. Sinauer Associates, Inc.

[2 marks]

(ii) State the blood type of a person who is a **universal donor** (can give blood to individuals of all ABO blood types) AND a person who is a **universal recipient** (can receive blood from individuals of all ABO blood types).

Universal donor _____ Universal recipient _____

[1 mark]

Total 10 marks

8. (a) Using ONE named example of EACH type of drug, distinguish between a socially-accepted drug and an illicit drug.

_____

_____

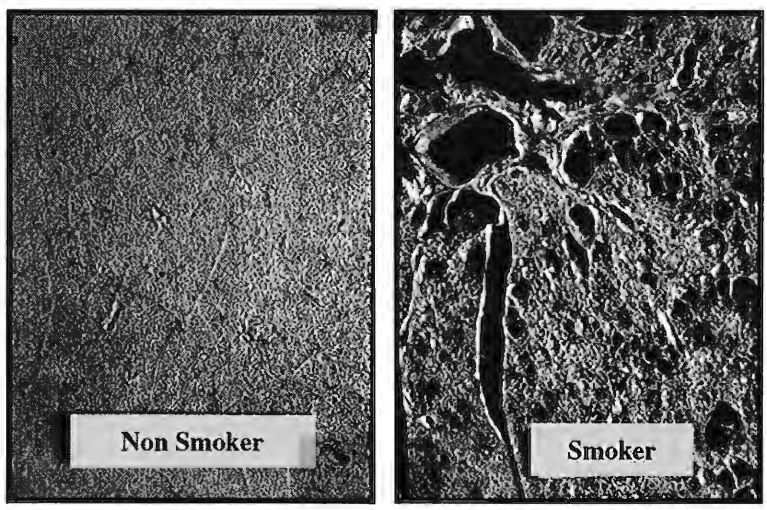
_____

_____

_____

[2 marks]

(b) Figure 8 below shows a part of the lungs of a non-smoker in photograph (a) and part of the lungs of a smoker in photograph (b).



(a) (b)

Figure 8. Lungs of a non smoker and a smoker

Biology of Life on Earth.
J. Audesirk, G. Audesirk, Prentice Hall

Explain what causes the lung of the cigarette smoker to appear as in photograph (b), Figure 8.

_____

_____

_____

_____

[2 marks]

GO ON TO THE NEXT PAGE

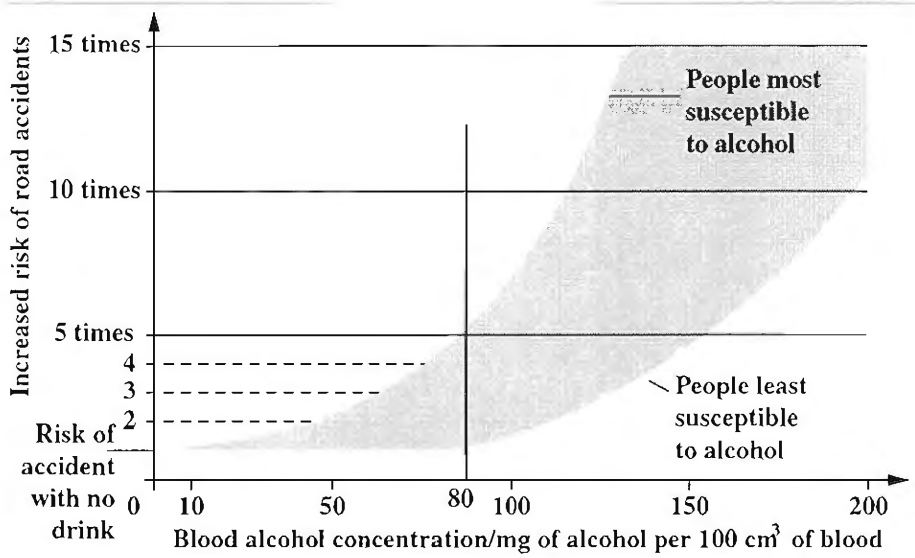
(c) Describe ONE symptom experienced by the cigarette smoker whose lungs are shown in (b).

_____

_____

[1 mark]

(d) The graph in Figure 9 below shows how the risk of road accidents increases as the blood alcohol concentration increases.



Human Health and Disease.
A. Fullick. Heinemann Educational Publishers.

Figure 9. How the risk of road accidents varies with blood alcohol concentration.

Examine the graph in Figure 9. With regard to road accident risk, describe the MAIN trend that is illustrated by the graph.

_____

_____

_____

_____

[2 marks]

(e) In developed countries, there are legal sanctions against driving with blood alcohol levels over a set limit. In Britain the limit is 80 mg per 100 cm^3 of blood. The police can stop drivers and ask them to take a Breathalyser test which involves breathing into a device that analyses the breath and estimates the content of alcohol in the blood. The graph in Figure 9 on page 20 shows how the risk of road accidents increases as the blood alcohol concentration increases.

Using the graph as well as your knowledge of the physical symptoms caused by different levels of alcohol in the blood, suggest, giving your reasons, where the legal alcohol limit should be set for your territory.

[3 marks]

Total 10 marks

9. (a) (i) A plasmid has taken up some genes, including the human insulin gene.

Outline THREE steps in the method for producing human insulin commercially through transgenic bacteria.

[3 marks]

(ii) Suggest ONE method which could be used to introduce new genes into eukaryotic cells.

[1 mark]

Restriction endonucleotidases are enzymes found in bacteria which recognise and cut DNA. The enzymes bind to the DNA at target sites and cut it at specific base sequences, as shown in Table 3 below.

TABLE 3

TARGET SITES OF RESTRICTION ENDONUCLEOTIDASES

Enzyme	Target site on DNA.
Hind II	G C A A ↓ A G C T T G G A C G T T T C G A ↑ A C C T
ECORI	G C A A ↓ A A T T T G G A C G T T T T A A ↑ A C C T

Figure 10 below shows sections of cut DNA, revealing "sticky ends".

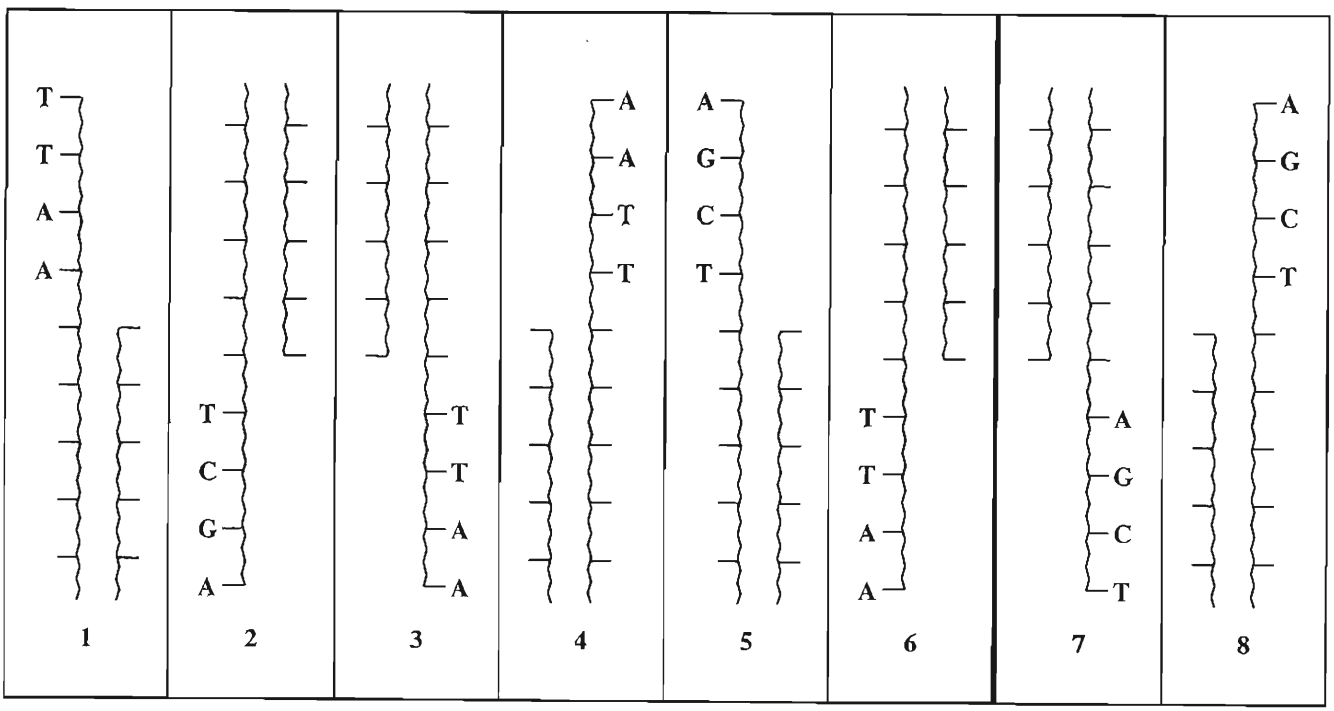


Figure 10. Sections of cut DNA revealing sticky ends

GO ON TO THE NEXT PAGE

(b) Use the numbers provided to identify the DNA whose "sticky ends" are complementary to each other, which would enable them to rejoin accurately.

(i) Number _____ and Number _____ (by Hind II)

(ii) Number _____ and Number _____ (by ECORI)

[2 marks]

(c) (i) Name the enzyme which seals the "sticky ends" together in complementary bonds.

_____

[1 mark]

(ii) State ONE function of this type of enzyme during meiosis I in eukaryotes.

_____

[1 mark]

(d) Genetic engineering has been used to integrate insecticide genes into the genome of crop plants, such as maize (corn). Each cell of the genetrically altered plant can produce the toxin which, when eaten, kills insects. Maize is a wind pollinated plant.

State TWO effects that this example of genetic engineering could have on the ecological balance of the environment.

_____

_____

_____

_____

_____

_____

[2 marks]

Total 10 marks

END OF TEST

TEST CODE **02207020**

FORM TP 2005173

MAY/JUNE 2005

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 2 – PAPER 02

$2\frac{1}{4}$ hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of NINE questions.
2. Section A consists of THREE questions. Candidates must attempt ALL questions in this section and should spend no more than 30 minutes on this section. Answers to this section MUST be written in this answer booklet.
3. Section B consists of SIX questions. Candidates must attempt THREE questions in this section, ONE question from EACH module. Answers to this section MUST be written in the answer booklet provided.
4. The use of silent non-programmable calculators is allowed.

SECTION A

You must attempt ALL THREE questions in this section. You should NOT spend more than 30 minutes on this section.

1. Figure 1 below shows the materials and experimental apparatus A, B and C, used to measure oxygen uptake under three different circumstances.

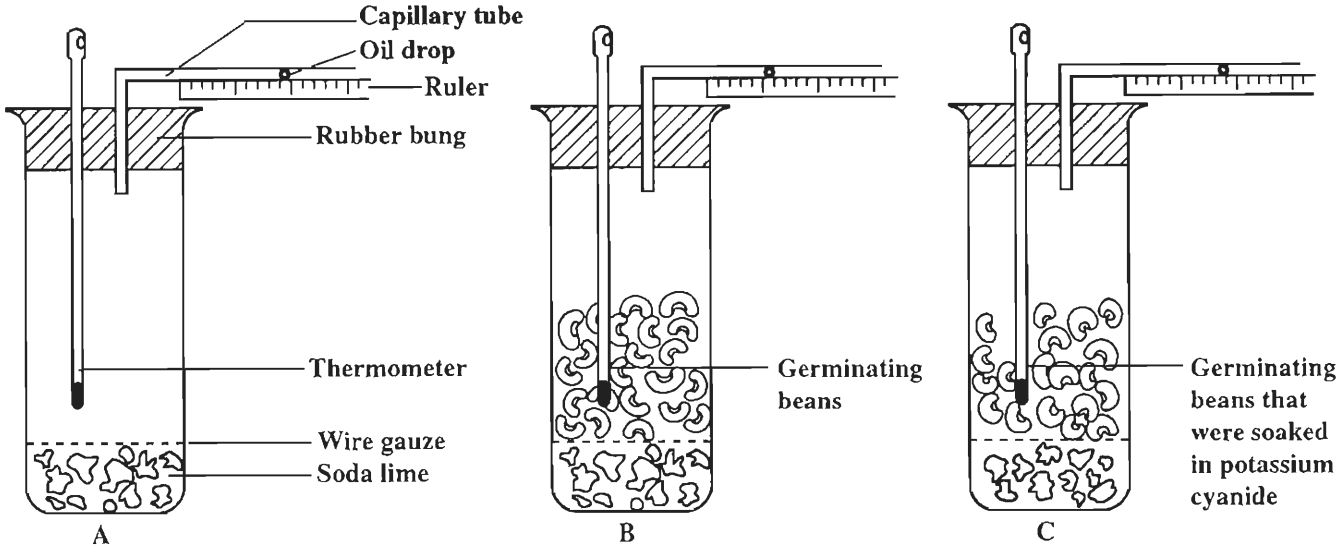


Figure 1. Oxygen uptake under different circumstances

(a) Outline an experiment, based on the apparatus in Figures 1 A and B, to measure oxygen uptake in germinating beans.

_____

_____

_____

_____

_____

_____

[4 marks]

(b) What is the purpose of the thermometers used in the experimental apparatus in Figures 1 A and B?

_____

_____

[1 mark]

(c) The beans in the experiment shown in Figure 1 C are soaked in potassium cyanide.

Suggest whether the beans soaked in potassium cyanide will take up oxygen. Give ONE reason for your answer.

_____

_____

_____

[2 marks]

(d) Figure 2 below shows the scheme for an experiment. The experiment has been designed to test whether a hydrogen ion (H^+) gradient can drive ATP synthesis by isolated mitochondria.

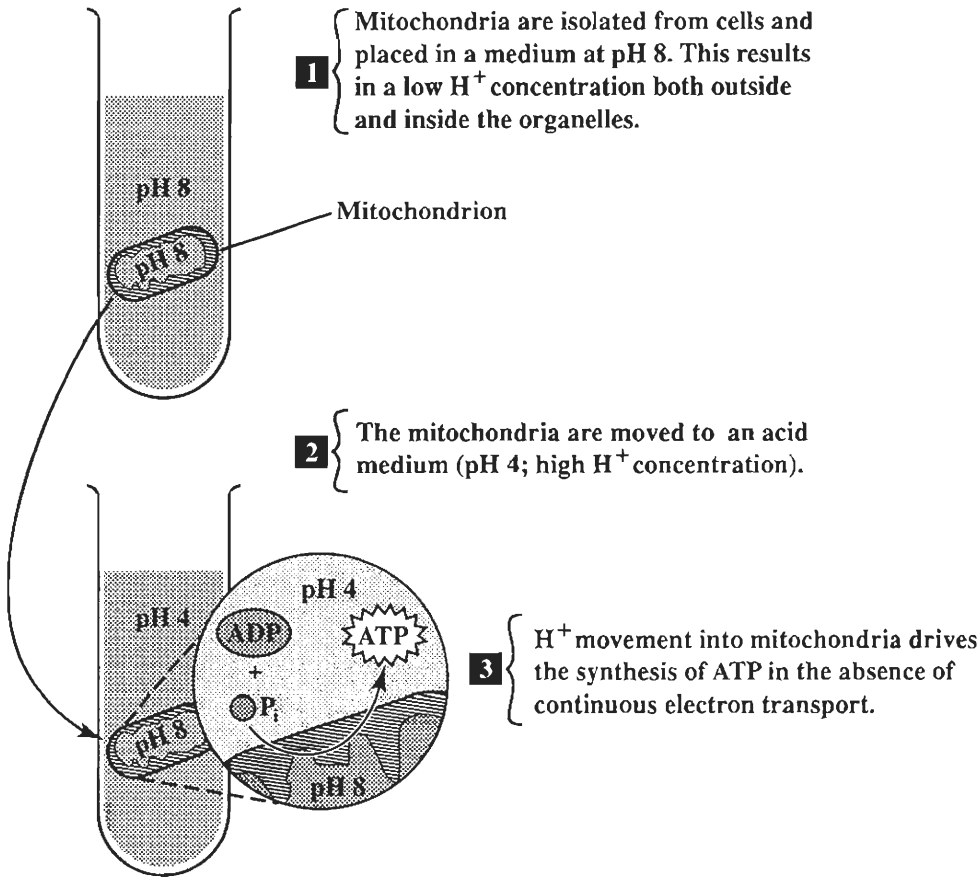


Figure 2. Experiment 1

What conclusion can be drawn from the results of Experiment 1?

_____

_____

_____

[1 mark]

GO ON TO THE NEXT PAGE

(e) Another experiment is designed to test the role of H^+ pumps in ATP synthesis. An artificial lipid vesicle with a proton pump is created and ATP synthase inserted into the membrane. Hydrogen ions, pumped into the vesicle to create a gradient, diffuse out through the ATP synthase, producing ATP.

What conclusion can be drawn about the conditions necessary for ATP synthase to form ATP?

_____

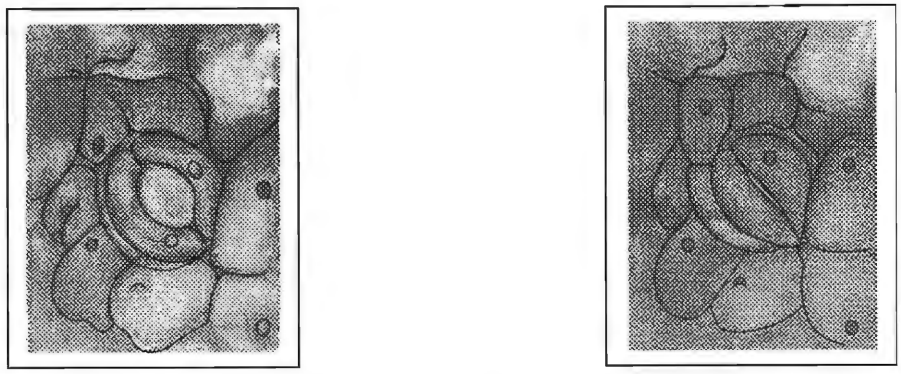
_____

_____

[2 marks]

Total 10 marks

2. (a) Figure 3 shows the stoma from the under surface of a leaf. In (A) the stoma is open while in (B) it is closed.



(A) Open **(B) Closed**

Figure 3. Stomata

Draw the stoma in Figure 3 (A) and the cells immediately surrounding it, as well as any other features of significance. The drawing should be twice the size of the specimen in the photograph (magnification x 2). Do not spend more than FOUR minutes on your drawing. **Labels are not required.**

[4 marks]

(b) Adjacent to the left guard cell in Figure 3 A is a long narrow cell called the "accessory cell to the guard cell".

Account for the difference in its shape in A as compared with B.

_____

_____

_____

_____

[1 mark]

GO ON TO THE NEXT PAGE

(c) (i) Figure 4 is a diagram frequently used in botanical textbooks to show the size of the stomatal aperture over a 24-hour period. Collect data from this diagram and use it to construct a histogram to show the relationship between the time and the width of the stomatal pore.

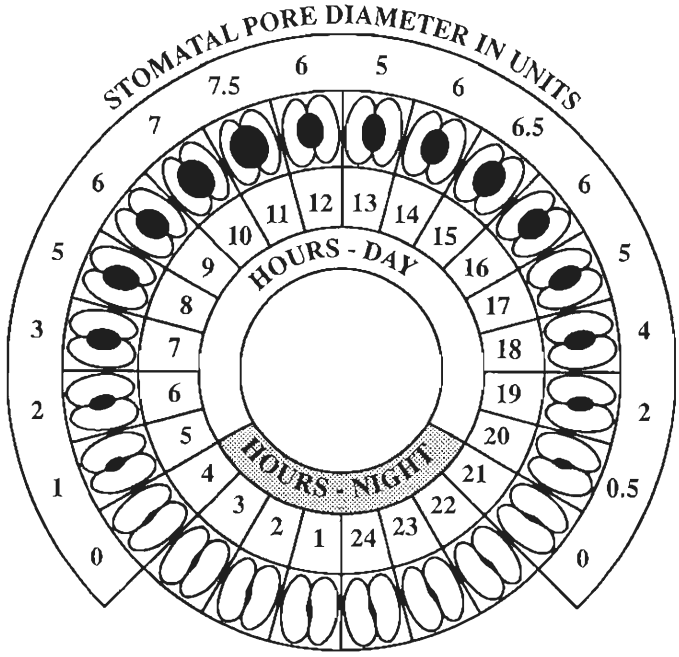


Figure 4. Stomatal pore-size over a 24-hour period

Histogram to show relationship between time and stomatal aperture

[4 marks]

(ii) Account for the shape of the histogram between 11.00 a.m. and 3.00 p.m.

[1 mark]

Total 10 marks

3. (a) Light exercise creates little demand on the rate of breathing and heart output but as exertion and duration increase, both breathing movements and heart output intensify. When the body is exercising at its maximum capacity, oxygen consumption is at its highest. This state is called the VO_2 max. It is measured as the volume of oxygen in cubic centimetres, used per kilogram of body mass per minute.

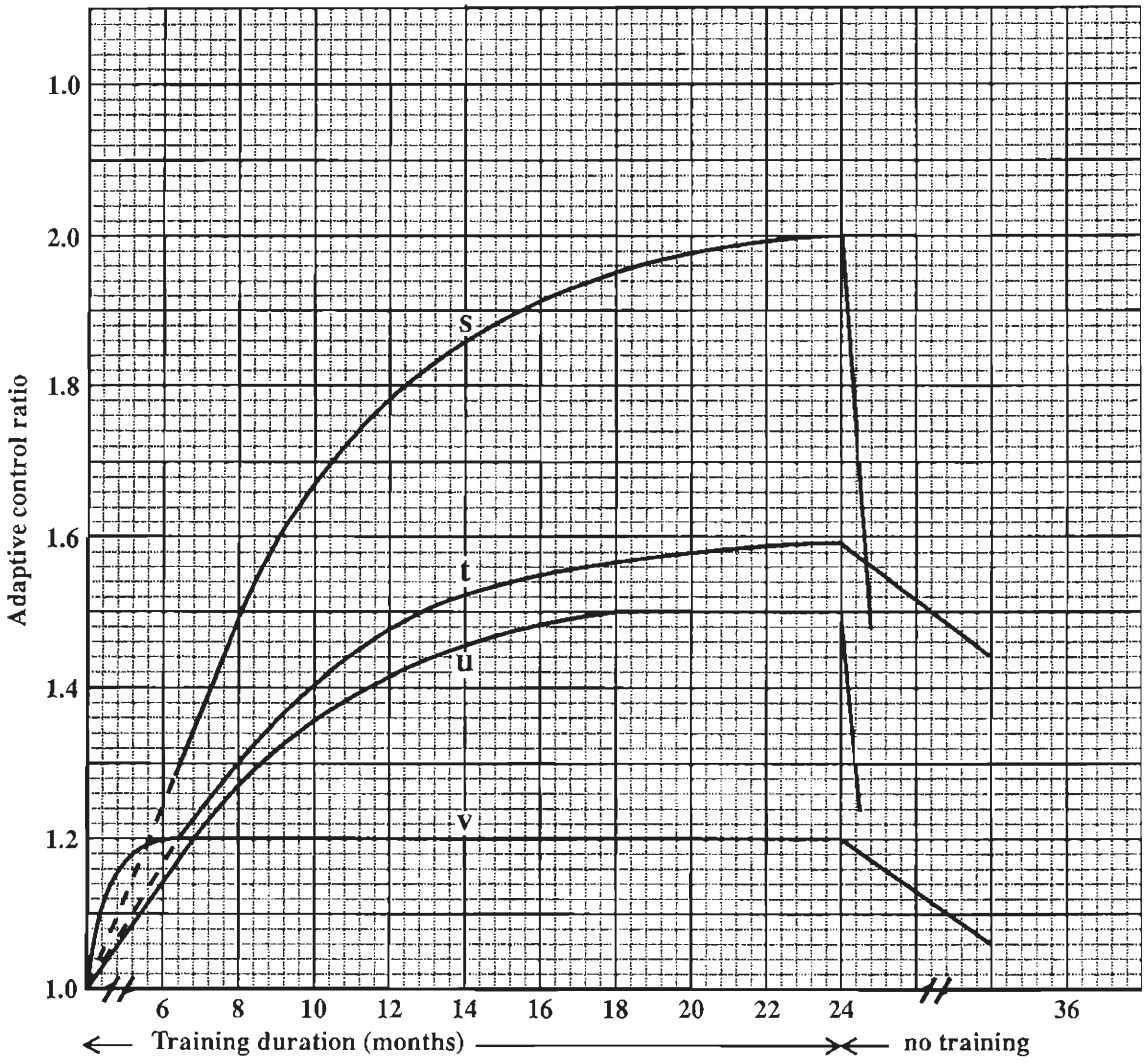
$$VO_2max = O_2\ cm^{-3}\ kg^{-1}minute^{-1}$$

A sports lab is equipped with a stopwatch, a weighing scale, appropriate tubing and a gas analyser, to measure oxygen consumption.

Explain the procedures you would use and the calculations you would make to find out the VO_2max of an athlete.

[4 marks]

(b) A 40-year-old subject signed up for a 24-month endurance training programme. The graph in Figure 5 summarizes the adaptive changes in the muscles.



KEY s – aerobic enzymes in citric acid cycle
t – capillary network
u – VO_2 max
v – cross-sectional size of muscle fibres

Figure 5. Adaptive changes in muscles

Adapted from Exercise Physiology: Energy, Nutrition and Human Performance, 5th Edition. W.D. Mc Ardle, F. I. Katch V. L. Katch. Lippincott Williams and Wilkins

With reference to the graph in Figure 5, answer questions (i) to (v).

(i) What is the percentage increase in VO_2max attained by the 40-year-old subject at the end of the 24-month period?

_____

[1 mark]

GO ON TO THE NEXT PAGE

(ii) Suggest why muscle fibres, which attain an increase in cross-sectional area in the first two months, do not achieve any further increase in diameter over the next 22 months.

_____

_____

_____

[1 mark]

(iii) If the muscle cells do not increase in size, suggest how muscles continue to cause an increase in VO_2max.

_____

_____

[1 mark]

(iv) At the end of 24 months, when training stops, why do curves 's' and 'u' decline abruptly, while curves 't' and 'v' decrease more slowly?

Reason 's' and 'u' decline abruptly: _____

_____

_____

[1 mark]

Reason 't' and 'v' decrease more slowly: _____

_____

_____

[1 mark]

(v) Fitness instructors are advised to exercise at 50% of their VO_2max, to maintain health. On the graph in Figure 5 draw the letter X at the points which show the 50% VO_2max value at 18, 20 and 22 months. **[1 mark]**

Total 10 marks

SECTION B

You must answer THREE questions in this section. Answer ONE question EACH from Modules 1, 2 and 3. You MUST write your answers in the answer booklet provided.

MODULE 1

Answer EITHER Question 4 OR Question 5.

4. (a) Explain how ATP and NADPH are synthesized in chloroplasts. **[10 marks]**

(b) The Calvin cycle stops in the dark.

Briefly outline the THREE main processes of the Calvin cycle and discuss why the processes stop in the dark. **[6 marks]**

(c) Forty morning glory plants grow crowded together in a well-watered flower plot, under a sealed bell jar in full sunshine. Twenty morning glory plants grow in a poorly-watered flower pot in the shade, under a sealed bell jar with a lizard.

Indicate, with reasons, FOUR factors which limit the rate of photosynthesis in the flower pots. **[4 marks]**

Total 20 marks

5. (a) (i) Difficulties with quantifying relationships between organisms in food chains led to the concept of pyramids of numbers.

Explain how a pyramid of numbers is constructed **and,** by means of TWO examples, why there may be inconsistencies in the shapes of the pyramid. **[5 marks]**

(ii) Pyramids of standing crop biomass are more accurate in recording trophic level measurements.

Why are they more accurate **and** how do they vary seasonally? **[5 marks]**

(b) In temperate forests of Alaska there may be fewer than 50 species of trees and shrubs per hectare, while in forests of Guyana there are over 500 different species of trees and shrubs per hectare.

(i) Discuss the effects of the variety of plant species in Guyana on the potential diversity of animal life. **[6 marks]**

(ii) Discuss how the stability of an ecosystem is related to its species diversity. **[4 marks]**

Total 20 marks

GO ON TO THE NEXT PAGE

MODULE 2

Answer EITHER Question 6 OR Question 7.

6. (a) (i) Describe the forces and conditions which cause blood from the right atrium to enter and fill the right ventricle. **[6 marks]**

(ii) The right and left ventricles force blood out of the heart at pressures of approximately 4 kPa and 16 kPa respectively. Why is this necessary? **[4 marks]**

(b) Discuss how the **blood vessels** of the circulatory system are well adapted, structurally and functionally to:

(i) the distribution of blood **[4 marks]**

(ii) the return of blood **[3 marks]**

(iii) the interchange of substances with the tissues **[3 marks]**

Total 20 marks

7. (a) With specific reference to the cells, explain how the structure of phloem is related to its function. **[10 marks]**

(b) A young bean seedling has two cotyledons, two developing leaves and one root. A sweet potato vine has a long stem, 40 mature leaves and four large sweet potatoes underground.

(i) State CONCISELY the pressure flow hypothesis, CLEARLY distinguishing between a source and a sink. **[2 marks]**

(ii) Identify the sources and sinks in the bean seedling and in the sweet potato vine. **[4 marks]**

(c) With reference to the bean seedling, outline the pathway a water molecule would take from the soil solution to the atmosphere via the xylem. **[4 marks]**

Total 20 marks

MODULE 3

Answer EITHER Question 8 OR Question 9.

8. (a) Describe the causes and effects of malnutrition with reference to:

(i) Protein energy malnutrition (PEM)

(ii) Anorexia **[8 marks]**

(b) The advice of dieticians is based on DRV.

(i) What is meant by the abbreviation 'DRV'?

(ii) State ONE advantage of fibre in the diet. **[2 marks]**

(c) A diet high in saturated fats is associated with atherosclerosis and coronary heart disease (CHD).

Give reasons for this fact. **[10 marks]**

Total 20 marks

9. (a) State briefly what is meant by the following terms:

(i) Humoral immune response

(ii) Cell mediated immune response **[4 marks]**

(b) Explain what is meant by the term 'monoclonal antibody' and describe the use of monoclonal antibodies in ONE diagnosis and ONE treatment procedure. **[6 marks]**

(c) (i) Distinguish between the two methods by which artificial immunity can be acquired AND suggest the advantages and disadvantages of this type of immunity. **[6 marks]**

(ii) **With reference to** the immune response generated, indicate how artificial immunity is beneficial to young children. **[4 marks]**

Total 20 marks

END OF TEST

TEST CODE **02107010**

FORM TP 2006176

MAY/JUNE 2006

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 1 – PAPER 01

$1\frac{3}{4}$ hours

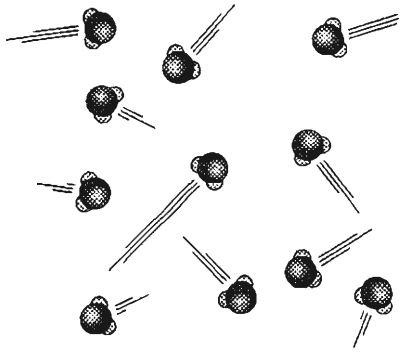
Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

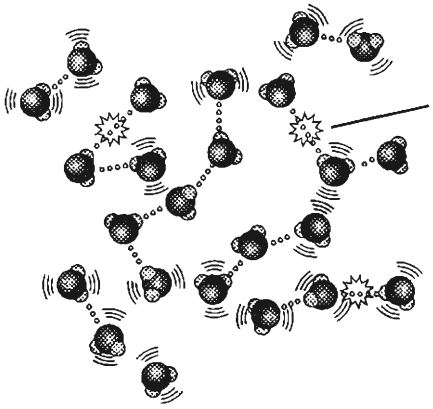
1. Candidates must attempt ALL questions in this paper.
2. Answers are to be written in the spaces provided in this answer booklet.
3. EACH question is worth 10 marks.
4. The use of silent non-programmable calculators is allowed.

1. (a) Figure 1 below shows three diagrams of water molecules in the solid, liquid and gaseous state.

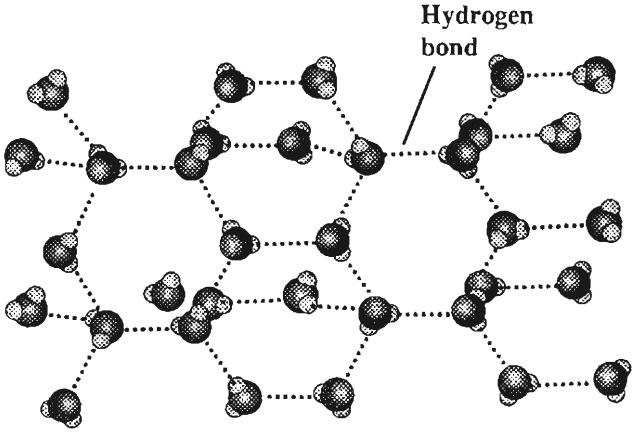
Indicate the state of the water molecules in EACH of the diagrams (i), (ii) and (iii).



(i) _____



(ii) _____



(iii) _____

Figure 1. Water molecules in three states

[3 marks]

(b) Ice floats on water.

Explain why this property of water is important.

_____

_____

_____

[1 mark]

(c) In Figure 2 below, an insect (a pondskater) uses the properties of water to skate on the surface.

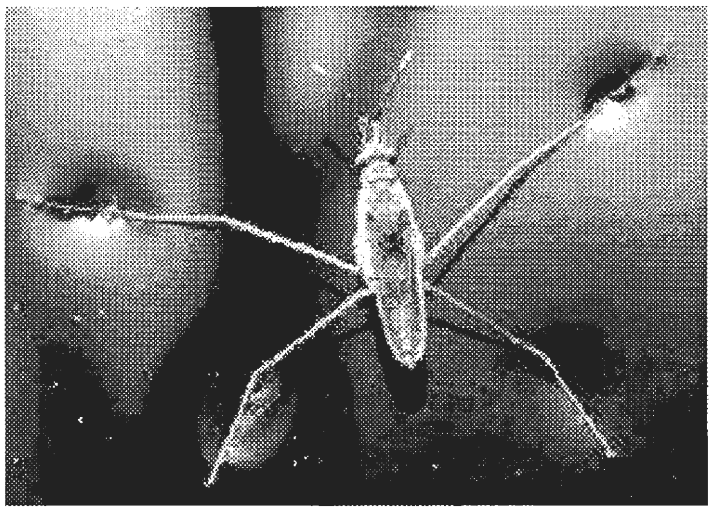


Figure 2. A pondskater skates across the surface of water

Name TWO properties of water used by the insect **and** describe how these properties operate.

Property 1: _____

_____

[1 mark]

Property 2: _____

_____

[1 mark]

(d) A saccharide molecule is shown in Figure 3 below.

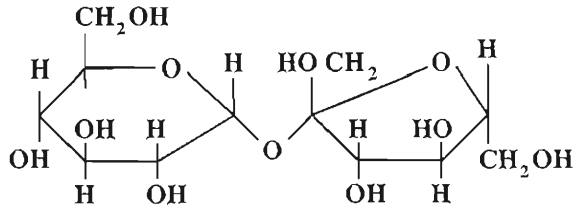


Figure 3. Molecule A

(i) Name Molecule A in Figure 3 and state what type of saccharide it is.

_____

[1 mark]

(ii) Describe the MAIN function of Molecule A in plants.

_____

_____

[1 mark]

(e) Name the MAJOR structural polymer that is found in plants that consist of glucose units.

_____

[1 mark]

(f) Explain why the polymer named in (e) is NOT soluble in water even though its component glucose units are very soluble in water.

_____

_____

[1 mark]

Total 10 marks

2. Figure 4 (i) and (ii) show a two-inch deep section of a cucumber, with a longitudinal strip cut from the side. The strip has a tough outer covering of cuticularized epidermis, while the inner part is composed of cortical parenchyma cells. As soon as the strip is cut out of the cucumber, it "bends backwards", as shown in Figure 4 (iii).

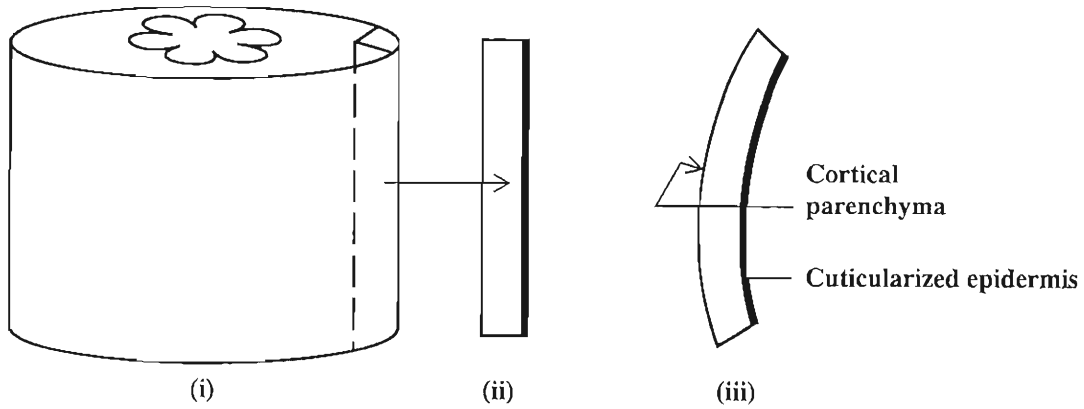
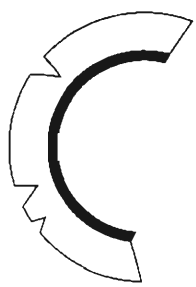


Figure 4. Sections cut from a cucumber

Five strips are cut, placed in petri dishes and covered with sucrose solutions of varying concentrations for 30 minutes. The degree of curvature in relation to the sucrose concentration is shown in Table 1.

TABLE 1: CURVATURE OF STRIPS IN RELATION TO SUCROSE CONCENTRATION

Molar concentration of sucrose solution	0.1 m	0.2 m	0.3 m	0.4 m	0.5 m
Shape of cucumber strips after 30 mins immersion					

(a) Define the following in terms of water potentials:

(i) Osmosis

[**1 mark**]

(ii) Isotonic

[**1 mark**]

(b) Use Table 1 to determine which solution is isotonic with the cucumber cells, and give ONE reason for your answer.

[**1 mark**]

(c) State precisely what happens to the cortical cells in the

(i) 0.1 m sucrose solution

[**2 marks**]

(ii) 0.5 m sucrose solution.

[**2 marks**]

(d) Give ONE reason why the strip shown in Figure 4 (iii) curves "backwards" immediately after it is released.

_____

_____

_____

[1 mark]

(e) The outer regions of the stems of herbaceous plants possess a cortex and an epidermis. Explain how these structures enable the stem to stay erect.

_____

_____

_____

_____

[2 marks]

Total 10 marks

3. Figure 5 shows a student's drawing of a plant cell as seen from an Electron Micrograph.

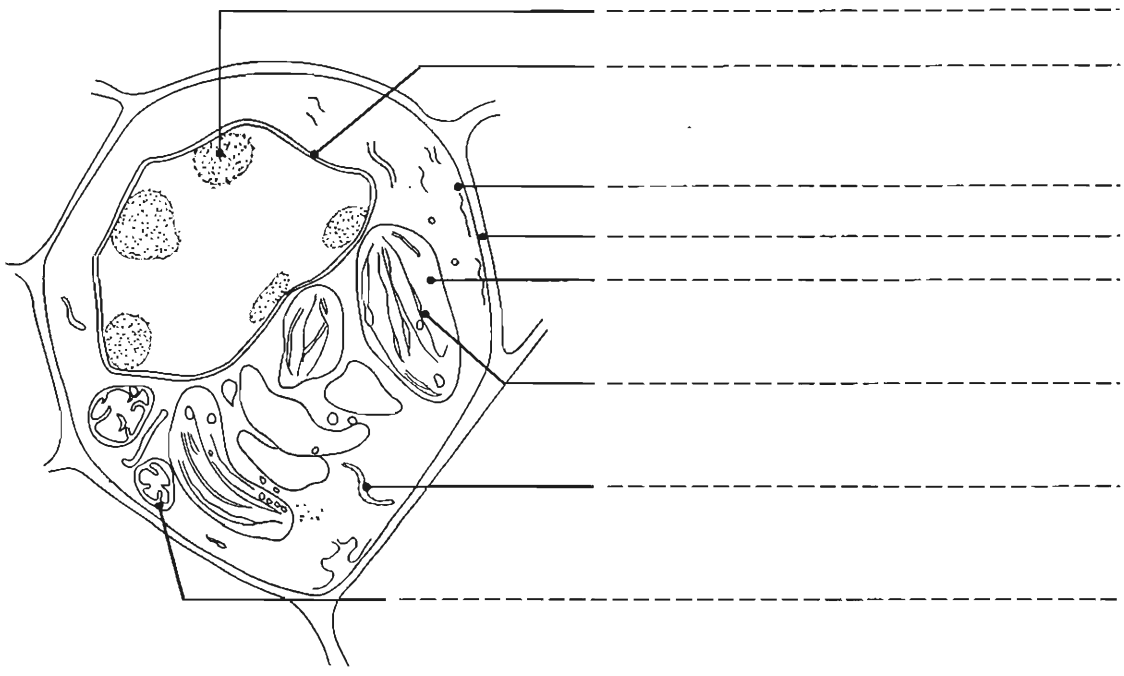


Figure 5. Student's drawing of a plant cell as seen from electron micrograph

(a) Complete the labelling of the student's drawing by writing in the spaces provided, the name of EACH part of the cell identified by the lines. **[4 marks]**

(b) The electron micrograph in Figure 6 below shows a membrane system in the cell.

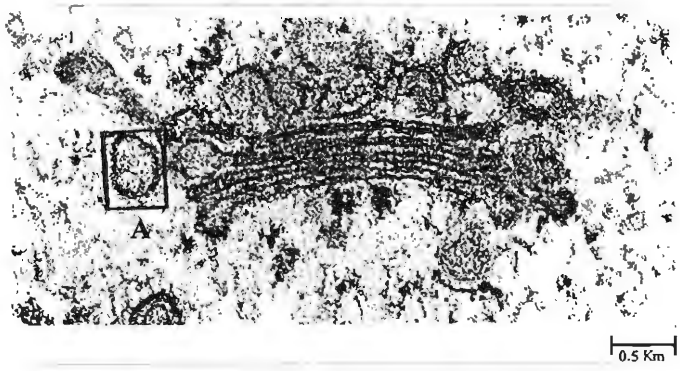


Figure 6. An electron micrograph of a membrane system

(i) Identify the membrane system shown in Figure 6.

_____

[1 mark]

(ii) Describe the function of the membrane system identified in (i).

_____

_____

[1 mark]

(iii) Determine the width of vesicle A within the box in Figure 6.

_____

_____

[1 mark]

(c) Figure 7 below shows an electron micrograph of an organelle found in plant and animal cells.

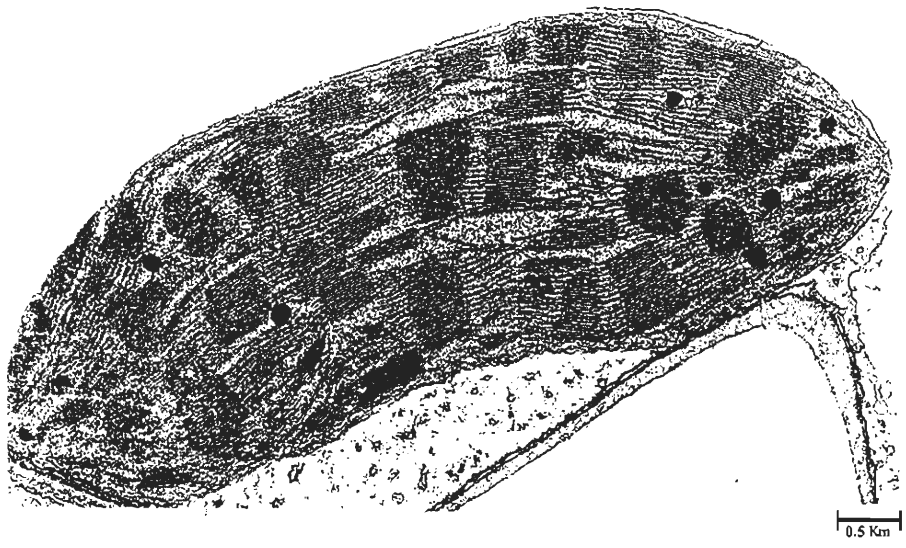


Figure 7. An electron micrograph of an organelle in the cell

Describe TWO functions of the organelle shown in Figure 7 above.

_____

_____

_____

_____

[2 marks]

(d) Name TWO organelles or cellular structures present in animal cells but absent from plant cells.

_____

[1 mark]

Total 10 marks

4. In Figure 8 below there are five micrographs, (i) – (v), of the stages of mitosis.

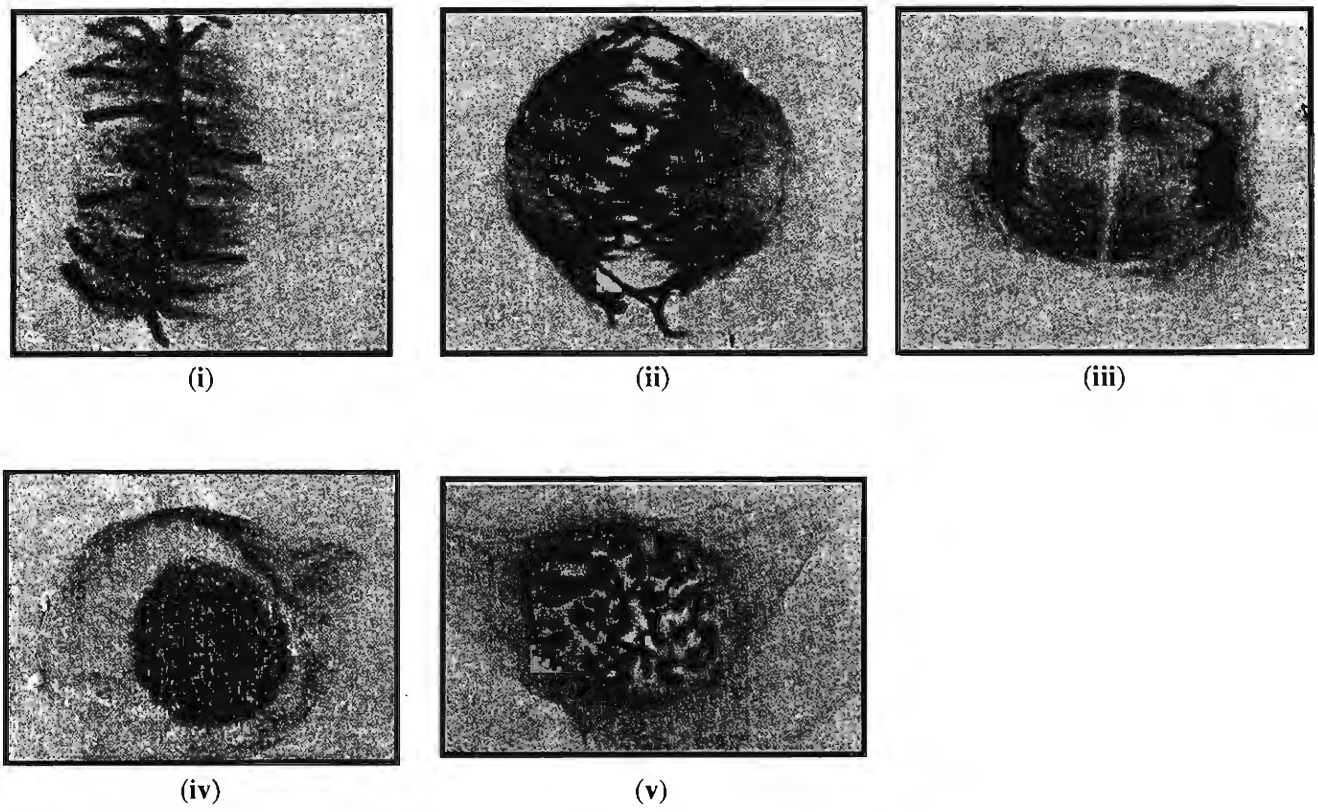


Figure 8. Stages of mitosis

(a) Name EACH of the stages of mitosis shown in Figure 8 above.

(i) _____ (iv) _____

(ii) _____ (v) _____

(iii) _____

[3 marks]

(b) A potato plant has 24 pairs of chromosomes in its somatic cells.

Determine the number of chromatids in its somatic cells at

(i) **Prophase** of mitosis _____

(ii) **Anaphase** of mitosis _____

[2 marks]

(c) A chemical disrupts the formation of spindle fibres when it is added to cells that are undergoing mitosis.

Predict the effect the chemical would have on the process of mitosis.

_____

_____

_____

[2 marks]

(d) Distinguish between the terms **'chromatid'** and **'chromatin'**.

_____

_____

_____

_____

[2 marks]

(e) Name TWO processes occurring in all living organisms in which mitosis plays an important role.

_____

_____

[1 mark]

Total 10 marks

5. Figure 9 below is a diagram of part of the human reproductive system during gestation.

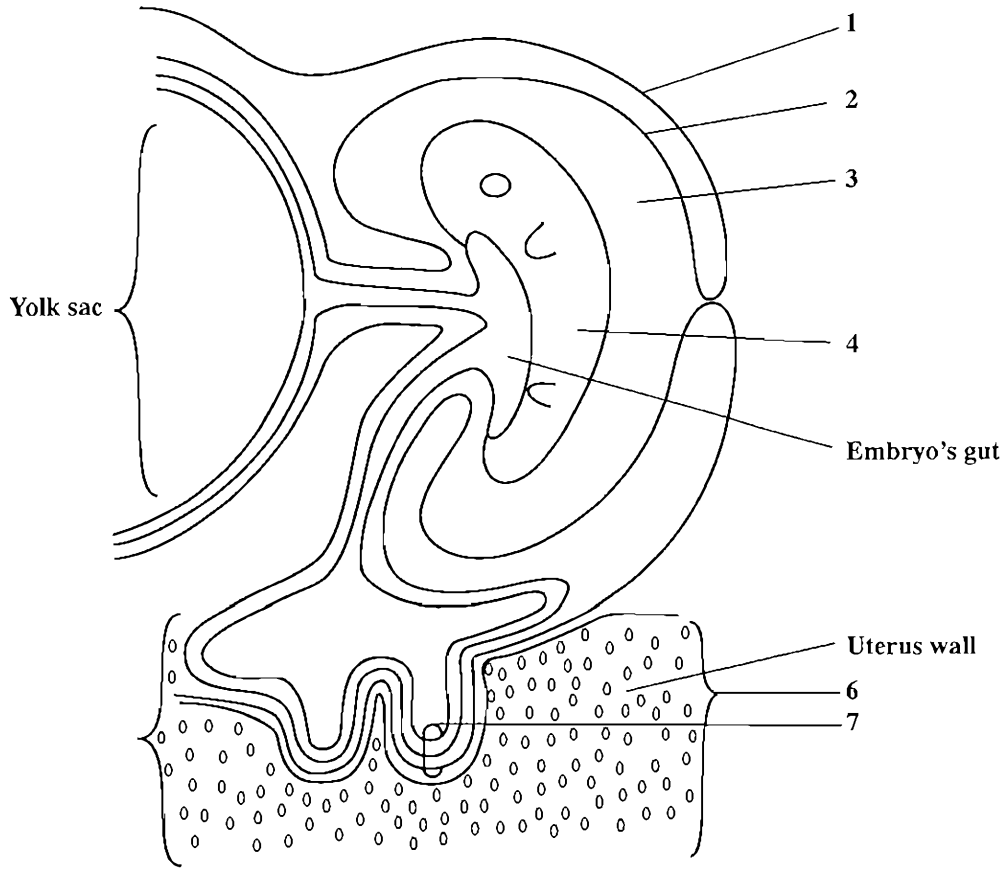


Figure 9. Reproductive system during gestation

(a) Identify the structures labelled 1 to 4 in Figure 9 above.

1 _____ 2 _____

3 _____ 4 _____

[2 marks]

(b) State TWO functions of the **amnion**.

_____

_____

_____

_____

[2 marks]

GO ON TO THE NEXT PAGE

(c) In Figure 9, in label 7, three membranes are closely associated.

Name these THREE membranes.

_____

_____

[1 mark]

(d) State how the structures at 6 and 7 develop further as gestation progresses.

_____

_____

_____

[2 marks]

(e) List FOUR functions of the placenta.

_____

_____

_____

_____

_____

[2 marks]

(f) "The umbilical artery carries oxygenated blood from the embryo's heart to the placenta".

Is this statement true or false? If it is true, write "TRUE" below. If it is false, write the corrected statement below.

_____

_____

_____

[1 mark]

Total 10 marks

6. Figure 10 shows various aspects of the human uterine and ovarian cycles.

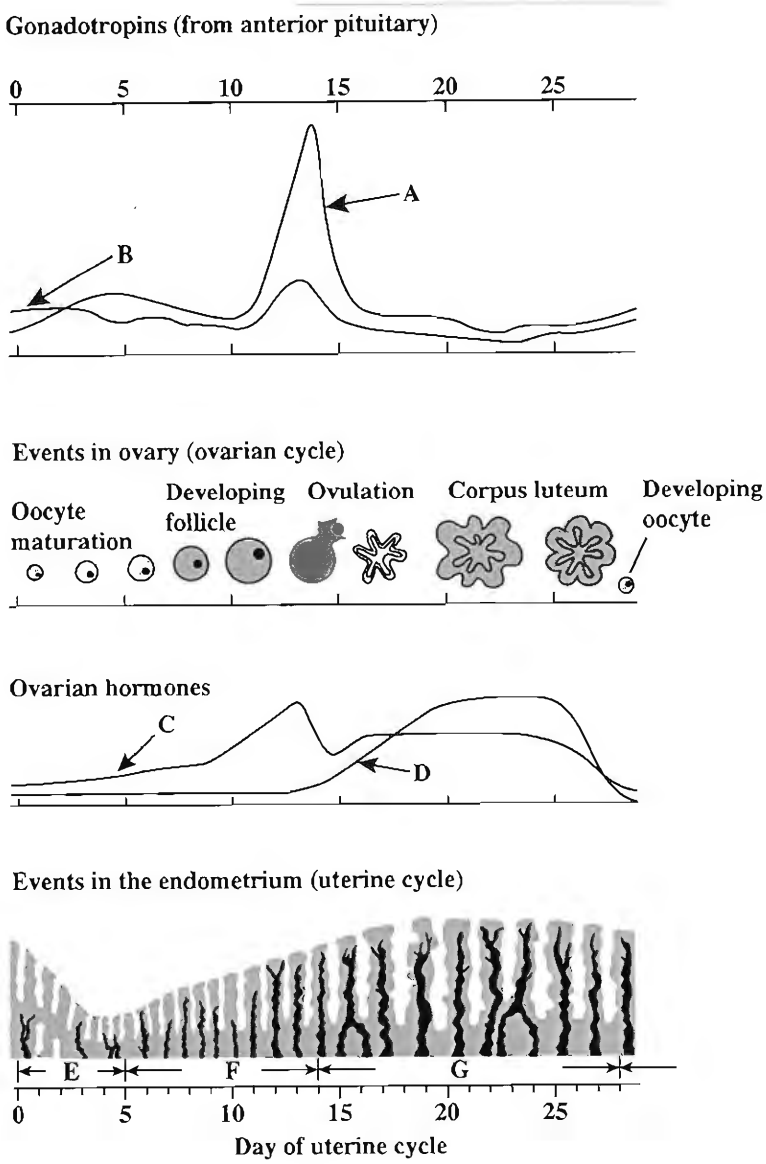


Figure 10. The human uterine and ovarian cycles

(a) Name the hormones A to D represented on the graphs in Figure 10.

Hormone A: _____

Hormone B: _____

Hormone C: _____

Hormone D: _____

[**2 marks**]

GO ON TO THE NEXT PAGE

(b) Describe the events occurring in the endometrium of the uterus at E, F and G in Figure 10.

Events at E: _____

_____

Events at F: _____

_____

Events at G: _____

_____

[3 marks]

(c) The birth-control pill RU-486 contains a progesterone-like molecule. Suggest how this pill prevents conception.

_____

_____

_____

_____

[2 marks]

(d) In the process of gamete production, state

(i) how many sperm are produced from EACH diploid sex cell (primary spermatocyte)

_____

[1 mark]

(ii) the number of secondary oocytes produced from EACH sex cell (primary oocyte)

_____

[1 mark]

(iii) the name of the other **type** of cell that is produced ALONG WITH the secondary oocyte.

_____

[1 mark]

Total 10 marks

7. (a) State TWO items of information which can be obtained by performing a Chi-squared (χ^2) test.

_____

_____

_____

_____

[2 marks]

(b) (i) State the phenotypic ratio obtained from an F_1 dihybrid cross.

_____

[1 mark]

(ii) When using a table of χ^2 values, state and explain why 3 would be choosen for the degrees of freedom from the F_2 progeny.

_____

_____

[1 mark]

(c) In summer squash, the fruit can be disc-shaped or spherical, and white or yellow in colour. The dihybrid genotype Ww Dd produces a white, disc-shaped phenotype. The school agricultural project harvested a field of squash and students counted 3220 in all, of which 1820 were white discs, 610 white spheres, 590 yellow discs and 200 yellow spheres. The students performed a chi-squared test on the results.

(i) Complete Table 2 to determine the value of χ^2, to TWO decimal places.

TABLE 2: TO DETERMINE CHI-SQUARED VALUE

Phenotype	Observed results (O)	Expected results (E)	(O – E)	$(O - E)^2$	$\left(\frac{(O-E)^2}{E}\right)$
White disc	1 820		8.75	76.56	
White sphere	610	603.75	6.25		
Yellow disc	590	603.75		189.06	
Yellow sphere	200	201.25	–1.25		

[4 marks]

(ii) What is the sum of $\left(\frac{(O-E)^2}{E}\right)$? _____ **[1 mark]**

(iii) Refer to Table 3 below to find the value of χ^2 at 5% probability.

TABLE 3: TABLE OF χ^2 VALUES

Degrees of Freedom	Number of Classes	χ^2 values					
1	2	0.46	1.64	2.71	3.84	6.64	10.83
2	3	1.39	3.22	4.61	5.99	9.21	13.82
3	4	2.37	4.64	6.25	7.82	11.34	16.27
4	5	3.36	5.99	7.78	9.49	13.28	18.47
Probability (p) that chance alone could produce the deviation		0.50 (50%)	0.20 (20%)	0.10 (10%)	0.05 (5%)	0.01 (1%)	0.001 (0.1%)

Value of χ^2 at 5% probability: _____

[1 mark]

Total 10 marks

8. (a) State clearly what is meant by the term 'mutation'.

_____

_____

[1 mark]

(b) State TWO conditions which cause mutations.

_____

_____

[1 mark]

(c) When chromosomes come together during meiotic interphase, exchange of chromosomal material may occur. Figure 11 below shows two homologous chromosomes (each composed of two chromatids) with chiasmata.

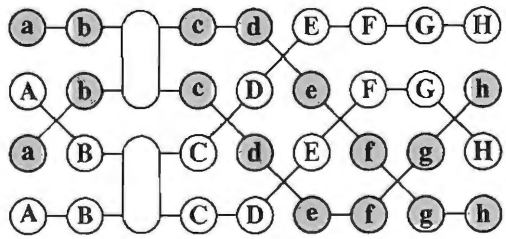


Figure 11. A pair of homologous chromosomes with chiasmata

(i) In Figure 12 below identify the letters in the four separate chromatids, after the above interaction, with the four separate centromeres. Use the upper-and lower-case letters to accurately indicate the arrangement of the alleles of the genes on the pairs of chromosomes. Assume a reconnection to the opposing homologue or chromatid at each chiasma.

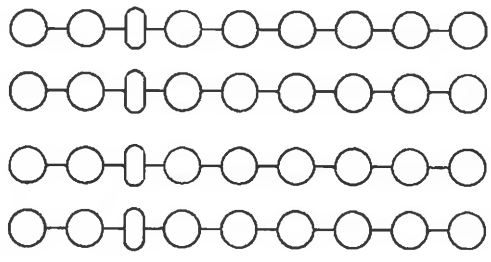


Figure 12. Incomplete diagram

[2 marks]

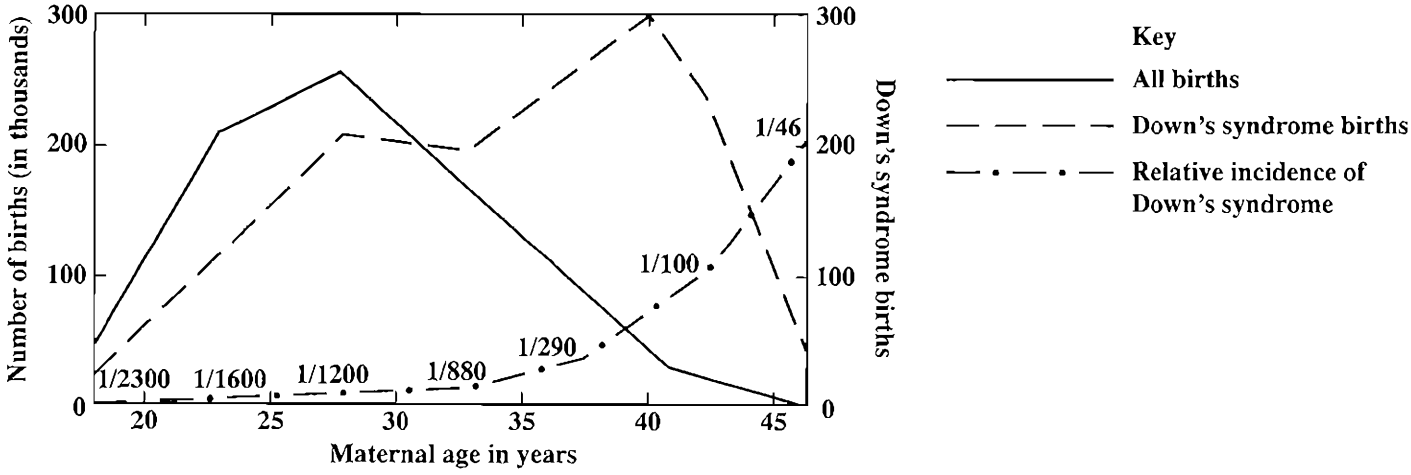
(ii) Name the type of rearrangement that has occurred when a chromatid results with the following combination of alleles:

A B C D H G F E I J K L

_____

[1 mark]

(d) Figure 13 shows the effect of maternal age on the incidence of Down's syndrome.



Adapted from: Heredity and Human Diversity, S. Tomkins, Cambridge University Press.

Figure 13. Effect of maternal age on incidence of Down's syndrome

(i) State how Down's syndrome is caused.

_____

_____

[1 mark]

(ii) With reference to Figure 13, comment on the relative incidence of Down's syndrome with maternal age.

_____

_____

_____

_____

[2 marks]

GO ON TO THE NEXT PAGE

(iii) After reaching a peak of around 300, the Down's syndrome birth-rate declines.

Suggest ONE reason for this abrupt decline.

_____

_____

[1 mark]

(e) How does a gene (point) mutation differ from the type of mutation exemplified in (c) (ii) and (d)?

_____

_____

_____

[1 mark]

Total 10 marks

9. (a) Define the term "natural selection".

_____

_____

_____

[1 mark]

(b) During the past 50 years, approximately 200 species of insects that attack agricultural crops have become resistant to the pesticide DDT.

Describe how widespread use of DDT could lead to the evolution of resistance in the pests.

_____

_____

_____

_____

_____

_____

[3 marks]

(c) Each of the following statements describes a process that leads to a specific type of speciation.

Identify the type of speciation indicated in EACH statement.

(i) Statement 1: This process in nature is most commonly a result of polyploidy.

Type of speciation: _____

[1 mark]

(ii) Statement 2: This process usually occurs in species that inhabit areas where sharp environmental differences exist.

Type of speciation: _____

[1 mark]

(d) There are many different races of humans, for example, African, European, Indian, Aborigines and Arabs. Although these races are phenotypically different, they belong to one species.

With reference to the biological species concept, explain why humans form a single species.

_____

_____

_____

[1 mark]

(e) Suggest why speciation is a gradual rather than an instantaneous process.

_____

_____

_____

_____

_____

_____

[3 marks]

Total 10 marks

END OF TEST

TEST CODE **02107020**

FORM TP 2006177

MAY/JUNE 2006

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 1 – PAPER 02

$2\frac{1}{4}$ hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of NINE questions.
2. Section A consists of THREE questions. Candidates must attempt ALL questions in this section and should spend no more than 30 minutes on this section. Answers to this section MUST be written in this question paper.
3. Section B consists of SIX questions. Candidates must attempt THREE questions in this section, ONE question from EACH module. Answers to this section MUST be written in the separate answer booklet provided.
4. The use of silent non-programmable calculators is allowed.

SECTION A

You must attempt ALL THREE questions in this section. You should NOT spend more than 30 minutes on this section.

1. The School Meals Department produces a popular dessert which the senior students take to the lab to analyse. They have access to distilled water, Bunsen burners, test tubes and the reagents listed in Table 1, Column 1. Table 1 is designed to show the tests, test results and deductions of the senior students.

(a) Complete Table 1 by describing the testing procedures the students use; and state the type of food molecule found (if any).

TABLE 1: ANALYSIS OF DESSERT

Test Reagents	Testing Procedure	Test Results	Deduction
Benedict's solution		Clear blue solution	
Benedict's solution Dilute acid Sodium bicarbonate		 Brick red precipitate	
Iodine in potassium iodide solution		Light yellow – brown colour	
Ethanol		White emulsion	
Biuret solution		Pale purple colour	

[5 marks]

(b) Suggest THREE food items you would purchase from the supermarket to make this dessert.

_____

_____

[1 mark]

GO ON TO THE NEXT PAGE

(c) Draw the following molecules accurately:

(i) A phospholipid molecule

[2 marks]

(ii) A portion of a cellulose molecule containing three glucose units.

[2 marks]

Total 10 marks

2. (a) The structures shown in Figure 1 below are 5 cm lengths of plasticine. One piece is white, and the other ink-coloured (blue or black).

Figure 1. Lengths of plasticine for chromosome models

Using the white and ink-coloured lengths of plasticine, you are asked to conceptualize models of the following chromosomes during the process of meiosis and to draw the models in the spaces provided below:

(i) ONE pair of homologous chromosomes aligning themselves.
Illustrate ONE cross-over between two of the chromatids.

To distinguish between the members of the pair of chromosomes, leave the white length of plasticine clear and the ink-coloured length of plasticine with hashed lines using your pen.

[2 marks]

(ii) Early anaphase of meiosis I, showing the exchanged chromatid material. (Shade appropriately).

[2 marks]

(b) Figure 2 shows the sex chromosomes of a mammal.

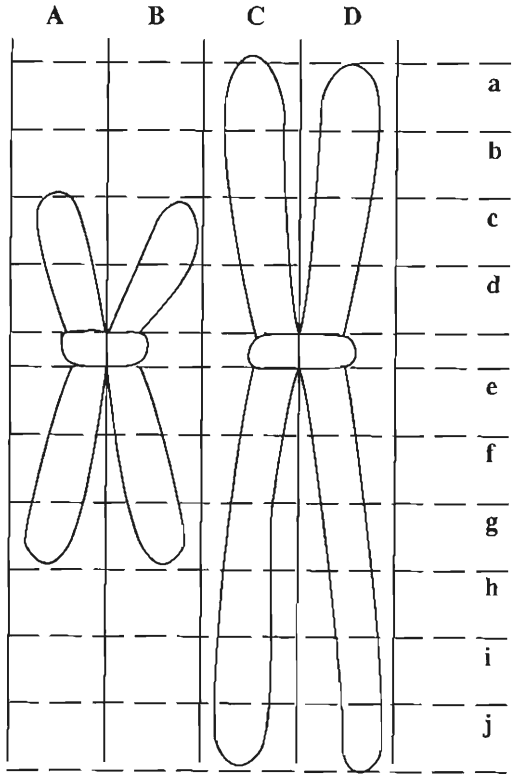


Figure 2. Sex chromosomes of a mammal

With reference to Figure 2 above, complete Table 2 to show which areas of the sex chromosomes can cross over to form chiasmata. (Place a tick (√) in the appropriate column).

TABLE 2: CHIASMATA FORMATION BETWEEN SEX CHROMOSOMES

Chiasma co-ordinates		Chiasma possible	Chiasma not possible
(i)	Ci and Di		
(ii)	Af and Df		
(iii)	Bc and Cb		
(iv)	eD and Be		

[2 marks]

(c) State TWO ways in which the process of meiosis contributes towards the variation of the gametes.

_____

_____

_____

_____

[2 marks]

(d) Table 3 is constructed to show the amount of DNA present in cells undergoing meiosis. The amount of DNA in a somatic cell is represented as 100 per cent.

Place a tick (√) in the column which shows the amount of DNA present at the stage of meiosis listed.

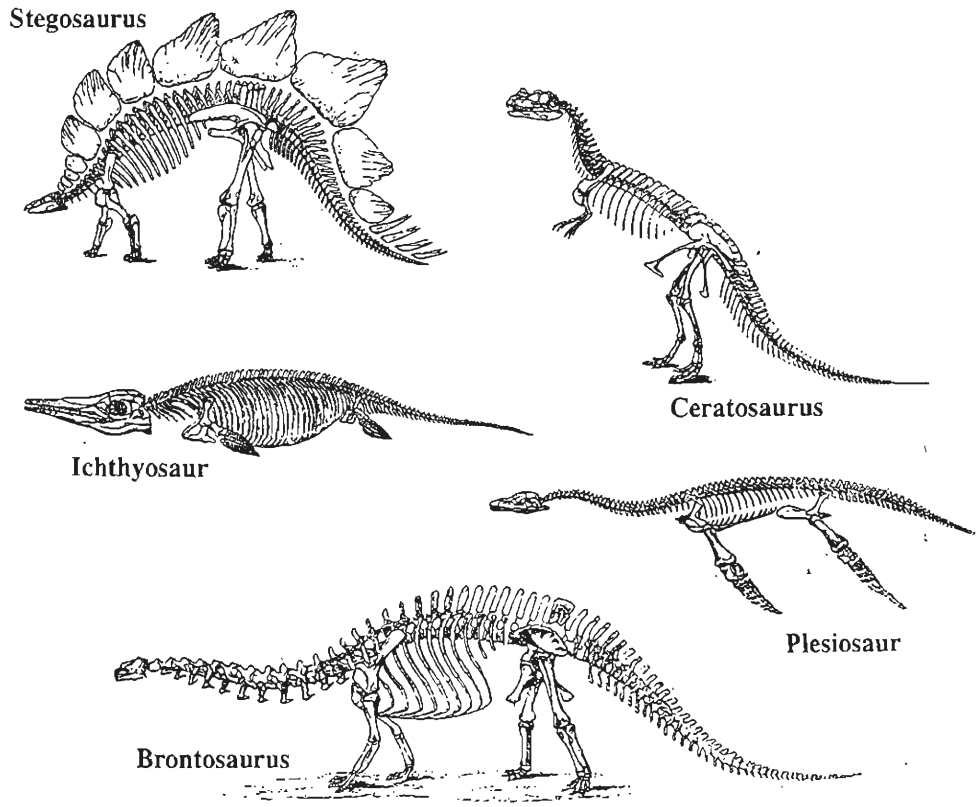
TABLE 3: AMOUNT OF DNA IN CELLS DURING STAGES OF MEIOSIS

Stage of meiosis	DNA present in the cells			
	50%	100%	150%	200%
Prophase I				
Anaphase I				
Cytokinesis I				
Metaphase II				
Telophase II				
Cytokinesis II				

[2 marks]

Total 10 marks

3. (a) Figure 3 shows the restored skeletons of fossil reptiles (not to scale).



Source: General Zoology, 3rd Edition. T. Storer and R. Usinger. McGraw-Hill Book Company, Inc. 1957.

Figure 3. Skeletons of fossil reptiles

Using distinguishing features of these reptiles, construct a set of dichotomous keys to assist in their identification.

[4 marks]

(b) Read the paragraph below, and then answer the questions that follow.

"Sixty million years ago, dinosaurs reigned over the world. These huge reptiles were well adapted to their environment and existed in harmony with the factors of the ecosystem. They changed little and prospered.

Various theories explain their demise. Evolving small mammals ate the eggs of the ground-based dinosaurs, and only the nesting types eluded them. Some scientists attribute their disappearance to a massive meteor, which threw up debris on impact. The atmosphere was darkened, preventing penetration of sunlight, obliterating photosynthesis, eradicating the primary producers, and eliminating the food chains."

State THREE types of selection mentioned in the paragraph, and for EACH type, paraphrase a sentence from the passage to describe it.

Type of selection _____

Description: _____

_____

_____

[2 marks]

Type of selection _____

Description: _____

_____

_____

[2 marks]

Type of selection _____

Description: _____

_____

_____

[2 marks]

Total 10 marks

SECTION B

You must answer THREE questions in this section. Answer ONE question EACH from Modules 1, 2 and 3. You MUST write your answers in the separate answer booklet provided.

MODULE 1

Answer EITHER Question 4 OR Question 5.

4. (a) Describe the structural features of a typical plant cell **and** point out the features of contrast shown in animal cells. **[10 marks]**

(b) "Prokaryotic cells differ from Eukaryotic cells."

Elaborate on these differences. **[6 marks]**

(c) Provide arguments in support of the endosymbiont theory. **[4 marks]**

Total 20 marks

5. (a) With reference to the structure of enzymes, distinguish between competitive and non-competitive enzyme inhibition. **[4 marks]**

(b) Describe the steps involved in an enzyme-catalysed reaction. In your description, make reference to the active site of an enzyme-substrate complex, lowering of the activation energy and enzyme specificity. **[6 marks]**

(c) (i) Alpha amylases catalyze the breakdown of starch in flour during the production of bread. The optimum temperature for alpha amylase activity is 38°C.

Giving ONE reason, predict the effect that baking the bread over 110°C will have on enzyme activity. **[2 marks]**

(ii) The enzyme pepsin digests protein in the stomach where hydrochloric acid maintains the contents at an optimum pH of between 1 and 3. The pancreas secretes alkaline bicarbonate ions into the duodenum.

Giving ONE reason, predict the effect that the addition of these bicarbonate ions will have on pepsin action as the stomach contents pass into the duodenum. **[2 marks]**

(iii) The enzyme xylanase digests xyloglucans in fresh apple juice. Twenty grams of purified xylanase clarifies 1000 litres of apple juice in 30 minutes. In a new clarification process, 30 g of xylanase will be used in the same volume of apple juice.

Giving ONE reason, predict the effect that the new weight of xylanase will have on the clarification process. **[2 marks]**

GO ON TO THE NEXT PAGE

(iv) During a shortage of xylanase, only 20 g of the purified enzyme is available to clarify 2000 litres of apple juice.

Giving ONE reason, predict the effect that this shortage will have on the clarification process. **[2 marks]**

(v) Xyloglucans are the principal hemicelluloses in dicotyledons. The xyloglucan molecule consists of a backbone of beta-glucose units to which side chains of xylose are attached. Xylans are the principal hemicelluloses in monocotyledons. The xylan molecule consist of xylose units only.

Giving ONE reason, predict what would occur if xylanase were used to clarify fresh sugar cane juice. **[2 marks]**

Total 20 marks

MODULE 2

Answer EITHER Question 6 OR Question 7.

6. (a) Explain how the sequence of nucleotides in the DNA molecule is related to:

(i) the sequence of nucleotides in the RNA molecule **[6 marks]**

(ii) the order in which the t-RNA molecules align specific amino acids. **[5 marks]**

(b) How are the following influenced by the organism's DNA?

(i) The precise and accurate folding of globular proteins **[5 marks]**

(ii) The erroneous formation of haemoglobins in sickle-cell anaemia **[4 marks]**

Total 20 marks

7. (a) Describe the structure of the anther **and** the way in which pollen grains are formed within it. **[10 marks]**

(b) Name the type of fertilisation exhibited by EACH of the following plants and **briefly** explain the mechanism being used:

- In the flower *Chamaenerion angustifolia*, the stamens and carpels reach maturity at different times.
- In the flower *Lilium longiflorum*, there is a wide separation of the anthers and the stigma.
- In *Cajanus cajan*, the pollen grains from mother plants do not germinate if placed on its own stigma.
- In *Mangifera indica*, honey bees visit the flowers bringing pollen from other flowers.
- In *Carica papaya*, male and female flowers are found on separate plants and pollen passes from male to female plants. **[5 marks]**

(c) Bananas and sweet potatoes reproduce by asexual methods. Tomatoes and peppers reproduce sexually.

Discuss the advantages and disadvantages of each type of reproduction in these plants. **[5 marks]**

Total 20 marks

MODULE 3

Answer EITHER Question 8 OR Question 9.

8. (a) What is meant by the following terms?

(i) Gene

(ii) Allele **[2 marks]**

(b) Explain the operation of multiple alleles in the ABO Blood Grouping System in humans **and** use genetic diagrams to show how parents with A (mother) and B (father) blood types may produce a family with all four types of blood group represented in the children. **[8 marks]**

(c) (i) What are sex chromosomes **and** how do they control the inheritance of sex? **[4 marks]**

(ii) With the aid of a genetic diagram, explain sex linkage, showing how it is possible for a normal sighted woman and a normal sighted man to have colour-blind sons. **[6 marks]**

Total 20 marks

9. (a) Describe the five-kingdom classification system **and** discuss the principles and importance of modern classification systems. **[10 marks]**

(b) A plant has been discovered that is unlike any in recorded literature. Suggest the procedure for classifying the new plant. **[5 marks]**

(c) Discuss the importance of conserving biodiversity. **[5 marks]**

Total 20 marks

END OF TEST

TEST CODE **02207010**

FORM TP 2006178

MAY/JUNE 2006

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 2 – PAPER 01

$1\frac{3}{4}$ hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. Candidates must attempt ALL questions in this paper.
2. Answers are to be written in the spaces provided in this answer booklet.
3. EACH question is worth 10 marks.
4. The use of silent non-programmable calculators is allowed.

1. (a) Name the MAJOR pigment **and** ONE accessory pigment used by plants in photosynthesis.

_____

[1 mark]

(b) State the wavelengths of light absorbed by Photosystems I and II.

(i) Photosystem I:

_____

(ii) Photosystem II:

_____

[1 mark]

(c) Figure 1 shows how electrons are transported through Photosystem I and Photosystem II in the light-dependent stage of photosynthesis.

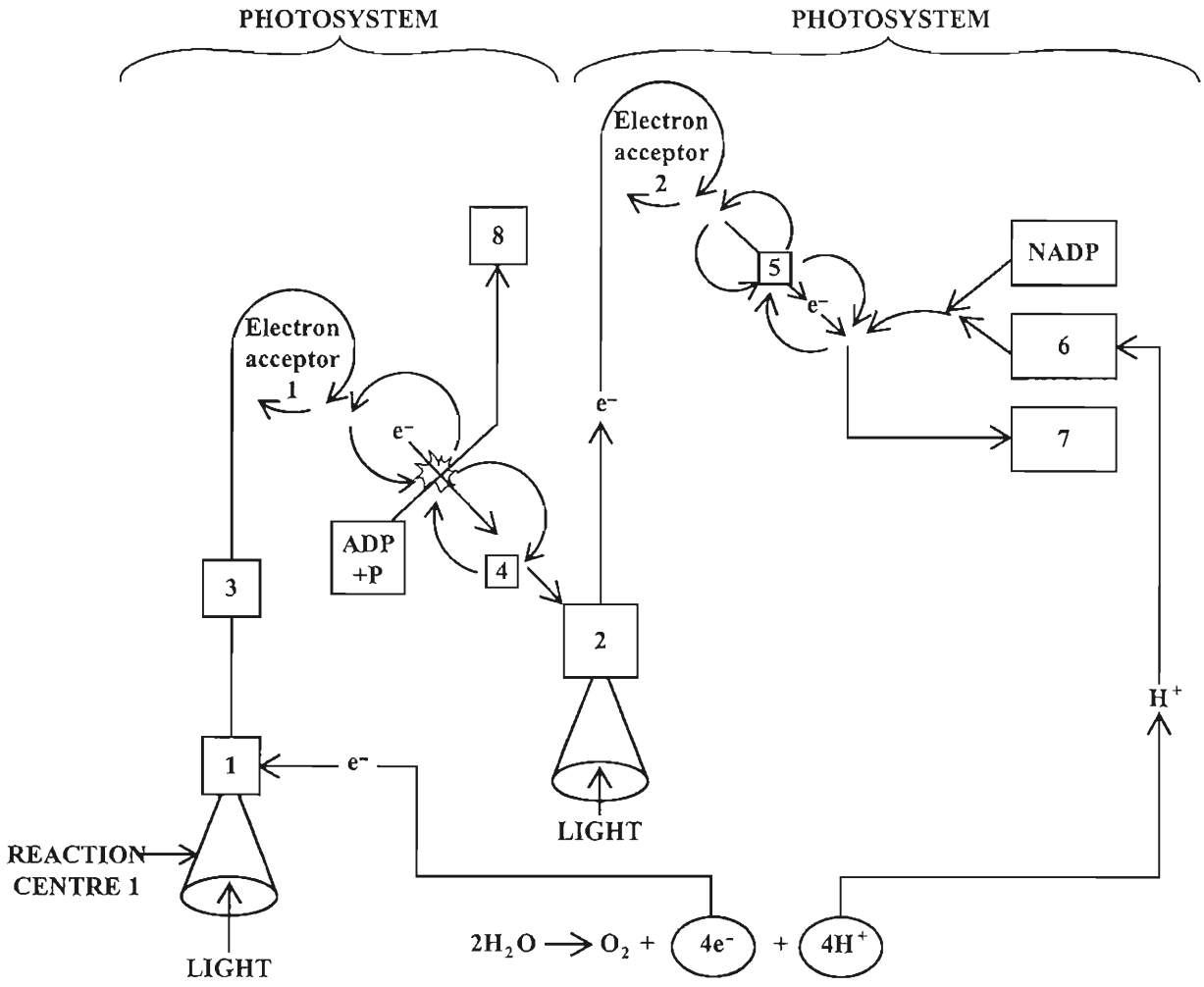


Figure 1. Light-dependent stages of photosynthesis

GO ON TO THE NEXT PAGE

With reference to Figure 1, answer questions (i) to (v).

(i) Identify the photosystems labelled at Boxes 1 and 2.

Photosystem at Box 1:

_____

Photosystem at Box 2:

_____

[1 mark]

(ii) Briefly explain

a) TWO events caused by incident light at Reaction Centre 1

Event 1: _____

_____

Event 2: _____

_____

[1 mark]

b) why electrons enter Box 1.

_____

_____

[1 mark]

(iii) State TWO events which occur between Boxes 3 and 4.

Event 1: _____

_____

Event 2: _____

_____

[2 marks]

(iv) State TWO events which occur between Boxes 4 and 5.

Event 1: _____

_____

Event 2: _____

_____

[1 mark]

(v) Identify the substances in Boxes 6, 7 and 8.

Box 6 _____

Box 7 _____

Box 8 _____

[1 mark]

(d) Each thylakoid has a flattened disc-like shape, and is composed of a thylakoid membrane enclosing an oval thylakoid space.

Which substance, e^- or H^+, is stored in the thylakoid space?

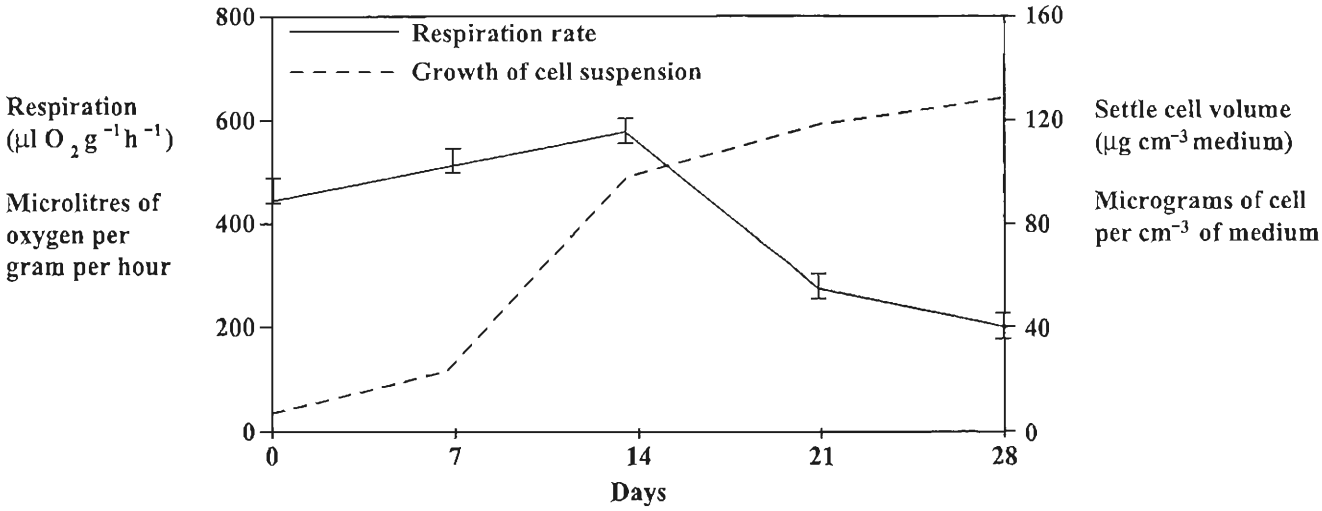
_____

[1 mark]

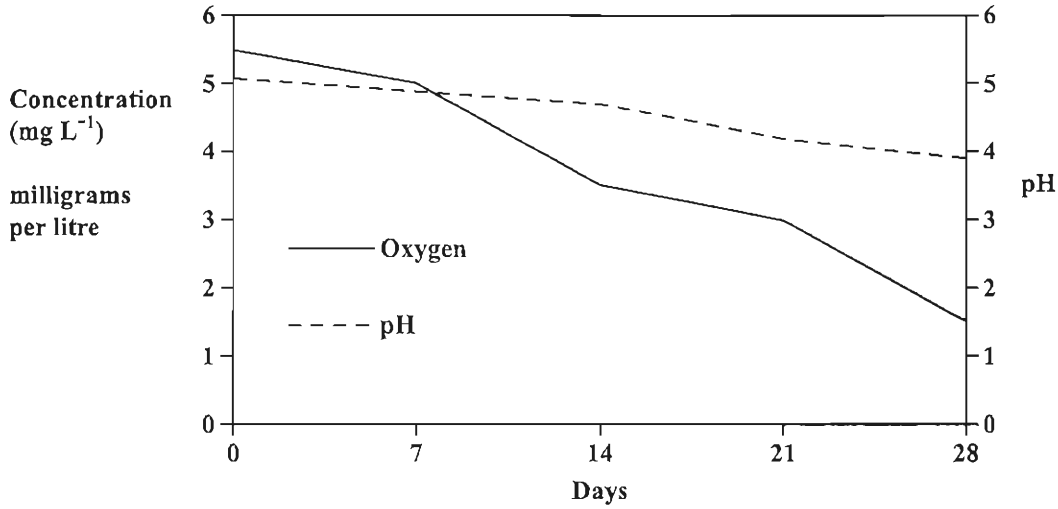
Total 10 marks

NOTHING HAS BEEN OMITTED.

2. The graphs in Figure 2 below show the rate of respiration and the rate of growth of cells in a culture medium as well as the changes in oxygen concentration and pH that take place in the culture medium.



Respiration rate and growth rate of the cell suspension in a culture medium



Changes in ph and oxygen concentration in the culture medium

Figure 2. Changes during growth of cell suspension

Adapted from: Bui Viet and Tran Huong, "Growth of Cell Suspensions of ev. Cau man". Info Musa The International Journal on Banana and Plantain, Vol. 13 No. 1. June 2004, pp. 2 - 3.

Examine the graphs in Figure 2 and answer the following questions.

(a) Determine the maximum respiration rate of the cell suspension.

_____

[1 mark]

GO ON TO THE NEXT PAGE

(b) Determine the concentration of oxygen in the cell suspension medium on the day of MAXIMUM respiration.

_____

[1 mark]

(c) Deduce what type of respiration is being carried out on Day 3 and Day 28. Give ONE reason for your answer.

Day 3: _____

Day 28: _____

[1 mark]

Reason: _____

[1 mark]

(d) Suggest why the pH of the cell suspension medium changes over the period of the experiment.

_____

_____

[2 marks]

(e) Determine the increase in the mass per cm^3 of cells in the cell suspension medium between Day 0 (start of the experiment) and Day 28.

_____

[1 mark]

(f) Explain why the number of cells present in the medium does NOT continue to increase indefinitely.

_____

[1 mark]

(g) Write a balanced equation for the fermentation of glucose to ethanol and state ONE use of this process.

Equation:

_____

[1 mark]

Use of the process:

_____

[1 mark]

Total 10 marks

3. Figure 3 is a diagram of the nitrogen cycle.

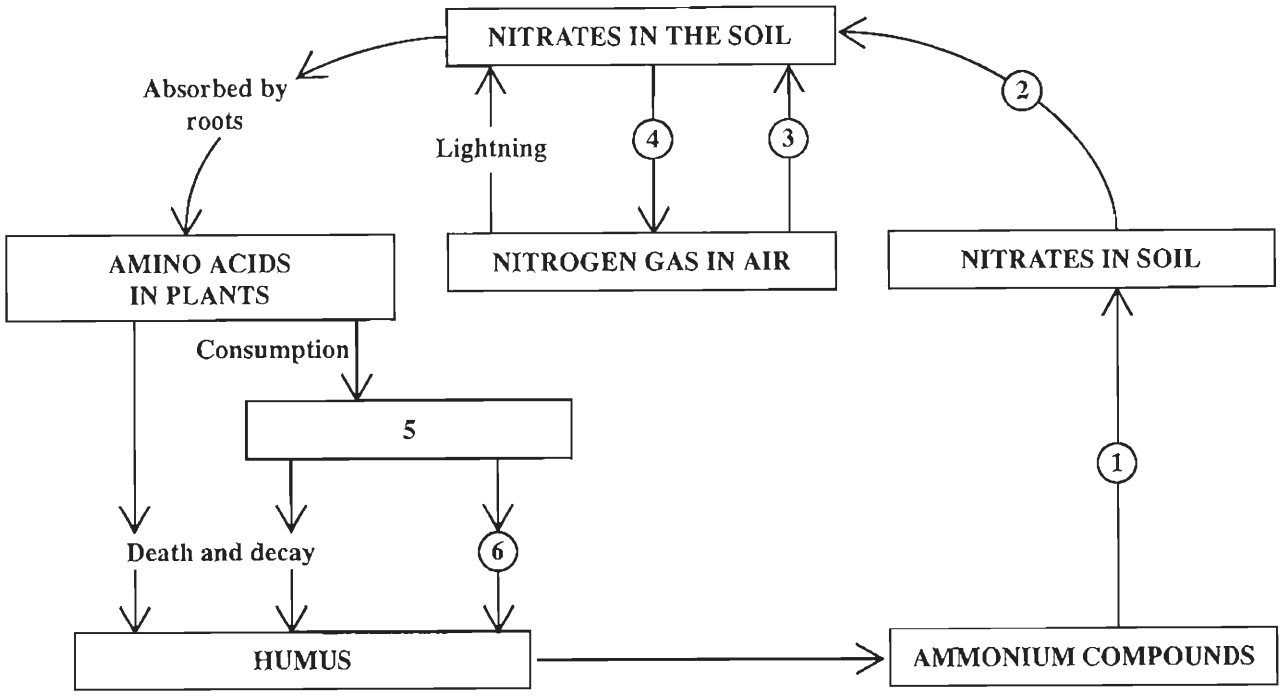


Figure 2. The nitrogen cycle

(a) (i) Identify the stages or organisms represented by the numbers 1 – 6 in Figure 3.

1 _____

2 _____

3 _____

4 _____

5 _____

6 _____

[3 marks]

(ii) Label (3) in Figure 3 represents a mutualistic relationship. Define the term 'mutualism'.

_____

_____

_____

[1 mark]

GO ON TO THE NEXT PAGE

(iii) Logging of trees for timber in tropical forests has ecological consequences for the ecosystem.

Briefly describe TWO **prominent** biological effects of logging.

Effect 1: _____

_____

_____

Effect 2: _____

_____

_____

[2 marks]

(b) State TWO benefits that bacteria derive from being part of the nitrogen cycle.

Benefit 1: _____

_____

Benefit 2: _____

_____

[2 marks]

(c) Giving ONE example, suggest the effect that flooding of farm fields would have on the nitrogen cycle.

_____

_____

_____

[1 mark]

(d) Although nitrogen is cycled, some of the stages of the cycle contain greater reserves of the element. State, with support, which is the LARGEST reserve.

_____

_____

_____

[1 mark]

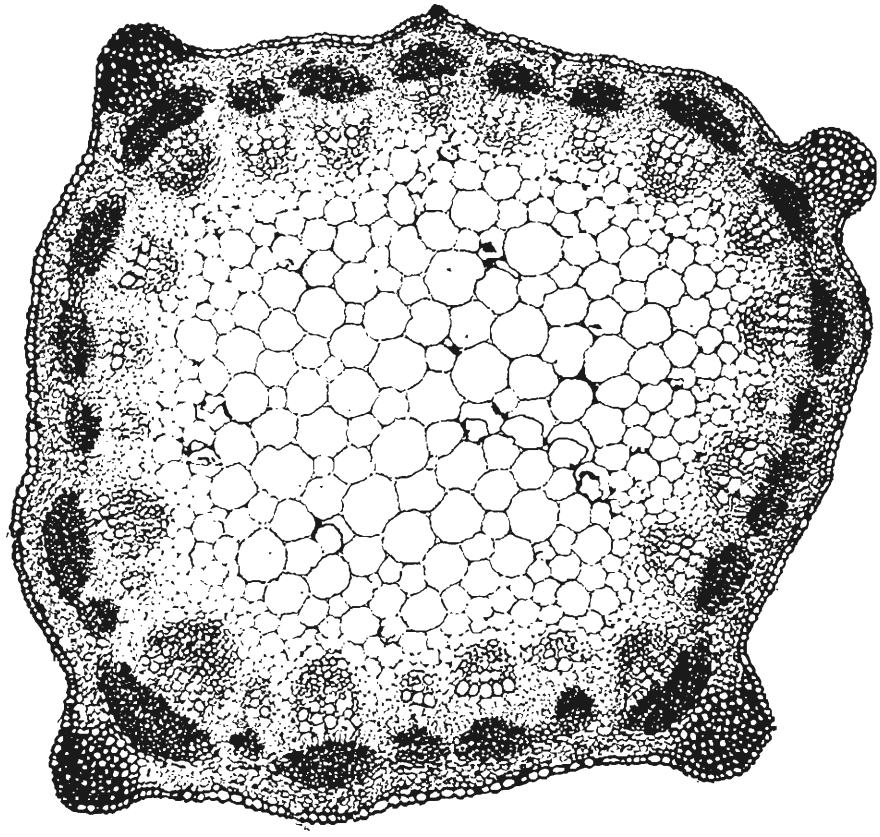
Total 10 marks

NOTHING HAS BEEN OMITTED.

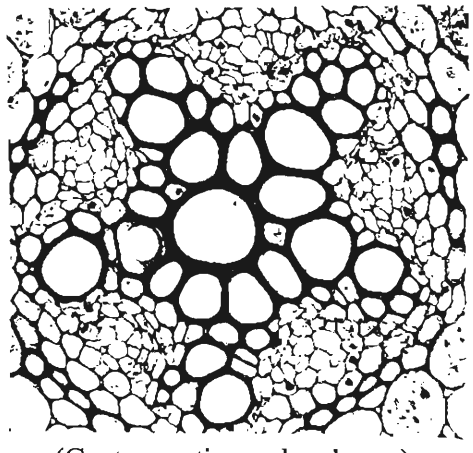
4. In Figure 4.1 below, there are micrographs of transverse sections of two plant organs.

(a) (i) On the micrograph of EACH organ, label ONLY the **phloem**. **[2 marks]**

(ii) Identify EACH plant organ in Figure 4.1. **[2 marks]**



Name of plant organ: _____



(Centre portion only, shown)

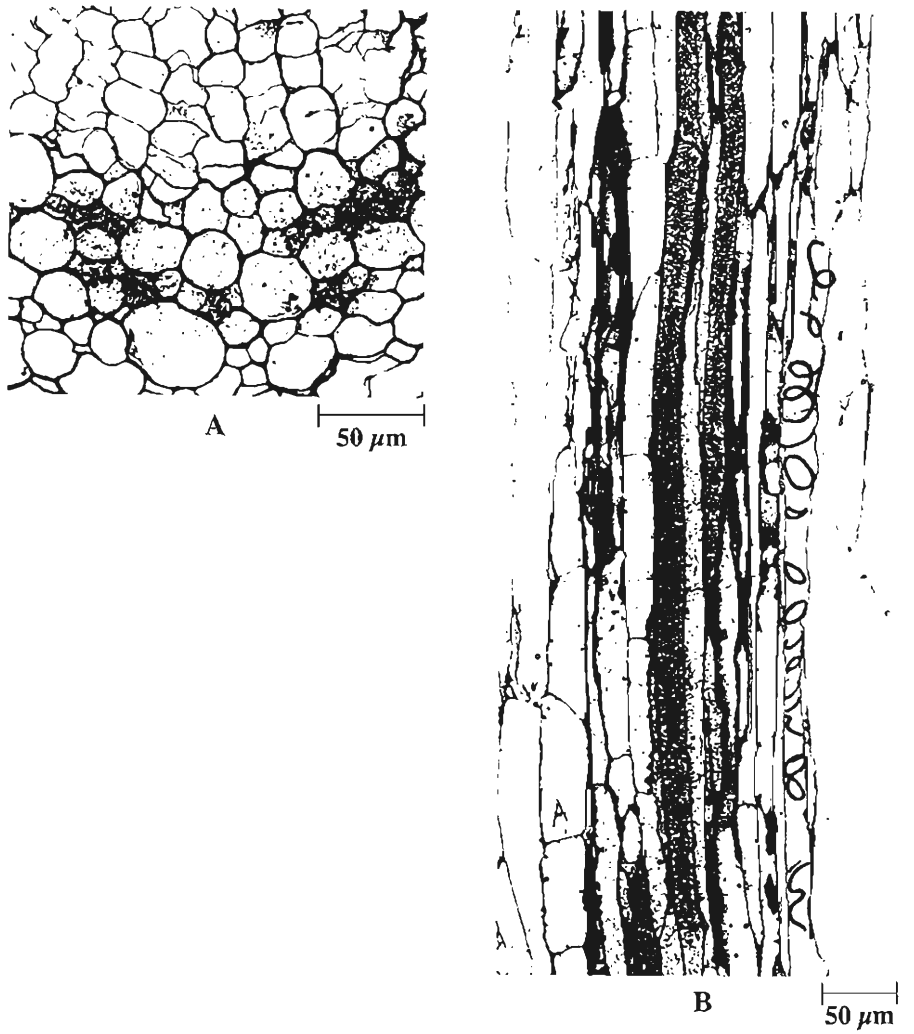
Name of plant organ: _____

Figure 4.1. Transverse sections of two plant organs

Sylvia S. Mader, Biology Evolution, Diversity, and the Environment, McGraw Hill, pp. 382 and 388.

(b) The leaf of the broad bean *Vicia faba*, is exposed to radioactive carbon dioxide for 35 minutes. Both transverse and longitudinal sections are made of the leaf to display the vascular bundles. The sections are placed in contact with an autoradiographic film, which shows up radioactivity as dark grains on the film. The film is left in contact with the sections for 32 days and then developed.

Figure 4.2 shows longitudinal and transverse sections of the vascular bundle.



Transverse section **Longitudinal section**

Figure 4.2. Sections of vascular bundles of *Vicia faba*

P. Raven, R. Evert and S. Eichhorn, Biology of Plants 6th Ed, W. H. Freeman and Company-Worth Publishers, 1999, p 766.

(i) Identify the groups of plant cells in Figure 4.2 that appear dark.

_____

[1 mark]

(ii) Explain why ONLY these cells appear dark.

_____

_____

_____

_____

[2 marks]

(iii) Calculate the width of the cell labelled A in the longitudinal section in Figure 4.2.

_____

_____

[1 mark]

(c) Briefly state the pressure flow hypothesis.

_____

_____

_____

[2 marks]

Total 10 marks

5. Figure 5.1 shows the relationship between the proximal convoluted tubules and a peritubular capillary, in longitudinal section.

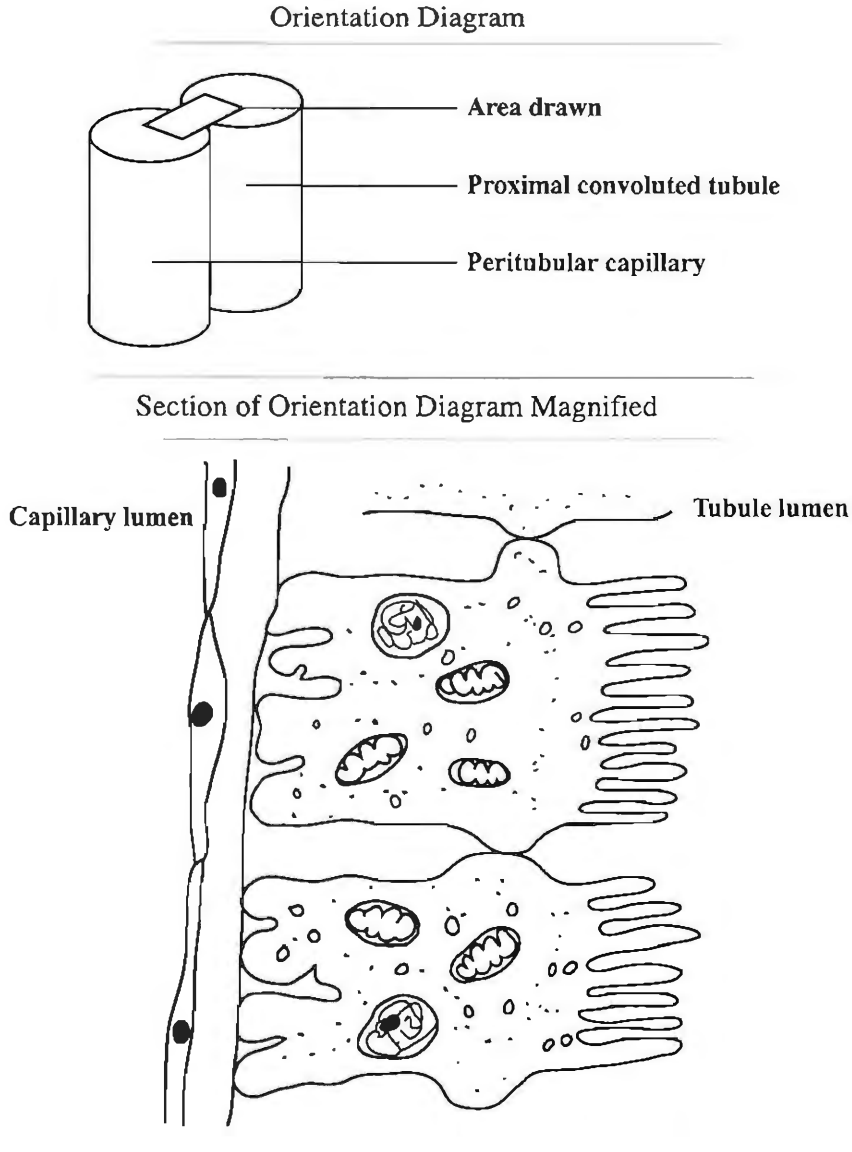


Figure 5.1. Proximal convoluted tubule and peritubular capillary

(a) (i) State FOUR substances, **other than** water and mineral ions, present in the tubule lumen in Figure 5.1 which will be absorbed by the tubule cells.

Substance 1: _____

Substance 2: _____

Substance 3: _____

Substance 4: _____

[2 marks]

(ii) Describe THREE processes used to transport **named** substances from the tubule lumen mentioned in (a) (i) into the tubule cells.

Process 1: _____

_____

Process 2: _____

_____

Process 3: _____

_____

[3 marks]

(iii) Give TWO reasons why substances which accumulate at the intercellular space between the tubule and capillary move into the capillary and do NOT return to the tubule lumen.

_____

_____

_____

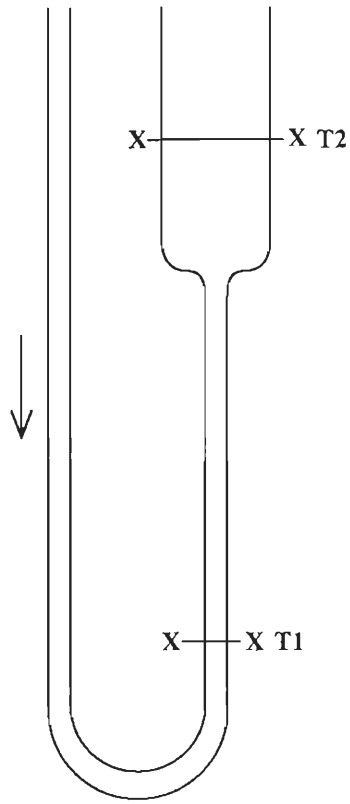
_____

[2 marks]

(b) Figure 5.2 below represents the loop of Henle.

(i) Based on your knowledge of kidney structure, sketch transverse sections of the tube at areas T1 and T2 to show the differences between their cellular structure. **(Make EACH drawing X5 the diameter of the tube).**

Transverse Section T1



Transverse Section T2

Figure 5.2. Loop of Henle

[2 marks]

(ii) Suggest the functional reason for the differences between T1 and T2.

_____

_____

_____

[1 mark]

Total 10 marks

GO ON TO THE NEXT PAGE

6. (a) State what actions of the heart are controlled by the

(i) sino-atrial node (SAN)

_____

_____

_____

[1 mark]

(ii) atrio-ventricular node (AVN)

_____

_____

_____

[1 mark]

(iii) Purkinje tissue.

_____

_____

_____

[1 mark]

(b) Give brief explanatory answers to the following:

(i) Why is there a 0.15 second delay between the effect of the SAN and the AVN?

_____

_____

_____

[1 mark]

(ii) What is the benefit of stimulating the contraction of the ventricles to begin at their base, further away from the AVN, and not their apex, next to the AVN?

_____

_____

_____

[1 mark]

(c) Two campers are awakened from rest when a jaguar looks into their tent. Frightened, the campers jump up and rush off. Their pumping leg muscles squeeze blood up the veins, back to the heart, and reserve blood from the spleen enters the circulation. Diaphragm muscles increase the breathing movements.

Complete Table 1 to identify the structures associated with this response, and the body's actions.

TABLE 1: STRUCTURES, LOCATIONS OR EFFECT OF BODY'S RESPONSES

ACTION IN BODY	ANSWER
(i) Location of structures which **respond** to the stimulus of increased blood flow in the cardiac area	
(ii) Type of nerve which **carries** stimulus to the brain.	
(iii) Name of area of brain which **responds** to stimulus and generates a reaction.	
(iv) Type of nerve which **transmits** the stimulus back to the heart.	
(v) Location in heart which **receives** the stimulus.	
(vi) **Effect** of stimulus on cardiac output.	

[3 marks]

(d) Non-nervous control of the heart may be affected by several factors. For each of the following stimuli, state its effect on the heart rate.

(i) Low pH

_____

(ii) Low body temperature

_____

[2 marks]

Total 10 marks

7. In 1999 – 2000, a British crime survey analysed alcohol-related crimes in relation to acts of violence performed against strangers (persons unknown to the perpetrators) or acquaintances (family or friends).

TABLE 2: INCIDENCE RATE OF CRIME AGAINST STRANGERS AND ACQUAINTANCES BY AGE AND GENDER OF THE ASSAULTER

Gender	Age	Number of victims (per 10 000 adults)	
		Strangers	Acquaintances
Male	16 – 19	749	559
	20 – 24	569	426
	25 – 29	339	277
	30 – 34	326	148
	35 – 39	101	64
	40 – 45	94	61
	45+	66	46
Female	16 – 19	157	338
	20 – 24	122	88
	25 – 29	70	96
	30 – 34	54	68
	35 – 39	15	56
	40 – 45	20	68
	45+	5	36

Adapted from: T. Budd, "Alcohol-related assault: findings from the British Crime Survey". Home Office Online Report 35/3, 2003, p. 25.

(a) (i) **Using references** to the data in Table 2, comment on the aggressiveness, under the influence of alcohol, of

a) drinkers in relation to their age

_____

_____

_____

_____

[2 marks]

b) males and females in relation to their choice of victim.

[**4 marks**]

(ii) Give ONE possible behavioural reason for your answer in (a) (i) b).

[**1 mark**]

(b) Figure 6 below shows the incidence rates of alcohol-related assaults on strangers, acquaintances and total assaults in 1999 by unit consumption.

(i) On the histogram in Figure 6, write in the missing data above the columns which represent the totals. **[1 mark]**

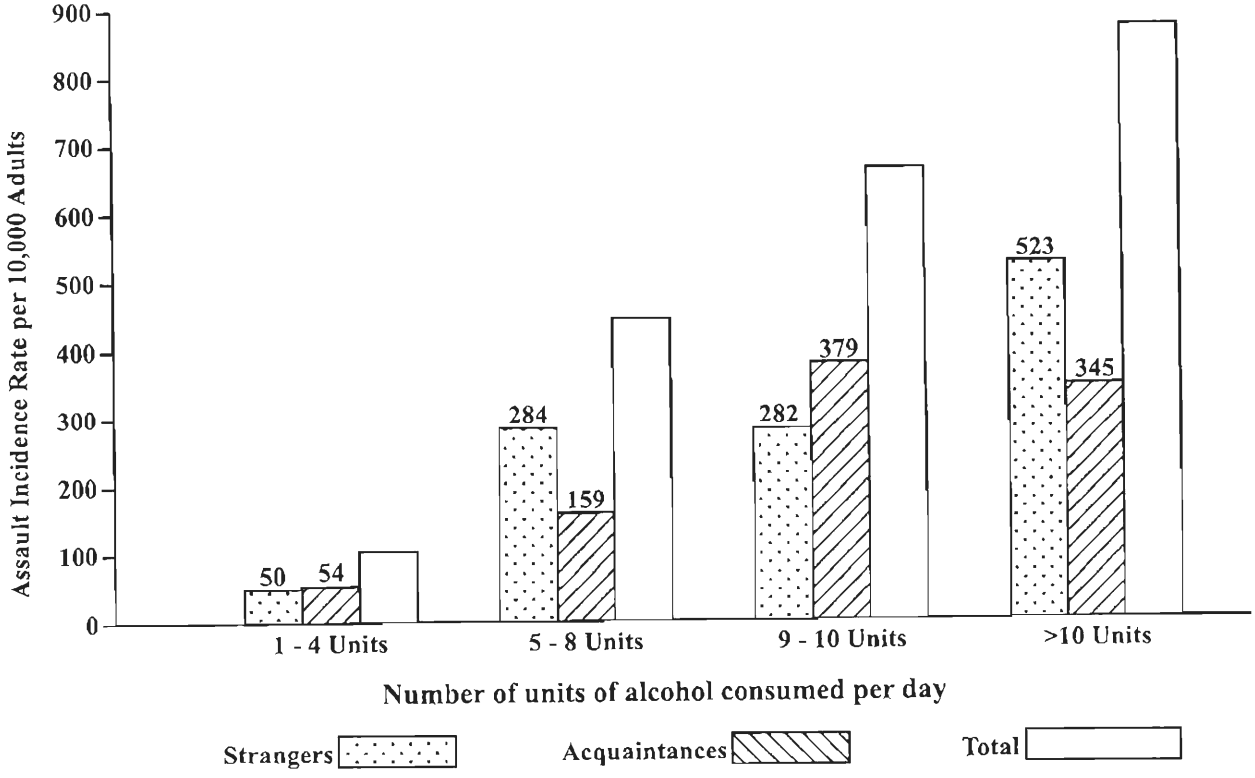


Figure 6. Incidence rate of alcohol-related assault in 1999, by unit consumption

Adapted from T. Budd, "Alcohol-related assault: findings from the British Crime Survey". Home Office Online Report 35/3, 2003, p. 25.

(ii) With **reference** to the data in Figure 6, comment on the relationship between alcohol consumption in units per day and total assault rate.

_____

_____

_____

_____

[1 mark]

(c) What is the accepted 'safe limit' of alcohol consumption in units per day for the average person?

_____

[1 mark]

Total 10 marks

8. Cigarette smoking can cause the healthy coronary artery, cross-section shown in Figure 7.1.A. below, to become the unhealthy artery, cross section shown in Figure 7.1.B.

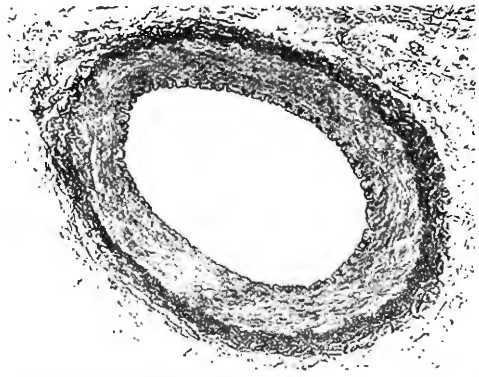


Figure 7.1.A

W. K. Parves et al. Life: Science of Biology, 6th Edition, W. H. Freeman and Company, 2001, p 878.

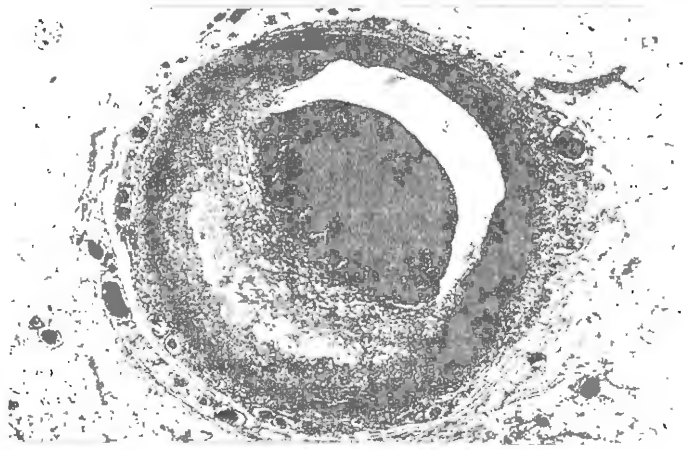


Figure 7.1.B

Chemistry in Britain. Royal Society of Chemistry. Thomas Graham House, Vol 38, #9, p. 35.

(a) (i) Name the disease that is characterized by the state of the coronary artery in Figure 7.1.B.

_____

[1 mark]

(ii) Briefly outline FOUR symptoms that a smoker with the coronary artery shown in Figure 7.1.B is LIKELY to experience.

_____

_____

_____

_____

[2 marks]

(iii) Estimate the percentage obstruction occurring in the lumen of the coronary artery in Figure 7.1.B.

_____

[1 mark]

GO ON TO THE NEXT PAGE

(b) Name TWO components of cigarette smoke and describe ONE effect of EACH component on the body.

Component 1: _____

Effect: _____

_____

Component 2: _____

Effect: _____

_____

[2 marks]

(c) Figure 7.2 below shows age standardized mortality rates from coronary heart disease (CHD) in men and women under 75 years of age in 1998.

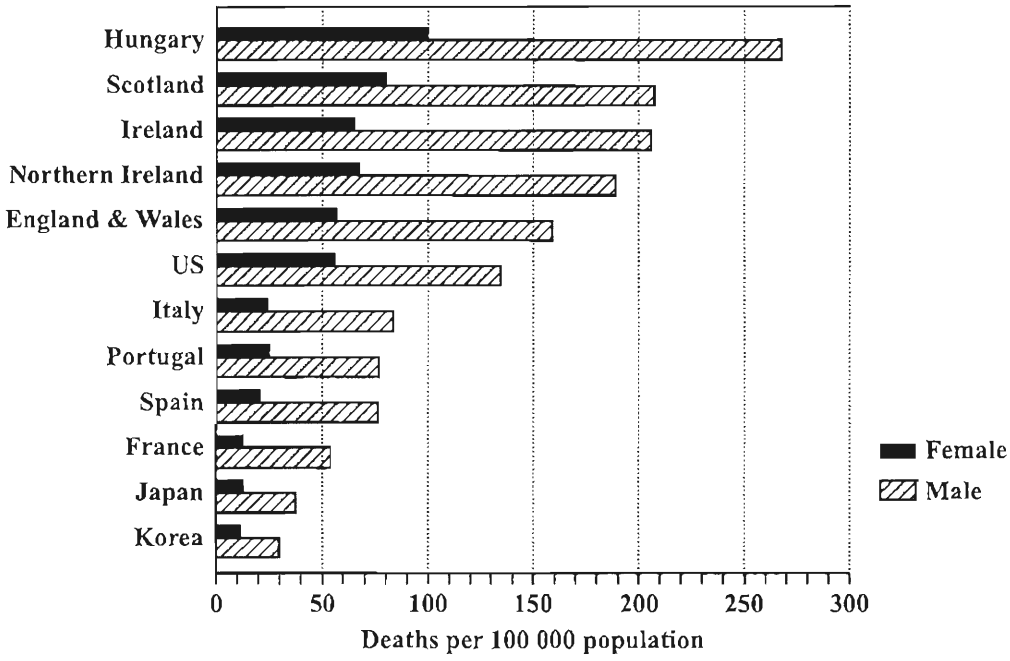


Figure 7.2. Age standardised mortality rates from CHD, men and women aged under 75, in 1998

Source: OHE and WHO in Chemistry in Britain. Royal Society of Chemistry, Thomas Graham House, Vol 38, #9, p 36.

Using Figure 7.2, determine the number of male and female deaths per 100 000 population, that occurred in the USA and Japan in 1998.

USA: Female _____ Male _____

Japan: Female _____ Male _____

[2 marks]

GO ON TO THE NEXT PAGE

(d) Japanese diet consists mainly of fresh fruit, vegetables, rice, fish and soybean curd. The American diet consists mainly of beef, pork, chicken, rice, potatoes, carbonated and alcoholic beverages.

Suggest how these differences in diet contribute to the CHD levels in EACH country.

_____

_____

_____

_____

_____

[2 marks]

Total 10 marks

9. (a) State FOUR methods that can be used to control mosquitoes.

_____

_____

_____

_____

[2 marks]

(b) An increase in the number of cases of mosquito-borne diseases is closely correlated with increases in rainfall.

Suggest why these trends are normally correlated.

_____

_____

_____

[2 marks]

(c) On the island of Trinidad the mosquito, *Anopheles albimanus*, breeds in swamps. *Anopheles bellator*, another species of mosquito found in Trinidad, breeds in water trapped between the overlapping leaf bases of bromeliads growing on the trunks of trees of the rain forests.

In the 1940's officials in Trinidad sprayed with insecticide and drained numerous marshes and swamps. However, the incidence of malaria remained unchanged.

Suggest why this campaign failed to reduce the incidence of malaria in Trinidad.

_____

_____

_____

_____

[1 mark]

(d) For EITHER dengue OR malaria

(i) name the specific causative agent

_____

[1 mark]

(ii) briefly describe FOUR typical symptoms of the disease

_____

_____

_____

_____

[2 marks]

(iii) use your knowledge of the habits of the mosquito that transmits the disease to suggest the part of the day when an individual is MOST likely to be bitten by the disease-transmitting mosquito.

_____

[1 mark]

(e) State TWO precautions that may be taken to reduce the chance of being bitten by a mosquito which is a vector for EITHER dengue OR malaria.

_____

_____

_____

[1 mark]

Total 10 marks

END OF TEST

TEST CODE **02207020**

FORM TP 2006179

MAY/JUNE 2006

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 2 – PAPER 02

$2\frac{1}{4}$ hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

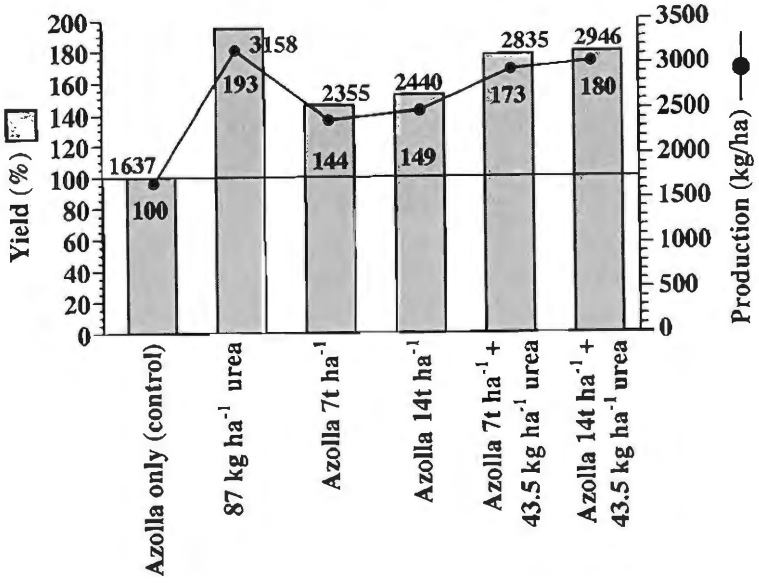
1. This paper consists of NINE questions.
2. Section A consists of THREE questions. Candidates must attempt ALL questions in this section and should spend no more than 30 minutes on this section. Answers to this section MUST be written in this answer booklet.
3. Section B consists of SIX questions. Candidates must attempt THREE questions in this section, ONE question from EACH module. Answers to this section MUST be written in the answer booklet provided.
4. The use of silent non-programmable calculators is allowed.

SECTION A

You must attempt ALL THREE questions in this section. You should NOT spend more than 30 minutes on this section.

1. Azolla is an aquatic fern that lives in an association with bacteria that help it to fix nitrogen. It is used as a green manure for fertilizing rice fields in Africa. Experiments were carried out using Azolla plus the chemical fertilizer urea to fertilize the rice fields.

The graph of Figure 1 shows the average production and yield in a rice field.



(kg ha^{-1}) Kilograms per hectare
(t ha^{-1}) Tonnes per hectare

Figure 1. Average production (kg ha^{-1}) and yield of rice (compared to control)

The above graph has been reproduced from Kannaiyan: Biotechnology of Biofertilizers.

(a) With reference to the graph in Figure 1 determine which fertilizer regimen gives the HIGHEST yield of rice.

_____

[1 mark]

(b) What is the PERCENTAGE increase in yield when the amount of Azolla is doubled from 7 t to 14 t as the sole fertilizer administered.

_____

[1 mark]

GO ON TO THE NEXT PAGE

(c) Determine the difference in rice production, in kg ha^{-1}, between the following fields:

One treated with urea only, at a rate of 87 kg ha^{-1} and the other treated with both urea, at 43.5 kg ha^{-1} and Azolla at 14 t ha^{-1}.

_____

_____

[1 mark]

(d) Name TWO factors, **other than** availability of nutrients from fertilizer, that would affect rice yield.

_____

[1 mark]

(e) Name ONE type of plant compound that requires the functionally useful element in urea.

_____

[1 mark]

(f) Suggest TWO reasons why it is better to use plant or animal manure rather than chemical fertilizers alone for fertilizing crops.

_____

_____

_____

[1 mark]

(g) Figure 2 below shows a transverse section through the leaf blade of *Syringa vulgaris*.

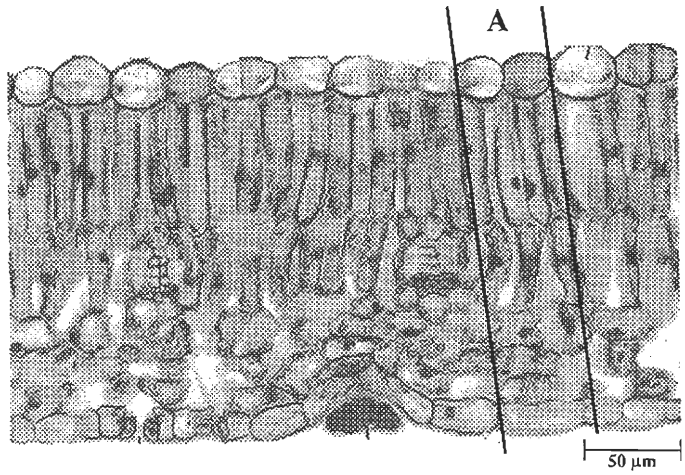


Figure 2. Transverse section through leaf of *Syringa vulgaris*
P. H. Raven el. al. Biology of Plants 6th Edition
W. H. Freeman and Company-Worth Publishers, 1999, p 290.

In the box provided below, draw and label the cells in A, between the parallel lines, in Figure 2.

[4 marks]

Total 10 marks

GO ON TO THE NEXT PAGE

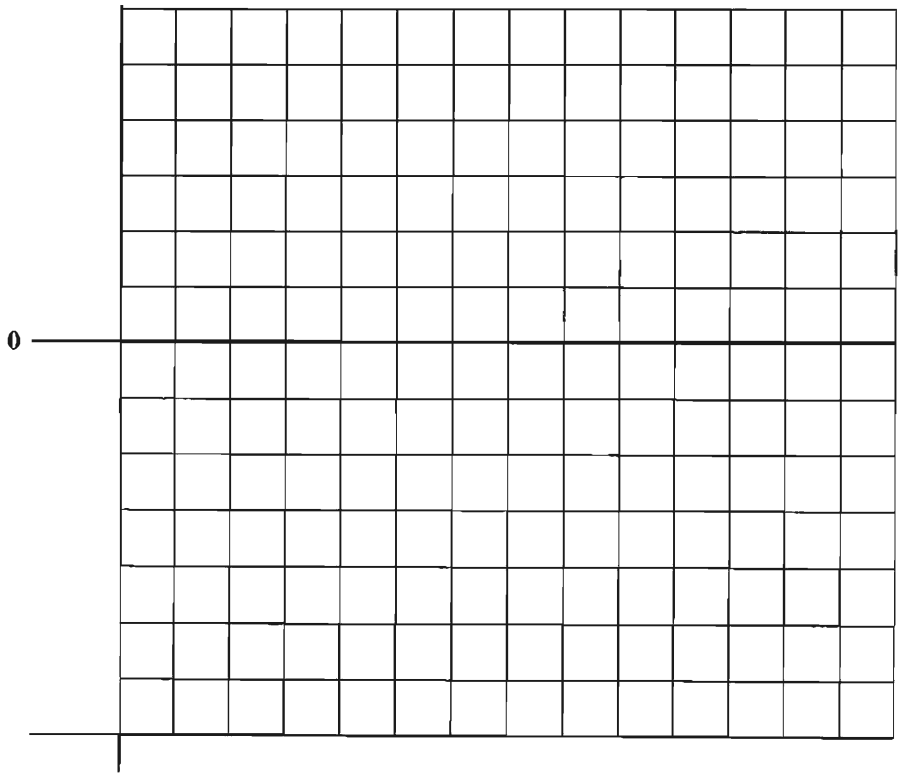
NOTHING HAS BEEN OMITTED.

2. A group of students investigated the effect of sodium ions on the production of action potentials in the large neurons extracted from squids. Since the squid is a marine mollusc, they used a bathing solution of seawater. One neuron was placed in normal strength seawater (A), and the other in seawater diluted 50:50 with distilled water, (B). They stimulated both neurons, and recorded the strength of the action potential in millivolts (mV). The results are set out in Table 1.

TABLE 1. MEMBRANE POTENTIALS IN TWO SOLUTIONS

Time Milliseconds	Membrane Potential mV	
	Normal Seawater A	Normal Seawater: distilled water, 50:50 B
0.0	–50	–50
0.2	–50	–50
0.4	+50	–30
0.6	+20	0
0.8	–60	+15
1.0	–70	–50
1.2	–60	–60
1.4	–50	–50

(a) (i) Use the grid provided to show these results graphically.



[6 marks]

(ii) State TWO differences between the peaks in A and B.

1. _____

2. _____

[2 marks]

(iii) State ONE cause of the differences between the membrane potentials reached in A and B.

_____

_____

_____

[1 mark]

(b) Figure 3 shows a specialized type of cell.

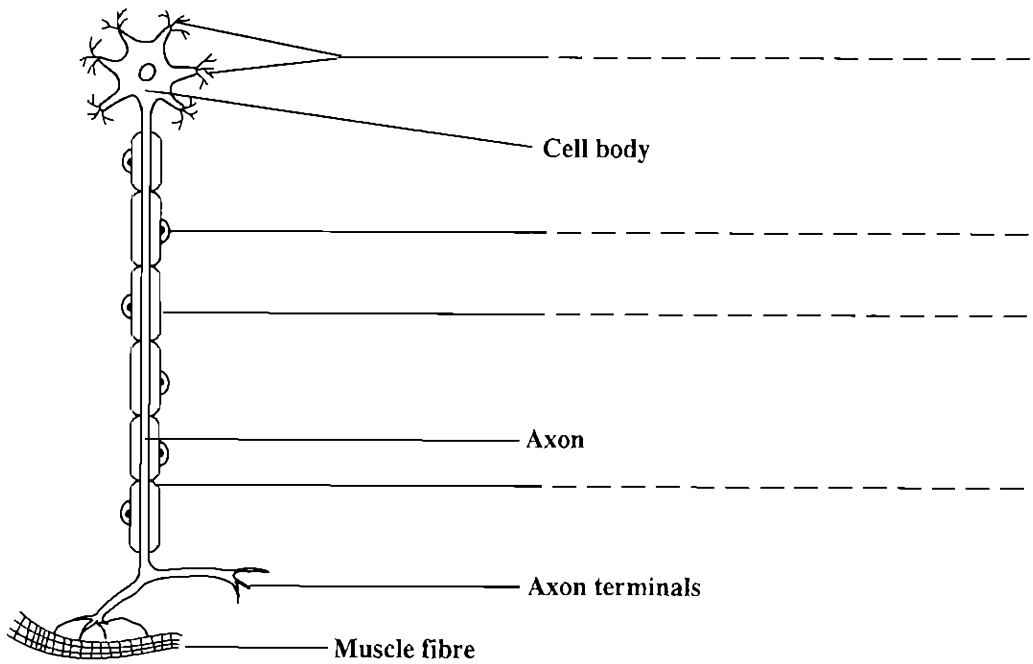


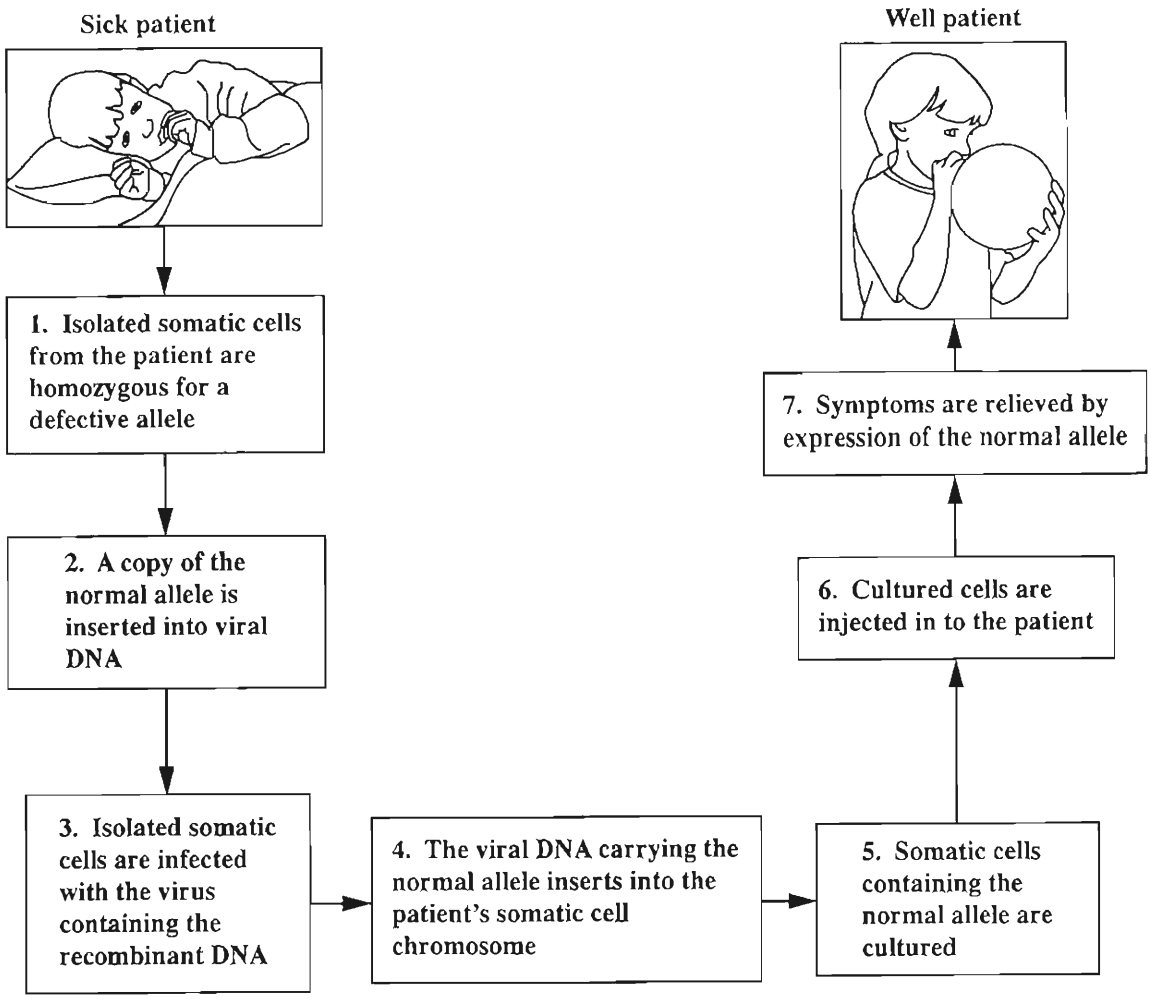
Figure 3. A nerve cell

On the diagram in Figure 3, complete the labelling of the nerve cell.

[1 mark]

Total 10 marks

3. Figure 4 below shows the stages in the therapy which a sick child undergoes.



W. Purves et al. Source: Life The Science of Biology 6th Ed. W. H. Freeman and Company, 2001, p 348.

Figure 4. Stages in the therapy of a sick child

(a) Name the type of therapy that the child is undergoing.

_____

[1 mark]

(b) Identify the type of enzymes used to remove the normal allele from the genome of the donor whose genes are being used in the treatment.

_____

[1 mark]

(c) Suggest ONE benefit and ONE hazard of the technique in Figure 4.

Benefit: _____

_____

Hazard: _____

_____

[2 marks]

(d) Can the change in the genome be passed on to the individual's offspring? Give ONE reason for your answer.

_____

_____

[2 marks]

(e) The bacterium *Escherichia coli* has a plasmid, A, in its cytoplasm. Plasmid A carries genes for resistance to two antibiotics, tetracycline and kanamycin. The gene for tetracycline resistance has a site for restriction enzyme A to cut and disrupt it.

The genome for corn has two sites for restriction enzyme A on either side of the gene for corn protein. Restriction enzyme A cuts out an entire functional gene for corn protein.

Restriction enzyme, A, plasmid A DNA and corn genome DNA are mixed together and recombinant DNA is formed. The recombinant DNA is mixed with a new *E. coli* strain that does not have any plasmid A. This *E coil* takes up the recombinant DNA.

Briefly outline a method of detection and what you would observe if

(i) *E coli* has taken up no DNA

_____

_____

[2 marks]

(ii) *E coli* has taken up recombinant DNA.

_____

_____

[2 marks]

Total 10 marks

SECTION B

You must answer THREE questions in this section. Answer ONE question EACH from Modules 1, 2 and 3. You MUST write your answers in the answer booklet provided.

MODULE 1

Answer EITHER Question 4 OR Question 5.

4. (a) Clarify the **actions** and **purposes** of the oxidative and decarboxylative reactions which occur in the mitochondria during the following events:

(i) Entry and processing of pyruvic acid **[4 marks]**

(ii) Rotation of the Kreb's cycle **[6 marks]**

(b) With the aid of a diagram, give an account of the process of oxidative phosphorylation (the electron transport chain), to show the roles of hydrogen and electron carriers, phosphate compounds and oxygen in the production of ATP. **[10 marks]**

Total 20 marks

5. (a) Define the following terms:

(i) Ecosystem **[1 mark]**
(ii) Habitat **[1 mark]**
(iii) Ecological niche **[1 mark]**
(iv) Food chain **[1 mark]**

(b) Discuss how the components in an ecosystem function to achieve and maintain ecological balance. **[4 marks]**

(c) (i) Explain why the flow of energy through ecosystems is linear and NOT cyclical. **[3 marks]**

(ii) Explain why food chains are generally limited to three or four links. **[3 marks]**

(d) In a forest there is a large tree that supports 500 caterpillars and 200 snails. There are five sparrows that live in the tree feeding on the caterpillars while one large hawk feeds on the sparrows. Consider this tree and its associated organisms as an ecosystem.

Describe the tree ecosystem in terms of: a pyramid of biomass, a pyramid of numbers and a pyramid of energy. **[6 marks]**

Total 20 marks

GO ON TO THE NEXT PAGE

MODULE 2

Answer EITHER Question 6 OR Question 7.

6. (a) Define the following terms and exemplify EACH one with reference to the glucose concentration of the blood **and** the endocrine-related actions of the pancreas and/or the liver:

(i) Homeostasis **[2 marks]**

(ii) Set point **[2 marks]**

(iii) Detectors **[3 marks]**

(iv) Regulators **[3 marks]**

(b) What reactions does the liver perform on protein material to process it to the body's advantage? **[10 marks]**

Total 20 marks

7. (a) Describe the ascent of water in plants from outside the root to the intercellular spaces of the leaf. Include the role of root pressure, capillarity, cohesion, adhesion, transpiration pull and stomata. **[10 marks]**

(b) Relate the structure of xylem vessels to their function. **[4 marks]**

(c) Plant 1 is placed in a pot with its roots immersed in a dilute solution of potassium cyanide and an atmosphere of 20 per cent humidity.

Plant 2 is placed in a pot with its roots in distilled water and an atmosphere of 100 per cent humidity.

Discuss the effects these conditions would have on water uptake, mineral ion transport and transpiration. **[6 marks]**

Total 20 marks

MODULE 3

Answer EITHER Question 8 OR Question 9.

8. (a) Describe the mode of action of:

(i) Phagocytes **[2 marks]**

(ii) Plasma cells **[2 marks]**

(b) Distinguish between B and T lymphocytes in relation to their origin and maturation process. **[6 marks]**

(c) Chloe gets a positive pregnancy test on a kit that she has used at home. The box label says it contains monoclonal antibodies. Her husband doesn't know whether to trust it. Chloe, who has studied Biology, persuades him that it is based on sound technology and is accurate.

What convincing points could she make? **[4 marks]**

(d) Active artificial immunity and passive artificial immunity are two methods of controlling disease, in cases where recipients do not have the necessary antibodies.

Compare TWO situations in which EACH of these methods is used to BEST advantage. Give examples to support your comparison. **[6 marks]**

Total 20 marks

9. (a) Using appropriate examples, recommend the appropriate diet for the following individuals:

(i) A lactating mother **[2 marks]**

(ii) Sedentary grandparents **[2 marks]**

(iii) An agricultural labourer **[2 marks]**

(b) For the TWO diseases, HIV/AIDS and diabetes

(i) state the disease categories under which EACH falls **[4 marks]**

(ii) discuss reasons for their global distribution. **[5 marks]**

(c) Betty, aged 38, eats mainly rice, potato chips, sweet potatoes, macaroni and cheese, cake and carbonated beverages. Betty is unwell and goes to the doctor who tells her that she is obese, and has developed diabetes. The doctor also tells Betty that she is malnourished but she indignantly responds that she eats plenty of good food.

With reference to the meaning of the term 'healthy', explain why the doctor considers Betty to be malnourished. **[5 marks]**

Total 20 marks

END OF TEST

TEST CODE **02107020**

FORM TP 2008160

MAY/JUNE 2008

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 1 – PAPER 02

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions.
2. Section A consists of THREE questions. Candidates must answer ALL questions in this section. Answers to this section MUST be written in this question paper.
3. Section B consists of THREE questions. Candidates must answer ALL questions in this section. Answers to this section MUST be written in the separate answer booklet provided.
4. The use of silent non-programmable calculators is allowed.

SECTION A

Answer ALL questions in this section. You must write your answers in the spaces provided in this answer booklet.

1. Figure 1 shows the transverse section of the root of a dicotyledon. Study Figure 1 and answer Questions (a) to (c).

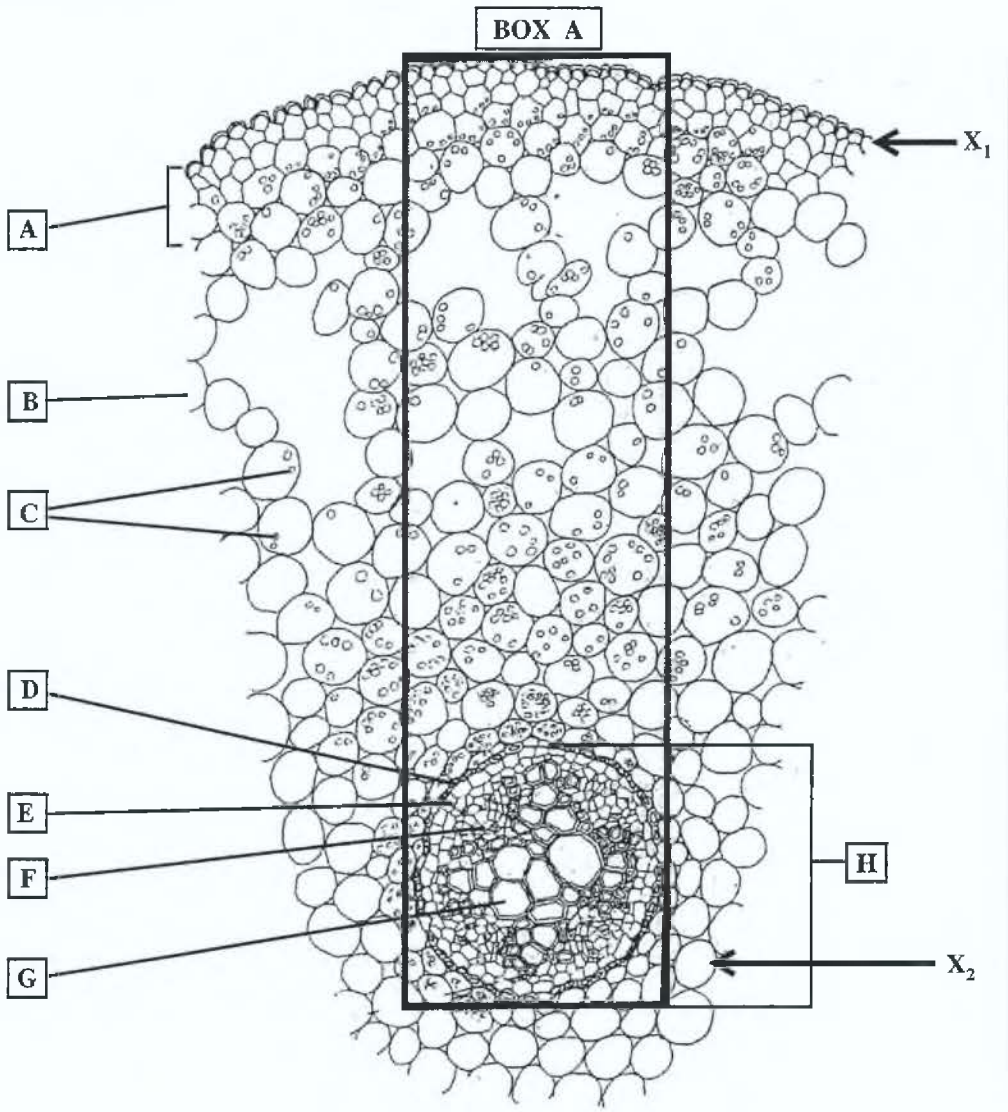


Figure 1. Transverse section of a dicotyledon root

Bracegirdle B. S. Miles P, An Atlas of Plant Structure Volume 1, Heinemann Educational Books, 1971, p.67.

(a) Identify the structures labelled A to H.

A _____ E _____

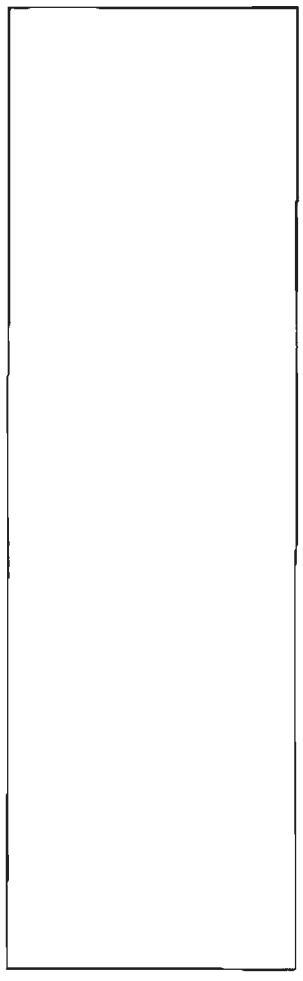
B _____ F _____

C _____ G _____

D _____ H _____

[4 marks]

(b) In the space provided, draw a plan diagram to show the distribution of the different types of tissues in Box A in Figure 1. Make your drawing the actual size of Box A. (No labels required).



[4 marks]

(c) If the photograph in Figure 1 has been magnified 100 times, what is the actual width of the specimen from X_1 to X_2?

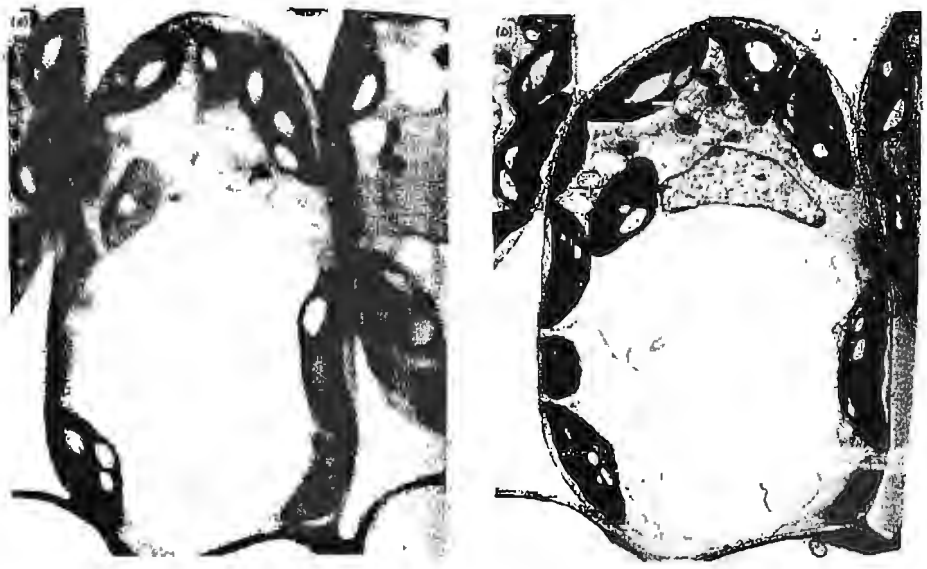
_____

_____

[1 mark]

GO ON TO THE NEXT PAGE

(d) Figure 2 shows photographs of the same plant cells seen (a) with a light microscope and (b) with an electron microscope. Both are shown at the same magnification of about x1500.



(a) (b)

Figure 2. Plant cells as seen by a light and an electron microscope

Biological Science 1 and 2, Taylor D. J. et al., Cambridge, page 132.

(i) Account for the difference in clarity between the two photographs.

_____

_____

_____

[2 marks]

(ii) Comment on the advantages and limitations of using a light microscope as compared to an electron microscope to examine cells or tissues.

_____

_____

_____

_____

_____

_____

_____

_____

[4 marks]

Total 15 marks

2. Flower colour in certain plants is controlled by two genes. One gene codes for colour pigments in the petals, and its alleles are R (red) and r (white). The alleles are co-dominant. The other gene codes for an enzyme system in the petals that enables the pigments to be made, and its alleles are C for active enzymes and c for inhibited enzymes. Plants with homozygous recessive, cc are unable to synthesize any pigment, and therefore produce white flowers.

(a) A plant with genotype RRCC is crossed with the double homozygous recessive plant. State the genotype and phenotype of the F_1 plant.

(i) Genotype _____

(ii) Phenotype _____

[1 mark]

(b) State the FOUR different combinations of the alleles carried in the gametes of this F_1 dihybrid plant (plant produced in (a) above).

(i) _____

(ii) _____

(iii) _____

(iv) _____

[1 mark]

(c) (i) Use the Punnett Square shown in Table 1 to show the genotypes of the F_2 generation of this dihybrid cross.

TABLE 1: PUNNETT SQUARE

Gametes → ↓					

[2 marks]

(ii) Give the ratio of red : pink : white flowers.

Red _____ : Pink _____ : White _____

[3 marks]

(d) A group of students determined the Chi-squared value from the figures shown in Table 2, which represent a monohybrid cross between CC (colour enzymes) and cc (no enzyme for colour).

TABLE 2: MONOHYBRID CROSS BETWEEN CC AND cc

	Colour, C	**No Colour, c**
Observed results (O)	95	35
Expected ratio	3	1
Expected results (E)	97.5	32.5
$O - E$		
$[O - E]^2$		
$[O - E]^2 \div E$		

Chi-squared is the sum of $\frac{[O-E]^2}{E}$ = ____

[4 marks]

(e) The students used the Table of Chi-squared values shown in Table 3 to determine whether the value you obtained in (d) on page 6 indicates that the difference between the observed and expected results are acceptable or not acceptable as being due to chance alone.

TABLE 3: TABLE OF χ^2 VALUES

Degrees of Freedom	Number of Classes	Chi-squared Values					
1	2	0.46	1.64	2.71	3.84	6.64	10.83
2	3	1.39	3.22	4.61	5.99	9.21	13.82
3	4	2.37	4.64	6.25	7.82	11.34	16.27
4	5	3.36	5.99	7.78	9.49	13.28	18.47
Probability that chance alone could produce this deviation		0.50 (50%)	0.20 (20%)	0.10 (10%)	0.05 (5%)	0.01 (1%)	0.001 (0.1%)

(i) How did the students determine the degrees of freedom?

_____

[1 mark]

(ii) The students checked the 5% probability in order to determine whether the result was significant or insignificant. What was their decision, and why?

_____

_____

[2 marks]

(iii) If the Chi-squared value had been 7.0, what information could have been gained concerning the results of the monohybrid cross experiment?

_____

_____

_____

_____

[1 mark]

Total 15 marks

3. Figure 3 shows the structure of a mammalian ovum and sperm. Study Figure 3 and answer Questions (a) and (b).

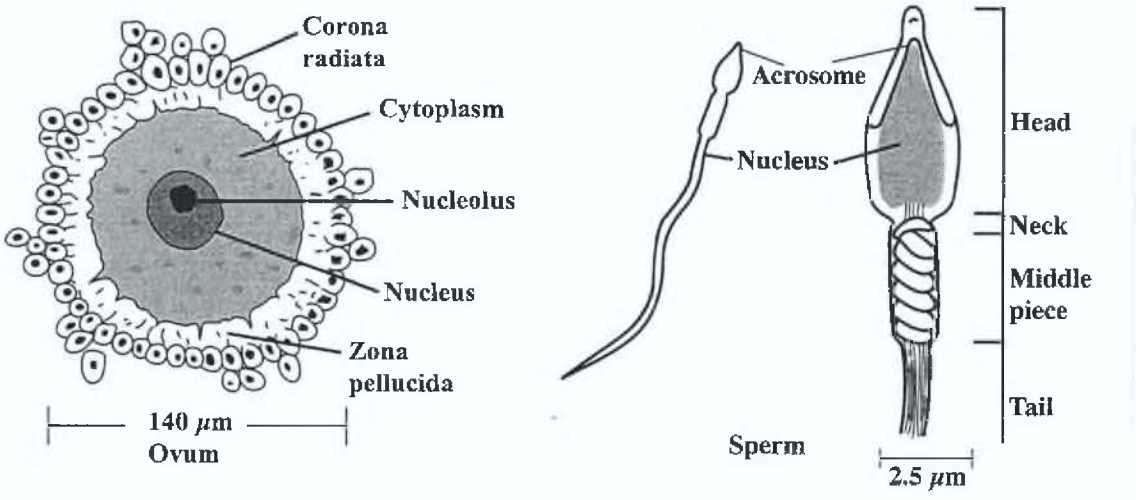


Figure 3. Structure of a mammalian ovum and sperm

http://www.humanillnesses.com/original/images/hdc_0001_0003_0_img0209.jpg

(a) (i) State FOUR structural differences observed between the ovum and the sperm.

_____

_____

_____

_____

_____

_____

_____

_____

[4 marks]

(ii) Based on features observed, comment, using two points, on how the ovum and the sperm are suited to their respective functions.

[4 marks]

(b) Explain why some scientists regard the ovum at the stage shown in Figure 3, to be a secondary oocyte.

[2 marks]

(c) Table 4 shows the results of an experiment investigating the influence of sperm velocity on fertilisation in the freshly diluted sperm of the sea urchin, *Lytechinus variegatus*.

TABLE 4: SPERM VELOCITY AGAINST FERTILISATION IN SEA URCHIN

Sperm velocity mm/sec	No. of sperm/cm^3 needed to fertilise 50% of female eggs (F_{50}) expressed as a log value
0.15	3.6
0.16	3.3
0.17	4.1
0.19	3.5
0.20	4.0
0.21	3.2
0.22	3.1
0.25	2.5
0.26	2.6
0.28	2.0

(i) On the graph grid on page 11, plot a graph to show the relationship between sperm velocity and fertilisation. **[4 marks]**

(ii) Suggest a likely conclusion from the findings of this experiment.

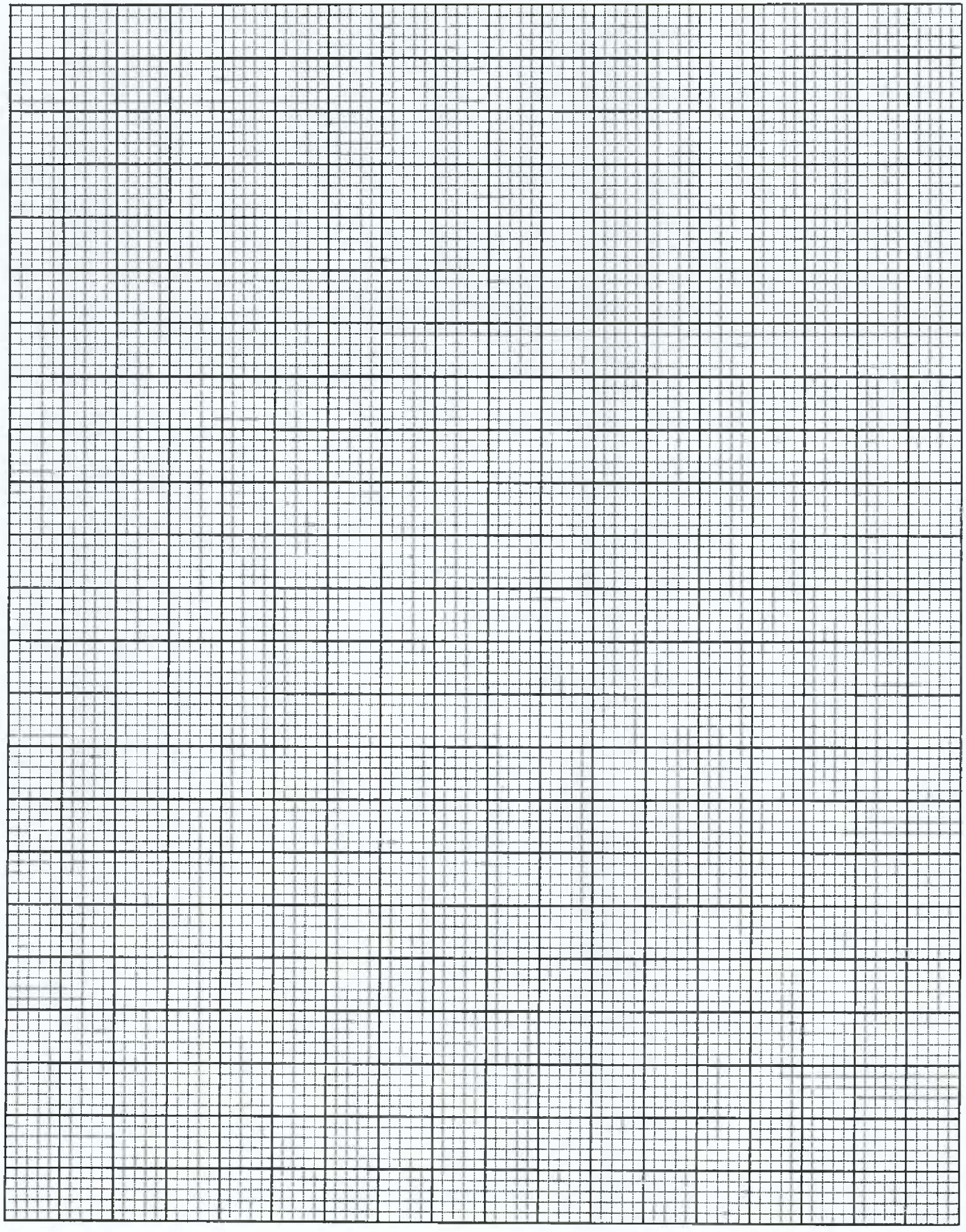
_____

_____

_____

[1 mark]

Total 15 marks



GO ON TO THE NEXT PAGE

SECTION B

Answer ALL questions in this section. You must write your answers in the answer booklet provided.

4. (a) By means of a diagram, show the molecular structure of sucrose. Show the position of the oxygen and all other groups, EXCEPT for the H.OH groups on the No. 2, 3 and 4 carbons of glucose, and the 1, 3 and 4 carbons of fructose. **[3 marks]**

   (b) Relate the structure of the water molecule to its

   (i) solvent properties

   (ii) high surface tension. **[4 marks]**

   (c) (i) Explain the mode of enzyme action according to the 'lock and key hypothesis'.

   (ii) Comment on differences in the way in which competitive and non-competitive inhibitors affect enzyme activity. **[8 marks]**

Total 15 marks

5. (a) State TWO ways in which variation can occur in sexually produced organisms and by means of a graph and an example, explain what is meant by EACH of the following:

   (i) 'Directional selection'

   (ii) 'Stabilising selection' **[7 marks]**

   (b) Outline the FOUR key steps involved in producing a recombinant piece of gene. **[4 marks]**

   (c) In general terms, discuss FOUR **major** issues associated with applications of genetic engineering. **[4 marks]**

Total 15 marks

6. (a) With reference to the human menstrual cycle, discuss the biological basis for the following two methods of contraception.

   (i) The rhythm method

   (ii) The contraceptive pill **[5 marks]**

   (b) Briefly comment on the role of the placenta as a guardian for the developing foetus. **[2 marks]**

   (c) Describe the structure of a young plant ovule. **[4 marks]**

   (d) Discuss the relative merits of cross-fertilisation and self-fertilisation in plants. **[4 marks]**

Total 15 marks

END OF TEST

TEST CODE **22107020**

FORM TP 2008160

MAY/JUNE 2008

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 1 – PAPER 02

2 1/2 hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions.
2. Section A consists of THREE questions. Candidates must answer ALL questions in this section. Answers to this section MUST be written in this question paper.
3. Section B consists of THREE questions. Candidates must answer ALL questions in this section. Answers to this section MUST be written in the separate answer booklet provided.
4. The use of silent non-programmable calculators is allowed.

SECTION A

Answer ALL questions in this section. You must write your answers in the spaces provided on the question paper.

1. (a) Carbohydrate molecules may be joined by either α or β linkages.

Figure 1 shows 2 glucose molecules joined by an α-1-4 glycosidic linkage.

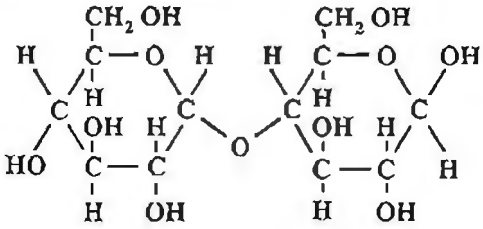


Figure 1. Two glucose molecules

(i) Using an **α-1-6 linkage**, attach a third glucose molecule in Figure 1.

[2 marks]

(ii) Name ONE example of a carbohydrate that is made up of components with BOTH an α-1-4 glycosidic linkage and an α-1-6 linkage.

_____

[1 mark]

(iii) Distinguish between an 'α glycosidic linkage' and a 'β linkage'.

_____

[1 mark]

(iv) Comment on the difference in function between a carbohydrate with α linkages and a carbohydrate with β linkages.

_____

_____

[2 marks]

GO ON TO THE NEXT PAGE

(b) (i) Keratin, a protein found in hair, is made up of α helices. Describe the α helix bond in keratin.

_____

_____

_____

[2 marks]

(ii) In contrast to keratin, fibroin, a protein found in silk, is made up of β pleated sheets. Comment on TWO differences in physical properties of these proteins. Write your answer in the table below.

α helixes	β pleated
1	
2	

[2 marks]

(iii) Figure 2 shows another two structural bonds found in proteins.

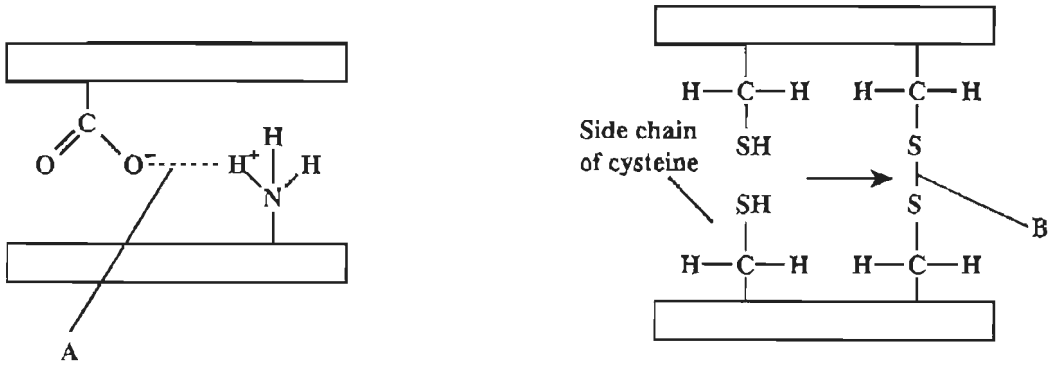


Figure 2. Structural bonds in proteins

Identify the TWO bonds labelled A and B as shown in Figure 2.

A _____

B _____

[2 marks]

GO ON TO THE NEXT PAGE

(c) Outline an experiment to determine experimentally the presence of catalase in chick peas.

[3 marks]

Total 15 marks

2. (a) (i) Briefly outline the role of DNA in genetic inheritance.

[2 marks]

(ii) Distinguish between the terms 'chromatin' and 'chromosome'.

Chromatin

Chromosome

[4 marks]

(b) State THREE reasons why mitosis is important in the life cycle of a eukaryotic organism.

1. _____

_____

2. _____

_____

3. _____

_____

[3 marks]

(c) Figure 3 shows two phases of the early stages of Meiosis I. In the labelled boxes provided in Figure 3, DRAW three **consecutive** phases to illustrate the MAIN changes that occur between the two phases shown.

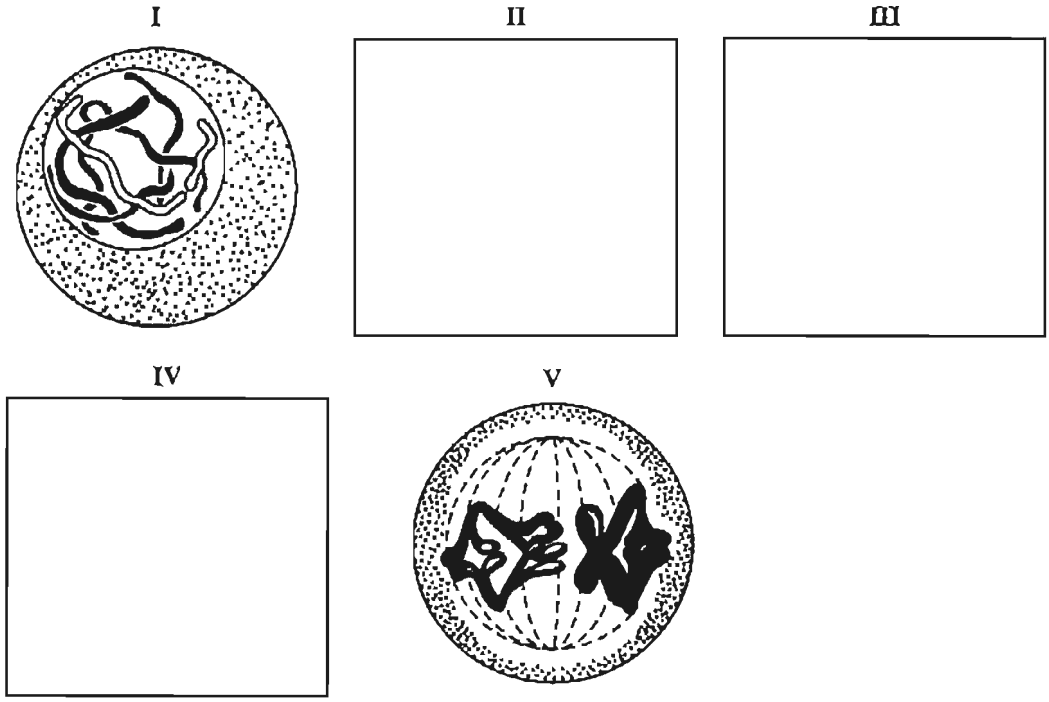


Figure 3. Diagrams showing two phases in Meiosis I

[6 marks]

Total 15 marks

3. (a) Figure 4 represents an incomplete longitudinal section (LS) through a carpel just **prior** to fertilization.

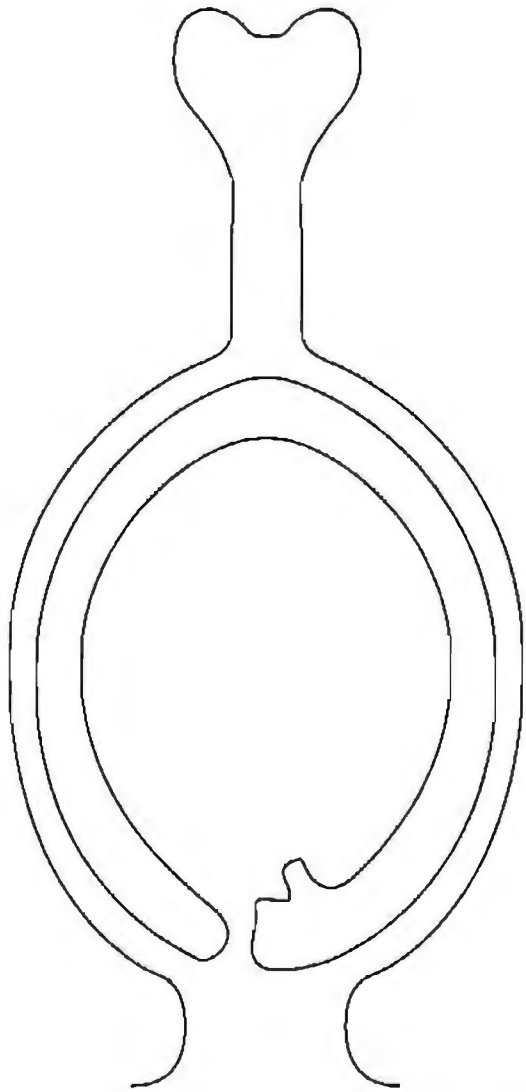


Figure 4. Incomplete LS through a carpel

(i) Draw on the diagram in Figure 4

a) the ovule **[2 marks]**

b) the path taken by the germinating pollen grain. **[1 mark]**

(ii) On Figure 4, label TWO features of the embryo sac. **[2 marks]**

(iii) Identify ONE role for EACH of the features in (ii) above.

_____

_____

[2 marks]

GO ON TO THE NEXT PAGE

(b) The pawpaw has male and female flowers which are borne on different plants.

(i) State the term used to describe this reproductive feature.

_____

[1 mark]

(ii) State ONE disadvantage to the plant in having this feature.

_____

[1 mark]

(c) (i) Plants can also be propagated non-sexually. Suggest TWO mechanisms that occur NATURALLY in plants to aid NON-SEXUAL propagation.

_____

_____

_____

_____

[2 marks]

(ii) State ONE advantage of the mechanisms you identified in (c) (i).

_____

_____

[1 mark]

(d) Methods exist for the artificial propagation of plants utilizing small amounts of plant materials. Discuss THREE advantages of these methods over the natural methods of non-sexual propagation.

_____

_____

_____

_____

[3 marks]

Total 15 marks

SECTION B

Answer ALL questions in this section. You must write your answers in the answer booklet provided.

4. (a) According to the endosymbiont theory, mitochondria and chloroplasts are organelles which are thought to have evolved from prokaryotes, and which established symbiotic relationships with eukaryotic cells.

(i) Describe TWO features of mitochondria and chloroplasts that support the theory that they have evolved from prokaryotic cells. **[2 marks]**

(ii) Define the term 'symbiosis'. **[2 marks]**

(iii) Comment on evidence that supports the theory that a symbiotic relationship existed between eukaryotic cells and chloroplasts and mitochondria. Include in your answer the benefits that BOTH the eukaryotic cells and the symbiont received. **[4 marks]**

(b) (i) Define the terms 'tissue' and 'organ'. **[2 marks]**

(ii) Use the dicotyledonous root to distinguish between the levels of organization found in tissues and organs. **[5 marks]**

Total 15 marks

5. (a) According to the biological species concept, a species represents the lowest taxonomic group which is capable of being defined with any degree of precision. While there are several ways in which the term may be defined, most biologists define species in relation to their breeding behaviour.

(i) State ONE definition of a species in terms of breeding behaviour. **[2 marks]**

(ii) Discuss the limitations of defining a 'species' in terms of breeding. **[6 marks]**

(b) (i) With reference to animal populations, outline the process by which a new species may arise from a previously existing one. **[4 marks]**

(ii) According to Darwin and Wallace the mechanism for speciation is natural selection. Comment on the basis of this mechanism. **[3 marks]**

Total 15 marks

GO ON TO THE NEXT PAGE

6. (a) (i) State the functions of EACH of the following in oogenesis in humans:

a) gonadotrophin releasing hormone

b) luteinising hormone

c) follicle stimulation hormone. **[4 marks]**

(ii) Explain how these hormones function in males as compared to females. **[3 marks]**

(b) The inhibition of the production of luteinising hormone and follicle stimulating hormone by oestrogen and progesterone is the basis of one contraceptive method in females. Comment on why the same principles CANNOT be applied to develop a male hormonal contraceptive. **[4 marks]**

(c) In addition to similarities, differences exist between oogenesis and spermatogenesis. Discuss TWO significant differences with respect to the timing of oogenesis and spermatogenesis. **[4 marks]**

Total 15 marks

END OF TEST

TEST CODE **02207020**

FORM TP 2008162

MAY/JUNE 2008

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 2 – PAPER 02

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions.
2. Section A consists of THREE questions. Candidates must answer ALL questions in this section. Answers to this section MUST be written in this answer booklet.
3. Section B consists of THREE questions. Candidates must answer ALL questions in this section. Answers to this section MUST be written in the answer booklet provided.
4. The use of silent non-programmable calculators is allowed.

SECTION A

Answer ALL questions. You must write your answers in the spaces provided in this answer booklet.

1. Figure 1 shows the apparatus used to investigate oxygen uptake in small organisms.

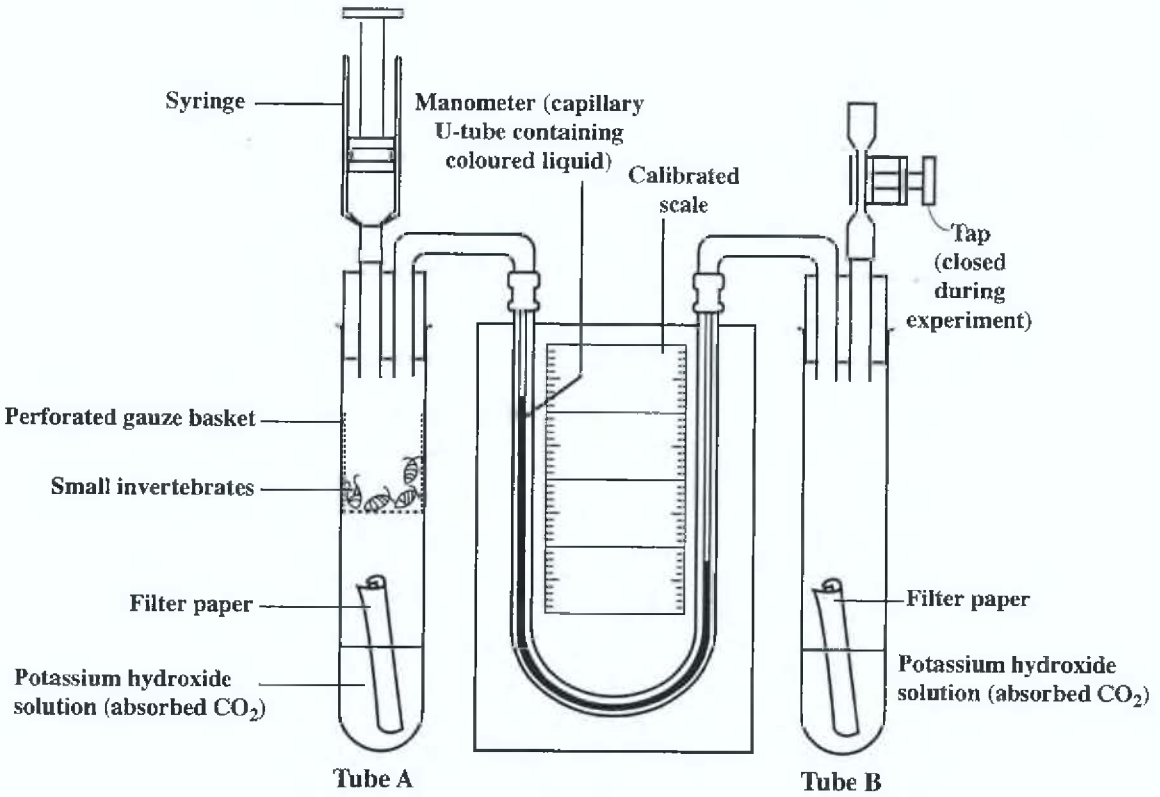


Figure 1. Apparatus to investigate oxygen uptake in small organisms

http://images.google.tt/imgres?imgurl=http://www.biologymad.com/PhotosynResp/Photos19.gif&imgrefurl=http://www.biologymad.com/PhotosynResp/PhotosynResp.htm&h=412&w=563&sz=14&hl=en&start=15&tbnid=5_NcsDmUuRo4zM:&tbnh=97&tbnw=133&prev=/images%3Fq%3D%2560respirometer%2527%26svnum%3D10%26hl%3Den%26lr%3D%26sa%3DN

(a) Explain how the apparatus is used to measure the rate of oxygen uptake by organisms.

[6 marks]

(b) Table 1 gives the results of an experiment in which the rates of oxygen uptake, by germinating and dry peas, were measured at two different temperatures over a period of 30 minutes. The results are expressed as the cumulative oxygen consumed (cm^3) by peas at different temperatures.

TABLE 1: RATE OF OXYGEN UPTAKE BY GERMINATING AND DRY PEAS

Temperature	Time in minutes	Germinating peas	Dry peas
10° C	0	0	0
	10	2.9	0
	20	6.2	0.2
	30	9.4	0.1
25° C	0	0	0
	10	8.8	0.2
	20	16.0	0.1
	30	23.7	0.0

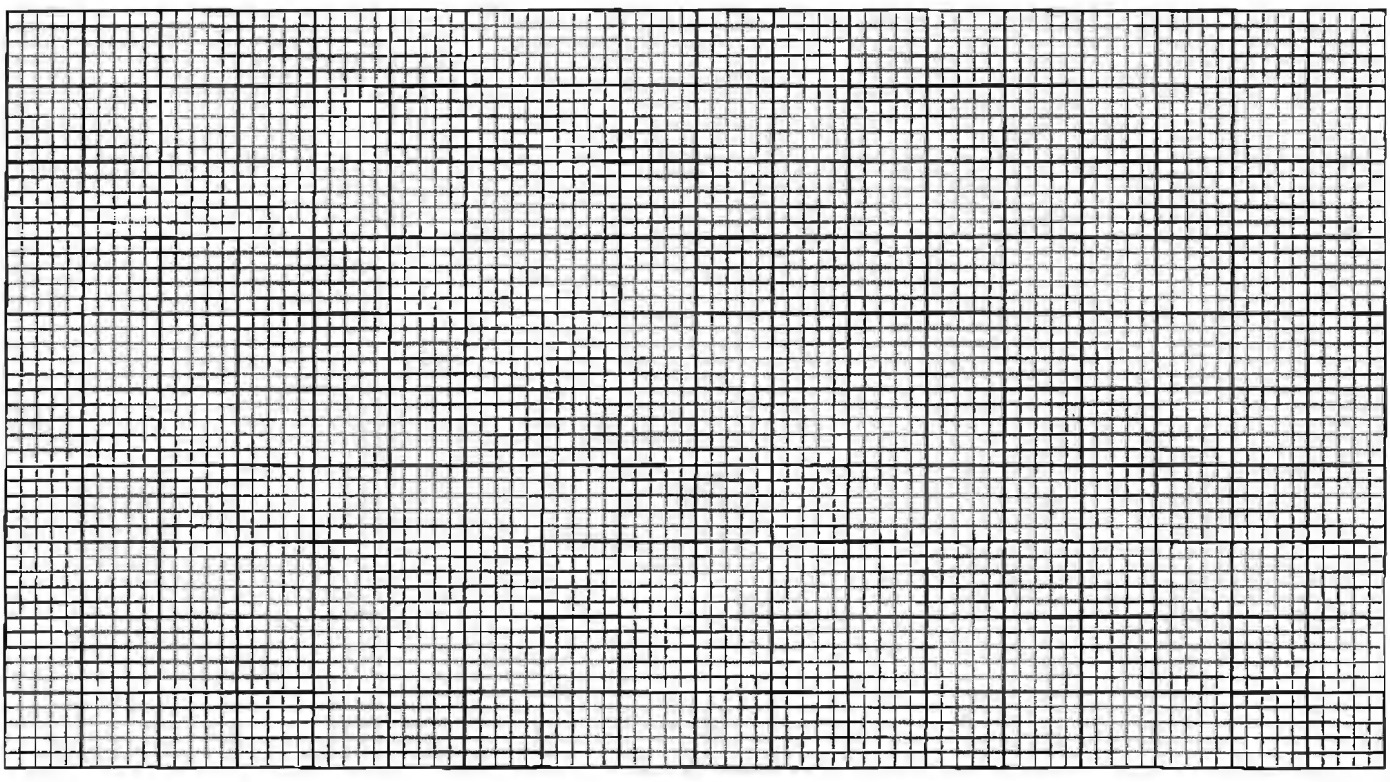
(i) Suggest a control for this experiment.

_____

_____

[1 mark]

(ii) On the graph grid provided below, plot the results for the germinating peas at 25 °C. **[4 marks]**



(iii) Calculate the rate of oxygen consumption for germinating peas at BOTH temperatures using the time interval between 10 and 20 minutes.

Rate at 10°C: _____

_____

Rate at 25°C: _____

_____

[2 marks]

(iv) Comment on the differences in oxygen consumption observed between

a) germinating peas at 10°C and 25°C

_____

_____

[1 mark]

b) germinating and dry peas.

_____

_____

[1 mark]

Total 15 marks

2. (a) Water is drawn up the entire xylem system due to a negative pressure created by loss of water from the leaf spaces into the atmosphere. This enormous upward pull on the xylem contents, especially in trees, could cause the xylem walls to cave inwards, (cavitation). In a study of trees, the mean diameters of the xylem vessels were measured in the tree trunks, the shallow roots and the deep roots. Two species were evaluated, Juniper (J) and Quercus (Q). The results are shown in Figure 2.

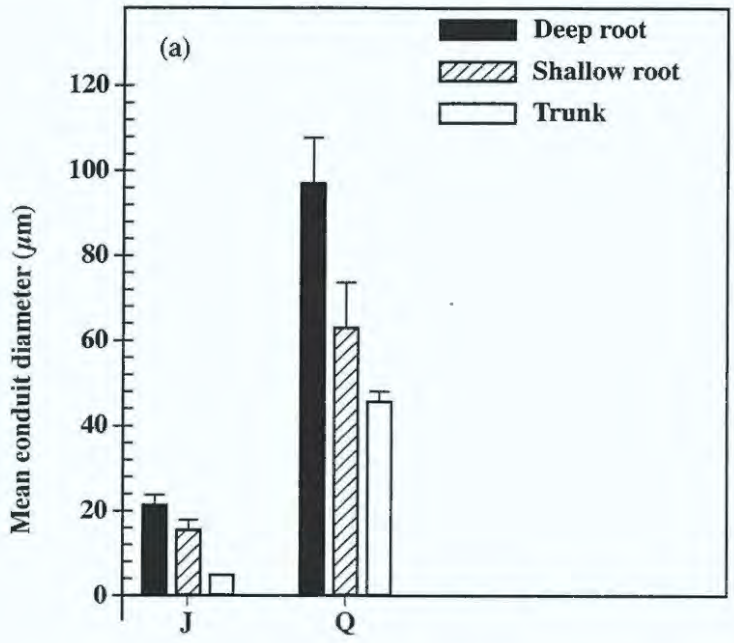


Figure 2. Xylem vessel diameters in trunks and roots

This bar chart has been adapted from
McElrone A, Pockman W, Martínez-Vilalta J and Jackson R.
Variation in xylem structure and function in stems and roots of trees to 20 m depth.
New Phytologist (2004) 163: p. 510.

(i) Complete the table of xylem diameters for Juniper and Quercus and determine the diameter of the trunk xylem as a percentage of the deep root xylem for Juniper and Quercus.

Diameter in μm	Juniper	Quercus
Deep root xylem		
Trunk xylem		
Diameter of trunk xylem as a percentage of the deep root xylem		

[2 marks]

GO ON TO THE NEXT PAGE

(ii) Account for the difference in diameter of the xylem between the trunk of the tree and the shallow roots.

_____

_____

_____

_____

[2 marks]

(iii) State TWO factors, **other than** transpiration pull from the leaves, that would account for water movement in the xylem of the roots.

_____

_____

_____

_____

[2 marks]

(b) Figure 3 shows part of a vascular bundle of a dicotyledon in transverse section.

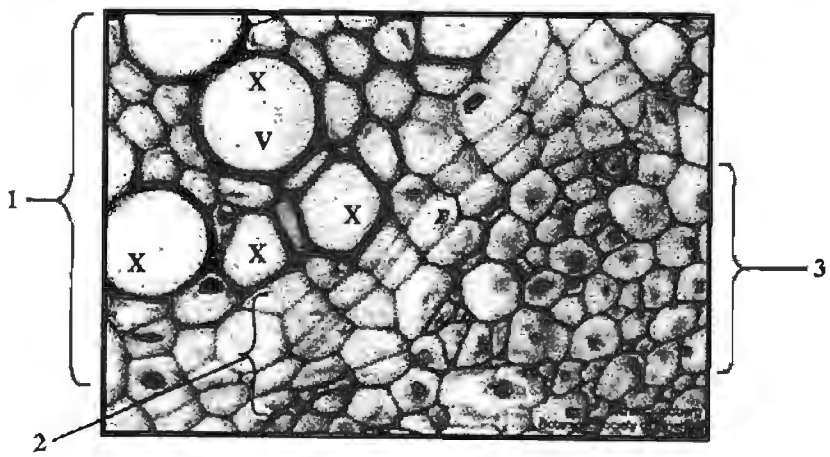


Figure 3. T.S. dicotyledon vascular bundle

http://www.botany.org/plantimages/ImageData.asp?IDN=B-036h

(i) Identify the THREE **main** tissue types shown.

1. _____

2. _____

3. _____

[1 mark]

GO ON TO THE NEXT PAGE

(ii) Four cells have an 'X' drawn in them. Draw these cells, and all the cells between them in correct proportion, at a magnification of x2.

[3 marks]

(iii) The cell labelled V has been magnified 300 times. What is the actual diameter of this cell?

_____

[1 mark]

(c) Figure 4 is an electron micrograph of a plant structure.

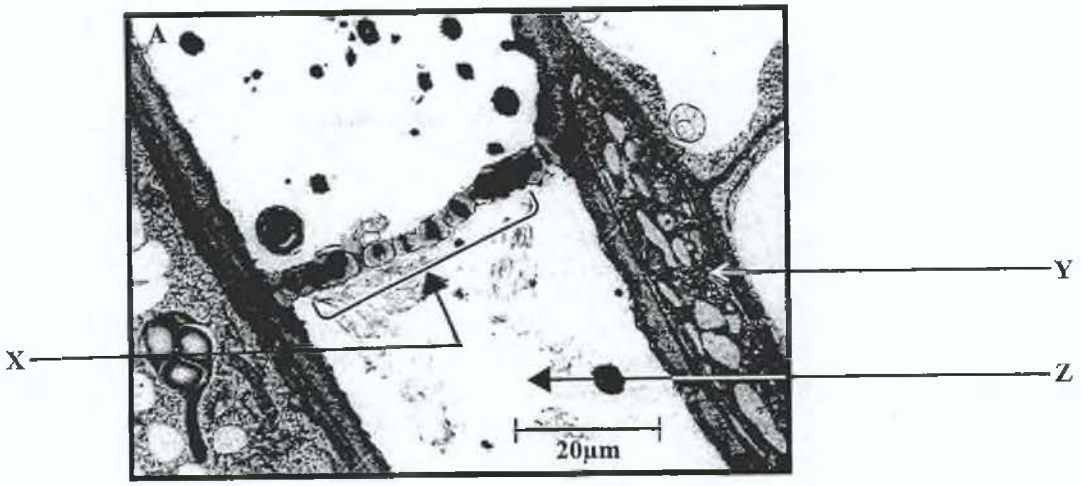


Figure 4. Electron micrograph of a plant structure

Roberts M., Reiss M. and Monger B., Advanced Biology. Nelson, 2000, p. 259.

(i) Identify the structures, X, Y and Z in Figure 4.

X _____

Y _____

Z _____

[1 mark]

(ii) State how EACH of these structures is adapted to its function.

X _____

_____

Y _____

_____

Z _____

_____

[3 marks]

Total 15 marks

3. In a country with a population of over 300,000,000, a survey was carried out to determine the number of fast food outlets (FFO) and the prevalence of obesity. ('Prevalence' is defined as the number of cases in the population at a specific time). The results of the survey are shown in Table 2.

TABLE 2. THE NUMBER OF FFO (FAST-FOOD OUTLETS) AND THE PREVALENCE OF OBESITY, 1985 - 2005

Year	Fast food outlets (FFO) thousands	Obesity prevalence (millions of cases)
1985	6	4
1990	10	5.5
1995	14	8
2000	18.5	13
2005	23	20

(a) Complete the graph provided on page 11, to construct the two 'best fit' lines to show the data. Use the same pair of axes for each graph, and provide a key to identify the two graph lines. **[6 marks]**

(b) With reference to the data (1985 – 2005), describe the relationship between the number of FFO (in thousands) and the prevalence of obesity (in millions).

_____

_____

_____

_____

_____

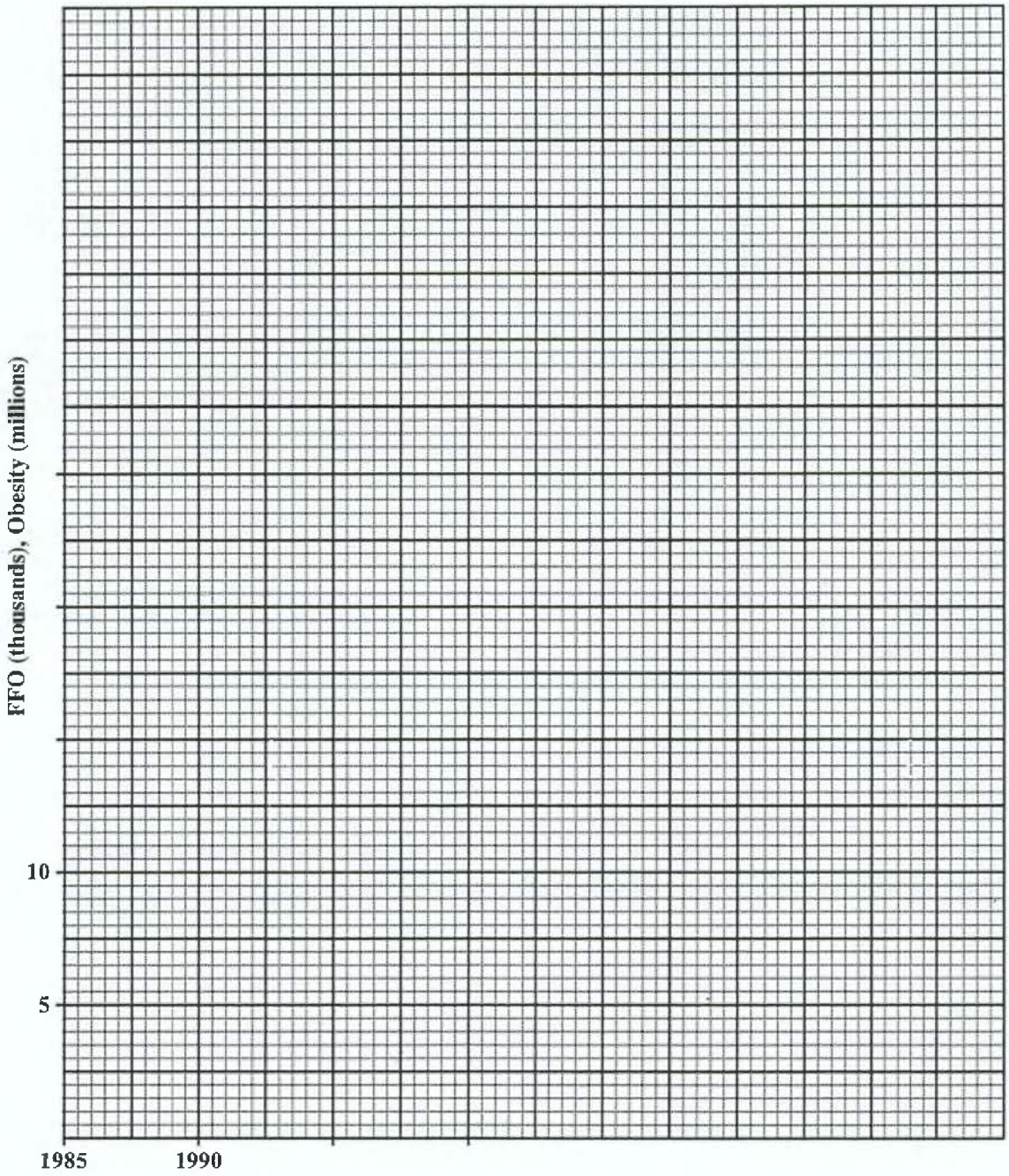
_____

_____

_____

_____

[3 marks]


FFO (thousands), Obesity (millions)
10
5
1985
1990

(c) By means of a sketched line, project the existing graph lines for FFO's and obesity to the year 2015. What is the projected relationship between them in 2015? Use the data to support your answer.

[3 marks]

(d) What THREE factors **other than** FFO (fast-food outlets) could be causative of obesity in our societies? Explain your answer.

[3 marks]

Total 15 marks

SECTION B

Answer ALL questions. You must write your answers in the answer booklet provided.

4. (a) Describe the structure of the thylakoids and explain clearly how they are adapted to their function. **[4 marks]**

   (b) Clarify the pathway and productivity of a ground electron from its entry into Photosystem I to its incorporation into a reduced phosphate containing product. **[4 marks]**

   (c) Explain the term 'ecological pyramid' and distinguish between the THREE **major** types of ecological pyramids. **[4 marks]**

   (d) Discuss how energy flows through an ecosystem. **[3 marks]**

Total 15 marks

5. (a) Describe the ways in which red blood cells and haemoglobin molecules are effective in maximising the uptake of oxygen. **[4 marks]**

   (b) The Bohr Effect has implications for the stability of oxyhaemoglobin in active muscle tissue. Explain this effect. **[4 marks]**

   (c) The normal concentration of glucose in human blood is 90 mg per 100 cm^3 and even after the heaviest meal the level rarely exceeds 150 mg per 100 cm^3.

   Discuss the hormonal processes involved in keeping this level constant. **[7 marks]**

Total 15 marks

6. (a) Give a drawing of an antibody molecule using annotated labels to relate the MOST important structural features to its functions. **[4 marks]**

   (b) Distinguish between and describe the modes of action of mature B and T cells in humoral and cell-mediated responses. **[4 marks]**

   (c) Distinguish between physical and psychological drug dependence. **[4 marks]**

   (d) Discuss the long-term consequences of alcohol consumption on the liver. **[3 marks]**

Total 15 marks

END OF TEST

TEST CODE **22207020**

FORM TP 2008162

MAY/JUNE 2008

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 2 – PAPER 02

2 1/2 hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions.
2. Section A consists of THREE questions. Candidates must answer ALL questions in this section. Answers to this section MUST be written in this answer booklet.
3. Section B consists of THREE questions. Candidates must answer ALL questions in this section. Answers to this section MUST be written in the answer booklet provided.
4. The use of silent non-programmable calculators is allowed.

SECTION A

Answer ALL questions in this section. You must write your answers in the spaces provided on the question paper.

1. Figure 1 below is a high power electron micrograph of a mitochondrion from a eukaryotic cell.

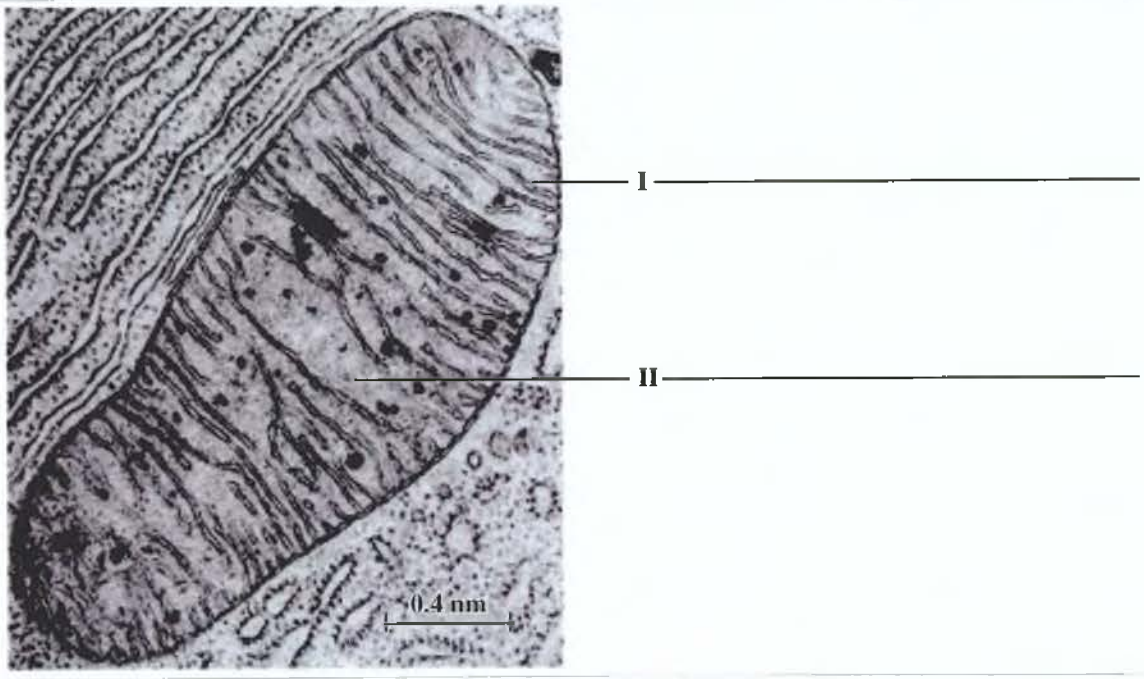


Figure 1. Electron micrograph of a mitochondrion

[http://content.answers.com/main/content/img/McGrawHill/Encyclopedia/images/CE428200FG0010.gif]

(a) (i) On Figure 1, label the structures highlighted as **I** and **II**. **[2 marks]**

(ii) For the structures labelled **I** and **II,** state their MAIN function in cellular respiration in the organelle.

I _____

_____

_____

II _____

_____

_____

[2 marks]

(iii) Calculate the length of the mitochondrion shown in Figure 1. Show your steps.

Calculations:

Length: _____

[2 marks]

(b) Chloroplasts are involved in energy conversion in plants and share some features in common with mitochondria.

State TWO structural features which are **similar** and ONE structural feature which is **different** in chloroplasts and mitochondria.

Similarities

(i) _____

_____

(ii) _____

_____

[2 marks]

Difference

(i) _____

_____

[1 mark]

(c) Using an annotated diagram ONLY, explain how energy is generated in the respiratory chain reaction in mitochondria.

[6 marks]

Total 15 marks

2. (a) In plants, phloem plays an important role in the transport of substances. Figure 2 is a model of the mass pressure-flow hypothesis which has been proposed as a possible mechanism of phloem translocation.

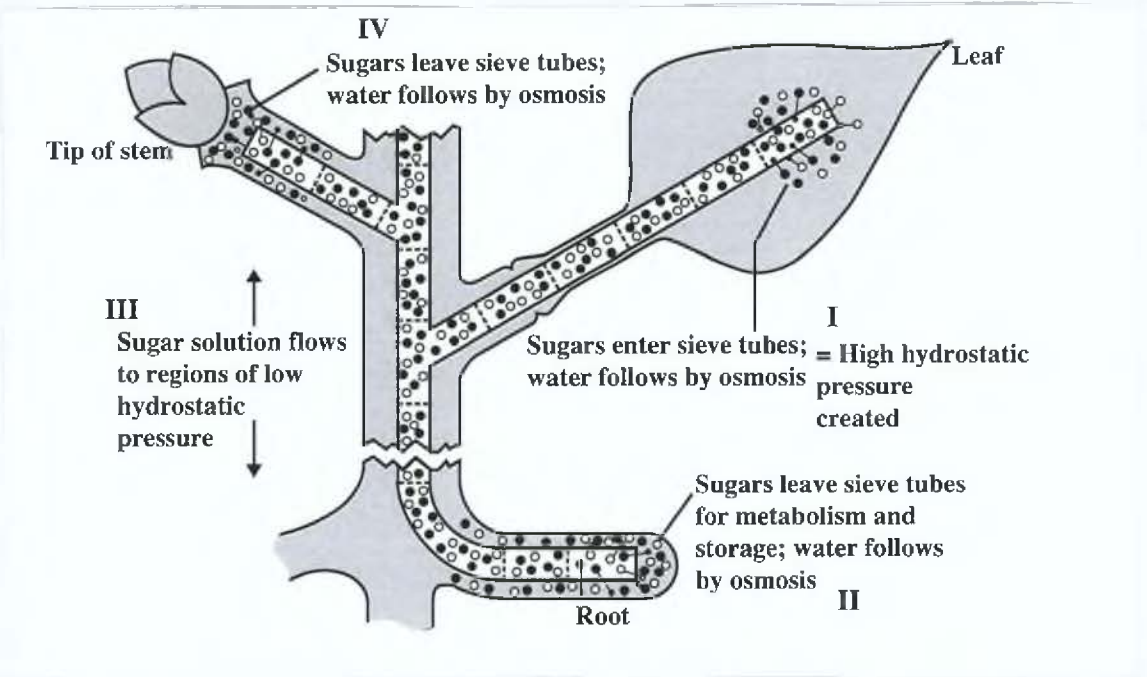


Figure 2. Model of mass pressure-flow

{http://www.ualr.edu/botany/pressflow.gif}

(i) With reference to the activities occurring at the stages highlighted by the labels I – IV, discuss the SIX key features of this hypothesis.

[6 marks]

GO ON TO THE NEXT PAGE

(ii) Xylem is also involved in transport in plants but differs from phloem in how this is achieved. Describe ONE **major** difference in the transport process.

_____

_____

_____

[2 marks]

(b) The mammalian heart is described as a double-circuit, chambered pump.

(i) In the box provided below, illustrate and label the MAIN chambers of the heart as seen in a longitudinal section. **[4 marks]**

(ii) On your drawing, use arrows to illustrate the circuit of blood flow through the various chambers. **[1 mark]**

(iii) Identify which chamber of the heart plays the MOST important role in the pumping function and describe the MAIN feature of the chamber which contributes to this function.

[2 marks]

Total 15 marks

3. (a) (i) Define the term 'health'.

[2 marks]

(ii) Using TWO examples, explain the difficulties involved in placing most diseases into one category.

[4 marks]

(b) As part of a routine medical test, a female measured her weight, height and blood cholesterol levels. Her weight was 75 kg, her height was 1.5 metres and her blood cholesterol level was 235 gm/dl.

(i) Calculate her Body Mass Index (BMI). Show your calculations.

[2 marks]

(ii) Comment on this BMI value in relation to what is acceptable.

_____

_____

[1 mark]

(iii) The acceptable range for blood cholesterol is 200 – 240 mg/dl. In light of the BMI and the cholesterol results, predict TWO medical conditions that this person may develop.

_____

_____

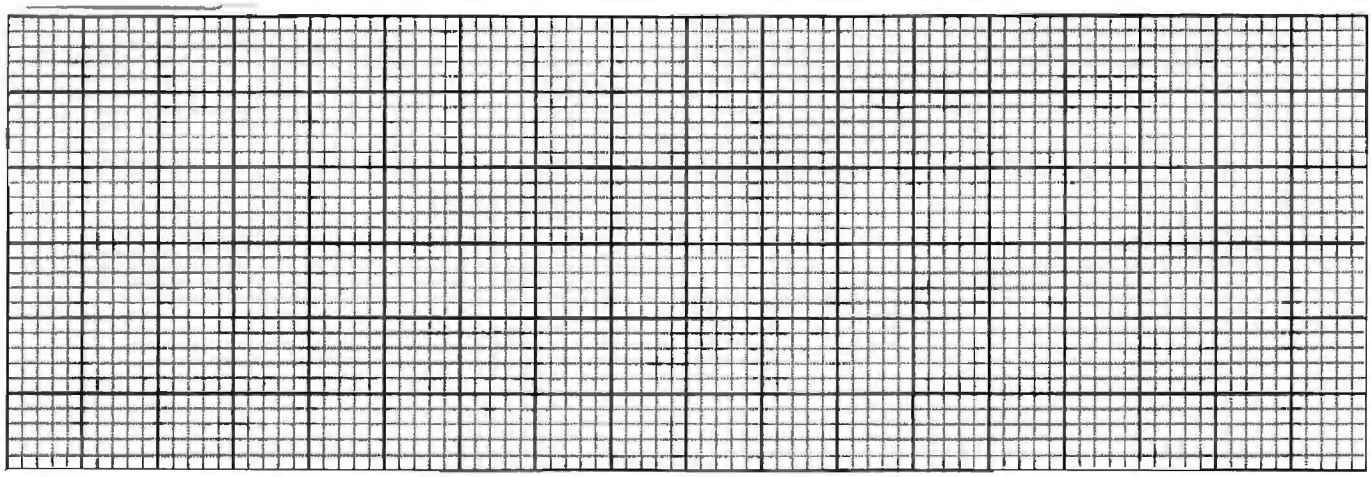
[2 marks]

(c) Table 1 below summarises mortality rates in a population for the period, 1990 to 2001.

TABLE 1. MORTALITY RATES

Year	Mortality rate (100,000) population
1990	135
1991	140
1992	139
1993	143
1994	145
1995	137
1996	133
1997	135
1998	130
1999	125
2000	120
2001	119

(i) In the space below, draw a graph to illustrate this data.



[3 marks]

(ii) Suggest ONE reason for the changes in the mortality rate after 1994.

_____

_____

_____

[1 mark]

Total 15 marks

SECTION B

Answer ALL questions in this section. You must write your answers in the answer booklet provided.

4. Conservation International has identified the Caribbean as a "hotspot" for biodiversity and as such conservation of biological resources has become a priority for several countries in the region.

   (a) (i) Discuss the concept of 'biodiversity' in terms of genetic, species and ecosystem diversity. **[4 marks]**

   (ii) Outline TWO reasons why it is important to conserve biodiversity. **[4 marks]**

   (b) (i) Define the term 'ecosystem'. **[3 marks]**

   (ii) Discuss why ecosystems are considered to be dynamic in nature. **[4 marks]**

Total 15 marks

5. (a) Describe the basic structure of a myelinated motor neurone. **[6 marks]**

   (b) Explain the basis of the electrical nature of a nerve impulse in relation to the structure of a neurone. **[6 marks]**

   (c) Citing THREE **main** phases of activity, discuss how a neurone functions to transmit an impulse upon receiving a stimulus. **[3 marks]**

Total 15 marks

6. (a) HIV infections and dengue are viral diseases of regional importance. Compare these diseases in relation to mode of transmission of the virus, onset of the symptoms, and prevention of transmission of the virus. **[6 marks]**

   (b) (i) Explain how HIV becomes a permanent part of the cell of infected persons. **[4 marks]**

   (ii) Suggest ONE reason why this does NOT occur with dengue. **[1 mark]**

   (c) Cancer tumours develop as a result of uncontrolled cells, suggesting that cancer is associated with changes in cell DNA. Assess the validity of this statement with reference to TWO common causes of cancers. **[4 marks]**

Total 15 marks

END OF TEST

TEST CODE **02107020**

FORM TP 2009147

MAY/JUNE 2009

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 1 – PAPER 02

$2\frac{1}{2}$ *hours*

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions.
2. Section A consists of THREE questions. Candidates must answer ALL questions in this section. Answers to this section MUST be written in this answer booklet.
3. Section B consists of THREE questions. Candidates must answer ALL questions in this section. Answers to this section MUST be written in the separate answer booklet provided.
4. The use of silent non-programmable calculators is allowed.

SECTION A

Answer ALL questions. You must write your answers in the spaces provided in this answer booklet.

1. (a) **Figure 1** below is an electron micrograph of an animal cell.

(i) **On the figure**, identify the structures labelled A,B,C and D

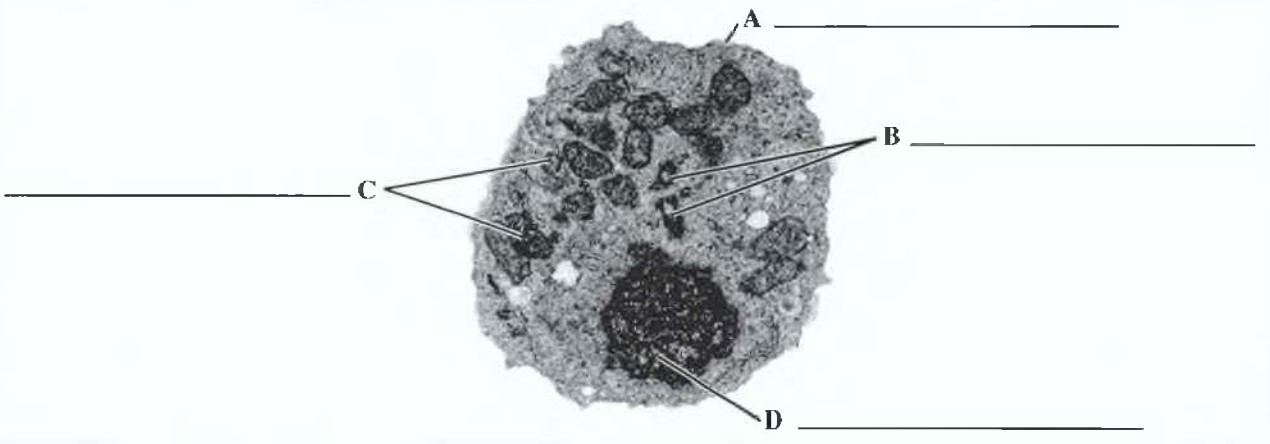


Figure 1. Electron micrograph of an animal cell

[2 marks]

(ii) With reference to the structures labelled in **Figure 1**, which structure is present only in animal cells and NOT in plant cells?

_____

[1 mark]

(iii) In addition to the structures labelled in **Figure 1**, there are **other** structures that work together to make lipids available to the cell. Name TWO of these structures.

_____

[1 mark]

(iv) Explain how the two structures named in (a) (iii) work together and make lipids available to the cell.

_____

_____

_____

_____

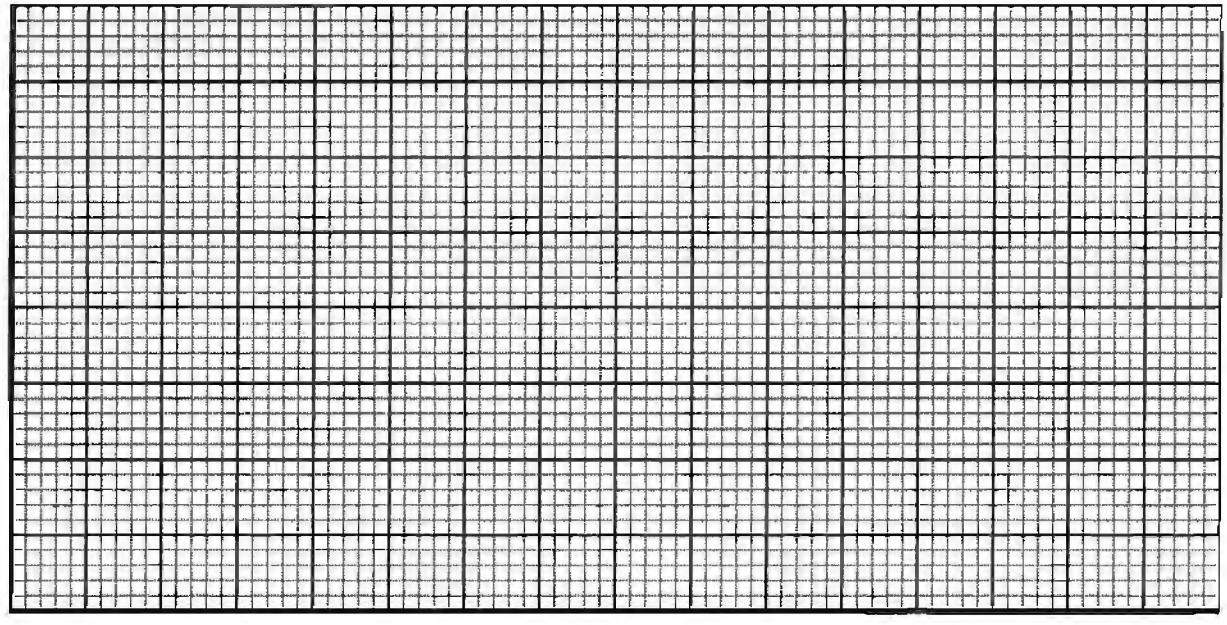
[3 marks]

(b) An experiment is conducted to investigate the effect of temperature on the rate of an enzyme catalysed reaction. In this experiment all other variables are kept constant. The results of this experiment are shown in Table 1.

TABLE 1 : EFFECT OF TEMPERATURE ON THE RATE OF AN ENZYME CATALYSED REACTION

Temperature (°C)	Quantity of product produced per unit of time
20	1.5
25	2.3
30	3.0
35	3.5
40	3.4
45	2.3

(i) Complete the graph below to show the results given in Table 1.



[4 marks]

(ii) Suggest an explanation for the shape of the curve.

_____

_____

_____

[2 marks]

GO ON TO THE NEXT PAGE

(iii) List TWO other variables that should be kept constant during this experiment.

_____

_____

[2 marks]

Total 15 marks

2. (a) Hair colour in mice is controlled by two genes. For one gene the dominant allele, B, results in mice with black hairs. The homozygous recessive condition, **bb**, gives a brown colour.

The second gene determines whether or not pigment will be deposited in the hair. The dominant allele, A, results in the deposition of either black or brown pigment. The homozygous recessive condition, **aa**, results in the hair being white (albino) regardless of the genotype at the black/brown locus.

(i) State the term used to describe the interaction of the two genes described above, and give an explanation of the nature of the interaction.

Term: _____

Explanation of the nature of the interaction:

_____

_____

[3 marks]

(ii) Crosses between black mice, all heterozygous for both genes, produced offspring with black, brown and white coat colour.

Determine the ratio of the phenotypes and for EACH phenotype suggest ONE genotype.

Ratio _____

Genotypes Black _____

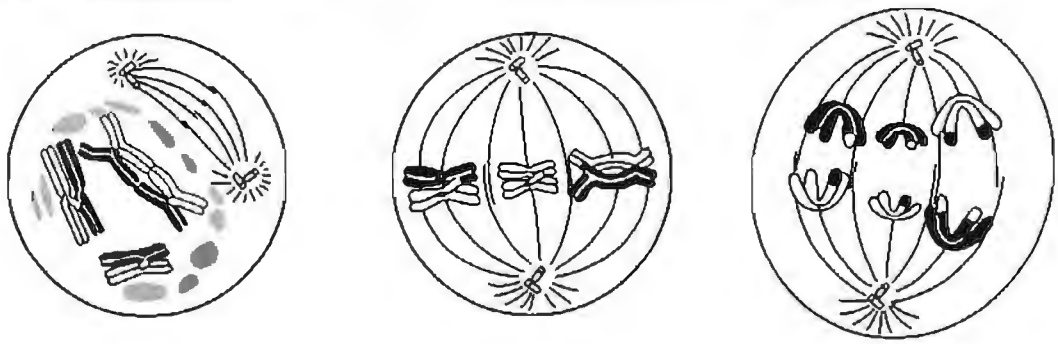
Brown _____

White _____

[5 marks]

GO ON TO THE NEXT PAGE

(b) **Figure 2** is a diagrammatic representation of three stages in Meiosis I.



Stage X **Stage Y** **Stage Z**

Figure 2. Three stages of Meiosis I

(i) Identify the stages labelled as X, Y and Z.

X : _____

Y : _____

Z : _____

[3 marks]

(ii) State TWO features of the stage in Meiosis I which comes **after** Stage Z.

_____

_____

_____

_____

_____

[2 marks]

(iii) Explain how the events shown in Stage X of Meiosis I contribute to heritable variation.

_____

_____

_____

_____

_____

[2 marks]

Total 15 marks

3. (a) (i) Define the terms 'asexual reproduction' and 'vegetative propagation'.

Asexual reproduction

_____

_____

Vegetative propagation

_____

_____

[2 marks]

(ii) Structures such as bulbs, corms and tubers are suitable for use in vegetative propagation. State ONE characteristic of the tissue of these structures, which facilitates this function (vegetative propagation).

_____

[1 mark]

(iii) State ONE function, other than vegetative propagation, that is often carried out by bulbs, corms and tubers.

_____

[1 mark]

(b) **Figure 3** below represents a mature pollen grain.

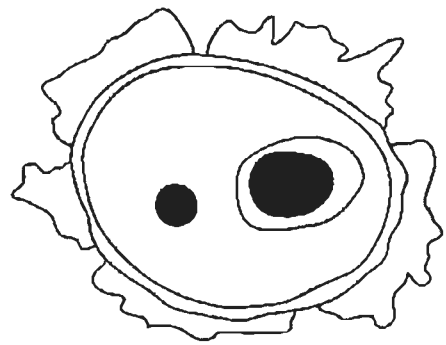


Figure 3. Mature pollen grain

(i) Briefly describe FOUR MAIN features of the pollen grain shown in Figure 3.

_____

_____

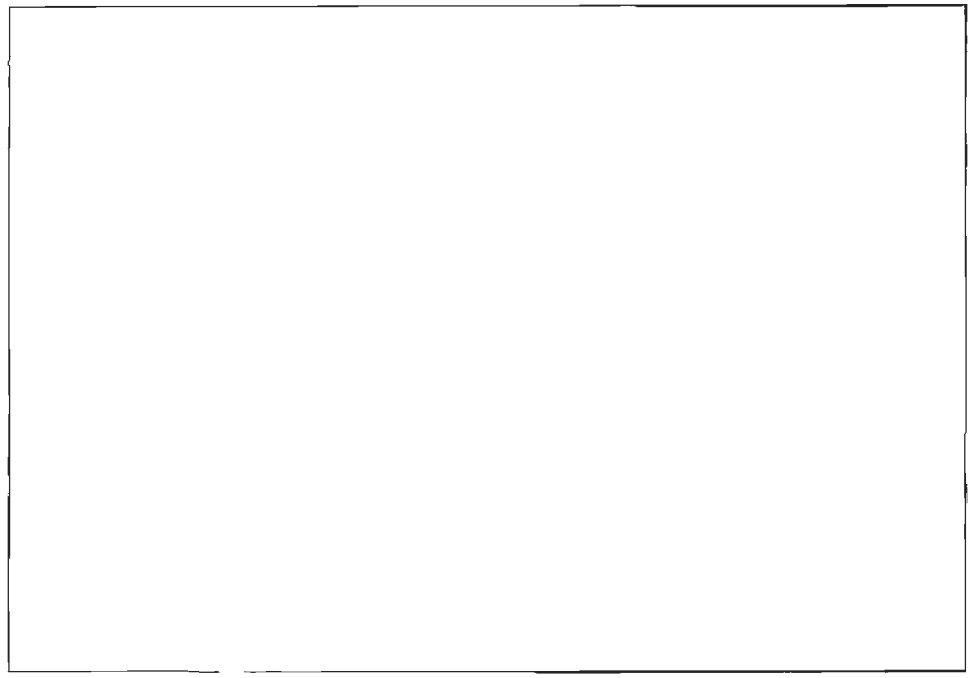
_____

_____

[4 marks]

GO ON TO THE NEXT PAGE

(ii) In the box below, draw and label the structure of the pollen grain at the END of germination.



[3 marks]

(iii) State ONE **major** change that occurs when a pollen grain germinates and explain its significance.

[2 marks]

(c) The stigma plays an important role in fertilization by providing a location for the pollen to be deposited. Explain TWO **other** ways in which the stigma plays an important role in fertilization.

[2 marks]

Total 15 marks

GO ON TO THE NEXT PAGE

SECTION B

Answer ALL questions. You must write your answers in the answer booklet provided.

4. (a) (i) With the aid of a simple diagram, describe the basic structure of a phospholipid. Detailed chemical formulae of the molecules are not required. **[5 marks]**

(ii) Phospholipids are a major component of the plasma membrane of a cell and are arranged as a lipid bi-layer.

With reference to the properties of phospholipids, explain why these lipids are arranged as a bi-layer in the plasma membrane. **[4 marks]**

(b) (i) Osmosis and endocytosis are cellular processes involved in the transport of materials across the plasma membrane. Describe TWO ways in which these processes **differ**. **[4 marks]**

(ii) Give TWO examples of the use of endocytosis for the uptake of nutrients in animal systems. **[2 marks]**

Total 15 marks

5. (a) (i) Explain the terms 'vector' and 'recipient' as applied to genetic engineering. **[2 marks]**

(ii) Discuss the role played by *E. coli* (as a vector and recipient) in the production of insulin, utilizing genetic techniques. **[4 marks]**

(b) (i) Describe the basic structure of RNA and explain how it **differs** from the structure of DNA. **[4 marks]**

(ii) Both DNA and RNA are involved in protein synthesis but they perform different roles. Differentiate between the roles played by DNA and RNA in protein synthesis. **[5 marks]**

Total 15 marks

GO ON TO THE NEXT PAGE

6. (a) Briefly describe FIVE **main** regions which make up the human female reproductive system. **[5 marks]**

(b) The human male reproductive system shares some structural similarities with the female system but is designed to perform different functions.

Select TWO of the regions described in (a) above. For EACH region, explain how its function is unique to females. **[4 marks]**

(c) Discuss the principle of negative feedback mechanisms as applied to the secretion of follicle stimulating hormone and its role in the control of the menstrual cycle. **[6 marks]**

Total 15 marks

END OF TEST

TEST CODE **02107032**

FORM TP 2009148

MAY/JUNE 2009

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 1 – PAPER 03/2

ALTERNATIVE TO INTERNAL ASSESSMENT

2 hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE questions. Answer ALL questions.
2. The use of silent non-programmable calculators is allowed.

1. Amylase is an enzyme, which catalyses the hydrolysis of starch into a reducing sugar. It is commonly found in human saliva and germinating seeds.

You are required to carry out a simple investigation into the effect of substrate concentrations on the rate of reaction of amylase. Carefully read the instructions that follow before starting.

(a) You are provided with a stock solution of starch.
Using the distilled water provided prepare a series of starch solutions at different concentrations as follows:

(i) Label 8 test tubes A, B, C, D, A1, B1, C1, D1

(ii) To EACH test tube add the following:

A: 5 cm^3 stock starch solution
B: 4 cm^3 stock starch solution and 1 cm^3 distilled water
C: 3 cm^3 stock starch solution and 2 cm^3 distilled water
D: 2 cm^3 stock starch solution and 3 cm^3 distilled water
A1, B1, C1, D1: 5 cm^3 distilled water

(b) Place all the test tubes in a test tube rack in the water bath (37 °C) provided and leave for 5 minutes to allow the temperature of the solutions to reach the temperature of the water bath.

(c) Remove test tubes A and A1 from the water bath. To each tube quickly add 0.5 cm^3 of the amylase enzyme solution provided. Swirl the contents of the test tubes and rapidly put them back into the rack in the water bath.

(d) START THE STOP CLOCK. At intervals of 1 minute remove 1 drop of the reaction mixture from each test tube and place in separate wells of the marble spot plate provided. Immediately add a drop of Benedict's solution. Record the starch concentration and colour changes in Table 1 on page 3. Repeat this for a period of 5 minutes.

(e) Carry out the same procedure outlined in Steps (c) and (d) for the remaining pairs of solutions as follows:

B and B1
C and C1
D and D1

[7 marks]

(f) Write an appropriate title for Table 1.

_____

_____

[1 mark]

TABLE 1

Test Tube	Starch Concentration	Time Intervals (minutes)	Colour Changes
A 5 cm^3 starch solution		1	
		2	
		3	
		4	
		5	
A1 5 cm^3 distilled water		1	
		2	
		3	
		4	
		5	
B 4 cm^3 starch solution and 1 cm^3 distilled water		1	
		2	
		3	
		4	
		5	
B1 5 cm^3 distilled water		1	
		2	
		3	
		4	
		5	
C 3 cm^3 starch solution and 2 cm^3 distilled water		1	
		2	
		3	
		4	
		5	
C1 5 cm^3 distilled water		1	
		2	
		3	
		4	
		5	
D 2 cm^3 starch solution and 3 cm^3 distilled water		1	
		2	
		3	
		4	
		5	
D1 5 cm^3 distilled water		1	
		2	
		3	
		4	
		5	

GO ON TO THE NEXT PAGE

(g) Based on the results recorded what can you deduce about the relationship between substrate concentration and enzyme activity?

(2 marks)

(h) Comment on the purpose of the distilled water in test tubes A1 to D1.

[1 mark]

(i) Give TWO reasons for the colour changes recorded over the five-minute test period, when Benedict's solution was added to the reaction mixtures.

[2 marks]

(j) Outline the procedure that you might use to produce quantitative colour standards for the reaction mixtures using Benedict's solution.

[3 marks]

Total 16 marks

GO ON TO THE NEXT PAGE

2. (a) In a study to determine the effects of the steroidal plant hormone, 24-epibrassinolide (BL), on the mitotic index and growth of onion (*Allium cepa*) root tips, the effect of BL on cell division is measured by recording the number of cells in various stages of mitosis and the mitotic index (% of cells examined in mitosis) in controls and BL-treated root tips. The results are shown in Table 2.

Table 2: Effects of various concentrations of 24-epibrassinolide (BL) on the mitotic index of regenerating onion root tips. Data based on 400 cells counted from each of five root tips from each group (total of 2000 cells from each group).

Concentration of BL	# Cells in interphase	# Cells in prophase	# Cells in metaphase	# Cells in anaphase	# Cells telophase	# Cells counted	Mitotic index ± SD[1]
Control	1907	44	37	11	1	2000	4.65 ± 1.34
0.5 ppm	1918	52	15	12	3	2000	☐ ± 1.34
0.05 ppm	1869	82	28	20	1	2000	6.55 ± 0.69**
0.005 ppm	1807	112	46	24	11	2000	☐ ± 1.76*

[1]Percent of cells in mitosis ± SD; *P ≤ 0.001; ** P ≤ 0.03.

Table taken from www.funpecrp.com.br/.../gmr0259 full text.htm

(i) Calculate the mitotic index (% cells examined in mitosis) for root tips treated with 0.5 ppm BL and 0.005 ppm BL.

0.5 ppm BL _____

0.005 ppm BL _____

[2 marks]

(ii) Based on the results given in Table 2, what TWO pieces of information can be deduced about the effect of the steroidal plant hormone on cell division in onion root tips?

_____

_____

_____

_____

_____

_____

[2 marks]

(b) In experiments investigating the inheritance of mutations in *Drosophila melanogaster*, students are given a stock of mutant flies with the following mutations:

1. Mutant flies have lighter than normal body colour – **yellow body colour**
2. Mutant flies have wings which **lack the normal veins**

In the **first part of the experiment**, crosses were made as follows:

A. True breeding normal (wildtype) virgin females are crossed with true breeding mutant males.

B. True breeding mutant virgin females are crossed with normal (wildtype) true breeding males.

The results of cross A produced F_1 progeny (male and female flies) which were wildtype with normal body colour and wings with veins. For B, the male F_1 progeny had all the mutations, while none of the F_1 female offspring had mutations (all wildtype).

For the second part of the experiment, the F_1 progeny from the cross B, are crossed together. The results of the second cross are given in Table 3.

TABLE 3: RESULTS OF F_1 CROSSES FROM B

Phenotype	Total
All mutants	475
Wildtype	785
Normal body colour, mutant wings	78
Mutant body colour, normal wings	62
TOTAL	1400

(i) Based on the results of the **first part of the experiment,** what can be deduced about the nature of the inheritance of the mutations?

_____

[1 mark]

(ii) Draw a genetic diagram to show the genotypes and phenotypes of the parents and offspring of the two crosses, A and B, of the **first part of the experiment**.

CROSS A

CROSS B

[8 marks]

(iii) Using the data from Table 3 on page 6, calculate the percentage of offspring exhibiting non-parental phenotypes.

[2 marks]

(iv) Explain the significance of finding offspring from the second cross (F_2) exhibiting non-parental conditions.

_____

_____

_____

_____

[1 mark]

Total 16 marks

3. (a) Specimen A is a stained transverse section of the ovary of a mammal.

(i) Make a labelled plan drawing of Specimen A in the box below.

[6 marks]

(ii) Examine the specimen and locate a mature Graafian follicle. Calculate the diameter of the mature oocyte. Show your calculations.

Calculations:

Diameter of oocyte _____

[2 marks]

GO ON TO THE NEXT PAGE

(b) Specimen B is a transverse section of an immature anther of a lily.

(i) Examine the specimen and locate a pollen sac. Make a DETAILED labelled drawing of a pollen sac in the box below.

[6 marks]

(ii) Comment on TWO **key** differences that you might expect to see if you were to observe the pollen sac in a section of a completely mature anther.

1. _____

2. _____

[2 marks]

Total 16 marks

END OF TEST

TEST CODE **02207020**

FORM TP 2009150

MAY/JUNE 2009

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 2 – PAPER 02

2 1/2 hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions.
2. Section A consists of THREE questions. Candidates must answer ALL questions in this section. Answers to this section MUST be written in this answer booklet.
3. Section B consists of THREE questions. Candidates must answer ALL questions in this section. Answers to this section MUST be written in the answer booklet provided.
4. The use of silent non-programmable calculators is allowed.

SECTION A

Answer ALL questions in this section. You must write your answers in the spaces provided on the question paper.

1. An experiment is conducted to determine the rate at which germinating peas at room temperature take up oxygen, using a respirometer. The apparatus is set up as shown in **Figure 1**.

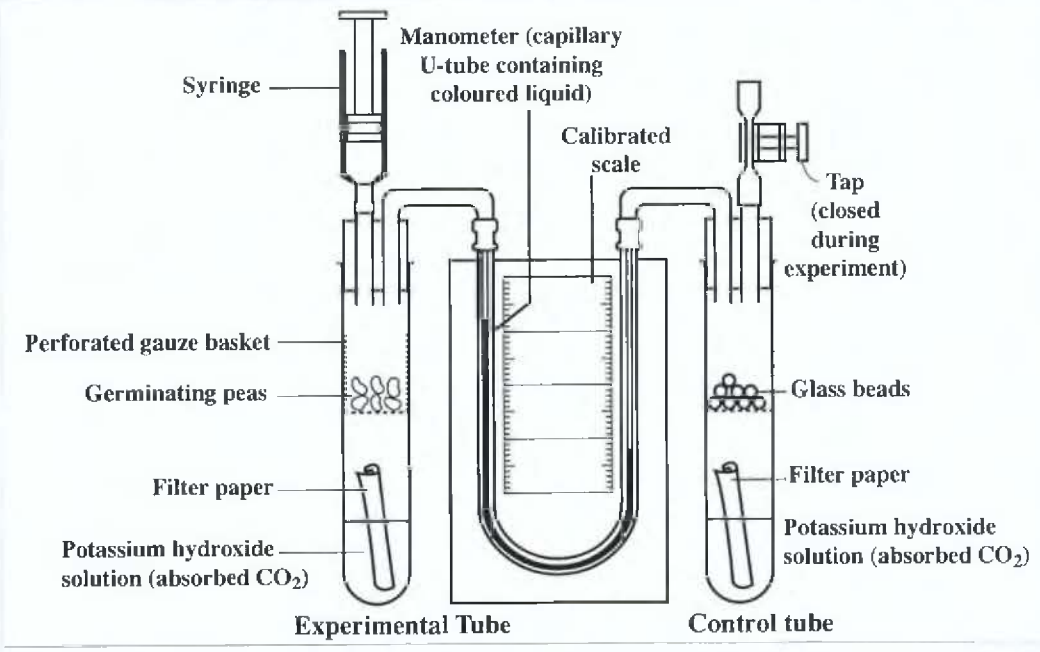


Figure 1. Apparatus used to investigate oxygen uptake in germinating peas

(a) Explain how the apparatus is used to investigate the rate of oxygen uptake of the germinating peas in the respirometer.

[6 marks]

(b) State ONE way in which the apparatus in Figure 1 on page 2 could be modified to determine the effect of temperature on the oxygen uptake by germinating peas.

_____

_____

[1 mark]

(c) **Figure 2** below is a simplified diagram of the Krebs cycle and the preceding reactions.

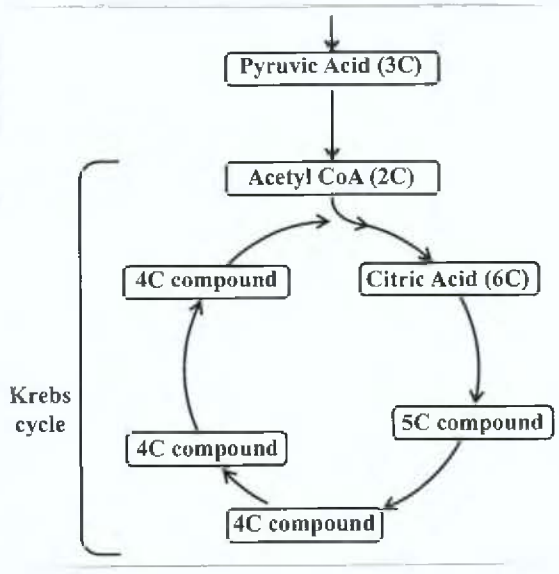


Figure 2. Krebs cycle

(i) On **Figure 2**, label EACH of the following stages with the letter

a) C to indicate decarboxylation reactions

b) H to indicate dehydrogenation reactions. **[5 marks]**

(ii) State EXACTLY where the Krebs cycle occurs in a cell.

_____

[1 mark]

(iii) Briefly explain the role of NAD in the Krebs cycle, in relation to energy production.

_____

_____

_____

[2 marks]

Total 15 marks

GO ON TO THE NEXT PAGE

2. (a) State FOUR structural features of xylem vessels.

(i) _____

(ii) _____

(iii) _____

(iv) _____

[4 marks]

(b) Xylem vessels play an important role in the conduction of water and mineral salts in plants. Using THREE of the features listed at (a), explain how EACH feature facilitates the conduction of water and mineral salts in plants.

_____

_____

_____

_____

_____

_____

[3 marks]

(c) **Figure 3** below is a cross-section of a mammalian muscular artery.

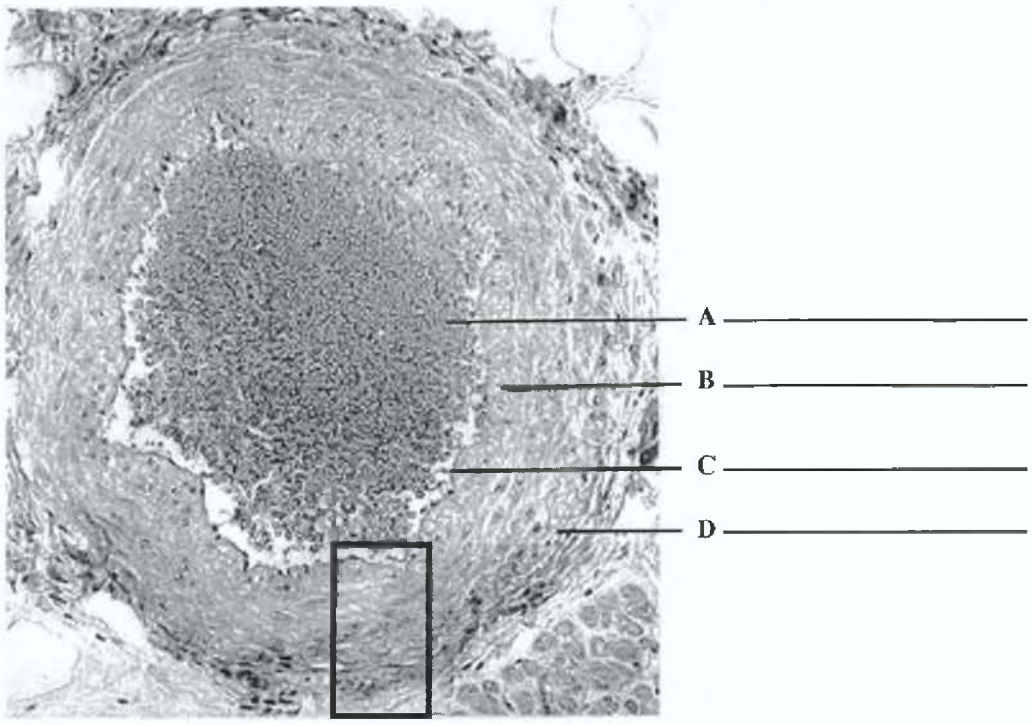


Figure 3. Cross-section of a mammalian artery

(i) Identify the tissues labelled A, B, C and D. Write your answers in **Figure 3**.
[2 marks]

(ii) **In the box provided** below, draw a plan diagram to show the distribution of the **major** tissues of the artery wall in Box A in **Figure 3**. Make your drawing twice the size of Box A.

[5 marks]

GO ON TO THE NEXT PAGE

(iii) The photograph in **Figure 3** on page 5 has been magnified 100 times. What is the ACTUAL width of the artery wall in the region of Box A?

_____

[1 mark]

Total 15 marks

3. A survey was conducted among the residents of a large metropolitan city in order to assess the use of psychoactive substances. Twelve hundred persons responded. The data that was collected is presented in **Table 1**.

TABLE 1. USE OF PSYCHOACTIVE SUBSTANCES

Substance	Number of Users		
	Males	Females	Total
Alcohol	450	420	**870**
Tobacco	380	310	**690**
Cannabis	80	25	**105**
Tranquilizers	10	20	**30**
Stimulants	15	10	**25**
Total	**935**	**785**	**1720**

Figure 4 below shows an incomplete bar chart of the data in **Table 1.**

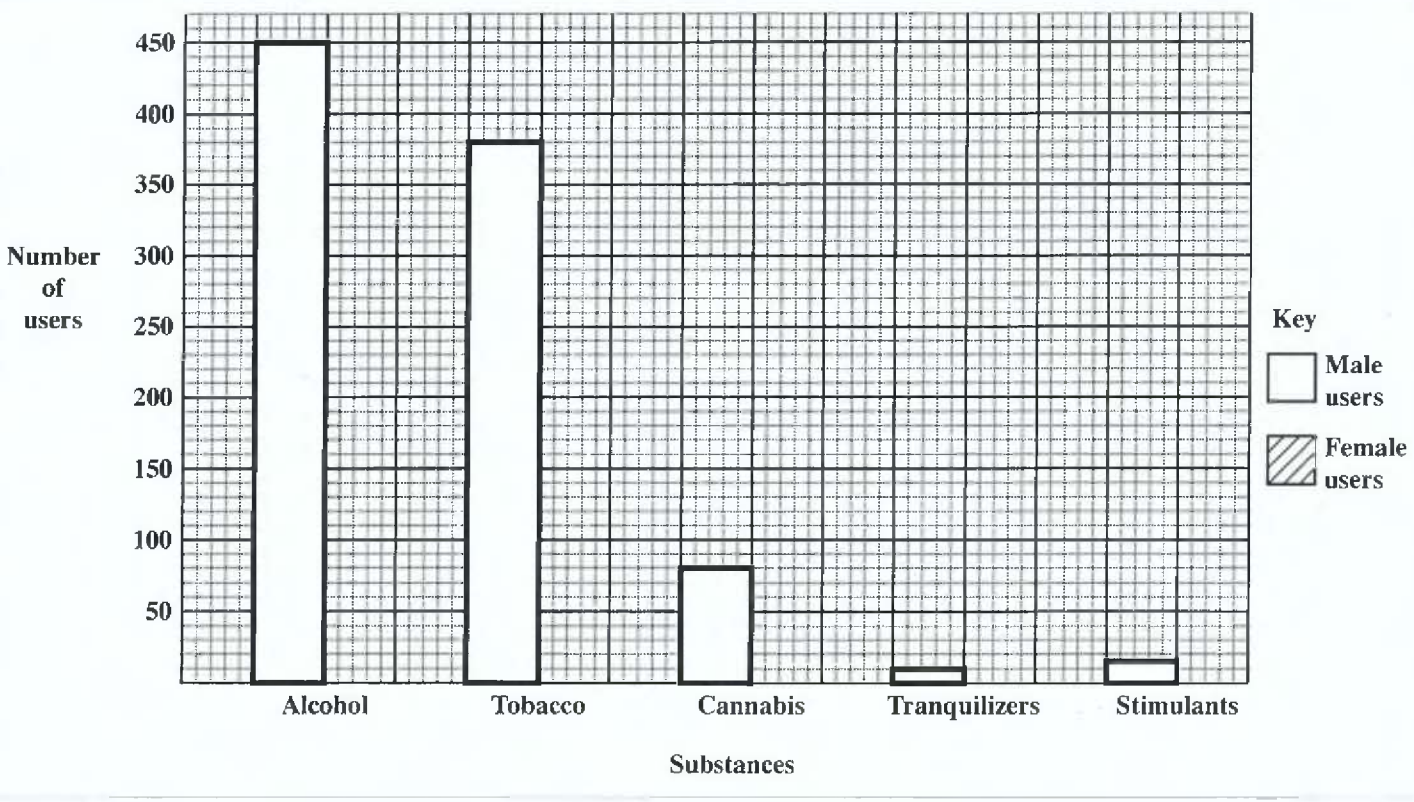


Figure 4. Bar chart

GO ON TO THE NEXT PAGE

(a) (i) Complete the bar chart shown in **Figure 4** to show the data collected on the **female** users. **[3 marks]**

(ii) State THREE significant trends in relation to the use of psychoactive substances that are demonstrated by the data.

_____

_____

_____

_____

_____

[3 marks]

(b) (i) Explain how consistent use of alcohol affects the liver. Your answer should include TWO points.

_____

_____

_____

_____

[4 marks]

(ii) State ONE way consistent use of alcohol during pregnancy can adversely affect the foetus.

_____

[1 mark]

(c) Although a large number of persons reported using these psychoactive substances, it cannot be concluded that their use constitutes either a health or social risk. Suggest, with an explanation, TWO other kinds of data that could be collected and used to make this determination.

_____

_____

_____

_____

[4 marks]

Total 15 marks

GO ON TO THE NEXT PAGE

SECTION B

Answer ALL questions. You must write your answers in the answer booklet provided.

4. (a) Distinguish between the terms 'ecosystem' and 'ecological niche'. **[4 marks]**

   (b) Explain why energy is said to **flow through**, and not cycle, as it is transferred within an ecosystem. **[4 marks]**

   (c) (i) Using examples, explain the difference between the terms 'in situ' and 'ex situ' as they relate to biological conservation. **[3 marks]**

   (ii) The population of many species of large mammals can be preserved by the use of zoological parks. Discuss TWO challenges associated with the use of zoological parks for the maintenance of biodiversity. **[4 marks]**

Total 15 marks

5. (a) (i) The external environment of animals is constantly changing, while the internal environment remains fairly constant. Explain how hormones contribute to the maintenance of this fairly constant internal environment. **[5 marks]**

   (ii) Ethene gas speeds up the ripening of fruits. Suggest TWO other ways in which ethene plays a regulatory role in plants. **[2 marks]**

   (b) A nephron consists of distinct sections, each of which serves a different function. Collectively, these sections ensure that urine is formed by a process of ultra-filtration, selective re-absorption and secretion.

   (i) Distinguish between 'ultra-filtration' and 'selective re-absorption' in relation to urine formation. **[2 marks]**

   (ii) The proximal convoluted tubule is responsible for the process of selective re-absorption. With reference to THREE structural features, discuss how the proximal convoluted tubule is ideally suited to this function (selective re-absorption). **[6 marks]**

Total 15 marks

6. (a) Diabetes has become a major contributor to morbidity, mortality and adult disability in the Caribbean.

(i) State THREE key features of diabetes. **[3 marks]**

(ii) Suggest TWO factors which are thought to be responsible for the increase in diabetes in the Caribbean. **[4 marks]**

(b) Distinguish between 'natural' and 'artificial immunity'. **[4 marks]**

(c) Define the term 'monoclonal antibodies' and THREE benefits of the use of monoclonal antibodies in the diagnosis of diseases. **[4 marks]**

Total 15 marks

END OF TEST

TEST CODE **02207032**

FORM TP 2009151

MAY/JUNE 2009

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 2 – PAPER 03/2

ALTERNATIVE TO INTERNAL ASSESSMENT

2 hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE questions. Answer ALL questions.
2. The use of silent non-programmable calculators is allowed.

1. (a) Specimen A is a stained transverse section of a mammalian blood vessel. Examine the specimen under the low power of your microscope.

(i) Make a labelled plan drawing of Specimen A in the box below.

[6 marks]

Examine Specimen A under the high power of your microscope.

(ii) Comment on TWO features observed which are adaptations for its function in the live animal.

[2 marks]

(iii) Based on the features observed for Specimen A, what can you deduce about the nature of the blood flow in similar blood vessels in a live animal?

[1 mark]

GO ON TO THE NEXT PAGE

(b) Specimen B is a transverse section of a dicotyledonous leaf.

(i) Examine the specimen and locate the mesophyll layer. Make a detailed labelled drawing of a palisade cell in the box below.

[5 marks]

(ii) Compare the palisade cell with the **other** MAJOR type of cell in the mesophyll layer. Comment on TWO differences between them.

[2 marks]

Total 16 marks

2. You are provided with the following apparatus and materials:

- Small glass jar
- Rubber bung (to fit jar) with two 4 mm holes and one 2 mm hole
- 2 cm^3 graduated pipette
- 10 cm plastic syringe
- Fresh plant cutting
- Lamp with high watt bulb
- Petroleum jelly
- Stop clock
- Sharp scissors
- Bucket of water
- Paper towel
- Black box

Use the apparatus above to plan and design an experiment to test the effect of an environmental factor on transpiration in plants.

(a) Formulate a suitable hypothesis for the factor being tested.

_____

_____

_____

[2 marks]

(b) Write a suitable aim based on the hypothesis given in (a).

_____

_____

_____

[1 mark]

(c) Design an experimental procedure capable of testing the aim outlined in (b).

[6 marks]

(d) Suggest TWO precautions that must be taken when setting up the experiment.

(i) _____

_____

_____

(ii) _____

_____

_____

[2 marks]

(e) What results might be expected from the investigation?

_____

_____

_____

_____

[1 mark]

(f) Design an appropriate table to show how the results could be presented.

[2 marks]

(g) Suggest TWO factors which may affect the accuracy of the experiment described.

(i) _____

_____

(ii) _____

_____

[2 marks]

Total 16 marks

GO ON TO THE NEXT PAGE

3. (a) Table 1 summarises the findings of an investigation on the effect of exercise on blood pressure in 12 human subjects following exercise on a treadmill jogger.

TABLE 1. EFFECT OF EXERCISE ON BLOOD PRESSURE IN 12 HUMAN SUBJECTS (MEAN VALUES)

Characteristic	Baseline	Measurement after exercise			
		Immediately (0 min)	15 min	30 min	60 min
Systolic blood pressure (mm Hg)	111	135	111	106	105
Diastolic blood pressure (mm Hg)	77	65	70	68	69

Data taken from http://www.ious.org/cgi/reprint/9/10/749.pdf

(i) On Figure 1, construct a graph of blood pressure for (i) systolic and (ii) diastolic changes over 60 minutes. Include the baseline values in your graph. (Use best-fit graph lines.)

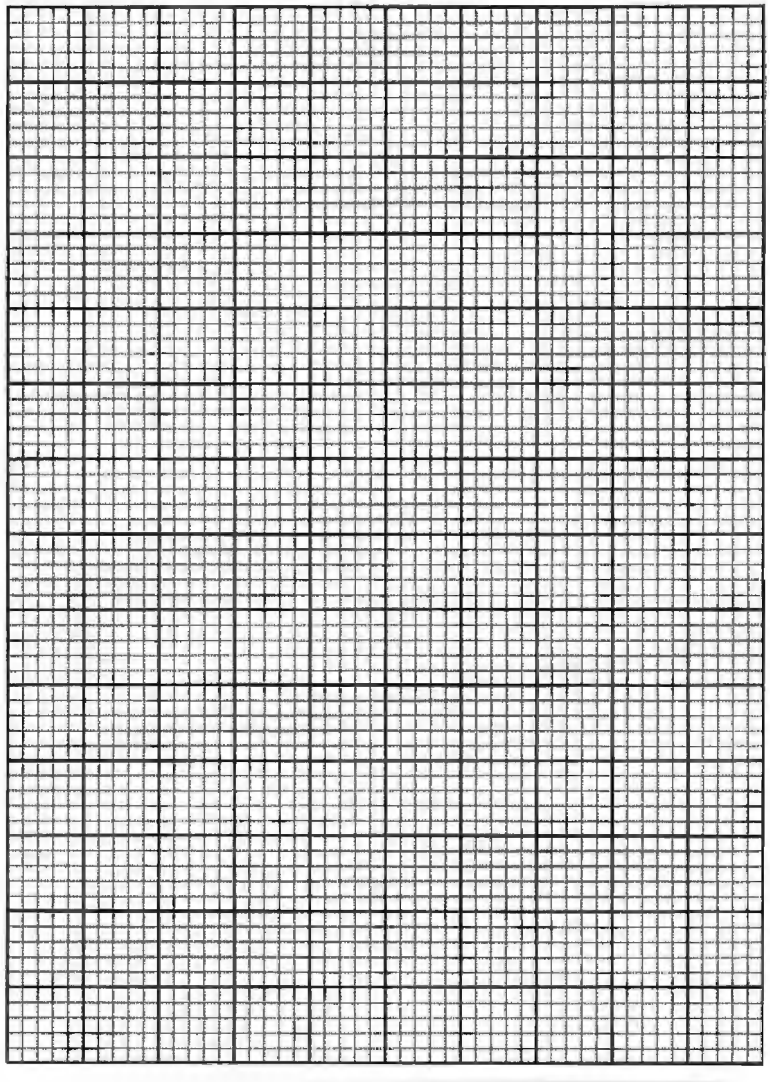


Figure 1

[7 marks]

GO ON TO THE NEXT PAGE

(ii) Comment on the effect of exercise on blood pressure in the human subjects, using quantitative information from the graph drawn on Figure 1 on page 7.

[2 marks]

(iii) What is the physiological significance of the change in systolic pressure recorded immediately after exercise?

[1 mark]

(b) In Guyana, cancer is among the principal causes of morbidity and mortality. Table 2 gives the incidence of cancer recorded over a five-year period.

TABLE 2. DISTRIBUTION OF THE INCIDENCE OF CANCER BY YEAR

YEARS	INCIDENCE RATE
2000	46.5
2001	53.0
2002	60.5
2003	77.3
2004	64.0

Data taken from http://www.health.gov.gy/cancer.html

(i) On Figure 2, construct a histogram to display the data given in Table 2.

[4 marks]

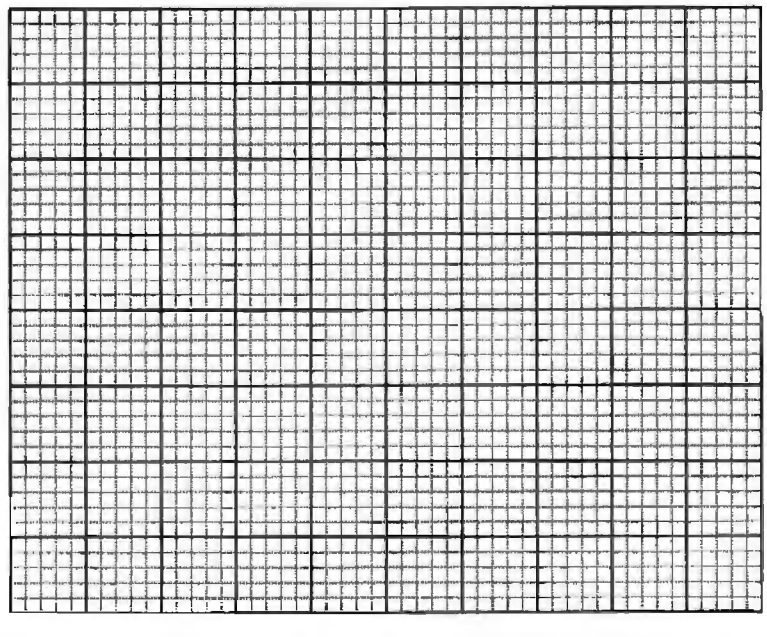


Figure 2

(ii) Comment on the incidence of cancer over the five-year period.

_____

_____

_____

[2 marks]

Total 16 marks

END OF TEST

TEST CODE **02107020**

FORM TP 2010140

MAY/JUNE 2010

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 1 – PAPER 02

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in two sections. Answer ALL questions.
2. For Section A, write your answers in the spaces provided in this booklet.
3. For Section B, write your answers in the spaces provided at the end of each question in this booklet.
4. The use of silent non-programmable calculators is allowed.

SECTION A

Answer ALL questions in this section. Write your answers in the spaces provided in this answer booklet.

1. (a) (i) List FOUR main functions of proteins in living organisms.

_____

_____

_____

_____

[2 marks]

(ii) Figure 1 represents the general structural formula of a peptide.

Circle a peptide bond in the structure in Figure 1. **[1 mark]**

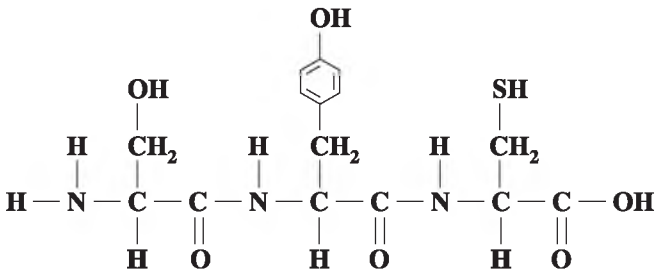


Figure 1. General structure of a peptide

(iii) In the boxes below, draw the structure of

a) an amino group

b) a carboxyl group.

Amino group	Carboxyl group

[2 marks]

(b) (i) Enzymes have many properties. State ONE property of enzymes that relates to their structure and ONE property that relates to their MAIN function in the cell.

_____

_____

[2 marks]

(ii) On the graph in Figure 2, sketch TWO curves to represent the progress of a reaction with and without the presence of an enzyme.

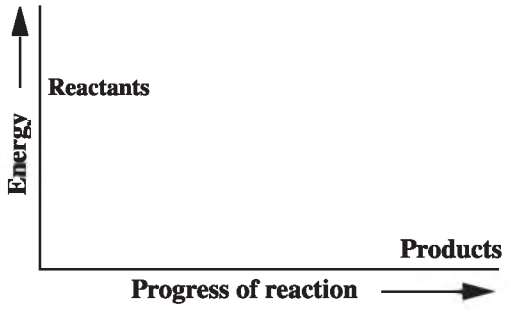


Figure 2. Reaction curves

[2 marks]

(c) The graphs in Figure 3 represent data from enzyme-controlled reactions in which an inhibitor is present.

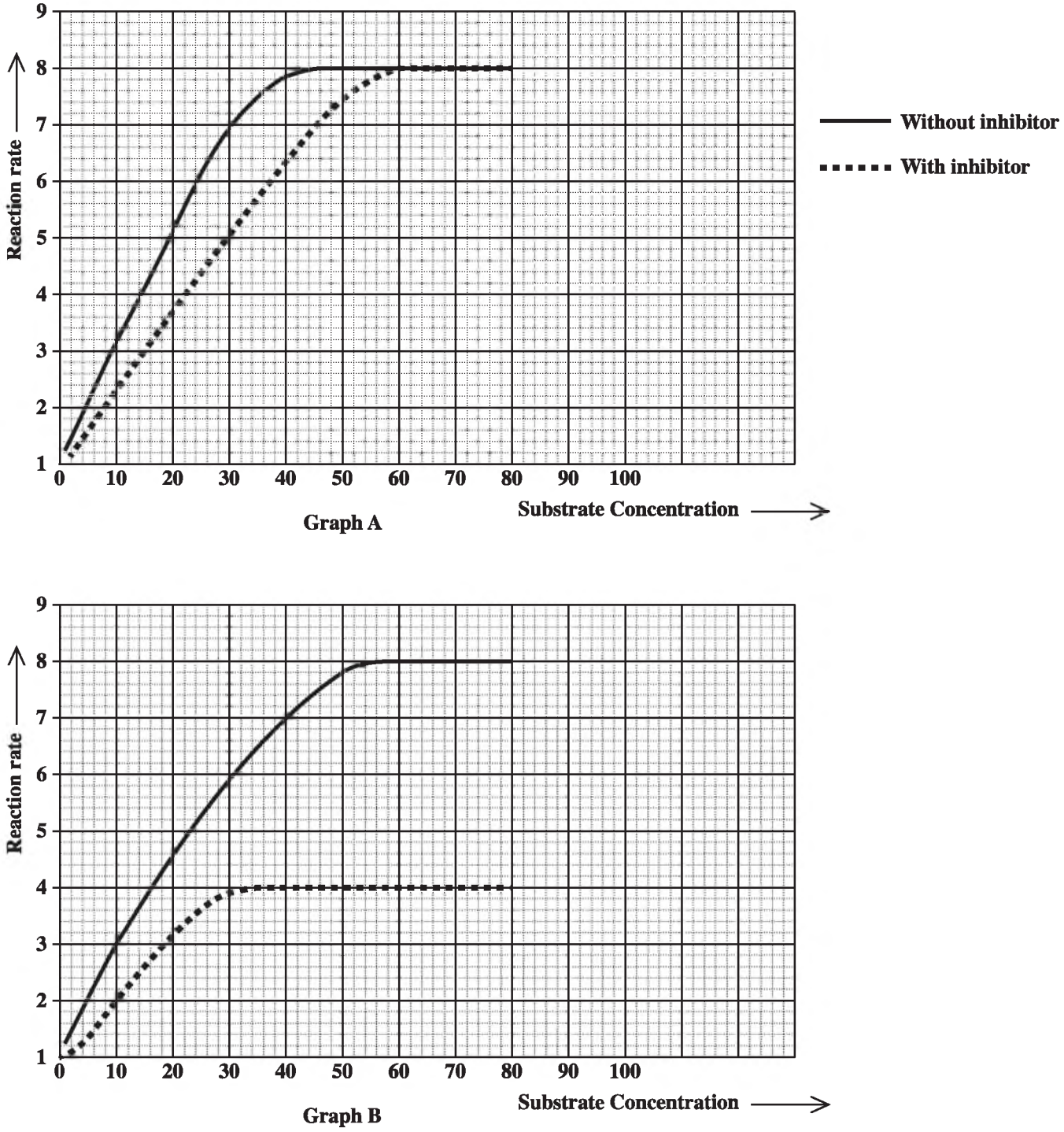


Figure 3. Graphs of enzyme-controlled reactions with and without inhibitors

(i) Describe the trend seen in EACH graph.

Graph A: _____

_____

Graph B: _____

_____

[2 marks]

(ii) Suggest the type of inhibition represented by the data in EACH graph and state the reason for your answer.

Graph A: _____

_____

_____

Graph B: _____

_____

_____

[4 marks]

Total 15 marks

2. Figure 4 is a diagrammatic representation of cells undergoing mitosis.

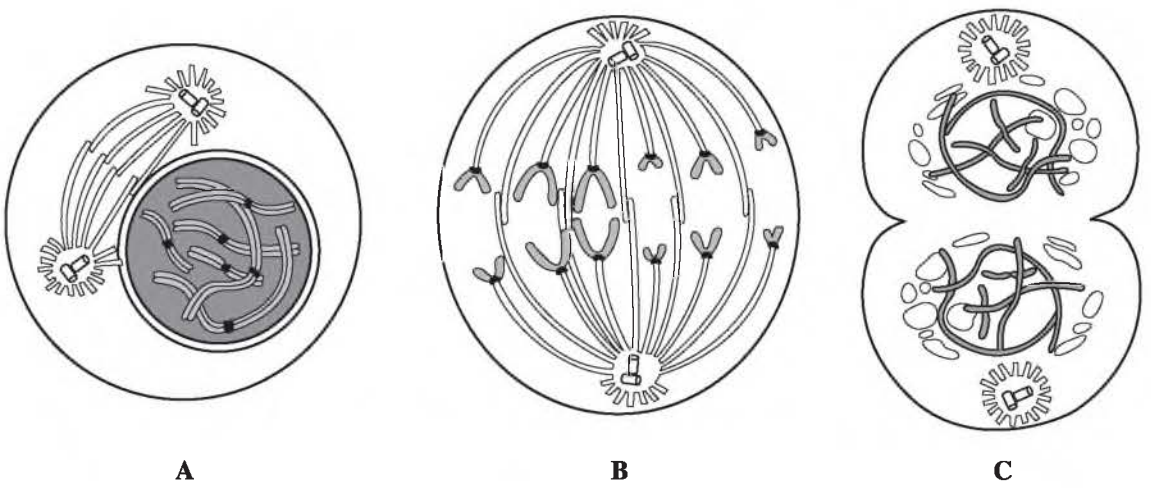


Figure 4. Cells undergoing mitosis

(a) Identify the stage of mitosis seen in the diagrammatic representation of the cells labelled A, B and C. State ONE characteristic feature of EACH of the stages identified.

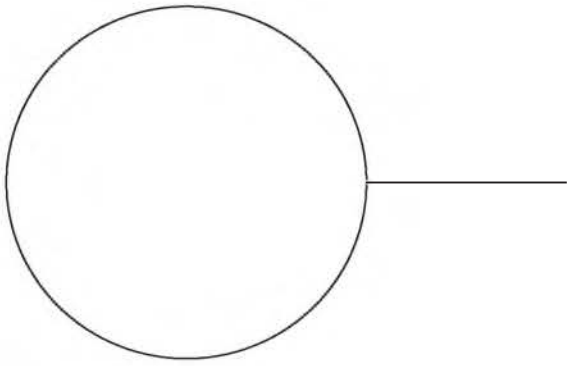
A _____

B _____

C _____

[6 marks]

(b) In the cell outline below, draw the arrangement of the chromosomes of a cell with a diploid chromosome number of 4 during metaphase 1 of meiosis.



[3 marks]

(c) Complete Table 1 to identify the key differences between the processes mitosis and meiosis.

TABLE 1: COMPARISON OF MITOSIS AND MEIOSIS

Features	**Mitosis**	**Meiosis**
Number of daughter cells produced		
Ploidy of daughter cells		
Genetic similarity of daughter cells to parent cell and to each other		

[3 marks]

(d) (i) Name the process which chromosomes must undergo prior to nuclear division and state at what stage of the cell cycle this takes place.

Process _____

Stage _____

[2 marks]

(ii) State ONE reason why the process named in (d) (i) is necessary.

_____

_____

[1 mark]

Total 15 marks

3. (a) Figure 5 is a diagram of a human sperm cell.

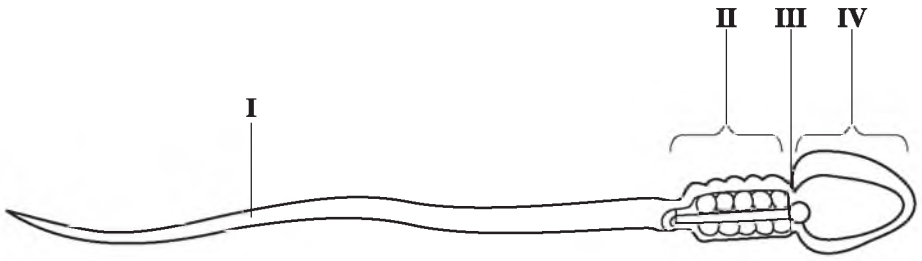


Figure 5. Diagrammatic representation of a mature human sperm cell

(i) Identify the structures labelled I, II, III and IV.

I _____

II _____

III _____

IV _____

[2 marks]

(ii) State the ploidy of the nucleus of the cell shown in Figure 5.

_____

[1 mark]

(iii) State TWO reasons why a large number of mitochondria is present in the sperm cell.

_____

_____

_____

_____

[2 marks]

(iv) In Figure 5, the acrosome of the male sperm is an organelle. Name the type of organelle and describe its function.

_____

_____

[2 marks]

(v) Figure 5 represents the sperm as it is released from the male. State the name given to the ovum as it is released from the ovary.

_____

[1 mark]

(vi) In the box below, draw and annotate the structure of the ovum as it is released from the ovary.

[4 marks]

(b) Complete Table 2 by inserting yes or no, to identify the key differences between the ovum and the sperm.

TABLE 2: COMPARISON OF SPERM AND OVUM

Feature/Function	Ovum	Sperm
Contains extra nuclear DNA		
Has larger food reserve		

[2 marks]

(c) State ONE similarity between the ovum and the sperm.

_____

[1 mark]

Total 15 marks

GO ON TO THE NEXT PAGE

SECTION B

Answer ALL questions in this section. Write your answers in the spaces provided at the end of each question.

4. (a) (i) Name FIVE chemical components in the structure of cell membranes and state the function of EACH component named. **[5 marks]**

(ii) Identify the chemical component of cell membranes that enables facilitated diffusion to occur, and explain how this occurs. **[2 marks]**

(b) (i) Distinguish between the terms 'prokaryotic' and 'eukaryotic'. **[2 marks]**

(ii) Explain how prokaryotes and eukaryotes differ with respect to genetic material, protein synthesis and photosynthetic structures. **[6 marks]**

Total 15 marks

Write your answer to Question 4 here.

GO ON TO THE NEXT PAGE

5. (a) (i) Sexual reproduction greatly increases the genetic variation in a population. Define 'genetic variation' and describe TWO sources of variation in sexually reproducing organisms. **[3 marks]**

(ii) Define 'mutation' and state in which cells of the organism mutations occur. **[2 marks]**

(iii) "A gene mutation which is the result of a deletion may be more harmful than a mutation resulting from the substitution of one base." Discuss this statement using relevant facts and information. **[4 marks]**

(b) (i) Explain the role of 'restriction enzymes' in bacterial cells. **[2 marks]**

(ii) Genetic variation in organisms may also involve genetic engineering techniques. Comment on the role of restriction enzymes in genetic engineering. **[4 marks]**

Total 15 marks

Write your answer to Question 5 here.

GO ON TO THE NEXT PAGE

6. (a) Define the term 'pollination' and describe the sequence of events from pollination to fertilization. **[6 marks]**

(b) Explain the term 'double fertilization' and briefly discuss the significance of the process. **[3 marks]**

(c) Discuss the importance of the changes which occur following fertilization, making reference to changes in the zygote, endosperm, the ovule and ovary. **[6 marks]**

Total 15 marks

Write your answer to Question 6 here.

END OF TEST

FORM TP 2010141

TEST CODE **02107032**

MAY/JUNE 2010

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 1 – Paper 03/2

ALTERNATIVE TO INTERNAL ASSESSMENT EXAMINATION

2 hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE questions. Answer ALL questions.
2. The use of silent non-programmable calculators is allowed.

1. You are provided with potato extract, which contains the enzyme catechol oxidase. This enzyme catalyses the removal of electrons and hydrogen from catechol. The product of the reaction is coloured.

You are required to carry out a simple investigation into the effect of substrate concentration on enzyme activity.

You are provided with the following concentrations of catechol solution:
0.001%, 0.01% and 0.5%.

Prepare the test tubes as outlined in Table 1.

TABLE 1: TEST TUBE PREPARATION

Test tube	Concentration of catechol solution (%)	Amount of catechol (cm^3)	Amount of distilled water (cm^3)	Amount of potato extract (catechol oxidase) (cm^3)
1	0.001	1.0	–	1.0
2	0.01	1.0	–	1.0
3	0.5	1.0	–	1.0
4	–	–	1.0	1.0
5	0.5	1.0	1.0	–

Please note that catechol is poisonous. Please use the gloves provided when handling the catechol solutions. If a spillage occurs wash your hands immediately and notify the invigilator.

Begin the experimental procedure by first adding 1 cm^3 catechol to the test tube (where indicated). Next add the distilled water to test tubes 4 and 5.

Do not add the potato extract to the first test tube until you have added the required volumes of catechol and distilled water to the tubes, 1 - 5 as outlined in Table 1. Start the reaction by adding the potato extract to the test tubes in sequence.

For each test tube note the initial colour of the reaction mixture, then record the colour change after 10 minutes.

GO ON TO THE NEXT PAGE

(a) Construct a table to show your results. The table should include the following:

- substrate concentration
- initial colour of the solution
- colour change after 10 minutes.

[4 marks]

(b) Suggest a specific aim for your experiment.

_____

_____

[2 marks]

(c) Based on your results deduce the relationship between substrate concentration and enzyme activity.

_____

_____

_____

[2 marks]

(d) Comment on the purpose of the test tubes, 4 and 5.

Test tube 4: _____

_____

Test tube 5: _____

_____

[3 marks]

(e) Identify ONE limitation of the experiment.

_____

_____

[1 mark]

(f) Suggest a method which could be used to accurately determine the differences between the colour change in each tube.

_____

_____

_____

[2 marks]

(g) State TWO factors other than substrate concentration that can affect the rate of an enzyme-catalysed reaction.

_____

_____

[2 marks]

Total 16 marks

2. (a) In an experiment, red-flowered, short-stemmed plants were crossed with yellow-flowered, long-stemmed plants. All of the F_1 phenotypes had red flowers and short stems. The F_1 generation was then test-crossed. The results of this cross are shown in Table 2.

TABLE 2: RESULTS OF TEST CROSS

Colour of flower	Stem length	Number of progeny
Yellow	Long	102
Yellow	Short	110
Red	Long	99
Red	Short	106

(i) State the ratio of the offspring in Table 2.

_____

[1 mark]

(ii) Explain, giving TWO reasons, why all of the F_1 progeny were phenotypically alike.

Reason 1:

_____

_____

Reason 2:

_____

_____

[2 marks]

(iii) Give an explanation for the ratio obtained from the test cross of the F_1 generation plants.

_____

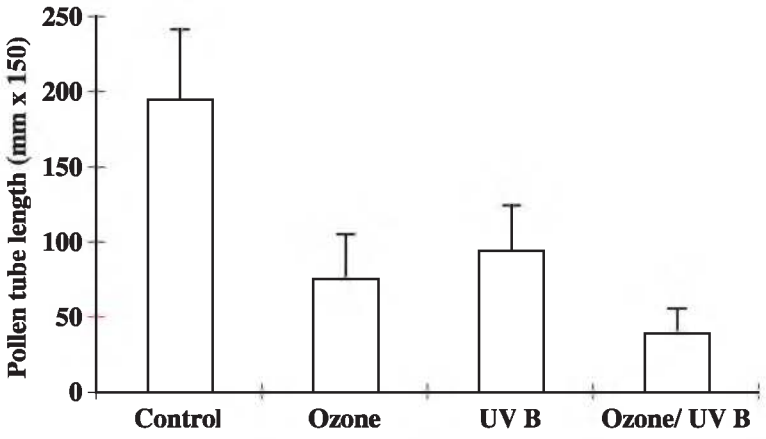
_____

_____

[3 marks]

(b) Environmental extremes influence phenotypic expression. Figure 1 shows the effect of ozone, ultraviolet radiation and a combination of these two stresses on the growth of pollen tubes in *Nicotiana tabacum* and *Petunia hybrida*.

Nicotiana tabacum



Petunia hybrida

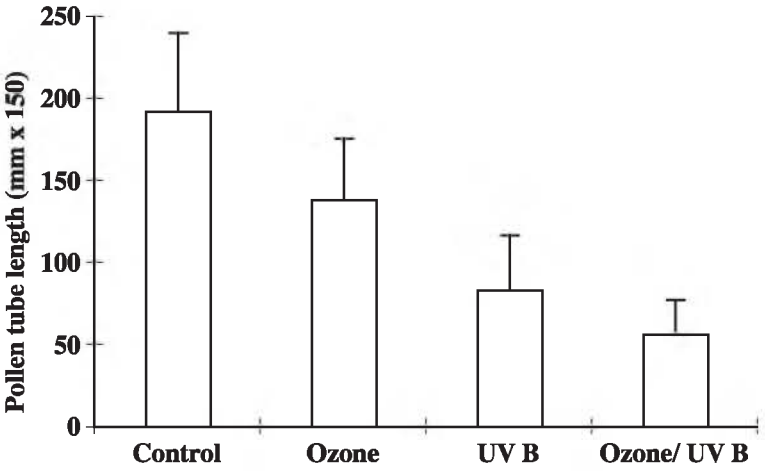


Figure 1. Effect of ozone and ultraviolet radiation on the growth of pollen tubes

Source: Selection in Extreme Environments; http:/www.sciencemag.org/cgi

(i) Study the histogram in Figure 1 and describe and explain the common trend in the data.

_____

_____

_____

_____

[2 marks]

(ii) Compare the effect of EACH of the treatments on *Nicotiana tabacum* and *Petunia hybrida*.

Ozone _____

_____

Ultraviolet radiation _____

_____

Combination of ozone and ultraviolet radiation _____

_____

[3 marks]

(iii) When interpreting the results of any experiment, consideration needs to be given to factors such as limitations to the methodology, sources of error and precautions to be taken. Based on the information with which you have been provided for this experiment, suggest TWO possible sources of error.

1. _____

_____

2. _____

_____

[4 marks]

(iv) Suggest how the effects of ozone and ultraviolet radiation on pollen tube growth could **negatively** impact the plant.

_____

_____

[1 mark]

Total 16 marks

3. (a) Specimen A shows the transverse section of an anther prior to dehiscence.

(i) In the box below, make a detailed annotated diagram of ONE of the pollen sacs.

[6 marks]

(ii) Calculate the magnification of the drawing.

[1 mark]

(iii) How would the appearance of the specimen have been different if dehiscence had taken place?

_____

_____

[1 mark]

(b) Specimen B is a section through a human ovary showing developing follicles.

(i) In the box below, make a plan drawing of the specimen to show FOUR key stages in the development of the Graafian follicle up to the time of ovulation. Label the stages and number the labelled stages in sequence of development.

[5 marks]

(ii) Calculate the diameter of the mature Graafian follicle drawn in (b) (i) above.

[2 marks]

(iii) State ONE observable distinguishing feature of the mature Graafian follicle in Specimen B.

_____

_____

[1 mark]

Total 16 marks

END OF TEST

TEST CODE **02207020**

FORM TP 2010143

MAY/JUNE 2010

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 2 – PAPER 02

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in two sections. Answer ALL questions.
2. For Section A, write your answers in the spaces provided in this booklet.
3. For Section B, write your answers in the space provided at the end of each question in this booklet.
4. The use of silent non-programmable calculators is allowed.

SECTION A

Answer ALL questions in this section. Write your answers in the spaces provided in this answer booklet.

1. (a) (i) In the space below make an annotated schematic drawing of a chloroplast.

[4 marks]

(ii) Identify and describe the TWO parts of the chloroplast that are important in the process of photosynthesis.

_____

_____

_____

_____

_____

[4 marks]

(b) Figure 1 is a diagram of the nitrogen cycle.

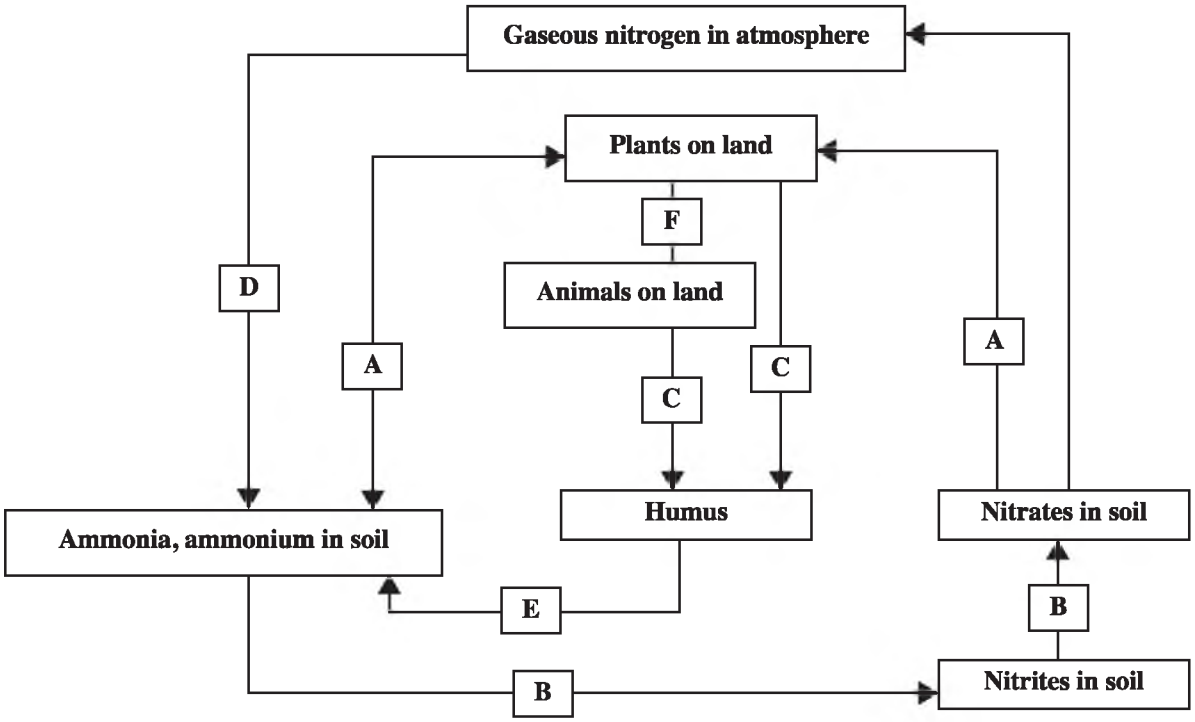


Figure 1. Nitrogen cycle

(i) Identify the processes in Figure 1 represented by the letters A, B, C, D, E and F.

A _____

B _____

C _____

D _____

E _____

F _____

[3 marks]

(ii) Describe TWO NATURAL ways by which nitrogen is lost from soil ecosystems.

_____

_____

_____

_____

[2 marks]

(iii) Describe TWO human activities which impact the nitrogen cycle.

_____

_____

_____

_____

[2 marks]

Total 15 marks

2. (a) Figure 2 shows apparatus that was used to investigate the distribution of stomata on the upper and lower parts of a leaf.

Figure 2. Apparatus for investigating stomata distribution in a leaf

Biological Sciences 1 and 2, 3rd Edition, p. 439

(i) Explain FOUR precautions that should be taken when setting up and conducting this experiment.

[4 marks]

(ii) From which surface will the water loss most likely be GREATER?

[1 mark]

(iii) Suggest an appropriate control for the experiment.

_____

_____

[1 mark]

(b) Identify THREE factors that affect the closing and opening of stomata, and explain how these factors function.

_____

_____

_____

_____

_____

_____

[3 marks]

(c) Figure 3 shows an electron micrograph of a plant structure.

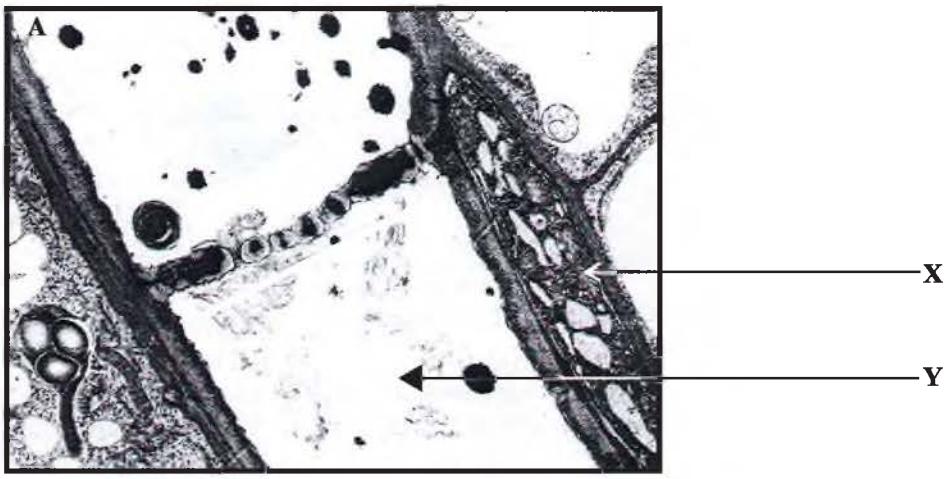


Figure 3. Electron micrograph of a plant structure

Roberts M., Reiss M. and Monger B., Advanced Biology. Nelson 2000, p. 259.

(i) Identify the structures labelled X and Y in Figure 3.

X: _____

Y: _____

[1 mark]

(ii) Discuss TWO structural differences between the cells labelled X and Y and describe how, in spite of these differences, they function as a unit.

_____

_____

_____

_____

_____

[4 marks]

(iii) Name ONE route by which substances move from the chloroplast in leaves to the phloem.

_____

[1 mark]

Total 15 marks

3. (a) (i) Define the term 'health'.

_____

_____

[1 mark]

(ii) A breakdown of health may lead to disease. Differentiate between EACH of the categories of disease listed below, with respect to the cause of the diseases.

Physical and mental

_____

_____

_____

Infectious and non-infectious

_____

_____

_____

Deficiency and inherited

_____

_____

_____

[3 marks]

(iii) Explain the difficulty in classifying protein-energy malnutrition as a non-infectious, physical, deficiency disease.

_____

_____

_____

_____

[3 marks]

(b) Figure 4 presents data on the number of deaths that occurred in women from laryngeal and lung cancer and breast cancer for the period 1975–2005, in a country.

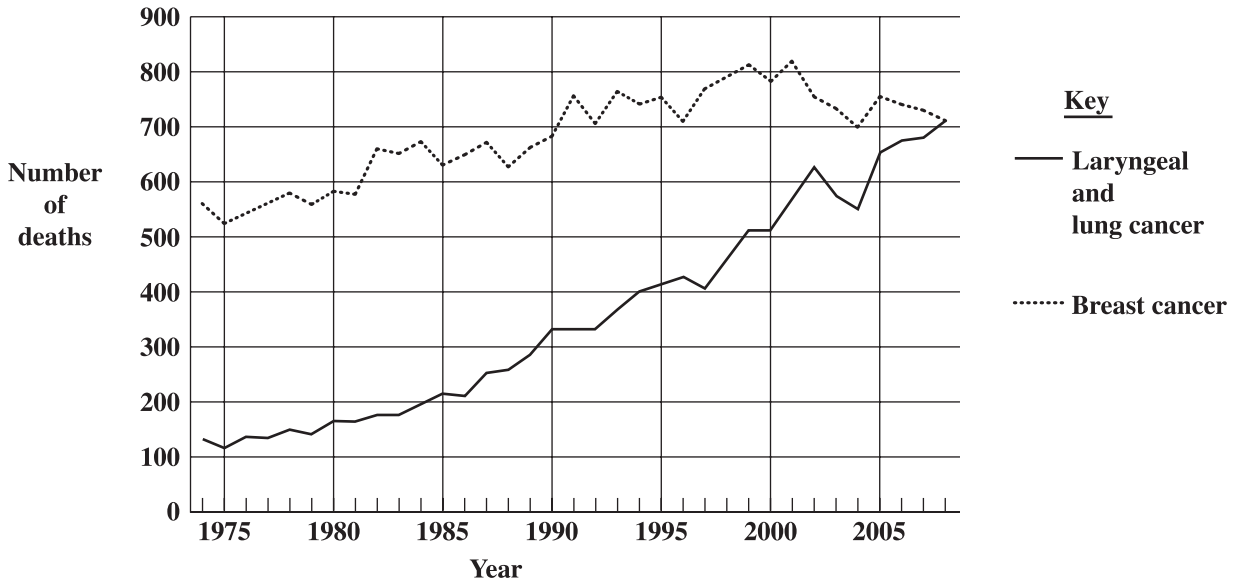


Figure 4. Deaths in women for the period 1975 - 2005

(i) Discuss the curves for laryngeal and lung cancer, and breast cancer.

Laryngeal and lung cancer

_____

_____

_____

Breast cancer

_____

_____

_____

[4 marks]

(ii) Suggest TWO reasons for the difference in the shapes of the curves.

_____

_____

_____

_____

_____

_____

[2 marks]

(iii) Outline TWO challenges that health authorities in the Caribbean may face in reversing the trends for laryngeal and lung cancer.

_____

_____

_____

_____

[2 marks]

Total 15 marks

SECTION B

Answer ALL questions. Write your answers in the spaces provided at the end of each question.

4. (a) (i) Explain what is meant by the term 'glycolysis' and state where it takes place in the cell. **[4 marks]**

(ii) Aerobic respiration is represented by the following equation

$$C_6H_{12}O_6 + 6\,O_2 \longrightarrow 6\,CO_2 + 6\,H_2O$$

Discuss FOUR reasons why this equation does NOT fully represent respiration. **[4 marks]**

(b) Explain the role of chlorophyll in photosynthesis. **[3 marks]**

(c) Comment on the significance of ATP and $NADPH_2$ in photosynthesis. **[4 marks]**

Total 15 marks

Write your answer to Question 4 here.

GO ON TO THE NEXT PAGE

GO ON TO THE NEXT PAGE

5. (a) (i) Use an annotated diagram ONLY to describe the structure of a motor neurone. **[5 marks]**

(ii) A farmer has been exposed to an insecticide that inhibits the enzymatic break-down of acetyl choline Explain why this causes muscular twitching and spasms in the farmer. **[4 marks]**

(b) (i) Outline TWO differences between hormonal and nervous control in animals. **[2 marks]**

(ii) Hormones contribute to the maintenance of health, while hormone malfunction may contribute to disease. With reference to diabetes mellitus, explain TWO ways in which a malfunction in hormone activity could lead to disease. **[4 marks]**

Total 15 marks

Write your answer to Question 5 here.

Space for diagram

GO ON TO THE NEXT PAGE

Write your answer to Question 5 here.

6. (a) Define the term 'immune response' and distinguish between cell mediated and humoral immune responses. **[4 marks]**

(b) Discuss the maturation of B and T cells in relation to their specific roles. **[4 marks]**

(c) Comment on the use of monoclonal antibodies in home pregnancy tests. **[3 marks]**

(d) Explain the difference between active artificial immunity and passive artificial immunity. **[4 marks]**

Total 15 marks

Write your answer to Question 6 here.

Write your answer to Question 6 here.

Write your answer to Question 6 here.

END OF TEST

FORM TP 2010144

TEST CODE **02207032**

MAY/JUNE 2010

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 2 – Paper 03/2

ALTERNATIVE TO INTERNAL ASSESSMENT EXAMINATION

2 hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE questions. Answer ALL questions.
2. The use of silent non-programmable calculators is allowed.

1. You are provided with the following apparatus and materials:

- Large beaker
- Cold water with ice
- Tripod
- Gauze
- Bunsen burner
- Matches
- Permanent marker
- Thermometer
- Germinating peas
- Dead peas

  Respirometer
  - 2 boiling tubes
  - Soda lime (avoid touching directly and inhaling)
  - Cotton wool
  - Manometer with a calibrated scale
  - Connecting tubing
  - Rubber bungs
  - 2 small perforated gauze baskets
  - Syringe
  - Rubber tubing
  - Spring clips

Use the apparatus and materials provided to plan and design an experiment to investigate the effect of temperature on the oxygen consumption of germinating peas.

(a) Formulate a suitable hypothesis for the stated investigation.

_____

_____

[2 marks]

(b) Write a suitable aim based on the hypothesis suggested in (a).

_____

_____

[1 mark]

(c) Design an experimental procedure capable of testing the hypothesis formulated in (a) on page 2. Set up the respirometer for your planned experiment using the apparatus and materials provided.

(i) In the space below make a drawing of your respirometer and experimental set-up.

[3 marks]

(ii) Briefly outline how you would conduct this experiment.

[6 marks]

(d) Suggest ONE precaution that must be taken when setting up the experiment.

_____

_____

_____

_____

[1 mark]

(e) Predict the expected results from this investigation.

_____

_____

_____

[1 mark]

(f) In the space provided below, design an appropriate table to show how the results could be presented.

[2 marks]

Total 16 marks

2. (a) Specimen **A** is a slide of a stained longitudinal section of a mammalian kidney. Carefully examine Specimen **A** under the low power of your microscope.

In the box below, make a labelled plan drawing to show accurately the shape of the section of the organ and the distribution of tissues in major regions of the kidney as seen in the Specimen A.

[8 marks]

(b) Figure 1 is a diagrammatic representation of a photomicrograph of a longitudinal section of phloem tissue.

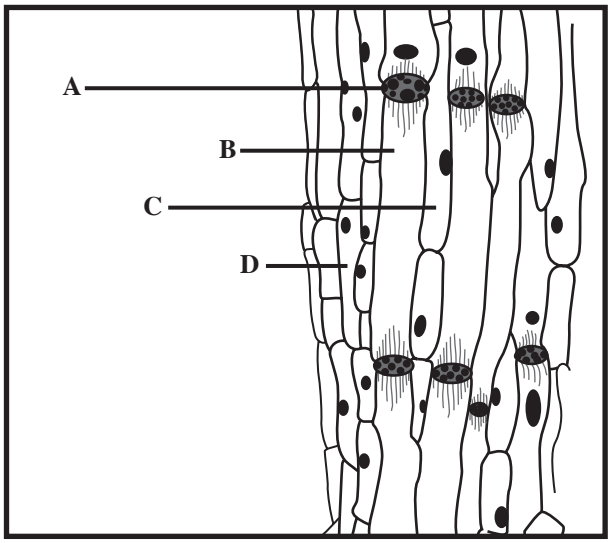


Figure 1. Diagrammatic representation of a photomicrograph of a longitudinal section of phloem tissue

Carefully examine, Figure 1 and identify the structures labelled A, B, C and D. For EACH structure identified state its main function.

A Identity _____

Function _____

_____

B Identity _____

Function _____

_____

C Identity _____

Function _____

_____

D Identity _____

Function _____

_____

[8 marks]

Total 16 marks

3. (a) Table 1 summarizes data on mortality rates for breast cancer in women for selected countries in the region over a 30-year period. It shows the three-year moving average age-standardized breast cancer mortality rate per 100 000 women ages 25 - 74, for selected countries of the Americas, plus Puerto Rico, 1966 – 1998.

TABLE 1: DATA ON MORTALITY RATES FOR BREAST CANCER

Subregion/Country	1966 - 1968	1976 - 1978	1986 - 1988	1996 - 1998
North America				
Canada	41.9	40.0	40.5	37.0
United States[a]	38.5	39.3	39.4	36.9
Southern Cone				
Chile	19.1	20.0	21.1	20.4
Uruguay	38.7	42.8	44.5	44.6
Caribbean				
Cuba	...[b]	26.4	25.2	25.0
Puerto Rico	...	16.9	23.5	24.4
Trinidad & Tobago	29.3	23.7	39.0	32.4

Source: Pan American Health Organization, Technical Information System, 1999.

[a] The figures for the United States of America do not include Puerto Rico.
[b] The ellipsis symbol (...) indicates that data were not available.

(i) Identify the country with the HIGHEST mortality rates overall for the period 1996 - 1998. Justify your answer using data provided in Table 1.

Country _____

Justification _____

_____

[2 marks]

(ii) Comment on the overall trend for the Caribbean countries in comparison to the North American countries.

_____

_____

_____

[2 marks]

(iii) Suggest a possible explanation for the trend noted for Canada and the United States.

_____

_____

_____

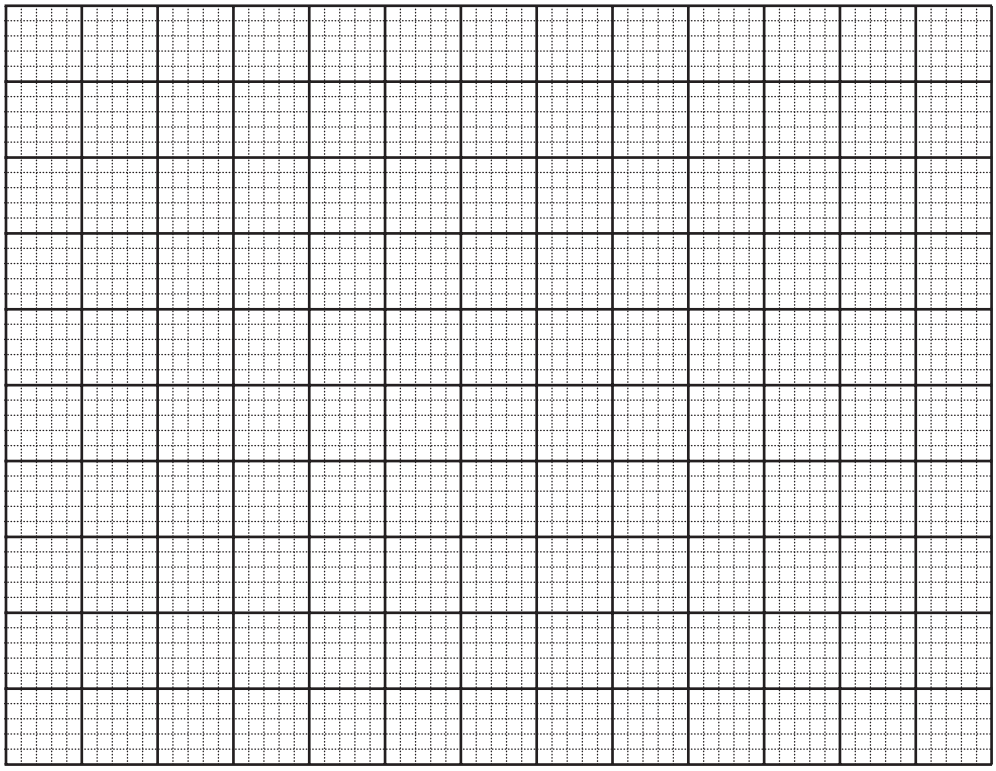
[2 marks]

(b) Table 2 shows the number of dengue fever cases reported in Latin America and the Caribbean over the period 1980 – 2005.

TABLE 2: DATA ON DENGUE FEVER

Year	Number of cases reported
1980	90,000
1985	175,000
1990	160,000
1995	365,000
2000	400,000
2005	420,000

(i) On the grid below, construct a bar chart to display the data given in Table 2.



[6 marks]

(ii) Using the formula provided below, calculate the incidence rate for the period 2000 - 2005. Show your calculations.

$$\text{Incidence rate} = \frac{\text{Number of new cases}}{\text{Number reported for the period}}$$

[2 marks]

(iii) Suggest TWO possible reasons for the increase in the number of dengue cases reported for the 1980 – 2005 period.

_____

_____

_____

_____

[2 marks]

Total 16 marks

END OF TEST

TEST CODE **02107020**

FORM TP 2011144

MAY/JUNE 2011

C A R I B B E A N E X A M I N A T I O N S C O U N C I L

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 1 – PAPER 02

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in two sections. Answer ALL questions.
2. For Section A, write your answers in the spaces provided in this booklet.
3. For Section B, write your answers in the spaces provided at the end of each question in this booklet.
4. The use of silent non-programmable calculators is allowed.

SECTION A

Answer ALL questions in this section. Write your answers in the spaces provided in this booklet.

1. (a) Figure 1 is an incompletely labelled diagram of a prokaryotic cell.

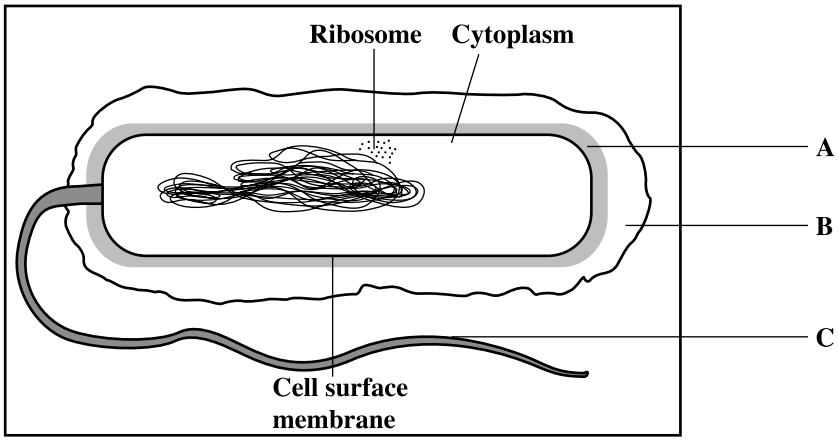


Figure 1. Structure of a prokaryotic cell

(i) Identify the structures labelled A, B and C in Figure 1.

A _____

B _____

C _____

[3 marks]

(ii) The structure labelled A in Figure 1 is also present in **some** eukaryotic cells. State how the structure of A in prokaryotic cells differs when present in eukaryotic cells.

_____

_____

[1 mark]

(iii) There are two types of eukaryotic cells, plant and animal. In which of these is the structure labelled A in Figure 1, NOT found?

_____

[1 mark]

(iv) Name the structure in a eukaryotic cell that serves the same function as the mesosomes of a prokaryotic cell.

_____

[1 mark]

GO ON TO THE NEXT PAGE

(v) Both eukaryotic cells and prokaryotic cells contain DNA. State ONE way in which the DNA in eukaryotic cells differs from the DNA in prokaryotic cells.

_____

_____

[1 mark]

(b) Table 1 summarises some of the differences and similarities between typical plant and animal cells. Complete the table by writing the correct answers in the spaces provided.

TABLE 1: COMPARISON OF PLANT AND ANIMAL CELLS

Feature	Plant Cells	Animal Cells
Generation of energy	By mitochondria	
Removal of foreign matter		Digestion by lysosomes
Communication between adjoining cells		Diffusion/ osmosis/ active transport across cell membranes

[3 marks]

(c) You are provided with a large uncooked potato and six solutions of different concentrations. One of the solutions has the same water potential as the potato.

(i) Outline a simple investigation to determine which solution has the same water potential as the potato.

_____

_____

_____

_____

_____

_____

_____

_____

[4 marks]

GO ON TO THE NEXT PAGE

(ii) Describe the expected observation in the solution with the same water potential as the potato.

_____

_____

[1 mark]

Total 15 marks

2. (a) In Leghorn chickens, coloured feathers are due to a dominant gene, **F**; white feathers are produced by its recessive allele, **f**. Another dominant gene, **A**, carried on a different chromosome, inhibits colour expression in birds with genotype **FF** or **Ff**. Consequently, both **F_A_** and **ff_ _** are white.

(i) State the term which describes the interaction of these two genes.

_____

[1 mark]

(ii) Define the terms 'allele' and 'dominant'.

Allele:

_____

_____

Dominant:

_____

_____

[2 marks]

(iii) A coloured rooster is mated with a white hen and produces all coloured offspring.

In the space provided, draw a genetic diagram to explain the cross. **[5 marks]**

(In your diagram, use the symbols **F** to represent the dominant gene for coloured feathers and **f** for the recessive allele which produces white feathers. Use **A** to represent the dominant gene which inhibits colour expression and **a** for the recessive allele.)

(b) In pea plants, tall (T) plants are dominant over short (t) plants, and round seeds (R) are dominant over wrinkled seeds (r). A cross between two heterozygous tall, round-seeded plants produced the following progeny:

Tall plants with round seeds	98
Tall plants with wrinkled seeds	46
Short plants with round seeds	44
Short plants with wrinkled seeds	14

(i) Based on the type of cross, deduce the expected ratio of the phenotypes.

Expected ratio: _____

[1 mark]

(ii) A Chi-square test was performed on the data in (b)(i). The calculated value for χ^2 is 10.81. Using the information provided, formulate a possible null hypothesis for the Chi-square test.

_____

_____

[1 mark]

(iii) State the formula for, and determine the number of degrees of freedom in the Chi-square test performed in (b)(ii), briefly explaining any terms used.

Formula:

_____

_____

Number of degrees of freedom:

_____

[2 marks]

(iv) Use the calculated value of χ^2 (10.81) and the probabilities provided in Table 2 to find the **probability** of the results of the cross departing significantly by chance from the expected ratio. State your findings.

TABLE 2: DISTRIBUTION OF χ^2

Degrees of Freedom	**χ^2 values**				
1	2.71	3.84	5.41	6.64	10.83
2	4.61	5.99	7.82	9.21	13.82
3	6.25	7.82	9.84	11.35	16.27
4	7.78	9.49	11.67	13.28	18.47
Probabilty (p) that chance alone could produce deviation	0.1 (10%)	0.05 (5%)	0.02 (2%)	0.01 (1%)	0.001 (0.1%)

Probability _____

[1 mark]

(v) What conclusion may be drawn from the probabilty found in (b)(iv)?

_____

_____

_____

[2 marks]

Total 15 marks

3. (a) Figure 2 is a schematic diagram of a human male reproductive system.

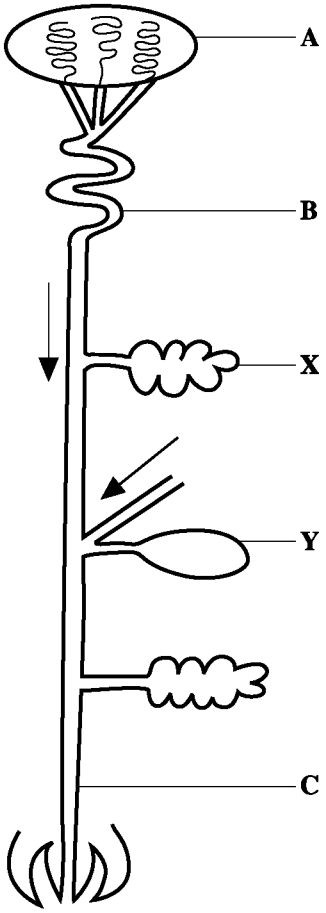


Figure 2. Schematic diagram of a human male reproductive system

(i) Identify the structures labelled A, B and C in Figure 2.

A _____

B _____

C _____

[3 marks]

(ii) State the function of EACH of the structures labelled X and Y.

X _____

Y _____

_____

[2 marks]

(b) Figure 3 is a drawing of a mature human spermatozoon.

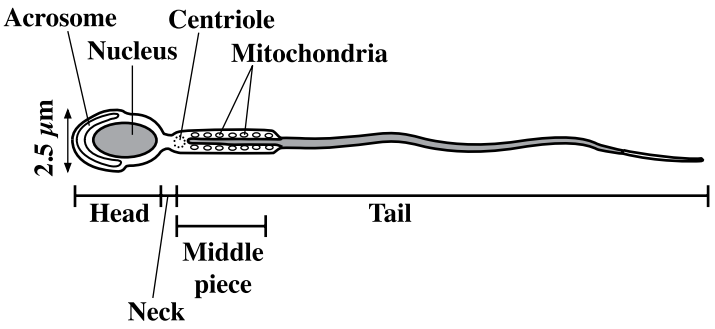


Figure 3. A mature human spermatozoon

(i) Calculate the actual length of the spermatozoon. Show the steps in your calculation.

[3 marks]

(ii) With reference to Figure 3, describe TWO ways in which a mature spermatozoon differs from an ovum.

_____

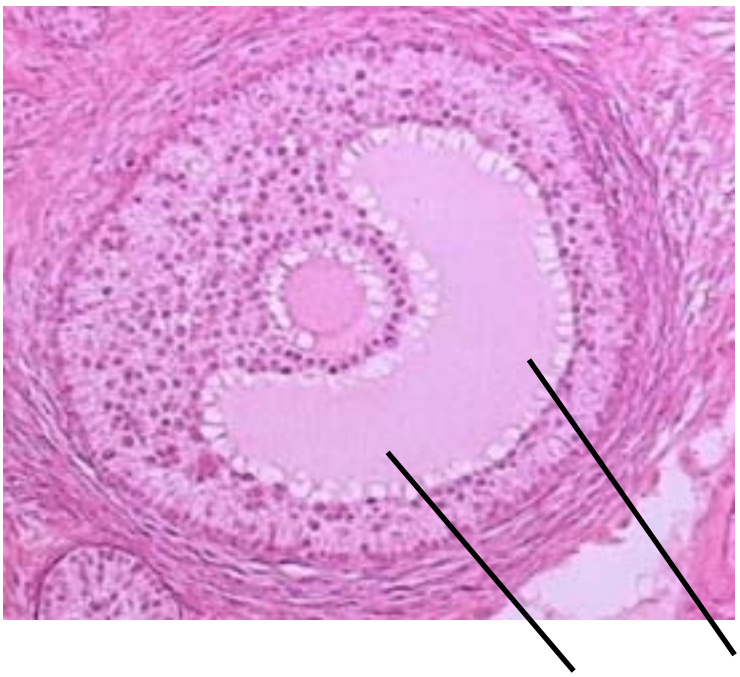
_____

_____

_____

[2 marks]

(c) Figure 4 is a photomicrograph of a section of a mature Graafian follicle.



Source: http://sprojects.mmi.mgill.ca/menstrualcycle/Images/

Figure 4. Mature Graafian follicle

(i) In the box below, draw and label a plan diagram of the section shown in Figure 4 as identified by the two lines in the lower part of the figure. Make your drawing two times the actual size of the section highlighted.

[4 marks]

(ii) Name the next stage in the development of the highlighted section in Figure 4.

_____

[1 mark]

Total 15 marks

SECTION B

Answer ALL questions in this section.

4. (a) (i) With reference to the levels of structural organization and types of bonds, describe the structure of the protein, collagen. (No diagrams are required.) **[6 marks]**

(ii) Explain ONE functional property of collagen which makes it suitable as a major component of tendons and ligaments. **[2 marks]**

(b) (i) Outline FOUR key stages in the mode of action of enzymes in catalysing chemical reactions. **[2 marks]**

(ii) Enzyme activity may be altered by poisons and drugs. Discuss, using a specific example, how poisons such as insecticides may affect enzyme activity. **[5 marks]**

Total 15 marks

Write your answer to Question 4 here.

GO ON TO THE NEXT PAGE

GO ON TO THE NEXT PAGE

GO ON TO THE NEXT PAGE

5. (a) (i) Outline the stages in Meiosis 1 and comment on the importance of this phase of meiosis. **[6 marks]**

(ii) State TWO ways in which daughter cells produced by meiosis differ from those resulting from mitosis. **[2 marks]**

(b) The black billed seed-crackers that inhabit a rainforest in Cameroon, West Africa were found to have EITHER large or small bills, with no birds having bills of intermediate sizes.

(i) Which of the three types of natural selection BEST describes the example above? Justify your choice. **[3 marks]**

(ii) Discuss how the frequency of the distribution of phenotypes in the example above would be different if the other two types of selection operated. **[4 marks]**

Total 15 marks

Write your answer to Question 5 here.

6. (a) (i) Define the term 'vegetative propagation'. **[2 marks]**

(ii) Discuss FOUR advantages and THREE disadvantages of using tissue culture as a method of vegetative propagation. **[7 marks]**

(b) (i) Distinguish between the terms 'pollination' and 'fertilization'. **[2 marks]**

(ii) Describe TWO reproductive strategies used by plants to promote cross-fertilization. **[4 marks]**

Total 15 marks

Write your answer to Question 6 here.

GO ON TO THE NEXT PAGE

END OF TEST

TEST CODE **02107032**

FORM TP 2011145

MAY/JUNE 2011

C A R I B B E A N E X A M I N A T I O N S C O U N C I L

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 1 – PAPER 03/2

ALTERNATIVE TO INTERNAL ASSESSMENT EXAMINATION

2 hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING DIRECTIONS CAREFULLY.

1. This paper consists of THREE questions. Answer ALL questions.
2. Write your answers in the spaces provided in this booklet.
3. The use of silent non-programmable calculators is allowed.

1. (a) The labels from four bottles of solutions required for a laboratory experiment were accidently removed. Each bottle contained one of the following: a protein solution, a sugar solution or distilled water. You are required to identify the contents of each bottle.

Materials

I Eight test tubes in a test tube rack labelled A1, A2, B1, B2, C1, C2, D1, D2.

II Four flasks labelled A, B, C and D respectively. The flasks contain samples of the solutions to be identified.

Procedure 1

I Using the measuring cylinder labelled A, pour 2 cm^3 of the solution from Flask A into each of the test tubes labelled A1 and A2.

II Using the appropriately labelled measuring cylinder, repeat Step I for the solutions in Flasks B, C and D.

III Using the measuring cylinder labelled KOH, add 2 cm^3 of 5% KOH to the test tube labelled A1 and shake the test tube to mix.

IV To the **same** test tube in III, add two drops of 1% copper sulphate solution and mix.

V Observe for two minutes and note any colour change.

VI Record your observation in Table 1 on this page.

VII Repeat Steps III to VI using the test tubes labelled B1, C1 and D1.

TABLE 1: OBSERVATION

(i)

Solution	Colour Change
A1	
B1	
C1	
D1	

[3 marks]

(ii) Name the food test being conducted in Procedure 1.

_____

[1 mark]

GO ON TO THE NEXT PAGE

(iii) State the conclusions that can be drawn from the observations in Table 1.

_____

_____

[2 marks]

(b) **Procedure 2**

I Using the measuring cylinder labelled Benedict's solution, add 2 cm^3 of Benedict's solution to the test tube labelled A2.

II Shake the test tube and warm gently over the Bunsen burner.

III Note the colour change and record your observation in Table 2 on this page.

IV Repeat Steps I to III for each of the second test tubes labelled B2, C2 and D2.

V Record your observations in Table 2 on this page.

TABLE 2: OBSERVATION

(i)

Solution	Colour Change
A2	
B2	
C2	
D2	

[3 marks]

(ii) Name the nutrient being tested for, in Procedure 2.

_____

[1 mark]

(iii) State the conclusions that can be drawn from the observations in Table 2.

_____

[1 mark]

(iv) Which test tube MOST likely contains distilled water?

_____

[1 mark]

(c) Some students in a class are asked to test fresh green beans for the presence of protein and reducing sugars.

(i) Suggest what should be done to the beans **before** the food tests are carried out.

_____

_____

_____

_____

[3 marks]

(ii) State ONE possible source of error in this investigation.

_____

[1 mark]

Total 16 marks

2. (a) Specimen A is a stained longitudinal section through a root tip showing cells in various stages of mitosis.

(i) Draw a different stage of mitosis in EACH of the four boxes below. Write the name of the stage under EACH box. **DO NOT label the drawings.**

_____ _____

_____ _____

[6 marks]

(ii) For EACH of the stages drawn, write the number 1, 2, 3 or 4, next to the name of the stage, to indicate the correct sequence in which they occur in the cycle. **[2 marks]**

(iii) Name ONE structure that is seen in some of the dividing cells in Specimen A but will NOT be seen in dividing **animal** cells viewed under the same magnification.

_____

[1 mark]

(b) In the sweet pea plant, flower colour is determined by two allelomorphic pairs of genes (R, r and S, s). Purple flowers are produced if at least one dominant allele for each gene is present in the flower. All other genotypes are white. A plant that is homozygous for purple colour is crossed with a plant having the genotype, RrSs.

(i) State the genotype of the flower that is homozygous for purple colour.

_____

[1 mark]

(ii) Complete the Punett square below to show the expected genotypes of the offspring of the cross.

[4 marks]

(iii) State the phenotype of the offspring produced by the cross.

_____

[1 mark]

(iv) Suggest how the results would have been different if both parents were hetorozygous for purple color.

_____

[1 mark]

Total 16 marks

3. (a) Table 3 presents data on the percentage of women in a sample who became pregnant while using specific contraceptive methods. The data was collected after the first 6 months of use and again after 12 months of use.

TABLE 3: PERCENTAGE OF WOMEN IN SAMPLE WHO BECAME PREGNANT, BY CONTRACEPTIVE METHOD AND DURATION OF USE

Contraceptive Method	Duration of Use	
	6 months	12 months
Pill	3.3	7.0
Diaphragm	5.8	9.5
Male condom	5.1	9.2
Periodic abstinence	13.8	20.5

(i) On the grid provided below, draw a bar chart to illustrate the data in Table 3.

[6 marks]

(ii) Identify THREE trends shown in the data.

_____

_____

_____

_____

_____

_____

[3 marks]

(b) Figure 1 illustrates the changes in total fertility rates for three countries in the Caribbean between 1970 and 1995.

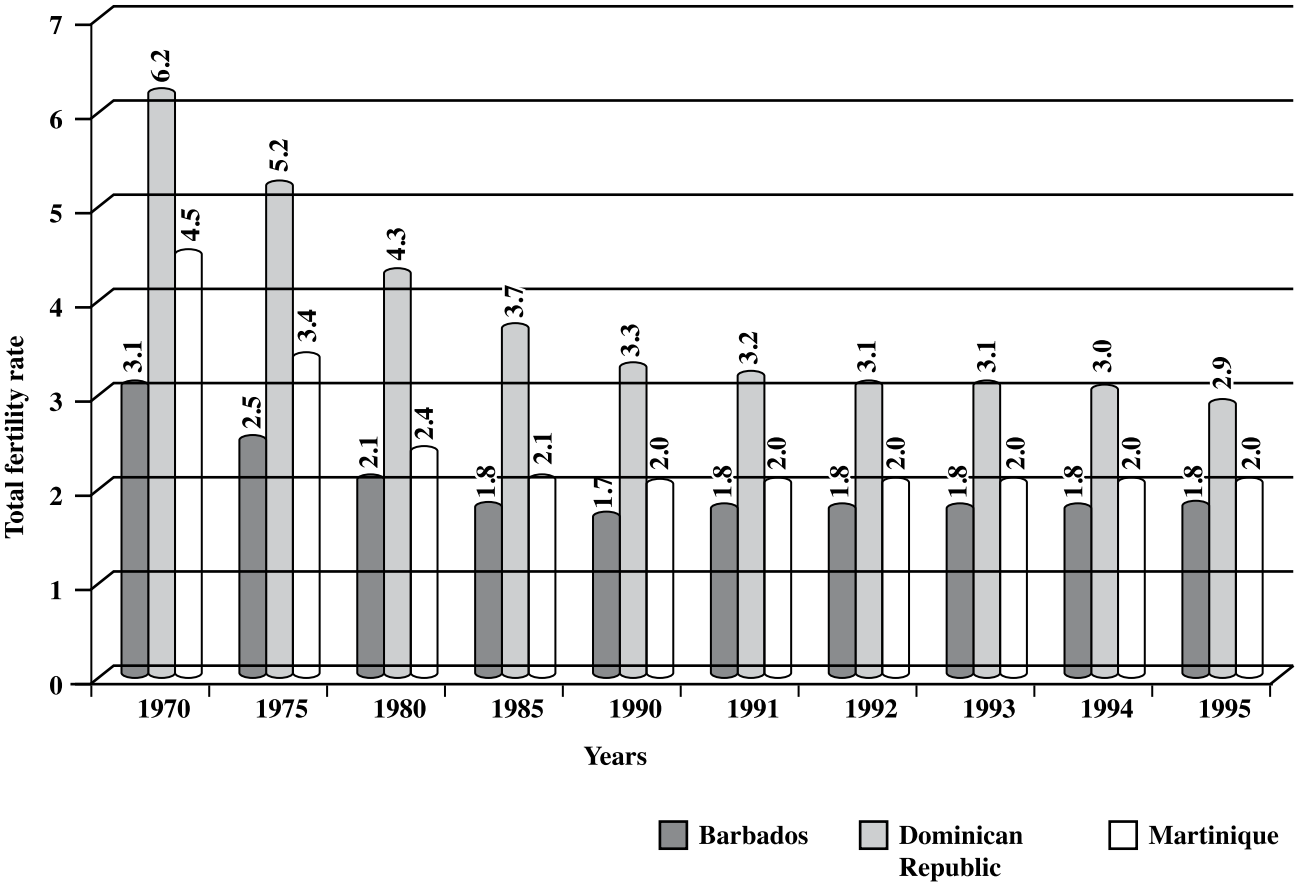


Figure 1. Changes in total fertility rates in Barbados, the Dominican Republic and Martinique

(i) Complete Table 4 using the data in Figure 1.

TABLE 4: TOTAL FERTILITY RATES FOR BARBADOS, THE DOMINICAN REPUBLIC AND MARTINIQUE

Country	Total Fertility Rate	
	1970	1995
Barbados		
Dominican Republic		
Martinique		

[3 marks]

(ii) Identify TWO general trends shown by the data over the period 1970 – 1995.

_____

_____

_____

_____

[2 marks]

(iii) Suggest the total fertility rate for the Dominican Republic for the year 1996.

_____

[1 mark]

(iv) Comment on the implications for the Caribbean of the trends in total fertility rates shown in Figure 1.

_____

_____

[1 mark]

Total 16 marks

TEST CODE **02207020**

FORM TP 2011147

MAY/JUNE 2011

C A R I B B E A N E X A M I N A T I O N S C O U N C I L

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 2 – PAPER 02

2 hours 30 minutes

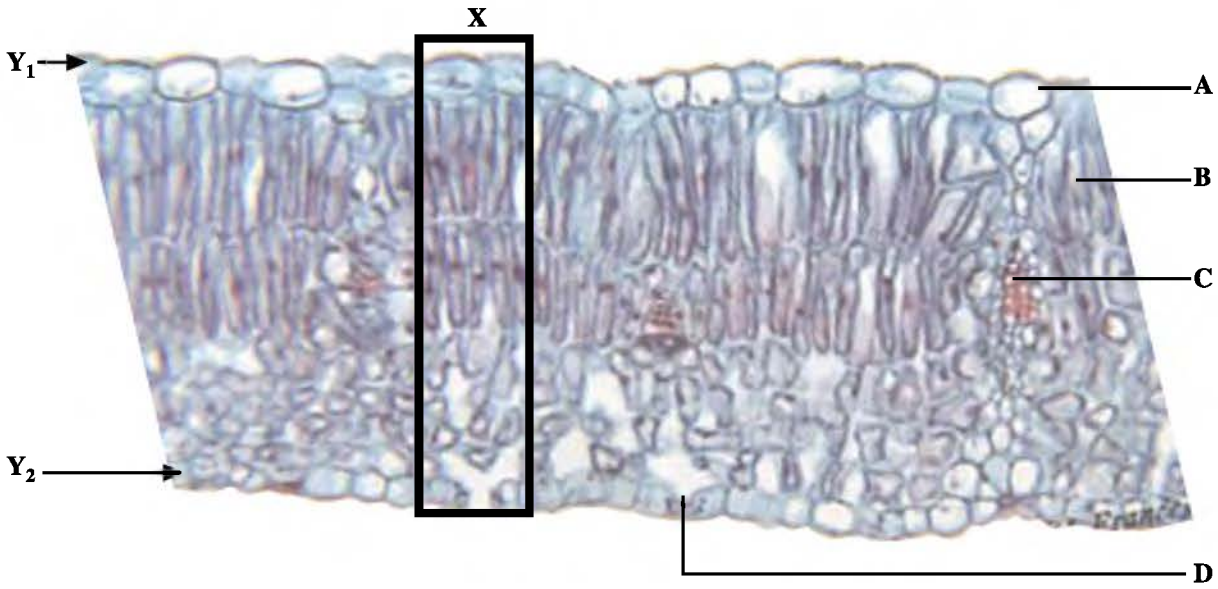
READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in two sections. Answer ALL questions.
2. For Section A, write your answers in the spaces provided in this booklet.
3. For Section B, write your answers in the spaces provided at the end of each question in this booklet.
4. The use of silent non-programmable calculators is allowed.

SECTION A

Answer ALL questions in this section. Write your answers in the spaces provided in this booklet.

1. Figure 1 is a photomicrograph of a cross-section of a typical dicotyledonous leaf.



Source: www.2.puc.edu/Faculty/Gilbert_Muth/botglosl.htm

Figure 1. Cross-section of a typical dicotyledonous leaf

(a) (i) Identify the structures labelled **A** to **D** in Figure 1.

A _____

B _____

C _____

D _____

[4 marks]

(ii) In the space provided below make a detailed drawing to show the cellular organization of the region highlighted by **Box X** in **Figure 1**. Make your drawing TWO times the actual size of Box X. (No labels required.)

[5 marks]

(iii) If the photomicrograph in Figure 1 has been magnified 150 times, what is the actual width of the specimen from Y_1 to Y_2?

Actual width from Y_1 to Y_2: _____

[1 mark]

(b) Figure 2 shows a biological pyramid.

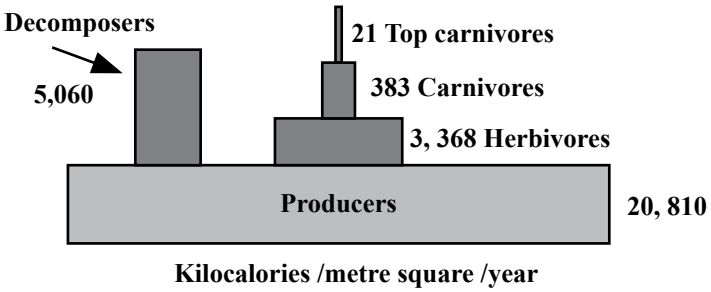


Figure 2. Biological pyramid

(i) Define the term 'biological pyramid'.

_____

_____

[2 marks]

(ii) Identify the type of biological pyramid shown in Figure 2.

_____

[1 mark]

(iii) Briefly explain the significance of the numerical values given in Figure 2.

_____

_____

_____

[2 marks]

Total 15 marks

2. (a) The apparatus in Figure 3 is used to investigate the effect of environmental factors on the rate of transpiration.

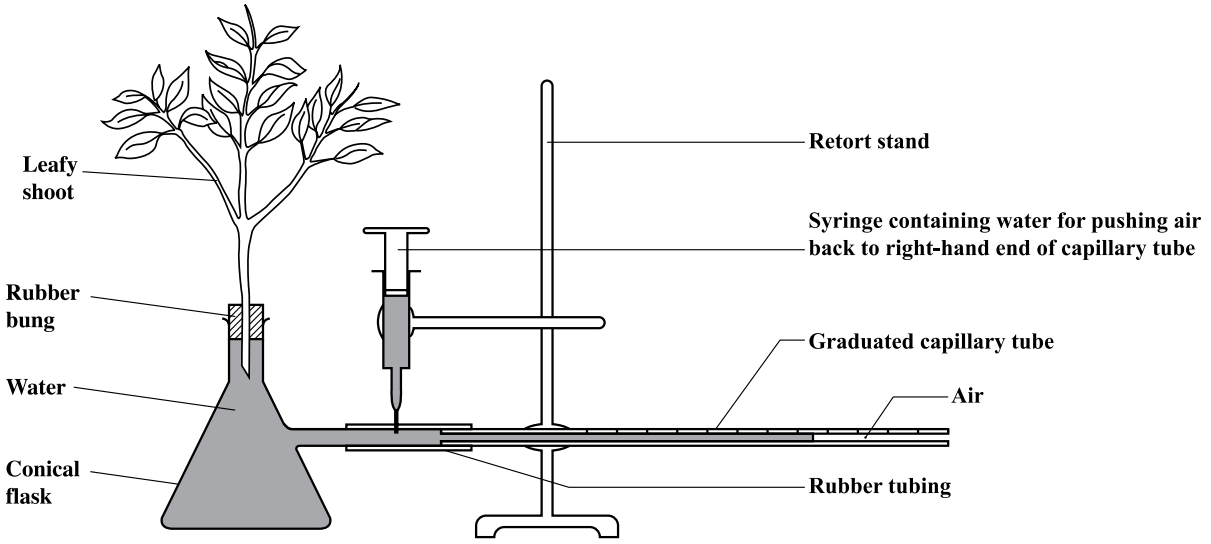


Figure 3. Apparatus for investigating the effect of environmental factors on transpiration rate

(i) What is the role of the syringe?

_____

_____

[1 mark]

(ii) State TWO precautions that must be taken when setting up the apparatus in Figure 3.

_____

_____

_____

[2 marks]

(iii) State TWO measurements that must be recorded to calculate the rate of transpiration.

_____

[1 mark]

(iv) State what should be done to ensure reliability of the results.

_____

_____

[1 mark]

(v) Describe how this apparatus could be used to investigate the effect of sunlight on transpiration. Suggest a possible control for the experiment.

_____

_____

Control: _____

_____

[2 marks]

(b) A nephron is a tubule which is divided into distinct regions, each of which serves a specific function. Figure 4 is a diagrammatic representation of the loop of Henlé of a nephron.

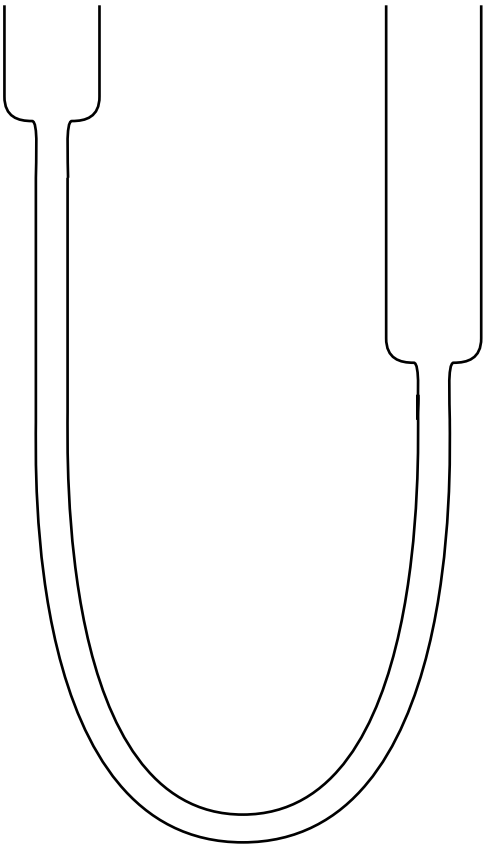


Figure 4. Diagrammatic representation of the loop of Henlé

(i) Using arrows labelled A, B, and C, indicate on Figure 4 where

a) A – water leaves the loop of Henlé by osmosis

b) B – sodium ions and chloride ions leave the loop of Henlé by diffusion

c) C – sodium ions and chloride ions leave the loop of Henlé by active transport.

[3 marks]

(ii) Account for the large number of mitochondria in the cells in the region of the loop of Henlé that is labelled C.

_____

_____

[1 mark]

(iii) How does the concentration of the urine of small mammals inhabiting a desert differ from that of small mammals inhabiting a moist tropical forest? Suggest ONE structural modification of the loop of Henlé that may be responsible for this difference.

_____

_____

_____

_____

[2 marks]

(iv) Protein and glucose were found to be present in a sample of human urine. Identify the regions of the nephron which may NOT have been functioning as they should, therefore resulting in the presence of these substances in the urine.

_____

_____

_____

[2 marks]

Total 15 marks

NOTHING HAS BEEN OMITTED.

3. (a) Table 1 summarizes the incidence of dengue fever in Argentina, Costa Rica, the Dominican Republic and Mexico for a period of seven years.

TABLE 1: INCIDENCE (rate per 100,000 inhabitants) OF DENGUE FEVER IN FOUR COUNTRIES

Country	2000	2001	2002	2003	2004	2005	2006
Argentina	4.6	0.03	0.6	0.4	8.7	0.1	0.5
Costa Rica	434.6	818.2	314.5	606.3	290.0	1165.2	345.1
Dominican Republic	40.7	42.3	37.6	72.5	27.6	33.7	72.3
Mexico	21.9	6.2	9.8	5.0	8.2	16.8	27.2

(i) Explain what is meant by the term 'incidence rate' as applied to diseases.

_____

_____

_____

[2 marks]

(ii) On the grid provided on page 11 draw a bar graph of the data in Table 1 for the Dominican Republic and Mexico. **[5 marks]**

(iii) Compare the trend in incidence rates for Costa Rica with that of Argentina and state TWO major differences observed.

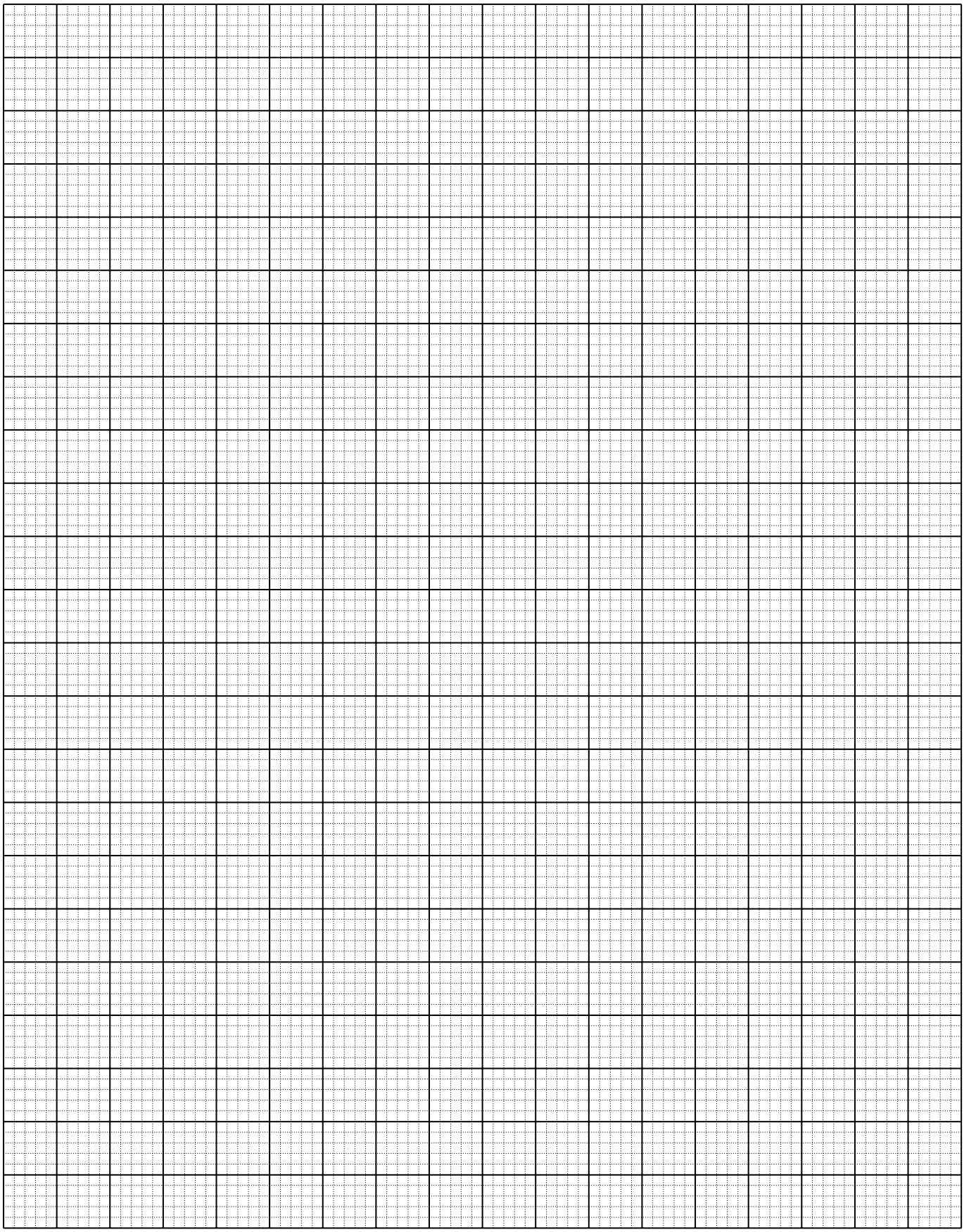
_____

_____

_____

_____

[2 marks]



(b) Figure 5 is a diagrammatic representation of the replication cycle of the Human Immunodeficiency Virus (HIV), the causative organism of Acquired Immune Deficiency Syndrome (AIDS).

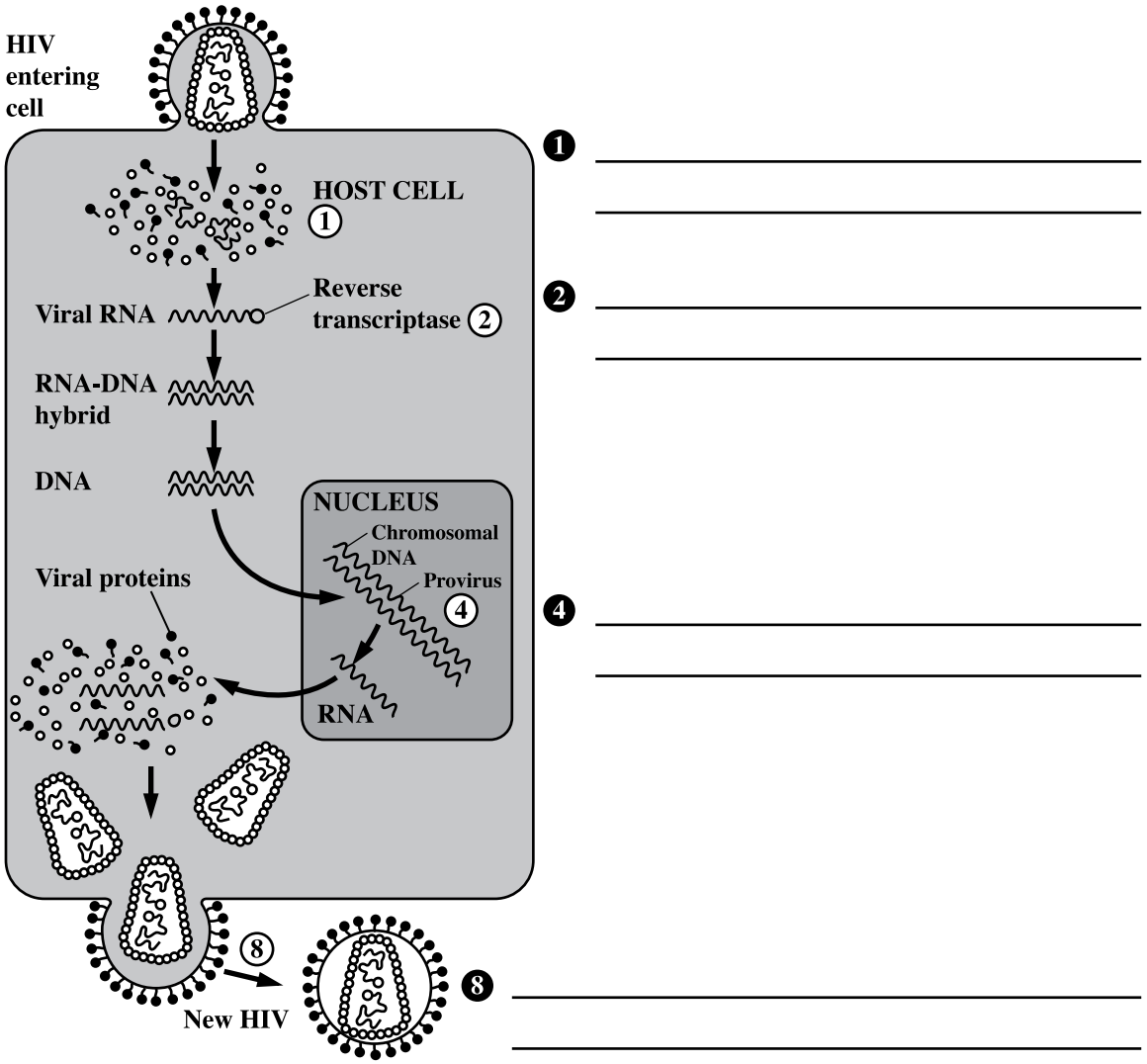


Figure 5. The replication cycle of HIV

(i) On Figure 5 describe, using annotations, the events occurring at Stages 1, 2, 4 and 8. Write your answers on the lines next to the number of the stages in Figure 5.

[4 marks]

(ii) Other than by exchange of body fluids during sexual intercourse, state TWO distinct routes by which HIV can be transmitted to human beings.

_____

_____

_____

[2 marks]
Total 15 marks

GO ON TO THE NEXT PAGE

SECTION B

Answer ALL questions in this section.

4. (a) Define the term 'phosphorylation' and distinguish between photophosphorylation and oxidative phosphorylation. **[3 marks]**

(b) Discuss TWO similarities and TWO differences between the chemical reactions which occur during photophosphorylation and oxidative phosphorylation. **[4 marks]**

(c) (i) Distinguish among the following terms as they relate to the nitrogen cycle: nitrification, denitrification and nitrogen fixation. **[5 marks]**

(ii) A farmer who is experiencing difficulty getting his grass to grow was advised to plant the legume, alfalfa, along with the grass. He was also advised to plough the legume into the soil after reaping the grass. Suggest THREE ways in which this practice enables him to have a better crop of grass. **[3 marks]**

Total 15 marks

Write your answer to Question 4 here.

5. (a) (i) Explain why haemoglobin functions as an efficient carrier of oxygen in blood. **[4 marks]**

(ii) Using haemoglobin as an example, and with the aid of a diagram, describe an oxygen dissociation curve. **[4 marks]**

(b) (i) Briefly explain the term 'translocation' as applied to plants. **[2 marks]**

(ii) Of the many mechanisms of translocation which have been proposed the mass (pressure) flow hypothesis has gained some support from experimental work.

Outline the principle of mass flow and discuss, using TWO examples, experimental evidence in support of mass flow as a possible mechanism of translocation. **[5 marks]**

Total 15 marks

Write your answer to Question 5 here.

Space for diagram

6. (a) When the human body is invaded by a foreign organism it responds by identifying and destroying the foreign organism in a manner that involves both a cell-mediated and humoral response.

(i) Distinguish between 'cell-mediated' and 'humoral immune' responses. **[4 marks]**

(ii) When Kayla was eight years old she was infected with measles. Ten years later while volunteering at an orphanage, she is required to take care of a baby with measles. Explain the immunological process which is responsible for Kayla not becoming ill. **[4 marks]**

(b) (i) Distinguish between physical and psychological dependence on drugs. **[4 marks]**

(ii) John is 40 years old and has consumed half of a litre of rum almost every day for the past 12 years. Explain THREE possible effects of this level of long-term consumption of rum on the nervous system. **[3 marks]**

Total 15 marks

Write your answer to Question 6 here.

END OF TEST

TEST CODE **02207032**

FORM TP 2011148

MAY/JUNE 2011

C A R I B B E A N E X A M I N A T I O N S C O U N C I L

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 2 – PAPER 03/2

ALTERNATIVE TO INTERNAL ASSESSMENT EXAMINATION

2 hours

Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING DIRECTIONS CAREFULLY.

1. This paper consists of THREE questions. Answer ALL questions.
2. Write your answers in the spaces provided in this booklet.
3. The use of silent non-programmable calculators is allowed.

1. (a) (i) Design an experiment to determine the rate of respiration in seedlings. The apparatus and materials for the experiment are listed below. Your answer must include EIGHT steps.

Apparatus and Materials

Soda lime granules in muslin	Manometer fluid
Two 2 cm^3 syringes	Stop clock
10 mung bean seedlings	Graph paper/ ruler
Capillary tube with rubber tubing	Filter paper/ tissue
10 small glass beads	

_____

_____

_____

_____

_____

_____

_____

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_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

[8 marks]

(ii) Give TWO limitations of using the simple respirometer outlined in the experiment you designed.

_____

_____

_____

_____

[2 marks]

(iii) State the purpose of EACH of the following in the experiment:

a) Soda lime granules

_____

[1 mark]

b) Glass beads

_____

[1 mark]

(b) A group of students performed a similar experiment in which they determined the rate of oxygen consumption of insect larvae at 20 °C and 35 °C. The apparatus was set up as shown in **Figure 1**, and the data collected are given in Table 1.

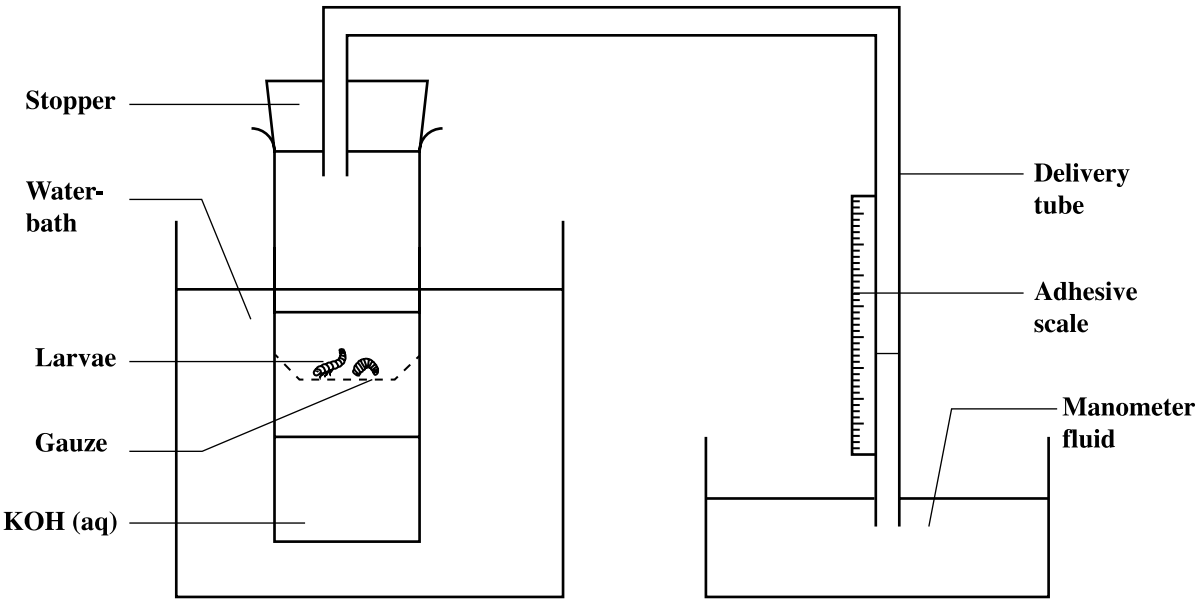

Figure 1. Simple respirometer used to measure rate of respiration

TABLE 1: DISTANCE TRAVELLED BY MANOMETER FLUID AT 20 °C AND 35 °C

Temperature (°C)	Cumulative Distance Travelled by Manometer Fluid at 15-second time intervals (mm)					
	0 s	**15 s**	**30 s**	**45 s**	**60 s**	**75 s**
20	0	10	21	29	41	65
35	0	20	37	56	73	92

(i) Calculate the oxygen consmption rate in mm per **minute** at

a) 20 ^{o}C

[1 mark]

b) 35 ^{o}C

[1 mark]

(ii) Comment on the difference observed at 20 ^{o}C and 35 ^{o}C and suggest a reason for the difference observed.

_____

_____

_____

_____

[2 marks]

Total 16 marks

2. (a) **Specimen A** is a sample of a blood smear obtained from an individual.

(i) Examine the specimen under the high-power, x40 objective, of your microscope.

Examine **Specimen A** to locate a lymphocyte, monocyte and phagocyte. In the labelled boxes below, make detailed drawings of these cells. **No labels are required.**

Lymphocyte

Monocyte

Phagocyte

[6 marks]

(ii) Calculate the magnification of the drawing using ONE of the cells drawn.

Type of cell used for calculation _____

Magnification calculation

[1 mark]

GO ON TO THE NEXT PAGE

(b) **Specimen B** is a cross-section of a mammalian blood vessel.

(i) In the box below, make a plan drawing of **Specimen B. Label** and **annotate** the drawing fully, stating how EACH structure is adapted to carry out its function.

[9 marks]

Total 16 marks

3. (a) Table 2 shows the correlation between the number of cigarettes smoked per day and the incidence of cancer among men from a survey conducted by the American Cancer Society.

TABLE 2: INCIDENCE RATES FOR LUNG CANCER AMONG MALE SMOKERS

Number of Cigarettes Smoked per Day	Incidence of Cancer per 100 000 men
5	25
10	40
15	60
20	140
25	160
30	300
35	355
40	420

Note: Values are given to the nearest 5

(i) On the grid provided on page 9, construct a line graph to show the relationship between the incidence of cancer and the number of cigarettes smoked per day.

[6 marks]

(ii) Give TWO limitations of the data collected, which may affect the interpretation of the results.

_____

_____

_____

_____

[2 marks]

(b) (i) With reference to the shape of the graph, describe the findings of the survey.

_____

_____

_____

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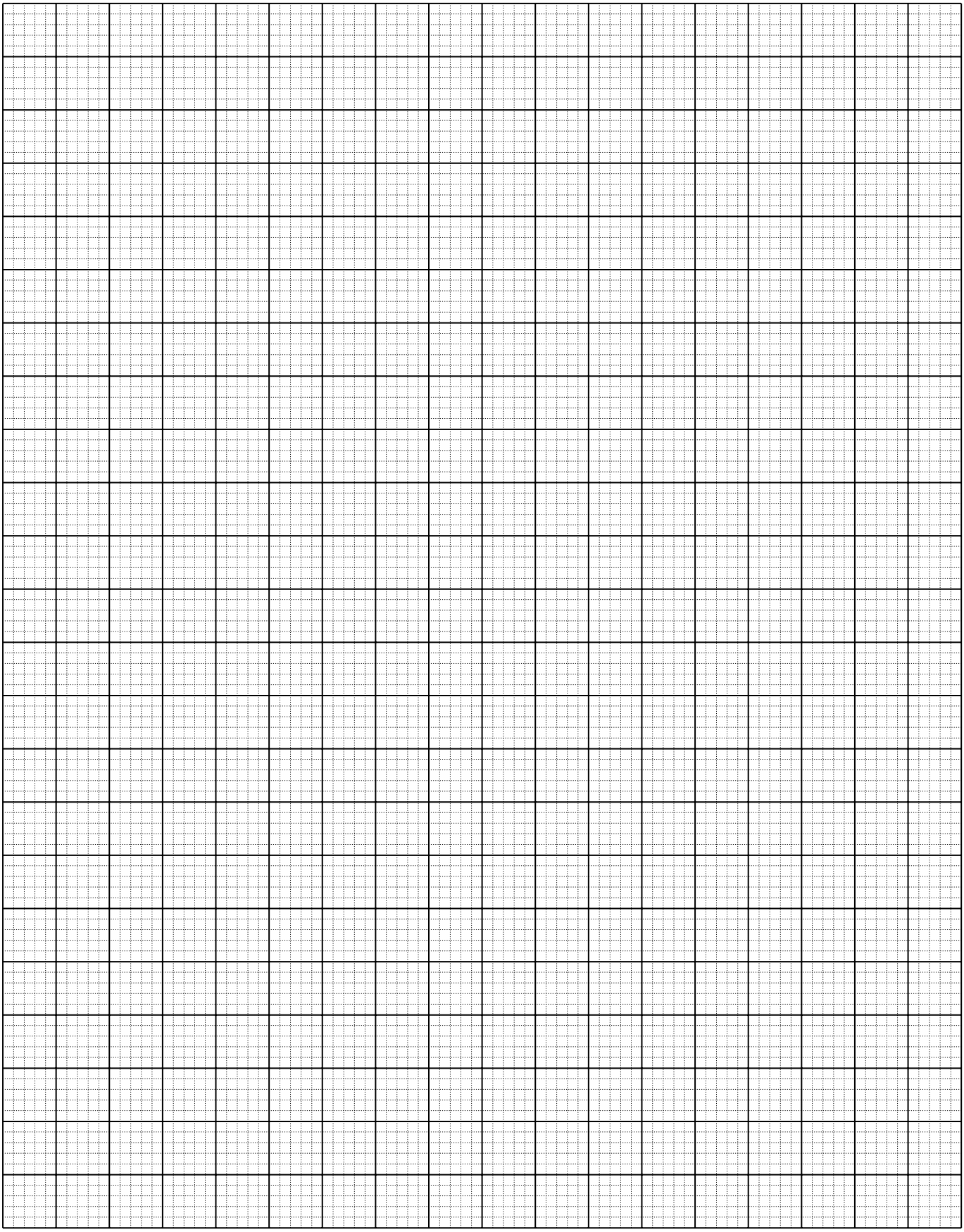
_____

_____

[2 marks]



GO ON TO THE NEXT PAGE

(ii) Suggest an explanation for the correlation between number of cigarettes smoked per day and the incidence of cancer.

_____

_____

_____

_____

_____

_____

_____

_____

[4 marks]

(iii) Give an appropriate conclusion to the findings in Table 2.

_____

_____

_____

[2 marks]

Total 16 marks

FORM TP 2012144

TEST CODE **02107020**

MAY/JUNE 2012

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 1 – Paper 02

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in two sections. Answer ALL questions.
2. For Section A, write your answers in the spaces provided in this booklet.
3. For Section B, write your answers in the spaces provided at the end of each question in this booklet.
4. You may use a silent, non-programmable calculator to answer items.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions.

Write your answers in the spaces provided in this booklet.

1. (a) Water is a molecule that is important to life due to the variety of its properties. Table 1 is an incomplete table showing the link between some properties of water and examples of its importance to life.

Complete Table 1 by writing the missing information in the spaces provided.

TABLE 1: PROPERTIES OF WATER AND ITS IMPORTANCE TO LIFE

Properties of Water	Examples of Water's Importance to Life
	Helps leaves to pull water upwards from the roots.
Solubility	
	Helps to stabilize the temperature of organisms and the environment.

[3 marks]

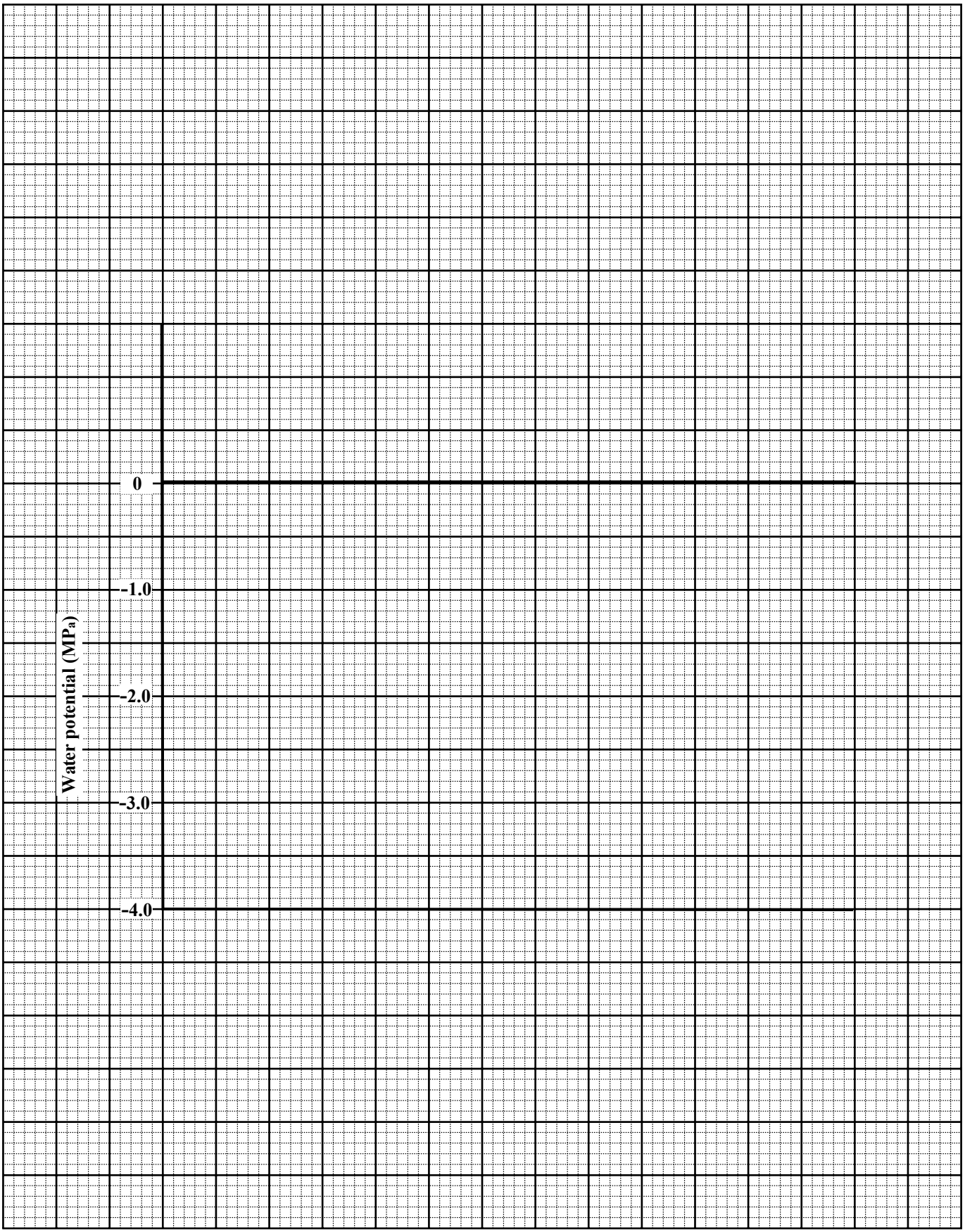
(b) Table 2 summarizes data on changes in water potential over an 18-hour period, beginning at 0400 hours, in the leaves of a shrub that grows in dry conditions. Note that 0400 hours is the same as 4:00 a.m.

TABLE 2: WATER POTENTIAL OVER AN 18-HOUR PERIOD

Time of day (hours)	Water Potential (MPa)
0400	-1.2
0600	-1.8
0800	-3.0
1200	-2.8
1600	-2.6
1800	-3.0
2000	-1.9
2200	-1.3

(i) On the grid provided on page 3, plot the data in Table 2 as a line graph. **[5 marks]**

Question 1 (b) (i)



(ii) Account for the shape of the graph. Include in your account a brief description of the shape of the graph.

_____

_____

_____

_____

_____

[3 marks]

(c) Figure 1 is a diagram of the structure of a generalized triglyceride.

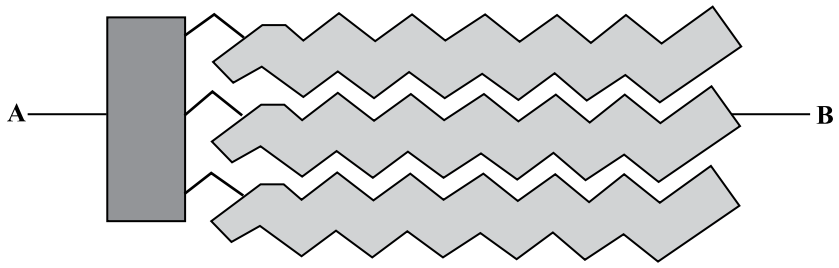


Figure 1. Structure of a generalized triglyceride

(i) Identify the structures labelled A and B in Figure 1.

A _____

B _____

[2 marks]

(ii) Label an ester linkage in the triglyceride shown in Figure 1. **[1 mark]**

(iii) State ONE feature of the triglyceride molecule that enables it to function as a better energy store than carbohydrates.

_____

[1 mark]

Total 15 marks

NOTHING HAS BEEN OMITTED.

2. Figure 2 summarizes the main steps in the replication of DNA in eukaryotes.

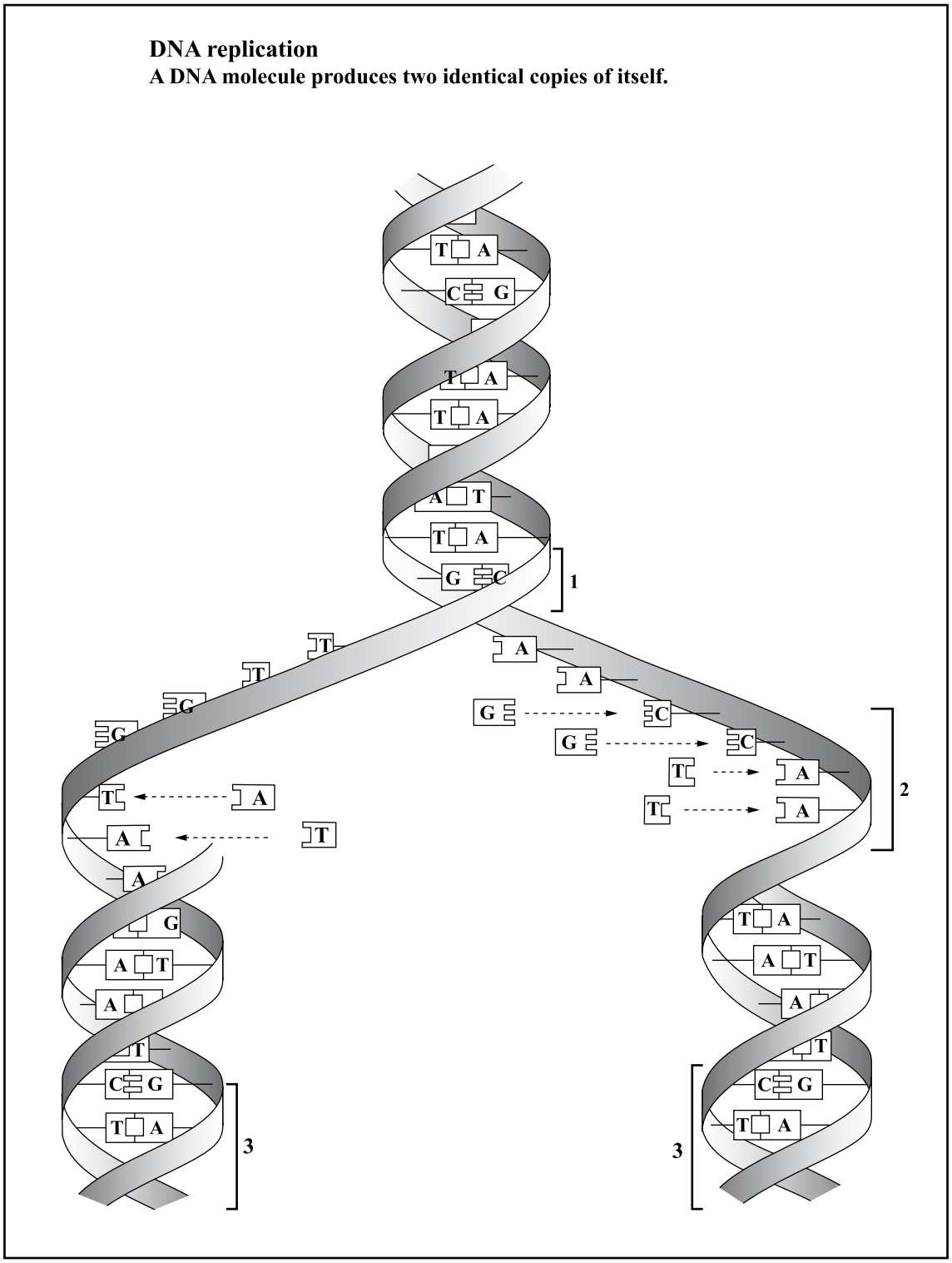


Figure 2. Steps in the replication of DNA in eukaryotes

(a) (i) Give a concise description of the events occurring at the steps labelled **1**, **2** and **3** in Figure 2.

Step 1 _____

_____

Step 2 _____

_____

Step 3 _____

_____

[6 marks]

(ii) DNA replication is regarded as being semi-conservative. Comment on the significance of this method of replication.

_____

_____

_____

[2 marks]

(b) Figure 3 shows the distribution of beak depth of medium ground finches on Daphne Major, a small island in the Galapagos. Initial measurements of all birds on the island were taken in 1976. In 1978, following a period of severe drought on the island in the previous year, the beak depth of the surviving population was recorded. The illustrations at the bottom of the graphs show the beak depths of the initial and surviving populations.

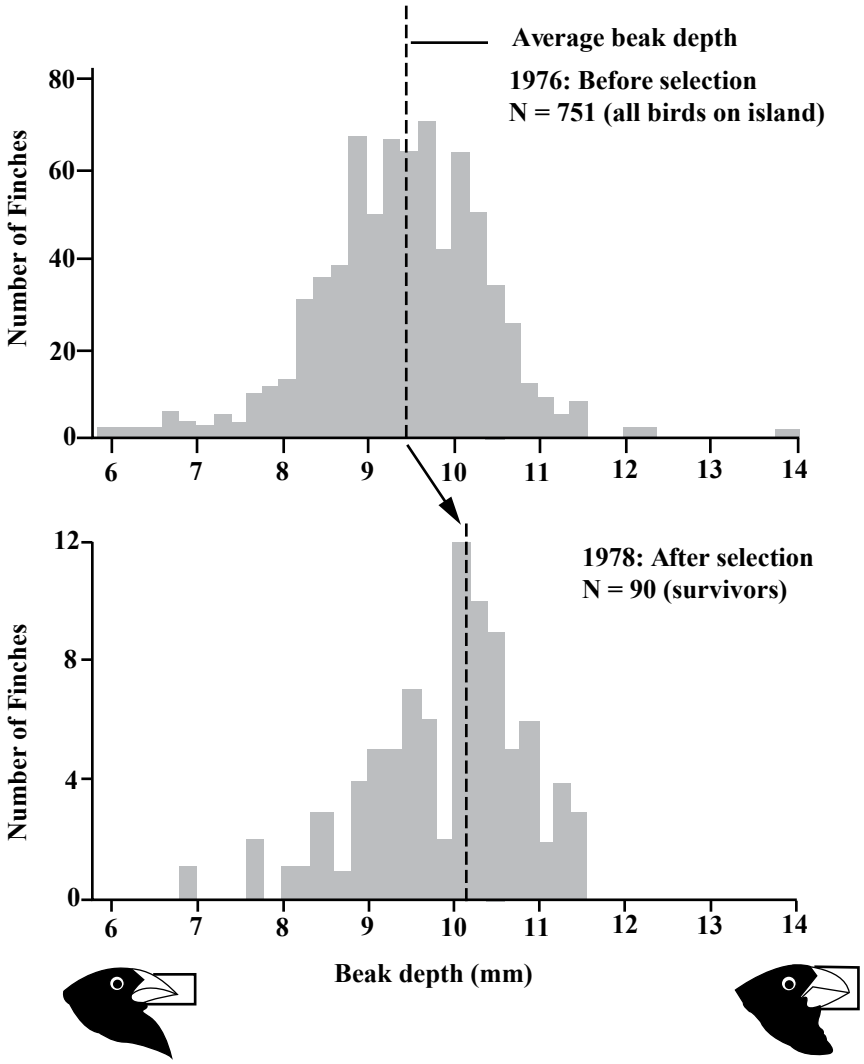


Figure 3. Beak depth of medium ground finches on Daphne Major before (1976) and after (1978) a drought period

Source: http://www.bio.miami.edu/~cmallery/150/unity/sf38x1b.jpg

(i) With reference to average beak depth (indicated by the broken line in Figure 3) and nature of the frequency distributions of the two populations, determine what effect the drought had on the finch populations. Quote values where appropriate.

_____

_____

_____

_____

_____

_____

[4 marks]

(ii) With the aid of a simple diagram, comment on the type of selection illustrated by the data shown in Figure 3.

Diagram:

[1 mark]

Comment: _____

_____

_____

_____

_____

[2 marks]

Total 15 marks

GO ON TO THE NEXT PAGE

3. (a) Figure 4 is an incomplete diagrammatic representation of the stages in the development of an embryo sac.

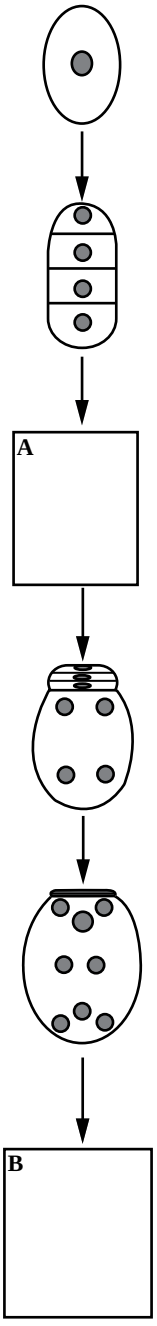


Figure 4. Stages in the development of an embryo sac

(i) Complete Figure 4 to show the missing stages in the boxes labelled A and B. **[2 marks]**

(ii) Use an arrow labelled C to indicate on Figure 4 where meiosis occurs during the development of the embryo sac. **[1 mark]**

(iii) Use an arrow labelled D to indicate the location of the female gamete on Figure 4.
[1 mark]

(iv) Angiosperms and mammals both produce haploid gametes. Comment on TWO OTHER ways in which sexual reproduction in angiosperms and mammals may be similar.

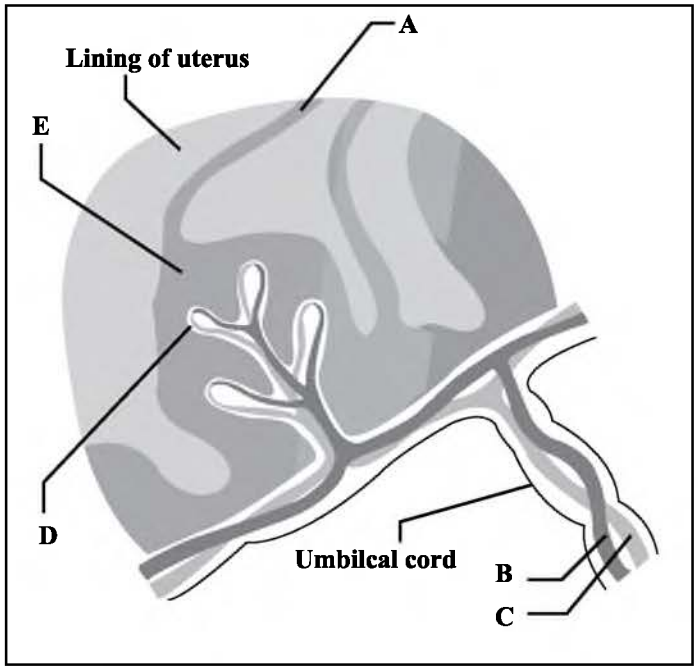
_____

_____

_____

_____
[4 marks]

(b) Figure 5 is a diagrammatic representation of a section of the placenta of a mammal.



http://www.natracare.com/images/help_for_schools/illustrations/placenta.gif

Figure 5. Section of the placenta of a mammal

(i) Identify the structures labelled A, B, C, D, and E in Figure 5.

A _____

B _____

C _____

D _____

E _____
[5 marks]

GO ON TO THE NEXT PAGE

(ii) Comment on the MAIN function of the structure labelled E.

_____

_____

_____

[2 marks]

Total 15 marks

SECTION B

Answer ALL questions.

Write your answers in the spaces provided at the end of each question.

4. (a) (i) Describe THREE structures which are common to a mitochondrion and a chloroplast. **[6 marks]**

(ii) Discuss how a mitochondrion differs from a chloroplast with respect to their MAIN function in a cell. **[4 marks]**

(b) Explain, using the dicotyledonous root as an example, the difference between a 'tissue' and an 'organ'. **[5 marks]**

Total 15 marks

Write the answer to Question 4 here.

_____

_____

_____

_____

_____

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_____

_____

Write the answer to Question 4 here.

Write the answer to Question 4 here.

5. (a) (i) Distinguish between the terms ‘gene mutation’ and ‘chromosome mutation’. **[4 marks]**

(ii) Using sickle-cell anaemia as the example, explain the sequence of changes triggered by the gene mutation that leads to the cells becoming sickle shaped. **[5 marks]**

(b) (i) Outline the procedure of somatic gene therapy, giving FOUR key steps. **[4 marks]**

(ii) With reference to cystic fibrosis, comment on ONE difficulty in using gene therapy to treat diseases. **[2 marks]**

Total 15 marks

Write the answer to Question 5 here.

Write the answer to Question 5 here.

Write the answer to Question 5 here.

6. (a) (i) Distinguish between 'binary fission' and 'budding'. **[4 marks]**

(ii) Discuss ONE advantage and ONE disadvantage of **asexual** reproduction. **[4 marks]**

(b) (i) Outline the sequence of events that leads from germination of a pollen grain to double fertilization in flowering plants. **[5 marks]**

(ii) Briefly comment on the significance of double fertilization in the life cycle of a flowering plant. **[2 marks]**

Total 15 marks

Write the answer to Question 6 here.

Write the answer to Question 6 here.

Write the answer to Question 6 here.

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

FORM TP 2012145

TEST CODE **02107032**

MAY/JUNE 2012

C A R I B B E A N E X A M I N A T I O N S C O U N C I L

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 1 – Paper 032

ALTERNATIVE TO SCHOOL-BASED ASSESSMENT

2 hours

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE questions. Answer ALL questions.
2. You are advised to take some time to read through the paper and plan your answers.
3. Write your answers in the spaces provided in this booklet.
4. You may use a silent, non-programmable calculator to answer items.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

1. Hydrogen peroxide (H_2O_2) is a poisonous by-product of metabolism that can damage cells if it is not removed. Catalase is an enzyme that speeds up the breakdown of hydrogen peroxide into water (H_2O) and oxygen gas (O_2). Catalase is found in plant and animal tissues and is especially abundant in the cells of potato and liver.

You are required to conduct a simple investigation into the **effect of substrate concentration on the rate of reaction of catalase**. Carefully read the instructions before starting the experiment.

The source of catalase is potato tissue. The indication of enzyme activity in this experiment is the height of the column of oxygen bubbles produced. See Figure 1 below.

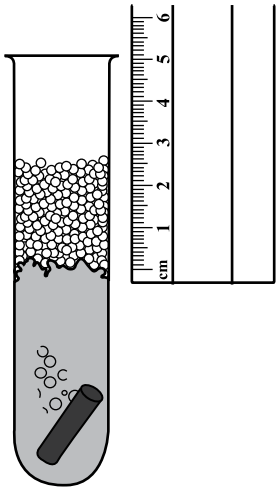


Figure 1. Demonstration of measurement of column of bubbles

(a) **<u>Procedure</u>**

(i) You are provided with eight test tubes labelled A, A1, B, B1, C, C1, D and D1, each containing 10 cm^3 of solutions as follows:

Test tubes A, A1	5% hydrogen peroxide
Test tubes B, B1	10% hydrogen peroxide
Test tubes C, C1	20% hydrogen peroxide
Test tubes D, D1	distilled water

Caution: Hydrogen peroxide is corrosive. You must use safety glasses and gloves when handing the test tubes.

GO ON TO THE NEXT PAGE

(ii) You are provided with eight cylinders of potato, each 2 cm × 0.5 cm, in a Petri dish.

(iii) Using a forceps, add one potato cylinder to Test Tube A and observe for release of bubbles for 3 minutes.

(iv) Measure the height (mm) of the column of bubbles in the test tube using a ruler, as shown in Figure 1.

(v) Record your result for Test Tube A in Table 1.

(vi) Repeat the procedure as outlined in Steps (iii), (iv) and (v) for the remaining solutions in Test Tubes A1, B, B1, C, C1, D and D1.

[8 marks]

TABLE 1.

Test Tube	Height of Bubbles (mm)	Average Height of Bubbles (mm)
A **5% H_2O_2**		
A1 **5% H_2O_2**		
B **10% H_2O_2**		
B1 **10% H_2O_2**		
C **20% H_2O_2**		
C1 **20% H_2O_2**		
D **Distilled water**		
D1 **Distilled water**		

(b) Write an appropriate title for Table 1.

_____

_____

[1 mark]

(c) Calculate the average height of the bubbles for EACH concentration of hydrogen peroxide and for the distilled water. Record your results in Table 1 on page 3. **[2 marks]**

(d) Based on the results recorded, what can be deduced about the relationship between substrate concentration and enzyme activity?

_____

_____

_____

_____

_____

[2 marks]

(e) State the purpose of the distilled water in Test Tubes D and D1.

_____

_____

[1 mark]

(f) Outline how the procedure used in this experiment could be modified to investigate the effect of **temperature** on enzyme activity.

_____

_____

_____

_____

_____

_____

[2 marks]

Total 16 marks

2. (a) You have been provided with plastic ties of three different colours and three different lengths.

(i) Use the plastic ties to construct a model which shows the structure of **bivalents for two chromosomes** of different lengths at the end of the **prophase stage of Meiosis I**.

For EACH chromosome use two different colours of the same lengths to represent the parts of the bivalent derived from each member of a pair of homologous chromosomes. Use the third colour to represent centromeres. **[4 marks]**

(ii) Show ONE **chiasma** on your model. **[1 mark]**

(iii) In the box below, **arrange your bivalents as you would expect to see them at the end of the prophase stage of Meiosis I.**

Draw an outline of the arrangement in the box.

Use the transparent tape provided to attach your bivalents to the paper in the box below. **[2 marks]**

(iv) In box above, draw the centrioles and spindle fibres in relation to your bivalents, as they would be seen at the end of Prophase I. **[2 marks]**

(b) Colour blindness is inherited as a sex-linked recessive disease with the mutant gene carried on the X chromosome.

A colour-blind male marries a female who is heterozygous for colour blindness.

(i) State the genotypes of the parents.

Male: _____

Female: _____

[2 marks]

(ii) In the space provided below, draw a Punnett square to show the possible offspring.

[3 marks]

(iii) State the phenotypes of the male and female offspring with respect to colour blindness.

Males: _____

_____

Females: _____

_____

[2 marks]

Total 16 marks

3. (a) Specimen A is a stained longitudinal section of the testis of a mammal. Examine the specimen using the lower power of a compound microscope.

(i) In the box below, make a labelled plan drawing to show the distribution of the tissues in the testis. **[7 marks]**

(ii) For EACH type of tissue labelled, state its function next to the corresponding labels on your drawing. **[2 marks]**

(b) Figure 2 is a diagram of the human female reproductive system.

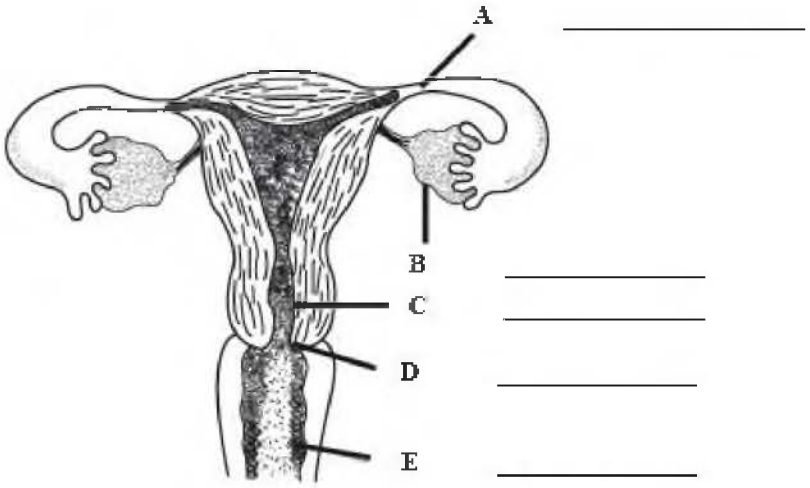


Figure 2. Human female reproductive system

Source:http://thornlea.sharpschool.com/UserFiles/Servers/Server_119514/File/Department%20Document%20%28BY%20SUBJECT%29/Documents%20Physical%20Education%20Department/Cassie%27s%20Folder/Gr%209/Female%20Reproductive%20System%20-%20Internal.jpg

(i) On the diagram in Figure 2, identify the structures labelled A, B, C, D and E. **[5 marks]**

(ii) On the diagram in Figure 2, indicate, using annotations, where fertilization of the ovum and implantation of the zygote occur. **[2 marks]**

Total 16 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

FORM TP 2012148

TEST CODE **02207032**

MAY/JUNE 2012

C A R I B B E A N E X A M I N A T I O N S C O U N C I L

ADVANCED PROFICIENCY EXAMINATION

BIOLOGY

UNIT 2 – Paper 032

ALTERNATIVE TO SCHOOL-BASED ASSESSMENT

2 hours

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE questions. Answer ALL questions.
2. You are advised to take some time to read through the paper and plan your answers.
3. Write your answers in the spaces provided in this booklet.
4. You may use a silent, non-programmable calculator to answer items.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

1. The following is a list of apparatus and materials that could be used to investigate oxygen uptake during respiration of germinating mung beans.

Apparatus

- 2 large boiling tubes.
- 2 two-hole rubber bungs with the same diameter as the boiling tubes.
- A large beaker to support the boiling tube.
- 2 short pieces of rubber tubing. To each is attached a short length of glass tubing at one end, and a spring clip at the other end.
- A tripod stand.
- A clock.
- 2 manometer tubes with coloured water.

Materials

- Graph paper
- Cotton wool
- Dried mung beans
- Germinating mung beans
- Soda lime

(i) In the space provided below, make a fully annotated drawing to show how the apparatus and materials should be assembled to determine the rate of oxygen uptake of germinating beans.

(Marks will be awarded for correct assembly and annotation of the apparatus.)

[8 marks]

(ii) State ONE precaution that needs to be taken in order to reduce possible sources of error when assembling the apparatus.

_____

_____

[1 mark]

(iii) Suggest ONE step that should be taken to ensure reliability of the results of the investigation.

_____

_____

_____

[2 marks]

(iv) If this investigation were being conducted, explain how the data would be collected and used to determine the amount of oxygen utilized by the germinating beans.

_____

_____

[2 marks]

(v) Explain why this apparatus might NOT be suitable for use when investigating the oxygen uptake of very small green plants.

_____

_____

_____

_____

_____

[3 marks]

Total 16 marks

2. (a) Specimen A is a stained prepared slide showing a transverse section through a mammalian vein and artery.

Examine the specimen, using the lower power of a compound microscope.

(i) In the box below, make an annotated plan drawing of the **vein** to show the distribution of the tissues. Include in your annotations the identity of the tissues drawn.

[6 marks]

(ii) Examine the artery in Specimen A and state TWO observable differences between the artery and vein.

_____

_____

_____

[2 marks]

(b) Table 1 summarises data on the size of stomatal apertures taken over a 14-hour period beginning at 0600 hours (6:00 am) in plants grown in a greenhouse.

TABLE 1: SIZE OF STOMATAL APERTURES

Time of day (hours)	Aperture (µm)
0600	1.0
0700	1.5
0800	2.5
1000	7.0
1200	6.5
1300	8.0
1400	5.0
1600	1.5
1800	1.75
2000	1.5

(i) On the grid provided on page 7, draw a line graph to illustrate the data in Table 1.

[5 marks]

(ii) Describe the trend shown and suggest a reason for the shape of the graph.

_____

_____

_____

_____

_____

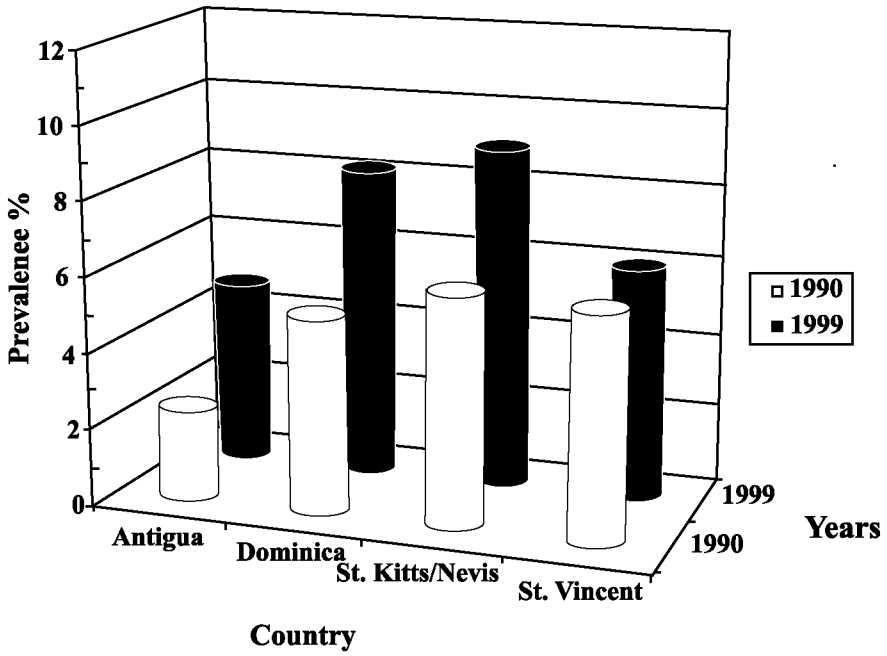
_____

[3 marks]

Total 16 marks

GO ON TO THE NEXT PAGE

3. (a) Figure 1 summarises trends in childhood (0 – 5 years) obesity for selected countries in the Caribbean over the period 1990 – 1999. Study Figure 1 and answer the questions that follow.



Source: Adapted from data and references in CFNI, 2001. Vol. 37, No. 1, 2004

Figure 1. Childhood obesity in selected Caribbean countries, 1990 to 1999

Note: Prevalence is defined as the percentage of obese individuals in a given population at a certain time.

(i) Using the data in Figure 1, complete Table 2 to show the prevalence of obesity in Antigua, and St Kitts/Nevis for the years 1990 and 1999.

TABLE 2: PREVALENCE OF CHILDHOOD OBESITY IN ANTIGUA AND ST KITTS/NEVIS FOR 1990 AND 1999

Country	Prevalence %	
	1990	1999
Antigua		
St Kitts/Nevis		

[2 marks]

(ii) State the country and the year in which the least prevalence and the greatest prevalence of childhood obesity were reported.

Country with LEAST prevalence _____

Year _____

Country with GREATEST prevalence _____

Year _____

[3 marks]

(iii) Name the country that recorded the smallest percentage **increase** in prevalence, and the greatest percentage **increase** in prevalence of childhood obesity over the period 1990 – 1999.

Country with SMALLEST per cent **increase** in prevalence _____

Country with GREATEST per cent **increase** in prevalence _____

[2 marks]

(iv) Comment on the trend in the prevalence of childhood obesity in the four Caribbean countries over the period 1990 – 1999.

_____

_____

_____

_____

_____

_____

_____

[3 marks]

(b) (i) Assuming that programmes to address childhood obesity were conducted in these four Caribbean countries over the period 1990 – 1999, suggest in which country the programmes would have been MOST successful. Give a reason for your answer.

Country _____

Reason _____

_____

[2 marks]

(ii) Discuss FOUR possible reasons for the increase in childhood obesity in the Caribbean.

_____

_____

_____

_____

_____

_____

_____

_____

[4 marks]

Total 16 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

TEST CODE **02107020**

FORM TP 2013144

MAY/JUNE 2013

CARIBBEAN EXAMINATIONS COUNCIL

CARIBBEAN ADVANCED PROFICIENCY EXAMINATION®

BIOLOGY

UNIT 1 – Paper 02

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULY.

1. This paper consists of SIX questions in two sections. Answer ALL questions.
2. For Section A, write your answers in the spaces provided in this booklet.
3. For Section B, write your answers in the spaces provided at the end of each question in this booklet.
4. The use of silent non-programmable calculators is allowed.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions.

Write your answers in the spaces provided in this booklet.

1. (a) Table 1 presents results of an investigation of the nutritional composition of various foods from an average American diet.

TABLE 1: ANALYSIS OF SPECIFIC NUTRIENTS IN COMMON FOODS USING KNOWN REAGENTS

{Note: For reagents which require a colour change to indicate the presence of a nutrient, results were recorded based on a colour index (range) of changes observed for any one reagent.}

Food Substance	FOOD TEST REAGENT			
	Biuret Solution	**Benedict's Solution**	**Lugol's Iodine (KI/I_2) Solution**	**Grease Spot on Brown Paper***
Eggs	Purple	Blue	Black	None seen.
Milk	Pink	Pale yellow	Dark blue	None seen.
Cheerios cereal	Pale blue (almost clear)	Brick-red	Blue-black	Only seen when food sample is dissolved in isopropyl alcohol and then tested.
Hamburger patty	Purple	Blue	Yellow	Clearly seen when rubbed on paper.
Carrot	Pale blue (almost clear)	Orange	Dark blue	None seen.
Potato chips	Pink	Brick-red	Black	Seen when rubbed on paper but not very transparent.
Pepperoni pizza	Purple	Yellow	Dark blue	Clearly seen when rubbed on paper.
Donut	Pink	Orange	Dark blue	Clearly seen when rubbed on paper.

*** Grease Spot on Brown Paper Test:**

1. Using a glass rod, a sample of the food being tested is rubbed on a section of brown paper (labelled with the sample being tested). "Wet" spot appears on the paper.

2. Any excess food which may stick to the paper is removed using a paper towel.

GO ON TO THE NEXT PAGE

3. The sample paper is left to dry for about 10 minutes.

4. A translucent spot indicates a positive result for the specific nutrient being tested.

5. Isopropyl alcohol serves to dissolve the nutrient in the food substance.

(i) State the nutrient being tested for, by EACH of the following tests:

Biuret: _____

Benedict's: _____

Lugol's Iodine: _____

Grease spot: _____

[2 marks]

(ii) Using the data presented in Table 1, determine TWO food substances which contain all four nutrients being tested for in this investigation.

_____

[1 mark]

(iii) With reference to the qualitative results given in Table 1, suggest which foods are good sources of nutrients for cell structure and growth of the cell, and for supply of energy. Justify your answer with a brief explanation.

Cell structure and growth of the cell:

_____

_____

_____

_____

Supply of energy:

_____

_____

_____

_____

[4 marks]

(b) Figure 1 is a diagrammatic representation of the molecular structure of a short section of a glycogen molecule.

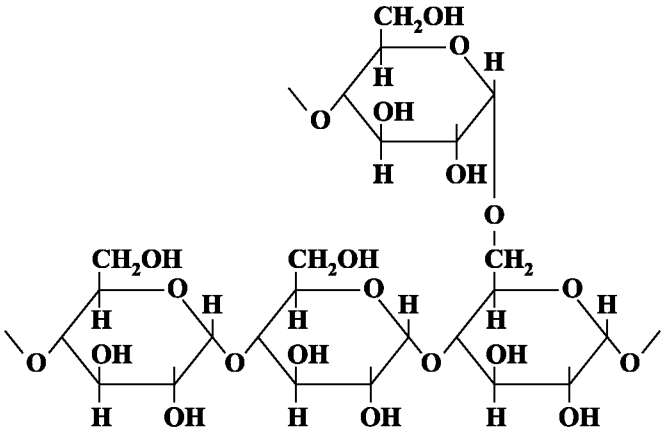


Figure 1. Short section of a glycogen molecule

(i) Using a labelled arrow on Figure 1, highlight the location of EACH of the following:

a) An alpha 1,4-glycosidic linkage

b) An alpha 1,6-glycosidic linkage **[2 marks]**

(ii) In the space below, sketch the general shape of one glycogen molecule.
[Details of individual glucose residues are NOT required.]

Space for diagram

[2 marks]

(iii) Amylose (starch) and cellulose are both polymers of glucose molecules but they differ in their structure and function in plant cells. With reference to ONE structural property, briefly explain the functional differences of amylose and cellulose in plant cells.

_____

_____

_____

_____

_____

_____

_____

_____

[4 marks]

Total 15 marks

2. (a) In a cross between a plant with purple flowers and a plant with white flowers, all the F_1 plants had purple flowers. When the F_1 offspring were crossed (selfed), 705 plants had purple flowers and 224 plants had white flowers.

(i) State the expected ratio for the cross of the F_1 offspring.

_____

[1 mark]

(ii) State an appropriate null (H_0) hypothesis and an appropriate alternative (H_1) hypothesis for a Chi-square test of the results.

H_0: _____

_____

H_1: _____

_____

[2 marks]

(iii) Complete Table 2 by calculating the missing values.

TABLE 2: DATA FOR CHI-SQUARE TEST

Phenotype	Observed (O)	Expected (E)	O − E	$(O - E)^2/E$
Purple flowers	705	696		
White flowers	224	233		
$\chi^2 = \Sigma \left[(O - E)^2/E\right]$				

[4 marks]

(iv) Determine the number of degrees of freedom. Show your calculation.

_____

[1 mark]

(v) Using the Chi-square values in Table 3, comment on the validity of the null hypothesis stated on page 5.

_____

_____

_____

[2 marks]

TABLE 3: CHI-SQUARE (χ^2) VALUES

Degrees of Freedom	Number of Classes	Chi-square Values					
1	2	0.46	1.64	2.71	3.84	6.64	10.83
2	3	1.39	3.22	4.61	5.99	9.21	13.82
3	4	2.37	4.64	6.25	7.82	11.34	16.27
4	5	3.36	5.99	7.78	9.49	13.28	18.47
Probability that chance alone could produce this deviation		0.50 (50%)	0.20 (20%)	0.10 (10%)	0.05 (5%)	0.01 (1%)	0.001 (0.1%)

(b) Figure 2 represents the elongation stage of translation in protein synthesis.

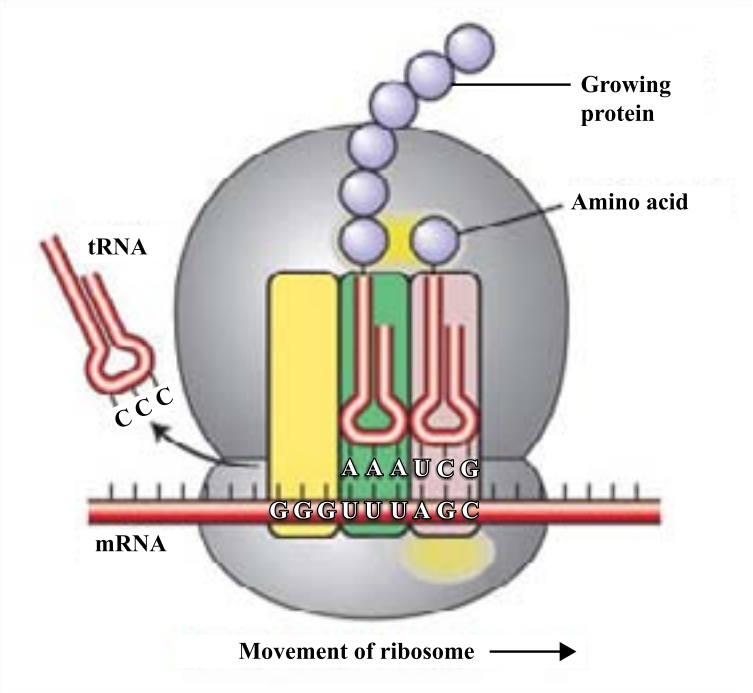


Figure 2. Elongation stage of translation in protein synthesis

Source: http://www.frontiers-in-genetics.org/page.php?id=protein-synthesis_en

(i) What is the term used to describe EACH group of three bases on the

mRNA _____

tRNA? _____

[1 mark]

(ii) Using the mRNA strand below, identify the corresponding triplet bases on the tRNA molecules. Write your answer in the boxes provided. Hint: Begin at the 5′ end.

mRNA **5′ UGG UUU GGC UCA 3′**

[2 marks]

(iii) Outline the nucleotide sequence on the DNA strand which serves as the template for the mRNA strand in (b) (ii).

_____

[2 marks]

Total 15 marks

GO ON TO THE NEXT PAGE

3. (a) Table 4 is an incomplete table comparing the process of spermatogenesis with that of oogenesis.

TABLE 4: COMPARISION OF THE PROCESS OF SPERMATOGENESIS AND OOGENESIS

Feature	Spermatogenesis	Oogenesis
Number of meiotic daughter cells which develop into mature gametes		
Duration of the process (mitotic division of stem cells and differentiated spermatogonia/oogonia) in the life span of the individual		

(i) Complete Table 4 with respect to the features listed for spermatogenesis and oogenesis in humans. **[3 marks]**

(ii) Outline the roles of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) in the regulation of spermatogenesis.

FSH: _____

_____

_____

LH: _____

_____

[3 marks]

(b) Figure 3 is a representation of a photomicrograph of a stained section through a human ovary showing developing ova.

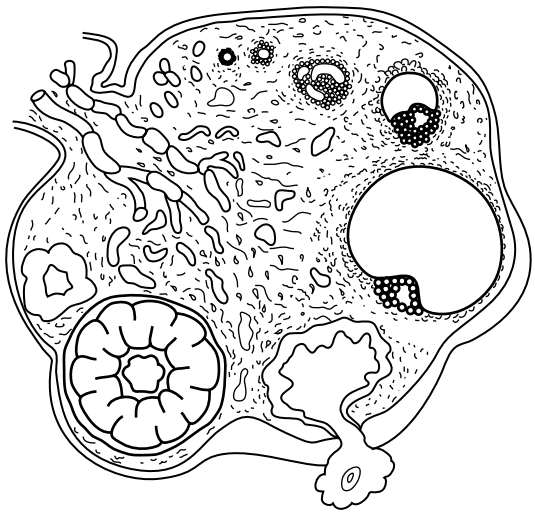


Figure 3. Representation of a photomicrograph of a section through an ovary

In the box below, make a plan drawing of the ovary to include the stage of the developing ovum just prior to release from the ovary.

[6 marks]

(c) Figure 4 is a diagram of a section through a carpel of an angiosperm plant showing the process of double fertilization.

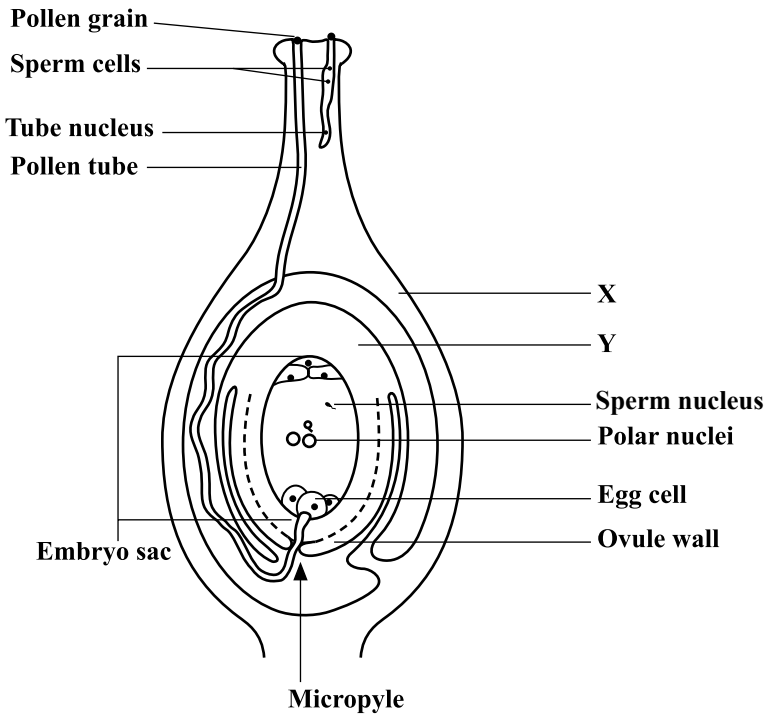


Figure 4. Section through the carpel of an angiosperm plant

Comment on the fate of the structure labelled X and the structure labelled Y, which includes the ovule walls and the embryo sac and its contents.

X: _____

_____

Y: _____

_____

_____

_____

[3 marks]

Total 15 marks

SECTION B

Answer ALL questions.

Write your answers in the spaces provided at the end of each question.

4. (a) Define the term 'diffusion', and distinguish between active transport and facilitated diffusion in cells. **[4 marks]**

(b) (i) With the aid of a simplified labelled diagram, describe the fluid mosaic model of membrane structure. **[6 marks]**

(ii) With reference to the fluid mosaic model, discuss how polar molecules and ions are transported. **[5 marks]**

Total 15 marks

Write the answer to Question 4 here.

Write the answer to Question 4 here.

Space for diagram.

5. (a) *Mycobacterium tuberculosis*, the bacterium that causes tuberculosis, has been virtually eliminated by the widespread use of two effective antibiotics. Due to the development of antibiotic-resistant strains of the bacterium, the disease has re-emerged as a major public health problem.

(i) Applying Darwin's theory of evolution by natural selection, discuss how resistance to antibiotics could have evolved in bacteria. Include in your discussion a concise explanation of natural selection. **[6 marks]**

(ii) Briefly comment on why mutation is regarded as a driving force of evolution. **[2 marks]**

(b) Define the term 'speciation', and using examples, explain how geographical isolation may lead to speciation. **[7 marks]**

Total 15 marks

Write the answer to Question 5 here.

Write the answer to Question 5 here.

6. (a) (i) Give a concise description of the key stages in the fertilization of a human secondary oocyte by a spermatozoon. Begin your account with the acrosome reaction. **[5 marks]**

(ii) Briefly comment on the significance of the process of fertilization. **[2 marks]**

(b) (i) Describe TWO major functions of the placenta. **[4 marks]**

(ii) Discuss TWO ways in which maternal behaviour can affect foetal development. **[4 marks]**

Total 15 marks

Write the answer to Question 6 here.

Write the answer to Question 6 here.

Write the answer to Question 6 here.

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

TEST CODE **02107032**

FORM TP 2013145

MAY/JUNE 2013

C A R I B B E A N E X A M I N A T I O N S C O U N C I L

CARIBBEAN ADVANCED PROFICIENCY EXAMINATION®

BIOLOGY

UNIT 1 – Paper 032

ALTERNATIVE TO SCHOOL-BASED ASSESSMENT

2 hours

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE questions. Answer ALL questions.
2. Write your answers in the spaces provided in this booklet.
3. You may use a silent non-programmable calculator.
4. Candidates are advised to use the first 15 minutes for reading through this paper carefully.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

Please begin Question 1 FIRST.

1. (a) (i) You are required to carry out a simple investigation to determine the sucrose concentration which is isotonic to the potato tuber cells.

You are provided with the following materials:

- Potato tuber cylinders
- 0.1 M, 0.3 M, and 0.6 M sucrose solution
- Distilled water

PROCEDURE

1. Place the 0.1 M, 0.3 M, and 0.6 M sucrose solution and distilled water in four beakers labelled A, B, C and D, as shown in the following table.

Beaker	Concentration of Solution
A	0.1 M
B	0.3 M
C	0.6 M
D	Distilled water

2. Remove any excess water from the potato cylinder using the paper towel. Measure the **initial** length of the potato cylinders to the nearest cm and record the average length in Table 1 on page 3.

3. Place three cylinders into each of the beakers labelled A, B, C and D **and let stand for one hour**.

4. Proceed to Questions 2 and 3.

5. After one hour, remove the potato cylinders from the beakers and blot to remove excess solution.

6. Measure the length of EACH potato cylinder in Beaker A and calculate the average length. Record your answer in Table 1 on page 3.

7. Repeat Step 6 for Beakers B, C and D.

8. For EACH solution, calculate the average change in length and record your findings in Table 1 on page 3.

TABLE 1: _____

_____

Length (cm)	A 0.1 M	B 0.3 M	C 0.6 M	D Distilled Water
FINAL average length (cm)				
INITIAL average length (cm)				
Change in average length (cm)				

[6 marks]

(ii) Suggest a specific aim for your experiment.

_____

_____

[1 mark]

(iii) Suggest an appropriate title for Table 1. Write your answer on the lines provided above the table. **[1 mark]**

(iv) Account for the change in length of the potato cylinders at 0.1 M and 0.6 M.

0.1 M _____

_____

_____

0.6 M _____

_____

_____

[2 marks]

(v) Describe TWO ways of using this data to estimate the osmolarity of the potato tuber.

_____

_____

_____

_____

_____

_____

_____

_____

[4 marks]

(b) Figure 1 is an electron micrograph of organelles in a eukaryotic cell.

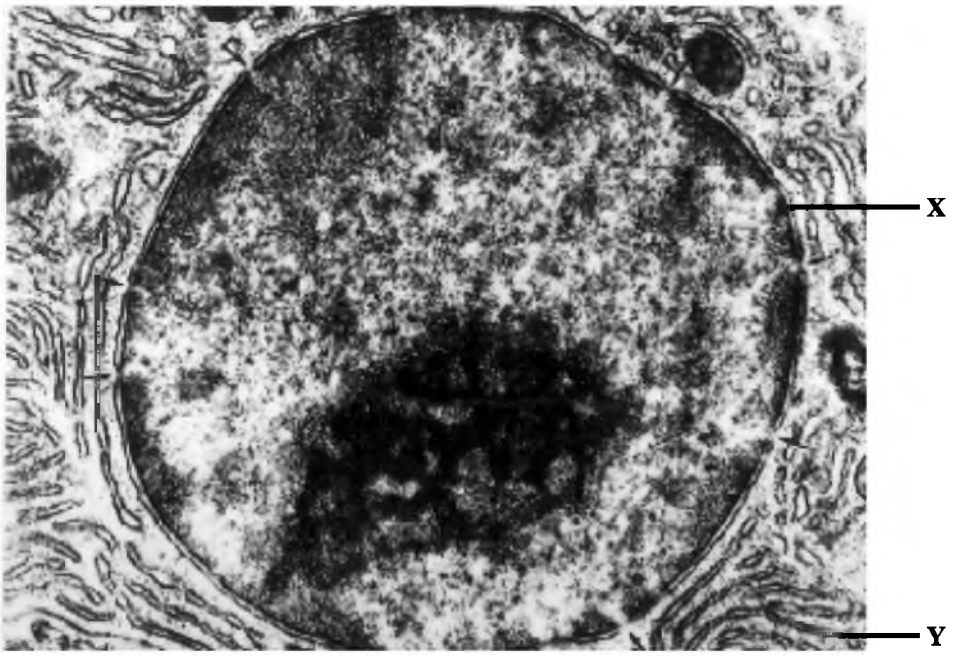


Figure 1. Electron micrograph of a eukaryotic cell

http://online-media.uni-marburg.de/histologie/introhis/HIS/txt/tacsem/tac01_sem.htm

Identify the structures labelled X and Y in Figure 1.

X: _____

Y: _____

[2 marks]

Total 16 marks

2. (a) In an experiment, a pigeon pea plant with green, round seeds and a pigeon pea plant with white, wrinkled seeds were crossed. All the F_1 plants had green, round seeds. The F_1 plants were then selfed. Table 2 is an incomplete table for the results of the F_1 cross.

(i) Complete Table 2 by writing the missing values for the F_2 progeny, and the expected phenotypic ratio for the cross.

TABLE 2: RESULTS OF F_1 CROSS

Phenotype/Seed Colour and Shape	**Number of Progeny**	**Expected Phenotypic Ratio**
Green round	780	
Green white	148	
White round		
White wrinkled		
Total	1136	

[3 marks]

(ii) Explain, giving TWO reasons, why all of the **F_1** progeny were phenotypically alike.

Reason: _____

_____

Reason: _____

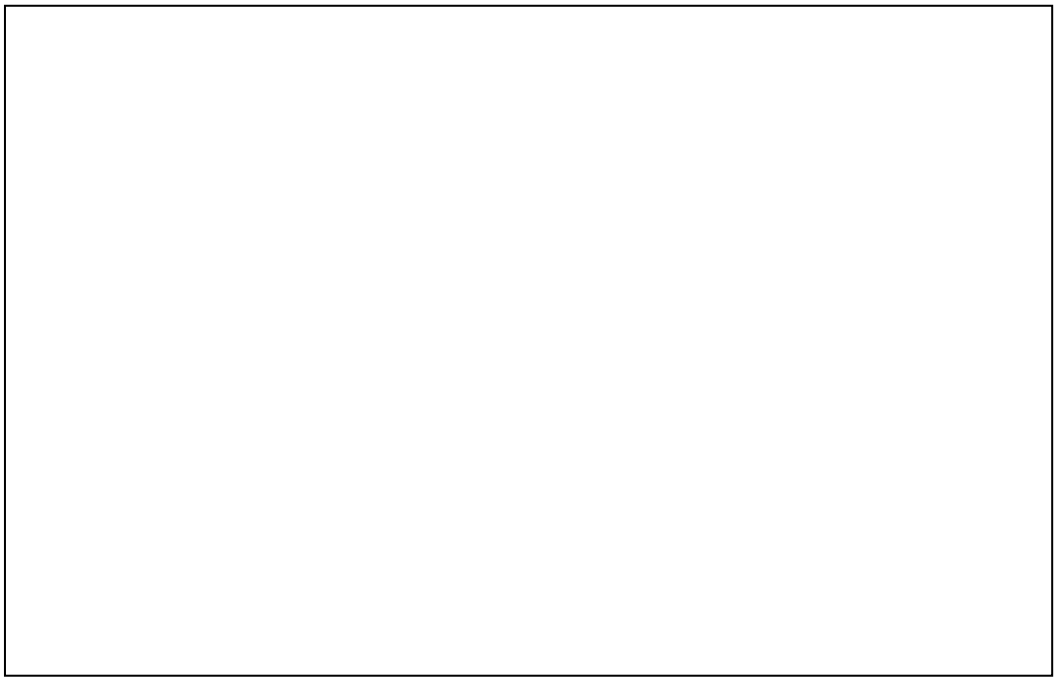
_____

[2 marks]

(iii) In the space provided below, construct a Punnett diagram for the test cross of a F_1 plant. Use the symbol G for the colour of the seeds and R for the shape of the seeds. (Include in your diagram an indication of the genotypic ratios for phenotypic categories.)

[6 marks]

(b) You are provided with a fresh slide preparation of onion root tip squash. In the box below, draw a cell undergoing metaphase of mitosis.



[5 marks]

Total 16 marks

3. (a) Figure 2 is a photomicrograph of a reproductive cell.

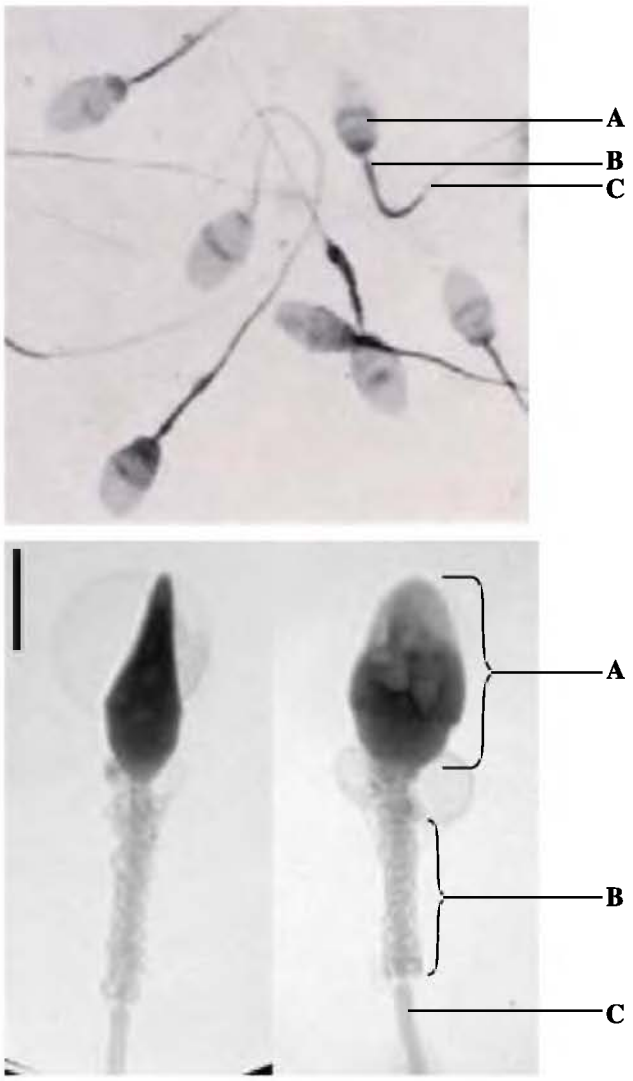


Figure 2. Photomicrograph of a reproductive cell

http://www.phys.au.dk/~jabraham/sperm98.gif

(i) Name the reproductive cell.

_____

[1 mark]

(ii) Identify the structures labelled A, B and C in Figure 2.

A: _____

B: _____

C: _____

[3 marks]

(iii) Comment on the function of the structure labelled B.

_____

_____

_____

_____

[3 marks]

(b) Table 3 shows data on the effectiveness of contraceptive methods, expressed as a percentage of women likely to become pregnant while using the method for one year.

TABLE 3: PREGNANCY RATES FOR CONTRACEPTIVE METHODS

Contraceptive Method	Rate of Pregnancy (expressed as a %)
Male sterilization	0.1
Female sterilization	0.5
Pill (combined progesterone/estrogen)	0.15
Intrauterine device	0.6
Male condom	2.0
Female condom	5.0
Spermicide	18.0
Natural method (*calendar, temperature, cervical mucus*)	9.0

(i) On the grid provided on page 9, construct a histogram for the data given in Table 3.

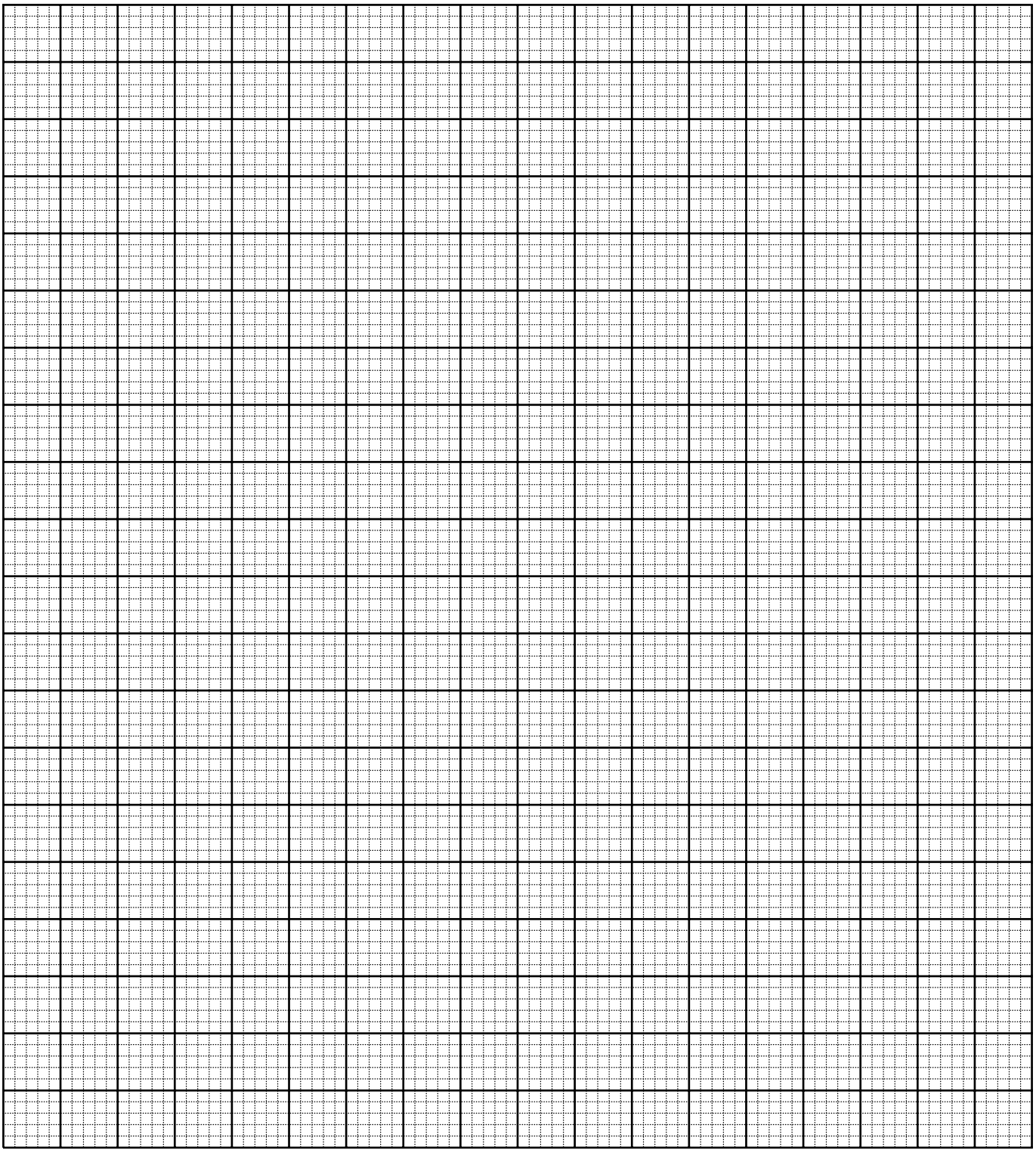
[4 marks]

(ii) Determine the most effective and the least effective method of contraception. Cite the data used to justify your answer.

Most effective method: _____

Least effective method: _____

[3 marks]



GO ON TO THE NEXT PAGE

(iii) Identify ONE method of contraception from Table 3, **other than** the male condom, which may give protection from HIV infection. Give ONE reason for your answer.

_____

_____

_____

_____

_____

_____

[2 marks]

Total 16 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

TEST CODE **02207020**

FORM TP 2013147

MAY/JUNE 2013

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BIOLOGY

UNIT 2 – Paper 02

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in two sections. Answer ALL questions.
2. For Section A, write your answers in the spaces provided in this booklet.
3. For Section B, write your answers in the spaces provided at the end of each question in this booklet.
4. The use of silent non-programmable calculators is allowed.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions.

Write your answers in the spaces provided in this booklet.

1. (a) Figure 1 is a flow chart which represents a part of the glycolysis pathway.

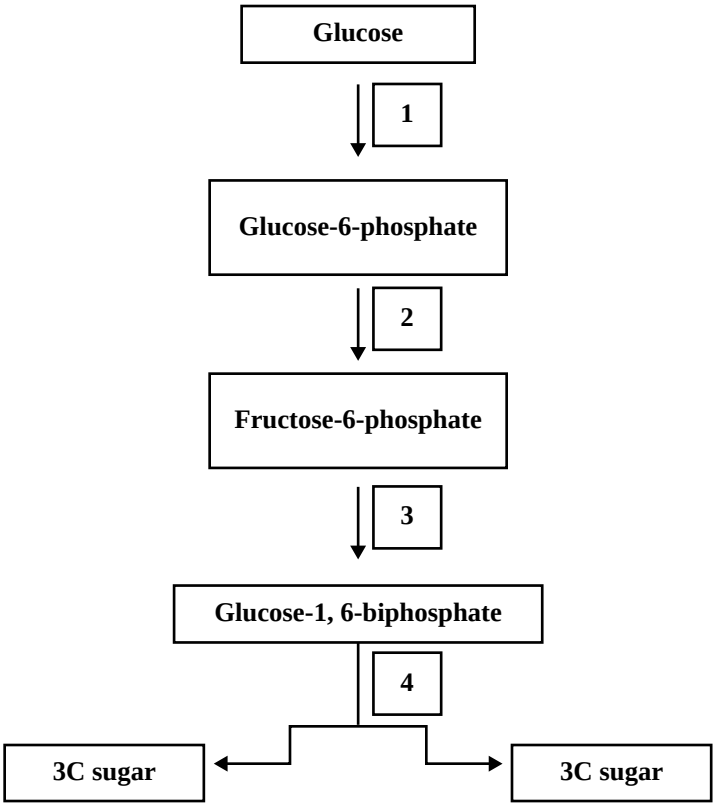


Figure 1. Part of the glycolysis pathway

(i) In which part of the cell does the process of glycolysis occur?

_____

[1 mark]

(ii) State what is occurring at EACH of the stages labelled 1, 2, 3 and 4 in Figure 1.

1:_____

_____

2:_____

_____

3:_____

_____

4:_____

_____

[2 marks]

(iii) Suggest the significance of the pathway shown in Figure 1.

_____

_____

_____

_____

[2 marks]

(b) Figure 2 represents a general model for nutrient cycling in an ecosystem highlighting the main reservoirs of elements. Arrows indicate the processes that move nutrients between reservoirs.

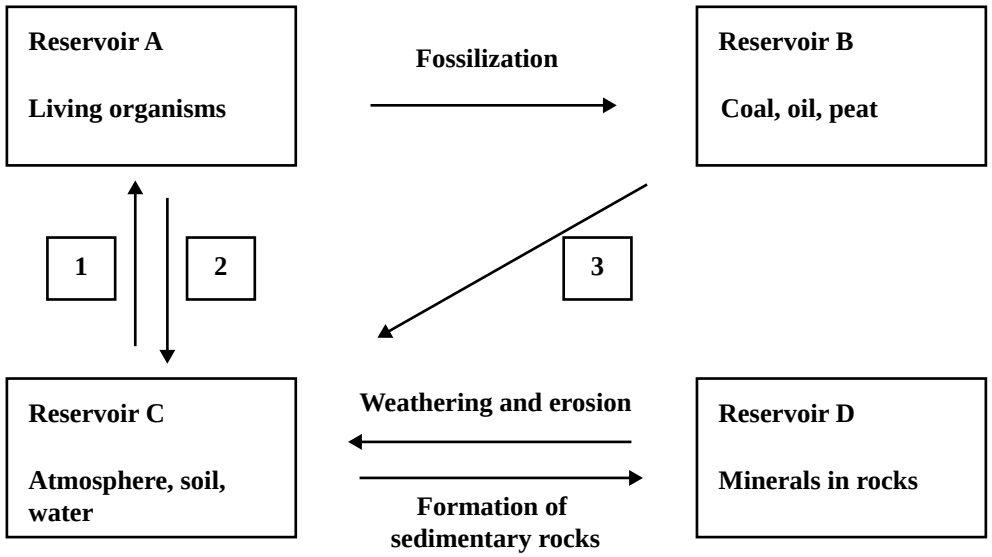


Figure 2. A general model for nutrient cycling

(Source: Adapted from Biology 2009 Campbell and Reece 8th Ed.)

(i) Deduce which reservoir has

a) **organic** materials which are **available** as nutrients

_____

b) **inorganic** materials which are **unavailable** as nutrients.

_____

[2 marks]

(ii) Name the processes highlighted by the arrows labelled 1, 2 and 3 in Figure 2, which must occur to transfer nutrients between reservoirs.

1: _____

2: _____

3: _____

[3 marks]

(iii) Recent evidence suggests that mycorrhizal fungi can release acids that dissolve some minerals. Use an arrow and the letter M to indicate on Figure 2 where this fungal activity fits into the model. **[1 mark]**

(c) Figure 3 represents the effect of light intensity on rate of photosynthesis.

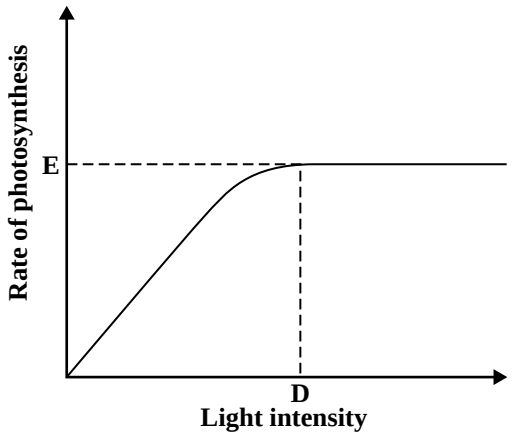


Figure 3. Effect of light intensity on rate of photosynthesis

(i) Use labelled double-headed arrows (↔) on the graph in Figure 3 to identify the region where

a) light is a limiting factor

b) other factors become limiting. **[2 marks]**

(ii) What is the significance of EACH of the points, **D** and **E**, on the axes of the graph in Figure 3?

Point D:

_____

_____

Point E:

_____

_____

[2 marks]

Total 15 marks

2. (a) Figure 4 is a photomicrograph of a stained, longitudinal section of vascular tissue showing phloem and xylem vessels.

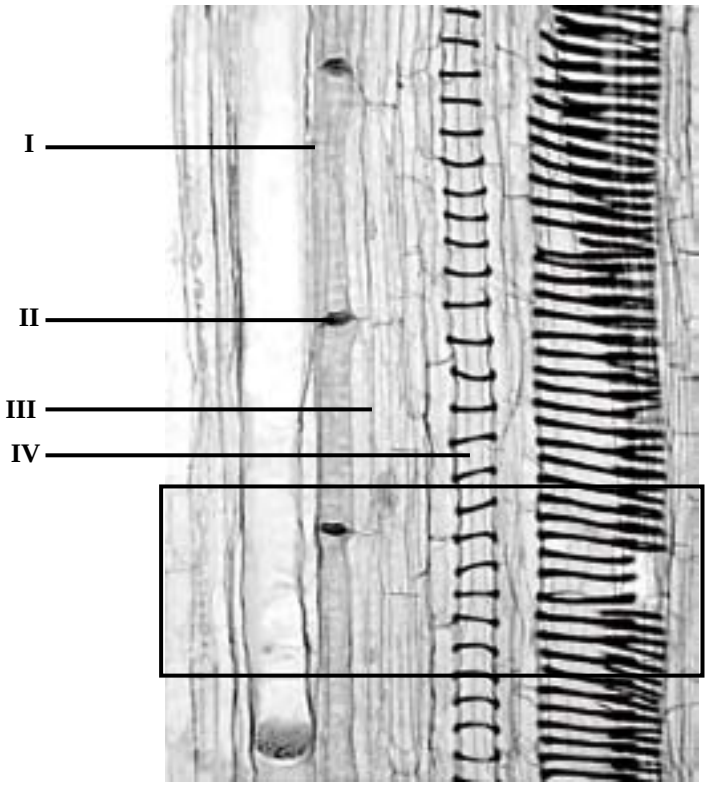


Figure 4. Photomicrograph of longitudinal section of vascular tissue

(Source: http://www.wellcome.ac.uk/en/bia/gallery.htm)

(i) In the space below, make a detailed drawing of the region highlighted by the box in Figure 4. Your drawing should be the actual size shown in Figure 4.

[5 marks]

(ii) Identify the structures highlighted by the lines labelled I, II, III and IV in Figure 4.

I _____

II _____

III _____

IV _____

[2 marks]

(b) Figure 5 shows the relationship between gender and age in an Arab population with a high cardiovascular risk profile.

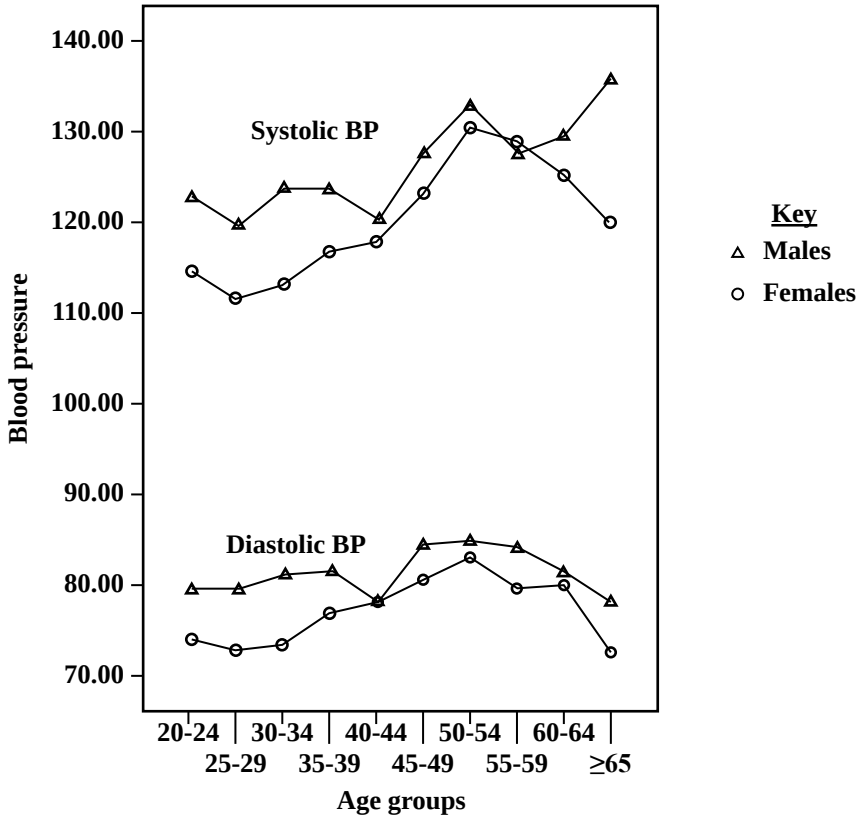


Figure 5. Gender influence on blood pressure and change in blood pressure with age

(Souce: http://www.cardiab.com/content/8/1/21/figure/F2?highres=y)

(i) Distinguish between the terms 'systolic' and 'diastolic' blood pressure.

_____

_____

_____

_____

[2 marks]

GO ON TO THE NEXT PAGE

(ii) Comment on the **overall** trend in changes in systolic and diastolic blood pressure of the population with increasing age.

Systolic: _____

_____

_____

Diastolic: _____

_____

_____

[4 marks]

(iii) What deduction can be made about the relationship between gender and blood pressure?

_____

_____

[2 marks]

Total 15 marks

3. (a) Table 1 shows mortality rates for some of the most common cancers in men and women of Latin America and the Caribbean in the year 2008.

TABLE 1: MORTALITY RATES FOR MEN AND WOMEN IN LATIN AMERICA AND THE CARIBBEAN. (RATE IS PER 100 000.)

Cancer	Men	Women
Breast	0	12.4
Cervix/uterus	0	10.8
Colorectum	7.1	6.1
Liver	5.9	4.8
Lung	17.7	7.3
Prostate	16.3	0
Stomach	12.8	6.8

(Source:www.paho.org/english/ad/dpc/nc/pcc-fact-sheet-LAC.pdf)

(i) On the grid provided on page 11, construct a histogram of the mortality rates for both men and women using the data given in Table 1. **[6 marks]**

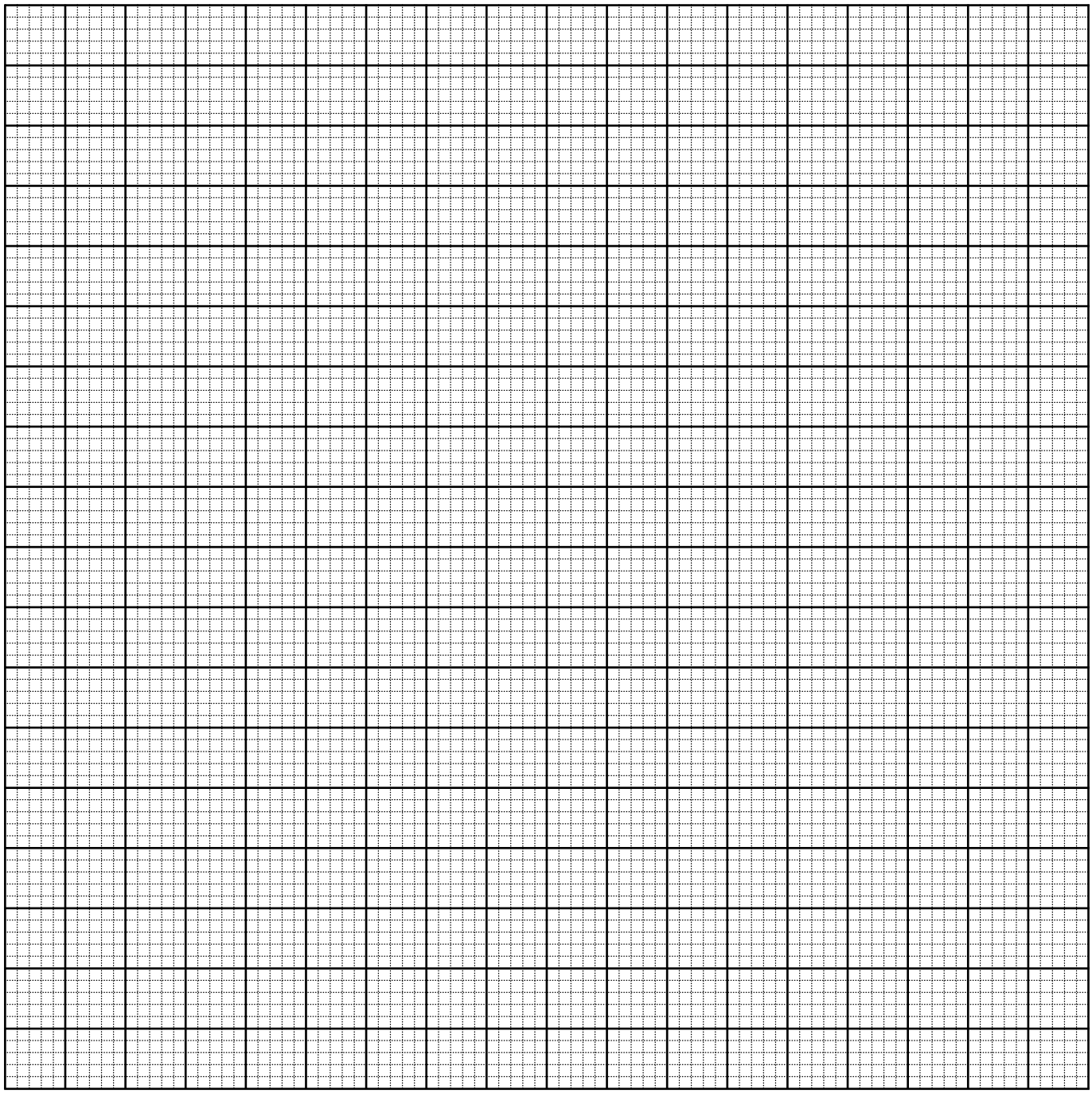
(ii) Based on the data presented in Table 1, comment on which type of cancer is the leading cause of death for men and women, and for both sexes combined. Quote the mortality rate in your answer.

Men: _____

Women:_____

Both sexes: _____

[3 marks]



(b) Figure 6 shows the general relationship between exercise intensity and oxygen consumption.

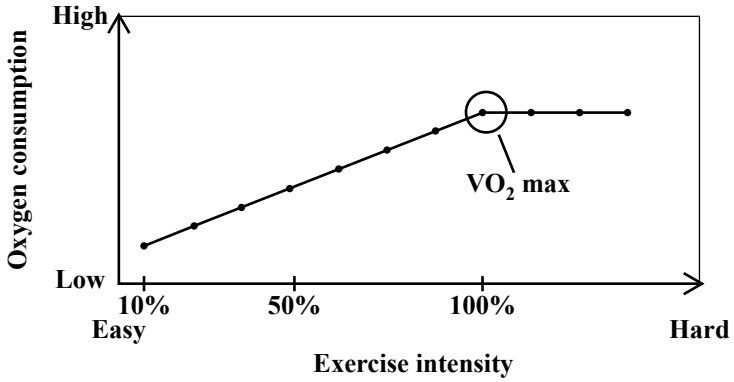


Figure 6. Oxygen consumption relative to exercise intensity

(i) Define the term 'VO_2 max'.

_____

_____

[2 marks]

(ii) Explain the change in the shape of the graph **after** the VO_2 max point.

_____

_____

_____

[2 marks]

(iii) State TWO factors which affect VO_2 max and for EACH give a brief explanation of how it affects the VO_2 max value.

Factor 1:

_____

_____

Factor 2:

_____

_____

[2 marks]

Total 15 marks

SECTION B

Answer ALL questions.

Write your answers in the spaces provided at the end of each question.

4. Global interest in biodiversity has grown rapidly in recent decades, in parallel with the growing concern about the need for conservation.

(a) (i) Explain the concept of 'biodiversity'. **[2 marks]**

(ii) Discuss why biodiversity loss is a major concern. In your discussion, cite ONE direct and TWO indirect benefits of maintaining biodiversity. **[6 marks]**

(b) (i) Distinguish between *in situ* and *ex situ* conservation of biodiversity, giving an example of EACH type of conservation. **[4 marks]**

(ii) Using your knowledge of *ex situ* conservation methods, briefly comment on THREE limitations of using *ex situ* conservation methods to maintain biodiversity. **[3 marks]**

Total 15 marks

Write the answer to Question 4 here.

Write the answer to Question 4 here.

Write the answer to Question 4 here.

5. (a) (i) Give a brief explanation of the concept of 'homeostasis'. **[2 marks]**

(ii) A homeostatic system consists of at least three key components: a receptor, a set point and an effector. Discuss the roles of these THREE key components in a homeostatic system. **[6 marks]**

(b) Collecting ducts play an important role in kidney function and the activity of these ducts is under hormonal control.

(i) Briefly describe the structure of a collecting duct and comment on its role in kidney function. **[4 marks]**

(ii) Explain how the antidiuretic hormone, ADH, regulates the function of the collecting ducts. **[3 marks]**

Total 15 marks

Write the answer to Question 5 here.

GO ON TO THE NEXT PAGE

Write the answer to Question 5 here.

Write the answer to Question 5 here.

6. (a) In addition to the lungs, the heart and circulatory system are also affected by cigarette smoking. Comment on TWO major effects of cigarette smoking on the cardiovascular system of heavy smokers. **[4 marks]**

(b) (i) Describe the origin and maturation of T lymphocytes. **[3 marks]**

(ii) State the THREE types of T-cells and for EACH type outline its main function. **[6 marks]**

(iii) With reference to HIV, explain why T-cells are sometimes unable to effectively eliminate foreign organisms. **[2 marks]**

Total 15 marks

Write the answer to Question 6 here.

Write the answer to Question 6 here.

Write the answer to Question 6 here.

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

TEST CODE **02207032**

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MAY/JUNE 2013

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BIOLOGY

UNIT 2 – Paper 032

ALTERNATIVE TO SCHOOL-BASED ASSESSMENT EXAMINATION

2 hours

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

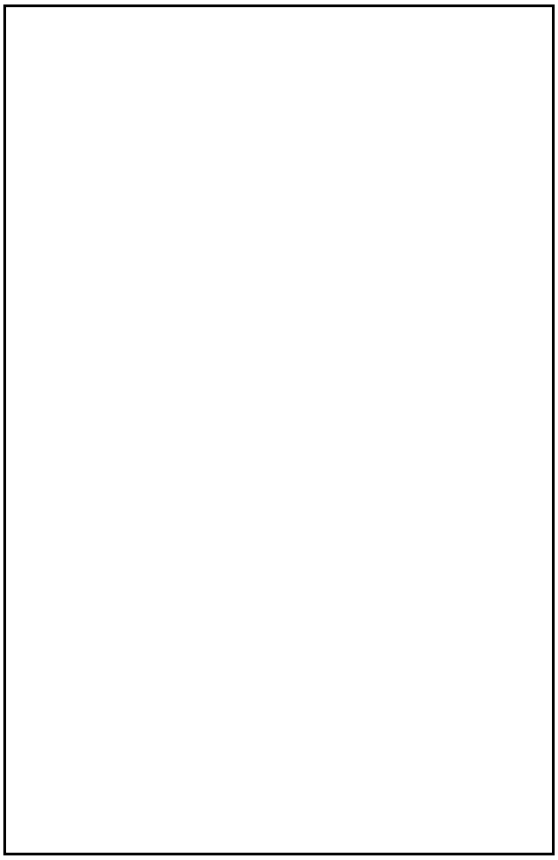
1. This paper consists of THREE questions. Answer ALL questions.
2. Write your answers in the spaces provided in this booklet.
3. You may use a silent non-programmable calculator.
4. Candidates are advised to use the first 15 minutes for reading through this paper carefully.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

1. (a) Specimen **A** is a stained slide of a transverse section of a dicotyledonous leaf. Carefully examine Specimen **A** under the high power objective of your microscope.

(i) In the box below, make a detailed drawing of a representative section of the specimen to show accurately the different types of cells and their distribution in the tissues in the specimen. **[7 marks]**

(ii) Using label lines, identify the main cell(s) of the tissues shown in your drawing. **[3 marks]**



(b) Figure 1 shows some of the relationships among organisms living in a wetland.

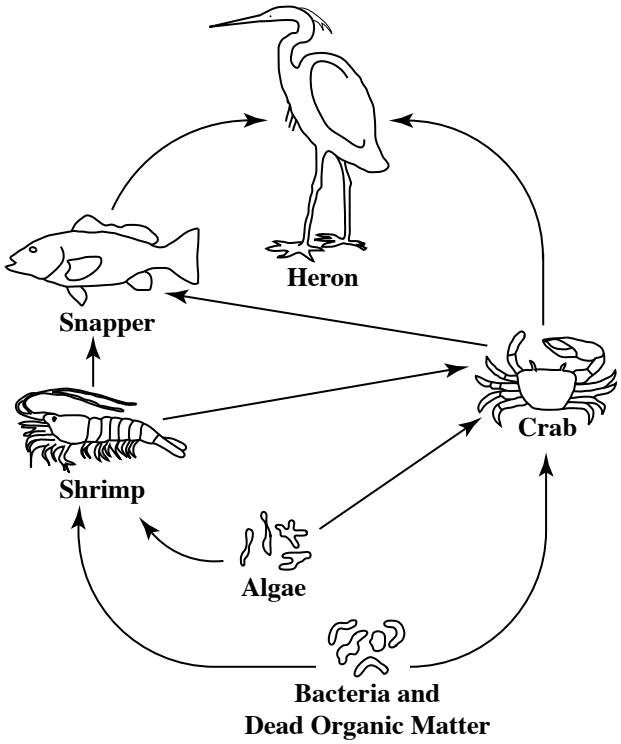


Figure 1. A wetland food web

(i) On Figure 1, use a labelled arrow line to indicate EACH of the following categories of organisms.

– Decomposer as A

– Primary producer as B

– Primary consumer as C

– Secondary consumer as D **[4 marks]**

(ii) Suggest, giving a brief explanation, ONE abiotic and ONE biotic factor which may affect the heron.

Abiotic factor _____

_____

Biotic factor _____

_____

[2 marks]

Total 16 marks

GO ON TO THE NEXT PAGE

2. (a) You are provided with the following apparatus and materials which can be used to investigate the effect of environmental factors on the rate of transpiration of a leafy shoot.

- Leafy shoot cutting
- Length of clear plastic tubing
- Calibrated pipette
- Plasticine
- Retort stand and two clamps

(i) Assemble the apparatus to form a simple potometer. In the box below, make a sketch of your potometer.

[3 marks]

(ii) Formulate a suitable null hypothesis for investigating the effect of wind on the rate of transpiration of a leafy shoot.

_____

_____

[2 marks]

(iii) Outline an experiment to investigate the effect of wind on the rate of transpiration of a leafy shoot. Begin your account from the stage where your potometer has been set up with the leafy shoot in place.

[5 marks]

(b) Figure 2 is a schematic diagram summarizing the sequence of events involved in transmission of a nerve impulse at a typical chemical synapse.

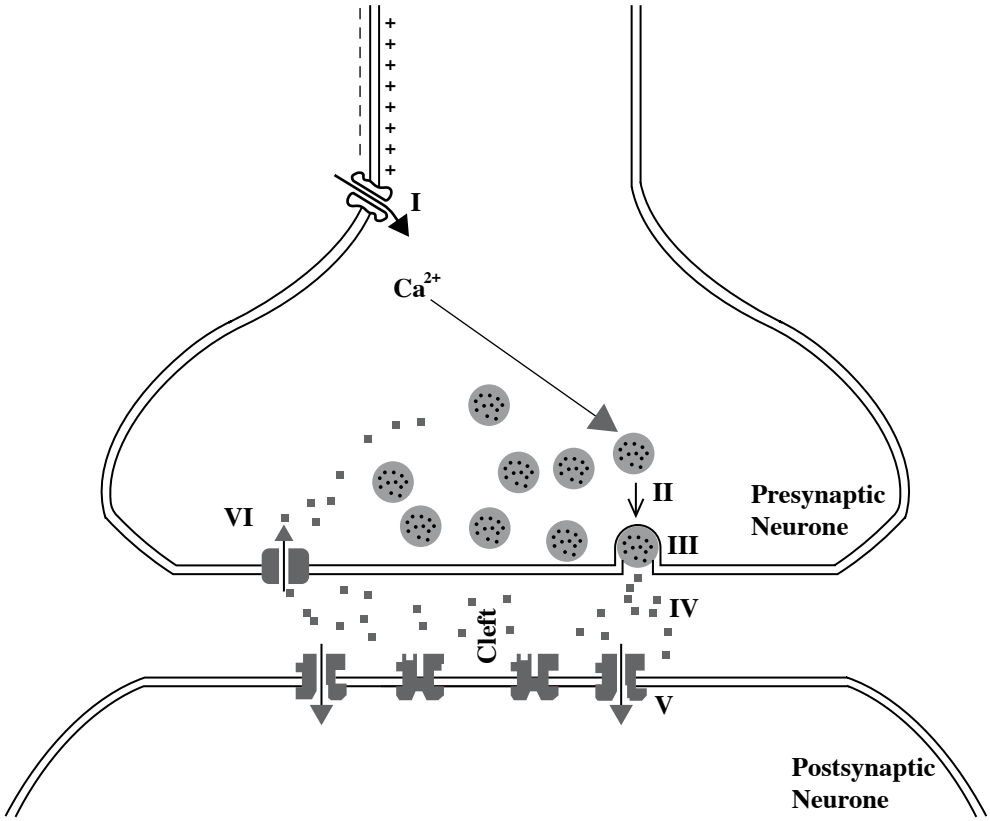


Figure 2. Summary of sequence of events at a chemical synapse

(i) Give a concise description of the events identified by labels I, II, III, IV, V and VI.

I. _____

_____

II. _____

_____

III._____

_____

IV._____

_____

V. _____

_____

VI. _____

_____

[6 marks]

Total 16 marks

3. (a) Table 1 shows the results of a comparison of alcohol, tobacco, and illegal drug use across ten different countries participating in the World Health Organisation World Mental Health Survey Initiative.

TABLE 1: COMPARISON OF ALCOHOL, TOBACCO AND ILLEGAL DRUG USE ACROSS TEN DIFFERENT COUNTRIES

Country	Usage (%)			
	Alcohol	**Tobacco**	**Cannabis**	**Cocaine**
Colombia	94.3	48.1	10.8	4.0
Mexico	85.9	60.2	7.8	4.0
USA	91.6	73.6	42.4	16.2
Germany	95.3	51.9	17.5	1.9
Netherlands	93.3	58.0	19.8	1.9
Ukraine	97.0	60.6	6.4	0.1
Israel	58.3	47.9	11.5	0.9
Nigeria	57.4	16.8	2.7	0.1
South Africa	40.6	31.9	8.4	0.7
PR China	65.4	53.1	0.3	0.0

(i) Describe the general trend in alcohol and tobacco use for the countries shown.

Alcohol _____

_____

_____

Tobacco _____

_____

_____

[4 marks]

GO ON TO THE NEXT PAGE

(ii) Identify the country that shows the HIGHEST use of cannabis and cocaine, and justify your answer with supporting data.

_____

_____

_____

_____

[2 marks]

(iii) Suggest ONE conclusion which may be made from this study.

_____

_____

_____

[2 marks]

(b) Table 2 shows the number of cases of dengue haemorrhagic fever in the Americas for the period 1990–2006.

TABLE 2: CASES OF DENGUE HAEMORRHAGIC FEVER IN THE AMERICAS FOR THE PERIOD 1990–2006

Year	Number of Cases
1990	4 000
1992	2 000
1994	4 100
1996	6 500
1998	12 000
2000	5 200
2002	15 000
2004	10 200
2006	16 000

(i) On the grid provided on page 9, plot a line graph for the data given in Table 2.

[5 marks]

(ii) Briefly describe the general trend in cases of dengue haemorrhagic fever recorded for the period 1990–2006.

_____

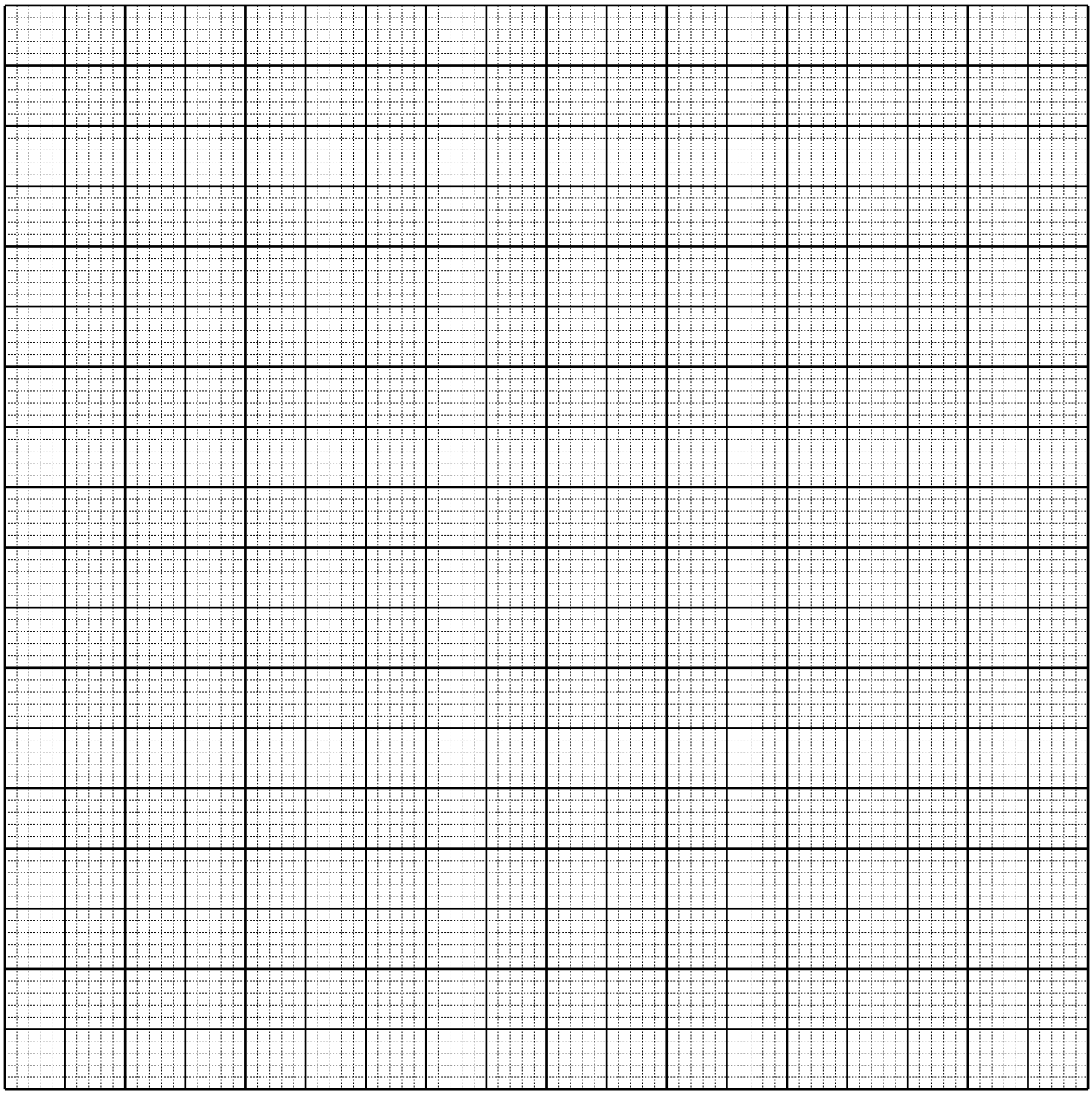
_____

_____

_____

[2 marks]

GO ON TO THE NEXT PAGE



(iii) With reference to the overall trend observed, predict the number of cases which may have been recorded for 2010.

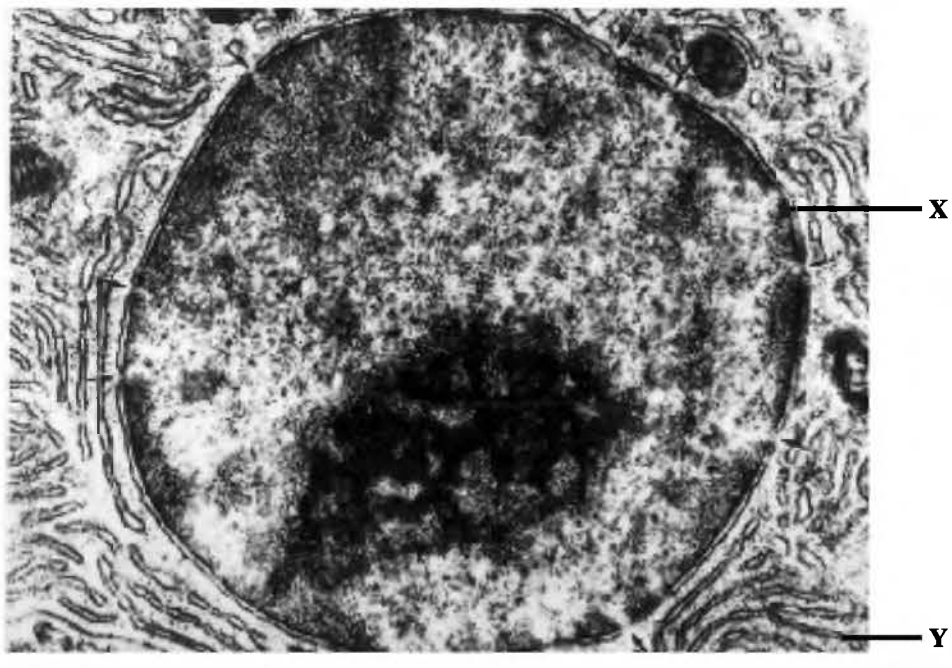
_____

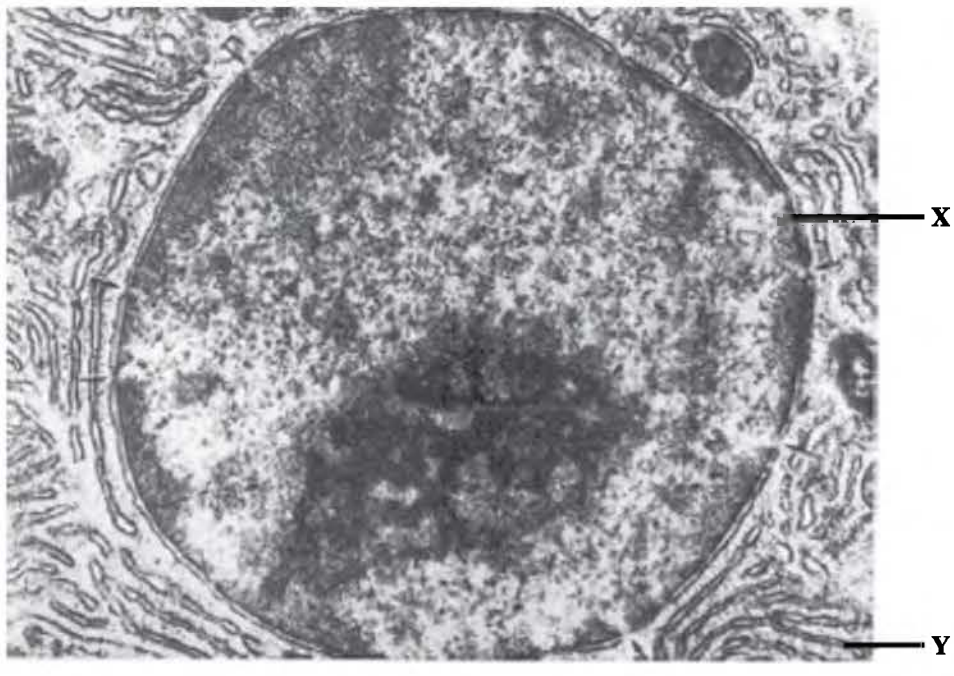
[1 mark]

Total 16 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.


X
Y


X
Y

TEST CODE **02107020**

FORM TP 2014141

MAY/JUNE 2014

CARIBBEAN EXAMINATIONS COUNCIL

CARIBBEAN ADVANCED PROFICIENCY EXAMINATION®

BIOLOGY

UNIT 1 – Paper 02

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULY.

1. This paper consists of SIX questions in two sections. Answer ALL questions.
2. For Section A, write your answers in the spaces provided in this booklet.
3. For Section B, write your answers in the spaces provided at the end of each question in this booklet.
4. You may use a silent non-programmable calculator.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions.

Write your answers in the spaces provided in this booklet.

1. (a) Using haemoglobin as an example, explain EACH of the following levels of structural organization of proteins:

(i) Primary structure

_____

_____

[1 mark]

(ii) Secondary structure

_____

_____

_____

_____

[2 marks]

(iii) Tertiary structure

_____

_____

_____

_____

[2 marks]

(iv) Quaternary structure

_____

_____

_____

_____

[2 marks]

(b) With reference to its protein structure, explain how the haemoglobin molecule functions in its essential role.

_____

_____

_____

_____

_____

_____

[3 marks]

(c) Figure 1 is a drawing of an electron micrograph of a plant cell.

Ramesar, Jones and Jones 2011, Fig. 2.15, page 41

Figure 1. Drawing of an electron micrograph of a plant cell (× 5600)

(i) Identify the organelles labelled A, B and C in Figure 1.

A: _____

B: _____

C: _____

[3 marks]

(ii) Calculate the actual maximum length of the organelle labelled X to the nearest micrometre (μm). **Show your working**.

Length: _____

[2 marks]

Total 15 marks

GO ON TO THE NEXT PAGE

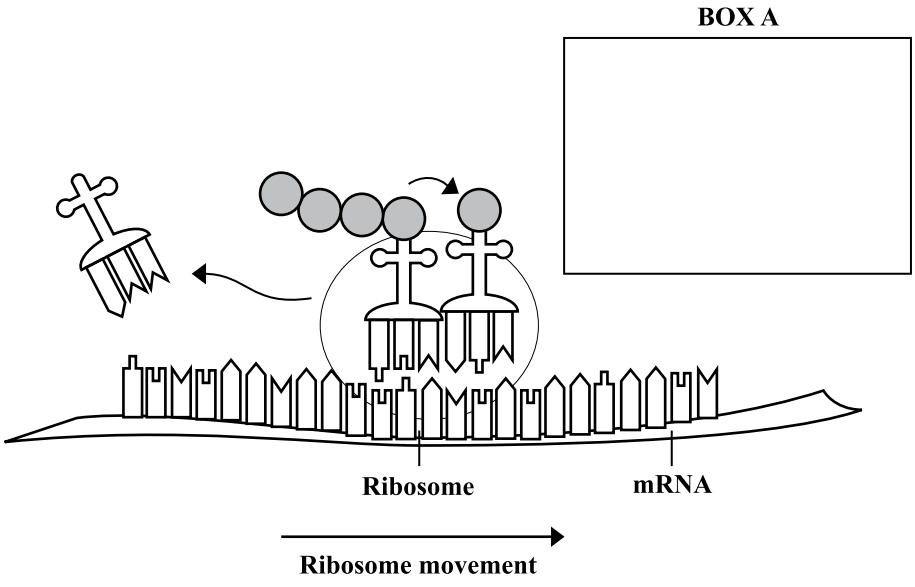
2. (a) (i) Protein synthesis requires two steps, transcription and translation. Table 1 is an incomplete comparison of some features of transcription and translation in eukaryotes. Complete Table 1 by writing the correct answers in the relevant spaces in the table.

TABLE 1: COMPARISION OF TRANSCRIPTION AND TRANSLATION

Feature	Transcription	Translation
Site	Generally in the nucleus	
Precursor molecule		mRNA
Enzymes and/or factors	RNA polymerase and other associated proteins	
Function		Produces the peptide sequence which is complementary to the mRNA

[4 marks]

(ii) Figure 2 is a diagrammatic representation of the elongation phase of translation. In the box labelled A in Figure 2, sketch a diagrammatic representation of the tRNA molecule carrying the next amino acid to be added to the growing polypeptide chain.



Source: http://www.motifolio.com/1021138.html

Figure 2. Diagrammatic representation of the elongation phase of translation

[3 marks]

GO ON TO THE NEXT PAGE

(b) In humans, the A, B, O blood groups are determined by multiple alleles of a single gene. The gene locus is usually represented by the symbol **I** and the blood genotypes may be represented as follows:

– $\mathbf{I^AI^A}$ **or** $\mathbf{I^Ai}$ = blood group A
– $\mathbf{I^BI^B}$ **or** $\mathbf{I^Bi}$ = blood group B
– **ii** = blood group O
– $\mathbf{I^AI^B}$ = blood group AB

(i) Briefly explain the nature of the relationship between the alleles in the AB blood group.

_____

_____

_____

[2 marks]

(ii) In a paternity suit, a female with blood type O has accused a male with blood type B of being the father of her child. The child has blood type O.

a) Deduce the blood genotype of the accused male which will clearly prove that he is NOT the father of the child. Give a brief explanation to justify your answer.

Blood genotype of male (no symbols required): _____

Justification: _____

_____

_____

_____

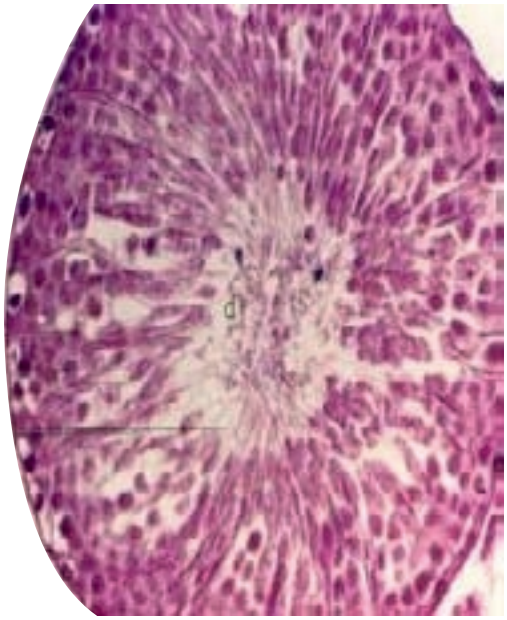
[3 marks]

b) If the male parent in (b) (ii) a) above has blood type B, demonstrate the inheritance of the blood type (O) of the child. Use the given symbols and a Punnett square.

[3 marks]

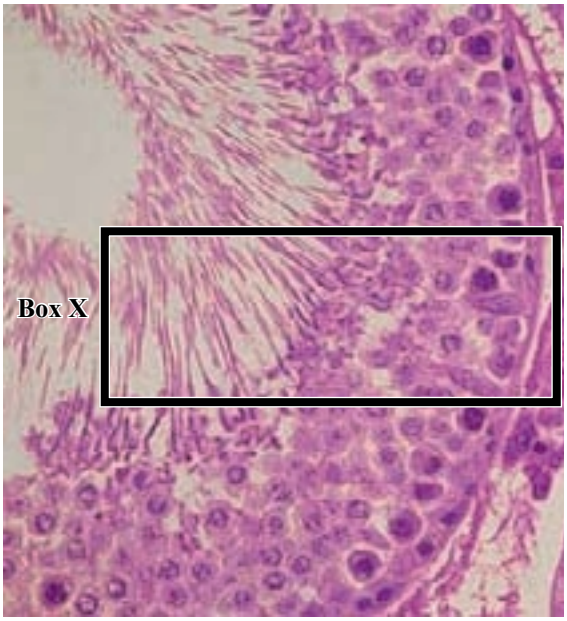
Total 15 marks

3. (a) Figure 3 is a photomicrograph of a cross section of a seminiferous tubule, and Figure 4 shows a part of the tubule.



A

Figure 3. Photomicrograph of a section of a seminiferous tubule



http://www.pmrc.org.pk

B

Figure 4. Part of Tubule A

(i) Make a detailed labelled drawing of the region highlighted by Box X in Figure 4 B. **[6 marks]**

(ii) Using Figure 3 or Figure 4 as a guide, outline the key development stages of spermatozoa within the seminiferous tubule.

_____

_____

_____

_____

_____

_____

[3 marks]

(b) An experiment is conducted to investigate the effect of sucrose concentration on the germination of pollen grains for a particular plant species. The results are shown in Figure 5.

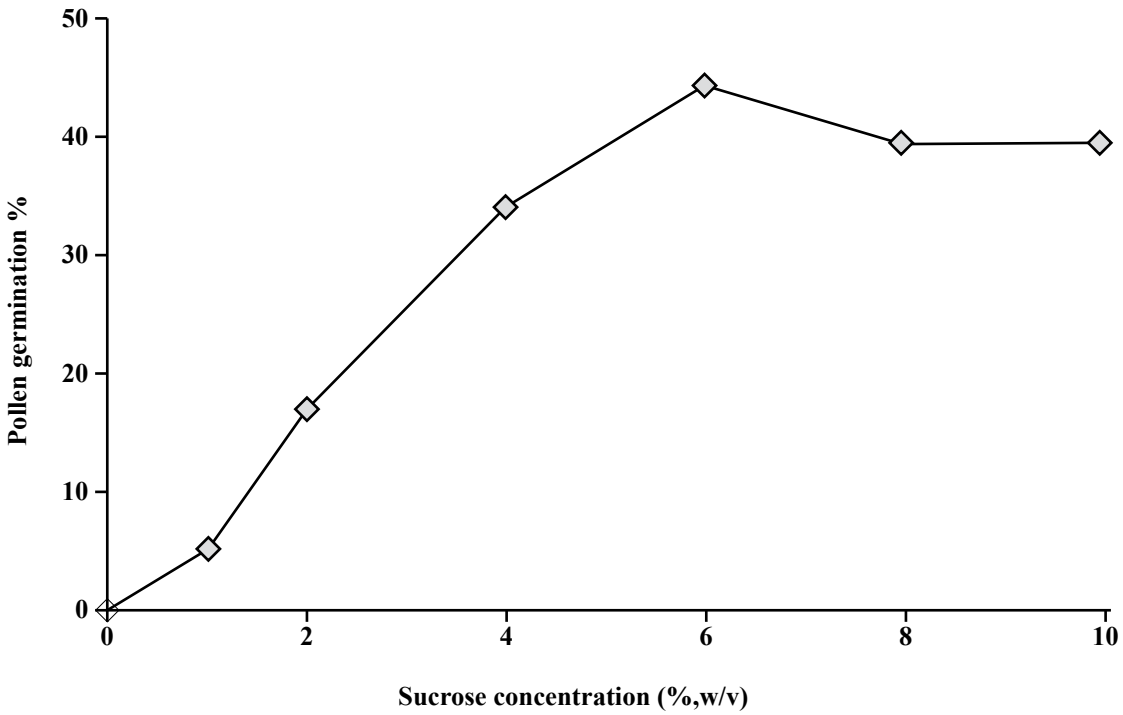


Figure 5. Effect of sucrose concentration on germination of pollen grains

(i) Briefly describe the results of this experiment shown in Figure 5.

_____

_____

_____

_____

[2 marks]

(ii) Explain the significance of this response for the pollination process.

_____

_____

_____

_____

_____

_____

_____

_____

[4 marks]

Total 15 marks

SECTION B

Answer ALL questions.

Write your answers in the spaces provided at the end of each question.

4. (a) Outline the structure of a molecule of water and explain how this structure allows water to be an excellent solvent. **[5 marks]**

(b) Discuss TWO major roles of water in cell function. **[4 marks]**

(c) Distinguish between endocytosis and exocytosis, and briefly comment on ONE cellular process that involves exocytosis. **[6 marks]**

Total 15 marks

Write the answer to Question 4 here.

Write the answer to Question 4 here.

Write the answer to Question 4 here.

5. (a) State FOUR observations and THREE deductions that formed the basis of Darwin's theory of natural selection. **[5 marks]**

(b) Use the theory of natural selection to explain how a new species can evolve from an existing one by allopatric (geographical) speciation. **[4 marks]**

(c) Discuss THREE potential threats to humans, and other organisms, of the use of genetically modified crops. Include a definition of the term 'genetically modified organism'. **[6 marks]**

Total 15 marks

Write the answer to Question 5 here.

Write the answer to Question 5 here.

Write the answer to Question 5 here.

6. (a) (i) Explain why vegetative propagation is NOT considered a form of sexual reproduction. Include in your explanation a brief definition of 'vegetative propagation'. **[3 marks]**

(ii) Comment on why vegetative propagation is especially beneficial to agriculturists and horticulturists. Limit your commentary to FOUR main points. **[4 marks]**

(b) (i) Give a concise explanation of how combined oral contraceptives work to prevent pregnancy. **[3 marks]**

(ii) A young, recently married couple seeks advice at a family planning clinic. The 23-year-old female explains that her last normal menstrual cycle started two weeks ago and they both confirm that they have not engaged in sexual intercourse since then. She would like to begin using combined oral contraceptives immediately, as she has been advised that there are no medical reasons which prevent her from using this form of contraception.

Suggest what advice should be given to the couple about the most appropriate way to use combined oral contraceptives. Include in your account, justification of your advice in relation to the physiological details provided by the couple and your knowledge of the menstrual cycle. **[5 marks]**

Total 15 marks

Write the answer to Question 6 here.

Write the answer to Question 6 here.

Write the answer to Question 6 here.

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

TEST CODE **02107032**

FORM TP 2014142

MAY/JUNE 2014

C A R I B B E A N E X A M I N A T I O N S C O U N C I L

CARIBBEAN ADVANCED PROFICIENCY EXAMINATION®

BIOLOGY

UNIT 1 – Paper 032

ALTERNATIVE TO SCHOOL-BASED ASSESSMENT

2 hours

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE questions. Answer ALL questions.
2. Write your answers in the spaces provided in this booklet.
3. You may use a silent non-programmable calculator.
4. You are advised to take some time to read through this paper carefully.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

Please begin Question 1 FIRST.

1. (a) (i) You are required to carry out a semi-quantitative test for glucose on an unknown solution, Z.

You are provided with the following five solutions in test tubes:

Test Tube A containing 2 cm^3 of distilled water

Test Tube B containing 2 cm^3 of 0.1% glucose

Test Tube C containing 2 cm^3 of 0.5% glucose

Test Tube D containing 2 cm^3 of 1.0% glucose

Test Tube E containing 2 cm^3 of the unknown solution, Z

PROCEDURE

1. Add 2 cm^3 of Benedict's solution to EACH of the test tubes labelled A, B, C, D and E.

2. Carefully shake each test tube and note the initial colour of the mixture. Record your observations in the appropriate column in Table 1.

3. Place the five test tubes in a heated water-bath to bring gently to a boil.

4. Remove the test tubes from the water-bath.

5. Note the final colour and record your observations in the appropriate column in Table 1.

TABLE 1: RESULTS OF EXPERIMENT

Test Tube	Solution	Initial Colour	Final Colour
A	Distilled water		
B	0.1% Glucose		
C	0.5% Glucose		
D	1.0% Glucose		
E	Solution Z		

[5 marks]

(ii) Based on your results, deduce the glucose concentration in Solution Z. Justify your answer.

Concentration of Solution Z: _____

Justificaiton: _____

_____

_____

[3 marks]

(b) Starting with a 10% glucose stock solution, calculate the volume of stock solution (cm^3) and distilled water (cm^3) that must be combined to give 100 cm^3 of 0.5% glucose solution. **Show your working**.

Volume of stock: _____

Volume of water: _____

[2 marks]

(c) Figure 1 shows the effect of temperature on the activity of a particular enzyme.

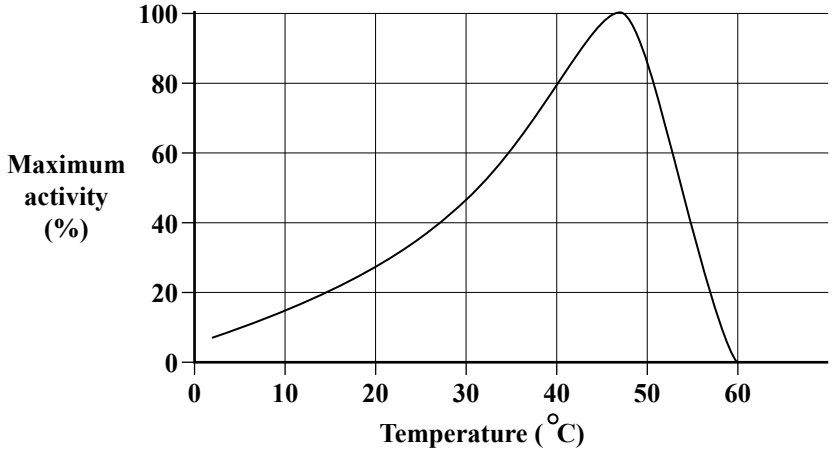


Figure 1. Effect of temperature on the activity of an enzyme

(i) Describe the effect of temperature on the activity of this enzyme.

_____

_____

_____

_____

_____

_____

[3 marks]

(ii) Determine the optimum temperature for the activity of the enzyme, based on the information provided in Figure 1.

_____

[1 mark]

(iii) Give an explanation for the steep decline in enzyme activity as temperatures become very high.

_____

_____

_____

[2 marks]

Total 16 marks

2. (a) Figure 2 is a photomicrograph of onion root tip cells, showing four key stages of mitosis.

I **II** **III** **IV**

Figure 2. Photomicrograph of onion root tip cells showing stages of mitosis

http://www.marietta.edu/-biol/introlab/Onion%20root%20mitosis.pdf

(i) Identify the stages labelled I, II, III and IV and for EACH stage, state ONE observable feature which justifies your identification.

Identity of Stage **I**: _____

Justification: _____

Identity of Stage **II**: _____

Justification: _____

Identity of Stage **III**: _____

Justification: _____

Identity of Stage **IV**: _____

Justification: _____

[8 marks]

(ii) Name TWO features that would be clearly observed during mitosis if Stage IV is examined at a higher magnification of a compound microscope.

_____

_____

[2 marks]

GO ON TO THE NEXT PAGE

(b) Seed colour in a plant species is determined by a single gene, Y, such that YY = yellow, Yy = yellow and yy = green. The expected and observed numbers of seeded offspring are given in Table 2.

TABLE 2: EXPECTED AND OBSERVED NUMBERS OF SEEDED OFFSPRING

Colour	Expected Number	Observed Number
Yellow	375	380
Green	120	120

(i) Calculate the Chi-square value using the following formula:

$$\chi^2 = \Sigma \frac{(O - E)^2}{E}$$

Show your working.

Value: _____

[3 marks]

(ii) If the Chi-square value for one degree of freedom at p = 0.05 is 3.84, what conclusions can be made, based on the results obtained in (b) (i) above.

_____

_____

_____

_____

[3 marks]

Total 16 marks

GO ON TO THE NEXT PAGE

3. (a) Specimen A is a section of an entire ovary of a mammal. Examine the section under a low power objective of the compound microscope. In the space below, make a labelled, plan drawing of the specimen to show accurately the shape of the ovary and the distribution of tissues in it. State the magnification of your drawing.

[7 marks]

(b) Table 3 shows data for changes in the lipid and sugar content of seeds during germination in the dark.

TABLE 3: LIPID AND SUGAR CONTENT OF SEEDS

Time From Sowing (days)	Mass per 100 Seeds (g)	
	Lipid	**Sugar**
2	26	2
4	24	6
5	16	11
6	12	20
7	8	23
8	5	24
10	3	20
11	2	18

(i) On the grid provided on page 9, draw line graphs to illustrate the data in Table 3.

[5 marks]

(ii) Describe the trend for changes in **sugar** content of the seeds shown in the graph.

_____

_____

_____

[2 marks]

(iii) Suggest reasons for the changes in lipid and sugar content of the seeds as germination progresses.

Lipid: _____

_____

_____

Sugar: _____

_____

_____

[2 marks]

Total 16 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

TEST CODE **02207020**

FORM TP 2014144

MAY/JUNE 2014

C A R I B B E A N E X A M I N A T I O N S C O U N C I L

CARIBBEAN ADVANCED PROFICIENCY EXAMINATION®

BIOLOGY

UNIT 2 – Paper 02

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in two sections. Answer ALL questions.
2. For Section A, write your answers in the spaces provided in this booklet.
3. For Section B, write your answers in the spaces provided at the end of each question in this booklet.
4. You may use a silent non-programmable calculator.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions.

Write your answers in the spaces provided in this booklet.

1. (a) Figure 1 is a diagram of the structure of part of a mitochondrion as seen in longitudinal section.

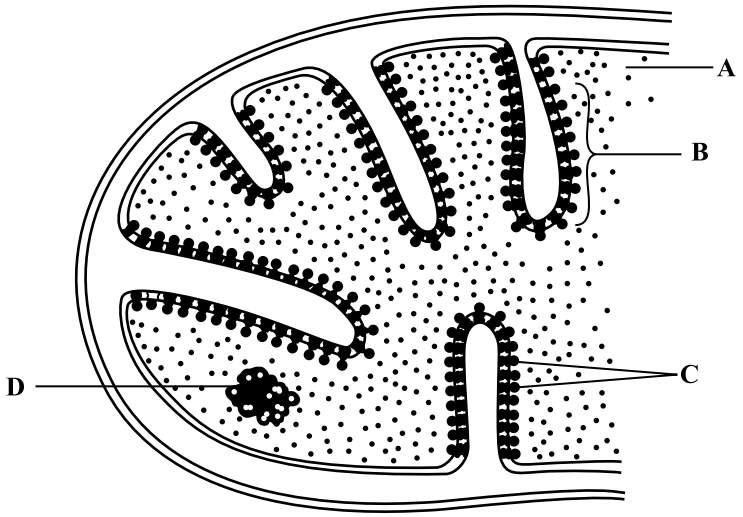


Figure 1. Structure of a mitochondrion

Redrawn from: http://www.hindawi.com/journals/jo/2010/604304/fig1/

(i) Identify the structures labelled A, B, C and D in Figure 1.

A: _____

B: _____

C: _____

D: _____

[4 marks]

(ii) Using an arrow labelled X, indicate the site of the Krebs cycle on Figure 1.

[1 mark]

(b) In an experiment investigating the effects of factors which may limit photosynthesis, some leaves are exposed to two concentrations of atmospheric carbon dioxide. The photosynthetic rates of the leaves are measured at different temperatures. The results of the experiment are shown in Figure 2.

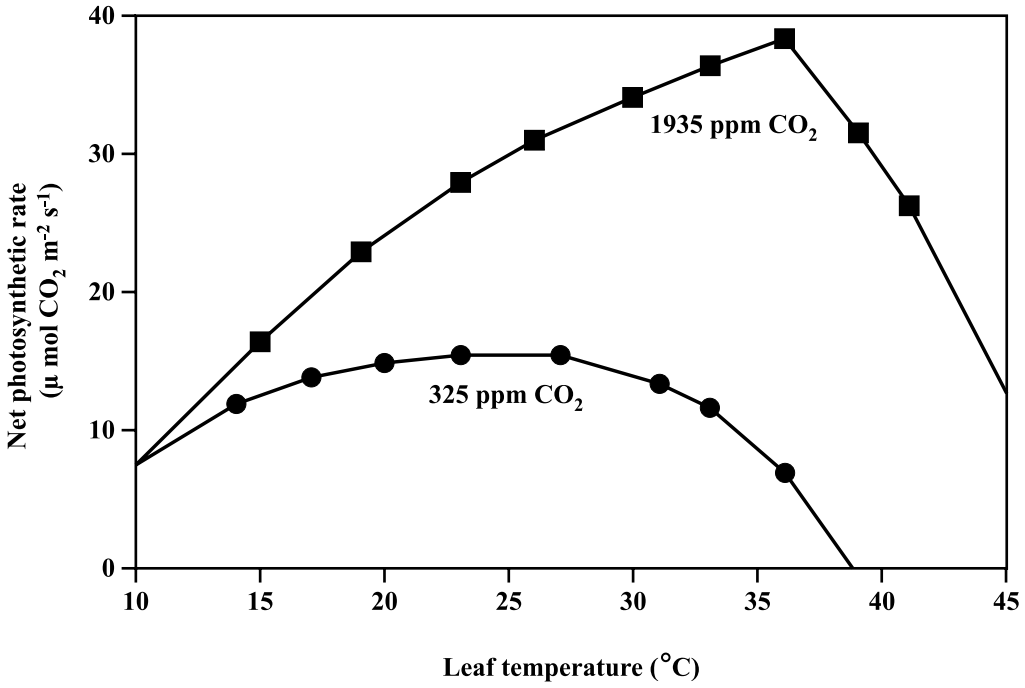


Figure 2. Effect of temperature and carbon dioxide concentration on photosynthetic rate of some leaves

http://www.friendsofscience.org/assets/documents/FOS%20Essay/Climate_Change_Science.html

(i) Describe the relationship between leaf temperature and net photosynthetic rate at **1935 ppm CO_2**.

_____

_____

_____

_____

_____

[3 marks]

(ii) With reference to data presented in Figure 2, explain the effect of the increase in CO_2 concentration on the rate of photosynthesis, taking into consideration the temperature of the leaf.

_____

_____

_____

_____

_____

_____

[3 marks]

(iii) Briefly comment on how an understanding of temperature and carbon dioxide, as limiting factors of photosynthesis, may be used by farmers to increase crop yield in greenhouses.

_____

_____

_____

_____

_____

_____

_____

[4 marks]

Total 15 marks

2. (a) The uptake of potassium ions by young cereal roots is measured over time at two temperatures, 0 °C and 25 °C. Potassium cyanide (a respiratory inhibitor) is added after 90 minutes, at both temperatures. The results are shown in Figure 3.

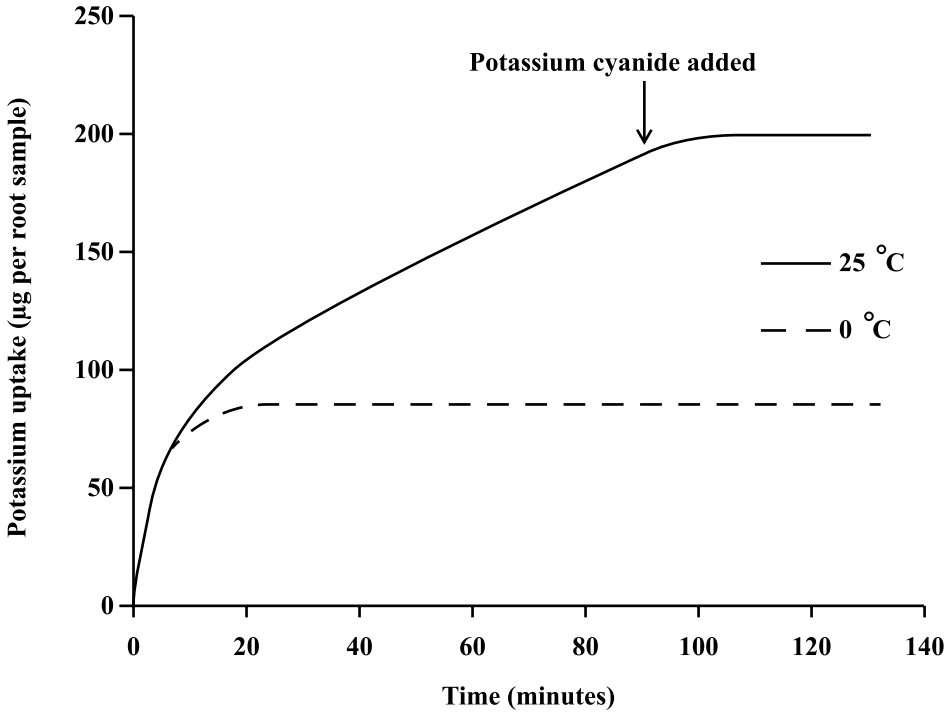


Figure 3. Absorption of potassium ions by young cereal roots at 0 °C and 25 °C

http://www.wellcome.ac.uk/en/bia/gallery.htm

State the effect of potassium cyanide on potassium uptake at EACH temperature (0 °C and 25 °C), and give a brief explanation.

0 °C: _____

_____

_____

25 °C: _____

_____

_____

[4 marks]

(b) Using a labelled diagram of a transverse section of a root (including a root hair), illustrate THREE pathways by which water moves from soil into root cells. Limit your illustration to a small section of the epidermis and cortex containing 6 – 8 cells.

Note: Use a key to distinguish between pathways.

[6 marks]

(c) Figure 4 is a simplified diagram of a longitudinal section of a mammalian heart.

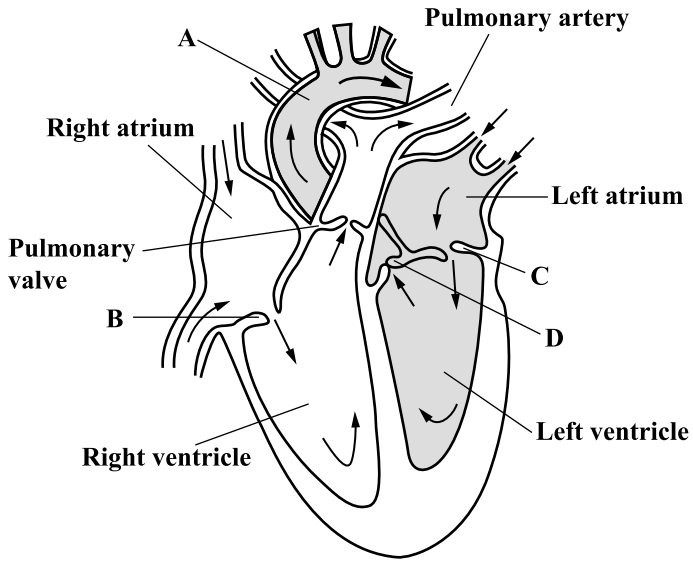


Figure 4. Simplified diagram of a longitudinal section of a mammalian heart

(i) Identify the structures labelled A, B, and C in Figure 4.

A: _____

B: _____

C: _____

[3 marks]

(ii) Explain how arterial pressure is affected if the structure **labelled D** is defective.

_____

_____

_____

_____

[2 marks]

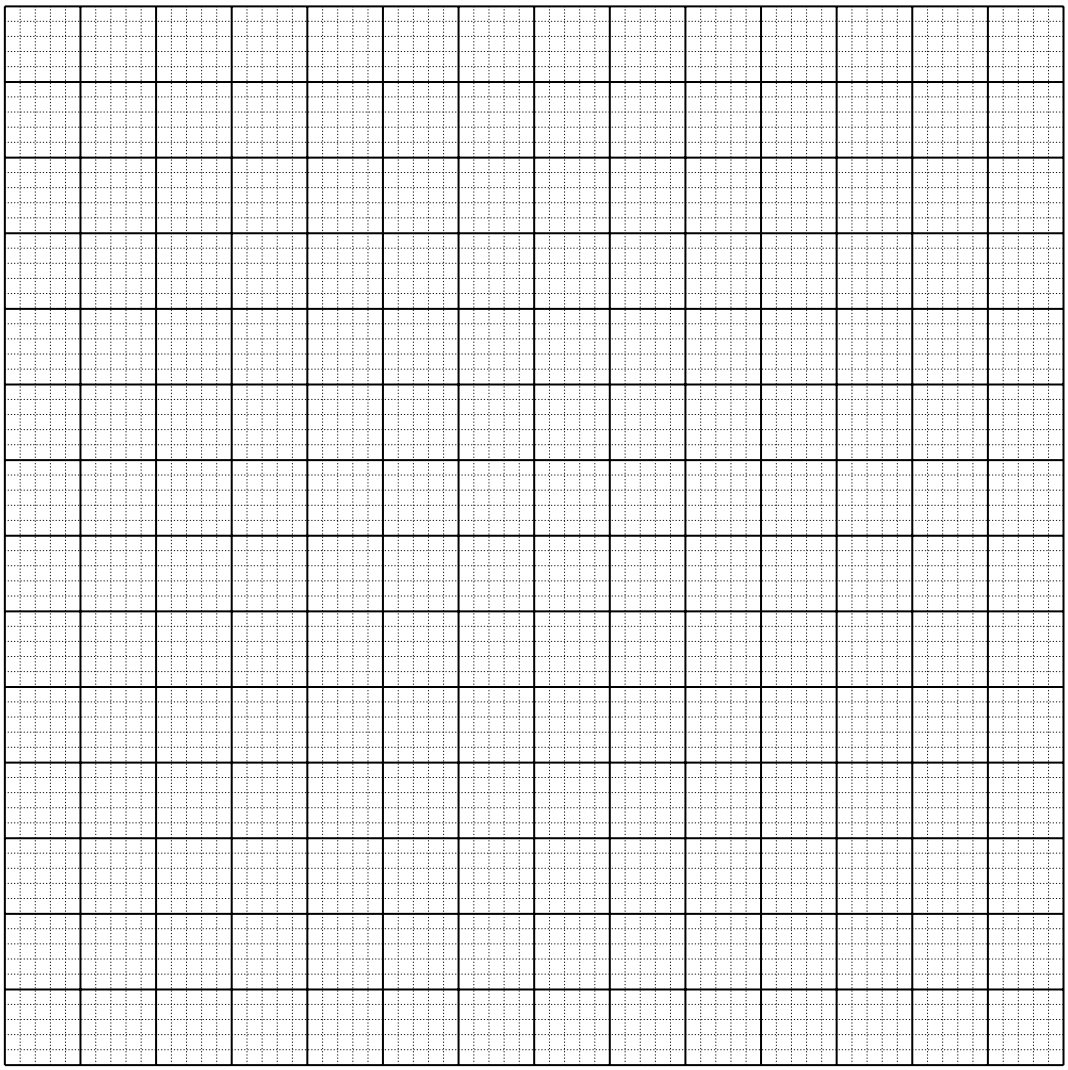
Total 15 marks

3. (a) Obesity in pre-school children (<5 years of age) has increased over recent decades but trends vary among different regions. Table 1 shows estimates of the percentage of overweight and obesity in pre-school children in different regions for the period 1990–2010.

TABLE 1: PERCENTAGE OF OVERWEIGHT AND OBESITY IN CHILDREN, 1990–2010

	1990	**1995**	**2000**	**2005**	**2010**
Africa	4.0	4.7	5.7	6.9	8.5
Asia	3.2	3.4	3.7	4.2	4.9
Latin America and the Caribbean	6.8	6.8	6.8	6.9	6.9

(i) On the grid provided below, draw line graphs of the data in Table 1 for **Africa** and **Asia**. **[5 marks]**



(ii) Compare the trend in percentage of overweight and obesity for **Africa** with that of **Latin America and the Caribbean**, over the period 1990–2010.

_____

_____

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_____

[2 marks]

(iii) Suggest TWO key strategies which may be effective in reducing or preventing obesity in pre-school children.

_____

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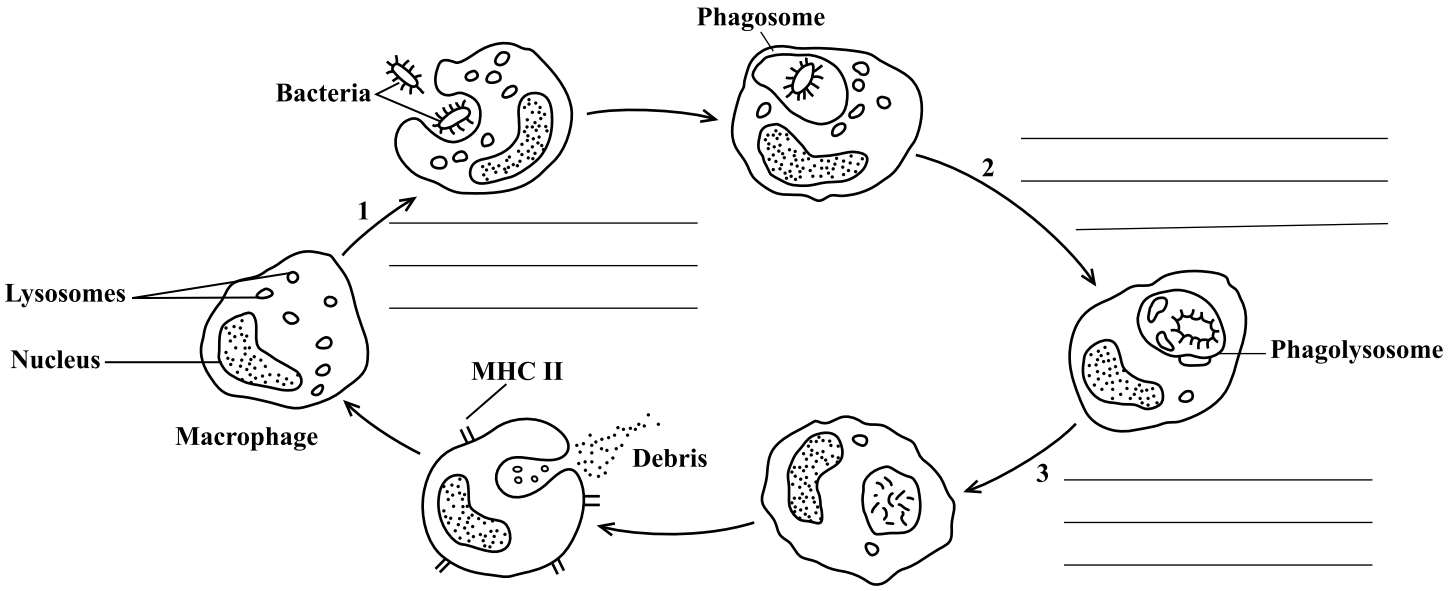
[2 marks]

(b) Figure 5 shows the steps involved in the phagocytic process in macrophages.



http://textbookofbacteriology.net/innate_5.html

Figure 5. Phagocytosis of bacteria by a macrophage

(i) On Figure 5, use annotations to describe the steps labelled 1, 2 and 3. **[3 marks]**

(ii) Outline how a macrophage may act as an antigen-presenting cell.

_____

_____

_____

_____

_____

_____

[3 marks]

Total 15 marks

SECTION B

Answer ALL questions.

Write your answers in the spaces provided at the end of each question.

4. (a) Give an analysis of potential energy losses across trophic levels in a food chain. **[4 marks]**

(b) Comment on the importance of food web complexity in an ecosystem. In your answer, explain what is meant by a food web. **[4 marks]**

(c) Describe SIX biotic interactions that can occur in an ecosystem. Include a brief explanation of the term 'biotic interaction'. **[7 marks]**

Total 15 marks

Write the answer to Question 4 here.

Write the answer to Question 4 here.

Write the answer to Question 4 here.

5. (a) (i) Give a concise explanation of the term 'translocation' in plants. **[2 marks]**

(ii) Apple growers in Japan sometimes make a non-lethal spiral slash around the bark of trees destined for removal after the growing season. This practice makes the apples sweeter.

With reference to the mass flow principle, explain the biological basis of this practice for making the apples sweeter. **[Note: details of mass flow hypothesis are NOT required.]** **[4 marks]**

(b) Mammalian neurones in a resting state normally have a membrane potential of approximately − 70 millivolts. If the plasma membrane is depolarized an action potential is generated.

(i) Outline the main steps in the depolarization phase of an action potential. **[Note: details of repolarization are NOT required.]** **[6 marks]**

(ii) A common practice in dentistry is the use of local anesthetic injections of Lidocaine to numb a target area. Lidocaine is known to bind to receptor sites of sodium channels.

Suggest, giving a brief explanation, what effect Lidocaine may have on the generation of an action potential. **[3 marks]**

Total 15 marks

Write the answer to Question 5 here.

Write the answer to Question 5 here.

Write the answer to Question 5 here.

6. (a) Explain the association between excessive dietary fat intake and hypertension. Include in your account a brief explanantion of the term 'hypertension', and a concise description of plaque formation in arteries. **[7 marks]**

(b) Distinguish between chronic bronchitis and emphysema, and explain how these chronic obstructive respiratory diseases can develop due to cigarette smoking. **[8 marks]**

Total 15 marks

Write the answer to Question 6 here.

Write the answer to Question 6 here.

Write the answer to Question 6 here.

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

TEST CODE **02207032**

FORM TP 2014145

MAY/JUNE 2014

C A R I B B E A N E X A M I N A T I O N S C O U N C I L

CARIBBEAN ADVANCED PROFICIENCY EXAMINATION®

BIOLOGY

UNIT 2 – Paper 032

ALTERNATIVE TO SCHOOL-BASED ASSESSMENT

2 hours

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE questions. Answer ALL questions.
2. Write your answers in the spaces provided in this booklet.
3. You may use a silent non-programmable calculator.
4. You are advised to take some time to read through this paper carefully.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

NOTHING HAS BEEN OMITTED.

1. (a) (i) Design an experiment to determine the effect of temperature on the rate of respiration in germinating peas. The apparatus and materials for the experiment are listed below. Your answer must include a minimum of EIGHT steps and must refer to ALL items listed below.

Apparatus and Materials

Soda lime granules in muslin	Manometer fluid
Two 5 cm^3 syringes	Stop clock
Germinating pea seeds	Water-bath
Dry pea seeds	Filter paper
Graduated capillary tube with rubber stopper	Ice
Petroleum jelly	

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[8 marks]

(ii) State TWO precautions which must be taken when setting up the apparatus.

_____

_____

[2 marks]

(b) Despite increased awareness about the importance of biodiversity, human activity continues to be a fundamental cause of loss of biodiversity. Figure 1 shows the relationship between human population growth and species extinction.

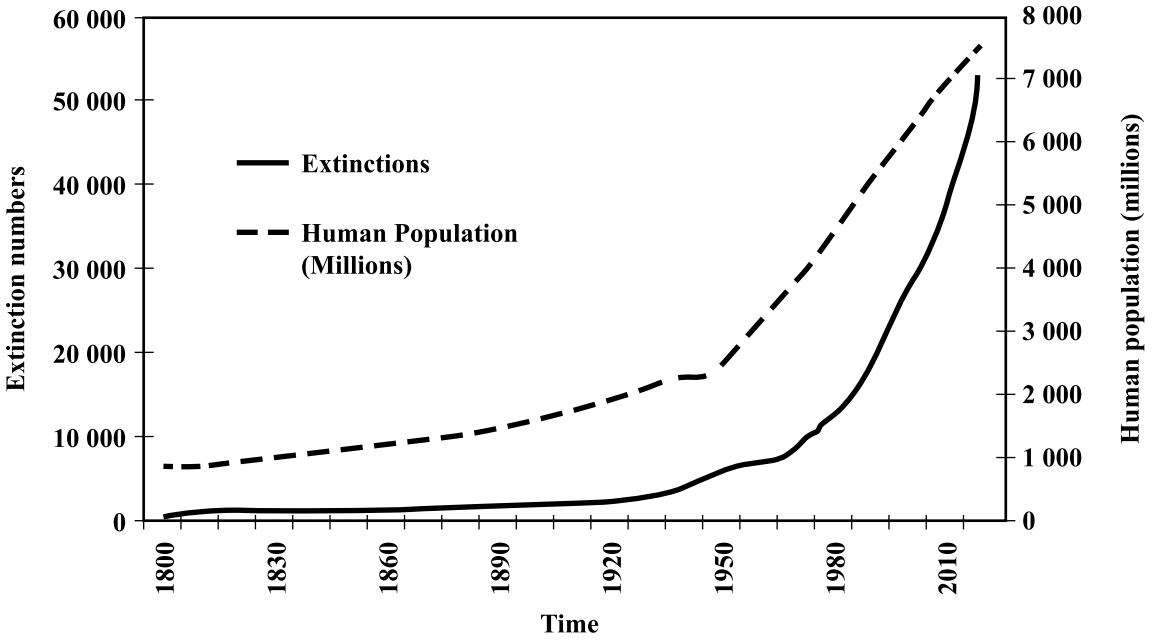


Figure 1. Human population growth and number of extinct species between 1800 and 2010

http://www.biologicaldiversity.org/campaigns/overpopulation/extinction/index.html

(i) With reference to Figure 1, describe the overall similarity between the trend observed for the rate of human population growth and the rate of species extinction, over the period 1800 to 2010.

_____

_____

_____

[2 marks]

(ii) Compare the rate of change in species extinction over the period 1800 to 1900 with the rate of change over the period 1900 to 2000. Note: exact values for the rates need NOT be stated.

_____

_____

_____

[2 marks]

(iii) Comment on the single GREATEST threat to world biodiversity in this century.

_____

_____

_____

[2 marks]

Total 16 marks

2. (a) Figure 2 is a photomicrograph of a section of a renal corpuscle in the kidney.

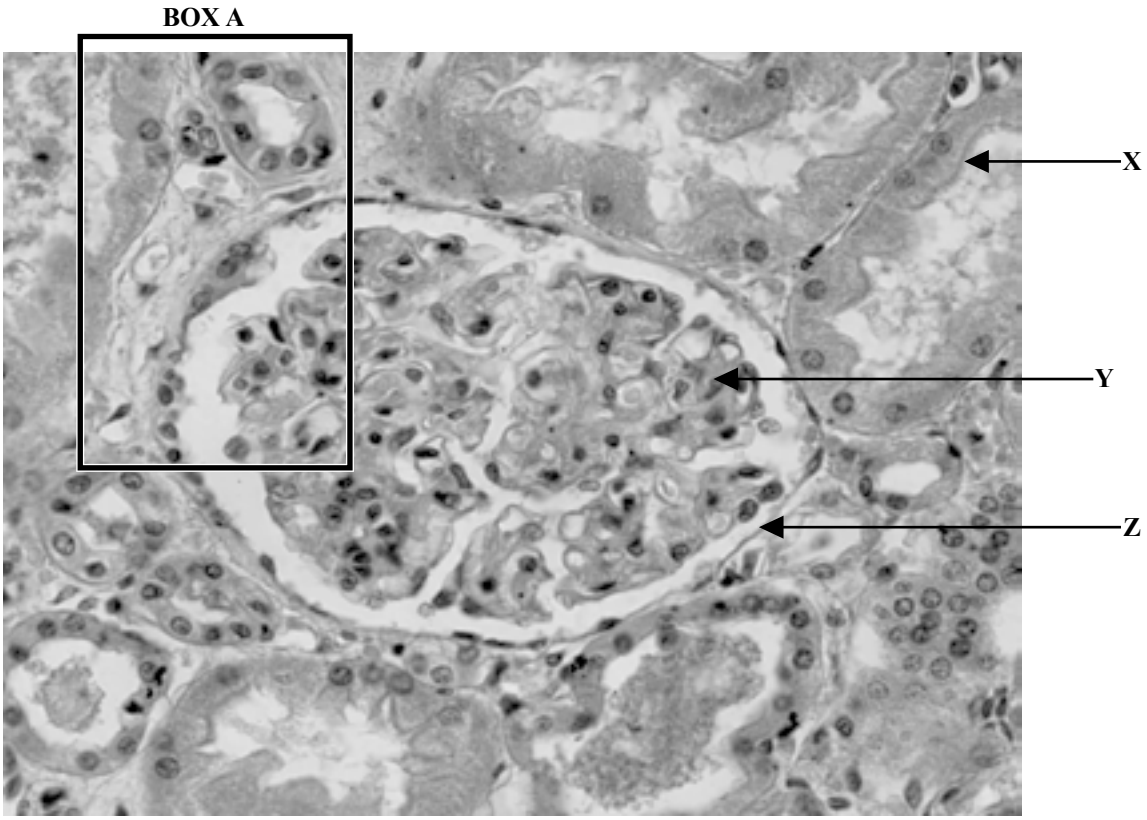


Figure 2. Section of a renal corpuscle in the kidney

http://www.onlinehealthcaredegrees.com/resources/picture-atlas-to-microanatomy/

(i) In the box below, make a detailed drawing of the region highlighted by Box A in Figure 2. Make your drawing the same size as the highlighted section.

[5 marks]

(ii) Identify the structures highlighted by the arrows labelled, X, Y and Z.

X: _____

Y: _____

Z: _____

[3 marks]

(b) Figure 3 is a photomicrograph of a transverse section of a companion cell (CC) and a sieve element (SE), in a minor vein of an *Amborella trichopoda* leaf, as seen under an electron microscope. Magnification bar = 1.0 μm.

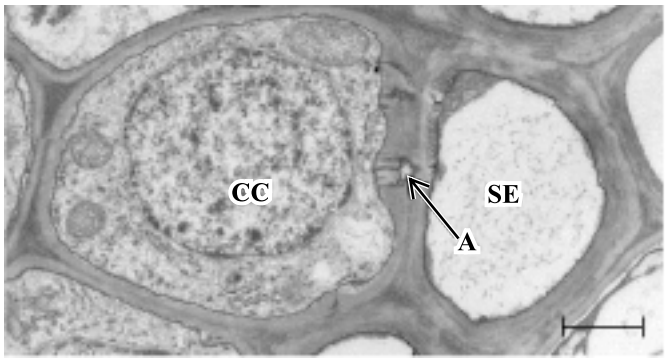


Figure 3. Transverse section of a companion cell and sieve tube element

http://accessscience.com/content/Phloem-loading/YB081920
(Electron micrograph by Robert Turgeon and Richard Medville)

(i) Compare the section of companion cell with that of the sieve tube element in Figure 3. In the table provided below, list THREE observable features which differ between the structures.

Companion Cell	Sieve Tube Element

[3 marks]

(ii) Identify the structure highlighted by the arrow labelled A in Figure 3 and state its function.

Structure: _____

Function: _____

[2 marks]

(iii) Using the given scale, calculate the actual width of the sieve tube element at its WIDEST point. **Show your calculations.**

Actual width: _____

[3 marks]

Total 16 marks

NOTHING HAS BEEN OMITTED.

3. (a) For the past two decades, lifestyle-related diseases have been the leading causes of death in the Caribbean. Table 1 shows the mortality rates for certain diseases for selected years, during the period 1985 to 2000 for CAREC affiliated countries.

TABLE 1: MORTALITY RATES (PER 100 000) FOR SOME DISEASES BY YEAR

	1985	**1990**	**1995**	**2000**
Heart Disease	107.2	109.5	114	102.5
Cancers	81.1	81.6	95.8	95.5
Diabetes	36.2	50	51.9	64.6
HIV (AIDS)	0.2	2.7	19.6	39.8

http://www.carec.net/pdf/Mortality_Final_LR%20_%20061205.pdf

(i) Give a concise explanation of the term 'mortality rate'.

_____

_____

[2 marks]

(ii) On the grid provided on page 11, draw a bar graph of the data on mortality rates in Table 1 for **Heart Disease** and **HIV (AIDS)** over the period 1985 to 2000.

[6 marks]

(iii) Based on the data presented in Table 1, deduce which disease was the leading cause of death over the period 1985 to 2000.

_____

[1 mark]

(iv) With reference to the HIV (AIDS) data for the period 1990 to 2000, briefly describe the trend in the mortality rates. Suggest TWO reasons which may account for this trend in the Caribbean.

Trend: _____

_____

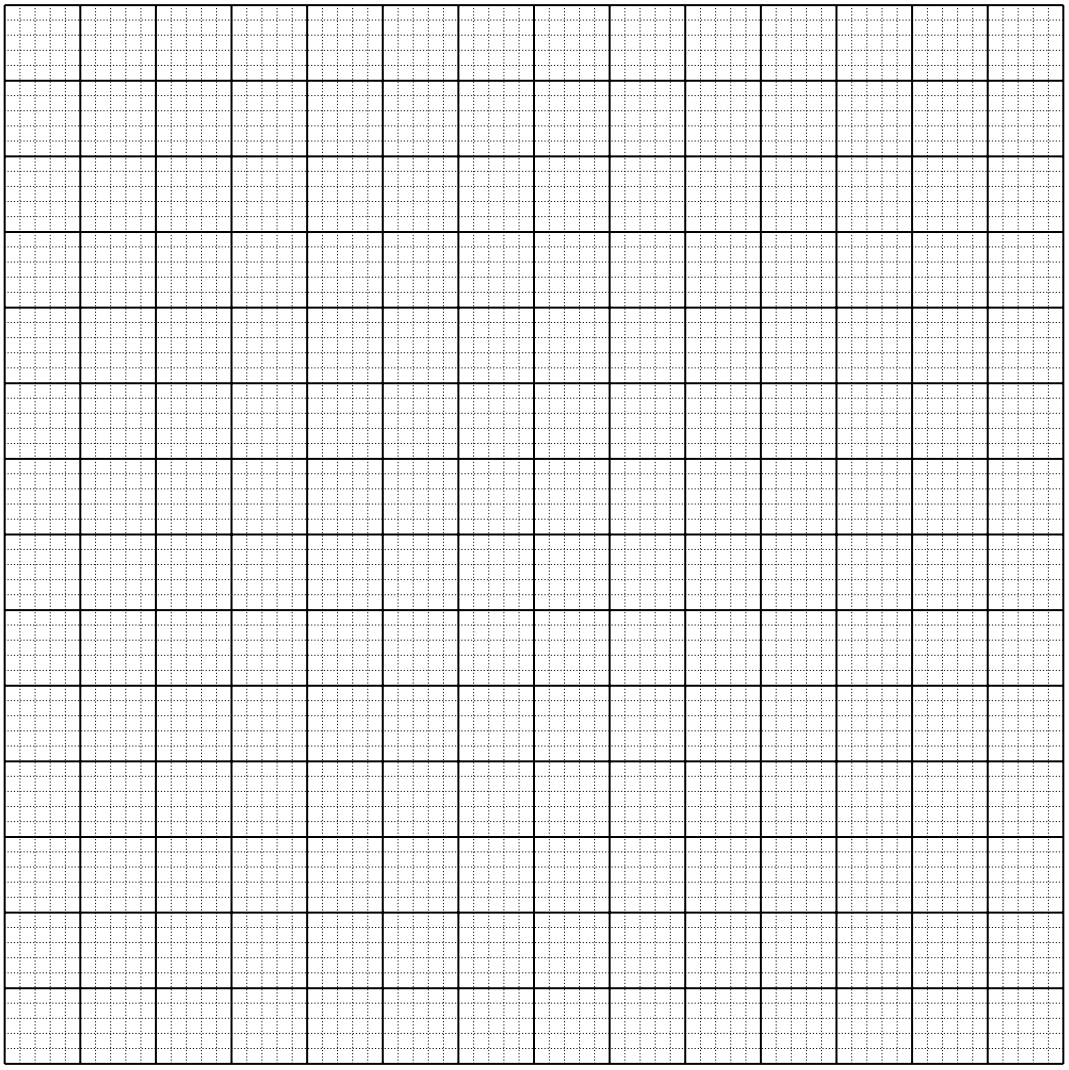
Reasons: _____

_____

_____

_____

[3 marks]



(b) Figure 4 illustrates the transmission cycle of dengue fever.

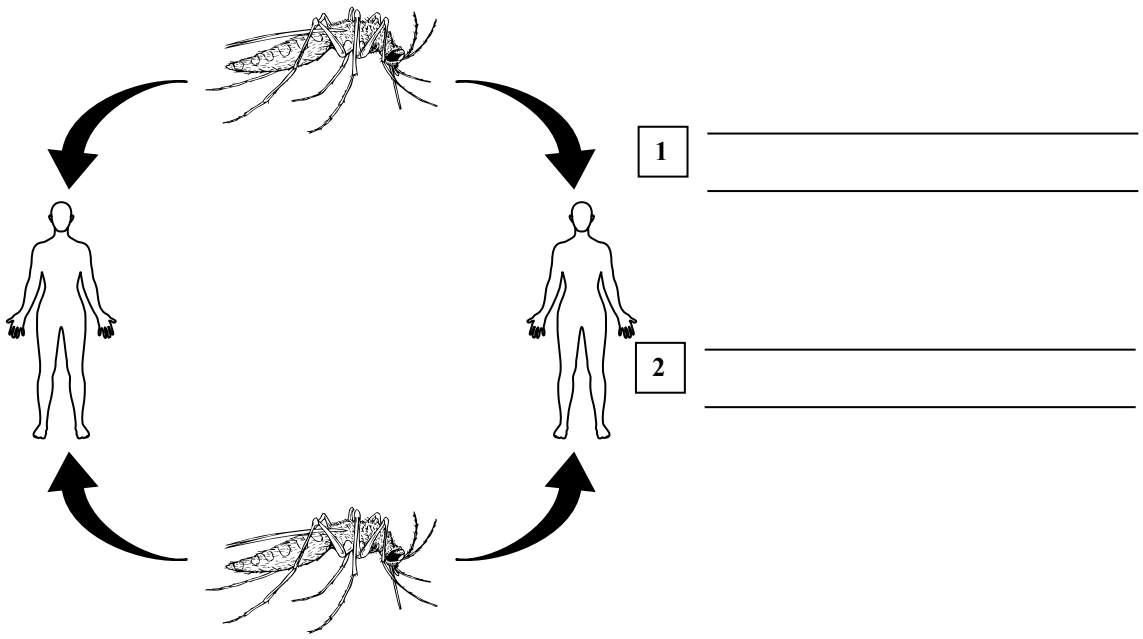


Figure 4. Transmission cycle of dengue fever

http://microbewiki.kenyon.edu/index.php/Dengue_transmission#Life_Cycle

(i) State the causative agent of dengue fever.

_____

[1 mark]

(ii) On Figure 4, outline, using annotations, the events occurring at the stages labelled 1 and 2. Write your answers on the lines provided next to the number of the stages.

[2 marks]

(iii) Name the category of disease to which dengue fever belongs.

_____

[1 mark]

Total 16 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.