

## BIOLOGY PAPER 1

8.30 am – 11.00 am (2 hours 30 minutes)  
This paper must be answered in English

### GENERAL INSTRUCTIONS

- (1) There are **TWO** sections, A and B, in this Paper. You are advised to finish Section A in about 35 minutes.
- (2) Section A consists of multiple-choice questions in this question paper. Section B contains conventional questions printed separately in Question-Answer Book **B**.
- (3) Answers to Section A should be marked on the Multiple-choice Answer Sheet while answers to Section B should be written in the spaces provided in Question-Answer Book **B**. **The Answer Sheet for Section A and the Question-Answer Book B for Section B will be collected separately at the end of the examination.**

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### INSTRUCTIONS FOR SECTION A (MULTIPLE-CHOICE QUESTIONS)

- (1) Read carefully the instructions on the Answer Sheet. After the announcement of the start of the examination, you should first stick a barcode label and insert the information required in the spaces provided. No extra time will be given for sticking on the barcode label after the 'Time is up' announcement.
- (2) When told to open this book, you should check that all the questions are there. Look for the words '**END OF SECTION A**' after the last question.
- (3) All questions carry equal marks.
- (4) **ANSWER ALL QUESTIONS.** You are advised to use an HB pencil to mark all the answers on the Answer Sheet, so that wrong marks can be completely erased with a clean rubber. You must mark the answers clearly; otherwise you will lose marks if the answers cannot be captured.
- (5) You should mark only **ONE** answer for each question. If you mark more than one answer, you will receive **NO MARKS** for that question.
- (6) No marks will be deducted for wrong answers.

Not to be taken away before the  
end of the examination session

There are 36 questions in this section.

The diagrams in this section are NOT necessarily drawn to scale.

**Directions:** Questions 1 to 3 refer to the table below, which shows the relative amounts of mitochondria, chloroplasts and endoplasmic reticulum in four cell types P, Q, R and S:

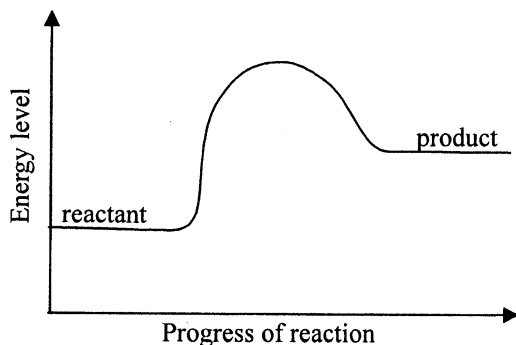
Cell type	Relative amount of the sub-cellular structure		
	Mitochondrion	Chloroplast	Endoplasmic reticulum
P	+	++	+
Q	+++	-	+
R	+++	-	+++
S	+	-	+

**Key:** number of '+' indicates the relative amount of the sub-cellular structure  
'-' indicates the absence of the sub-cellular structure

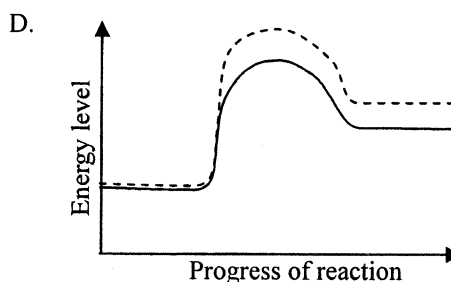
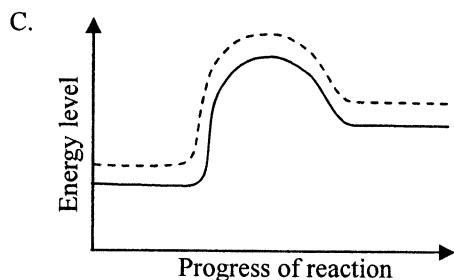
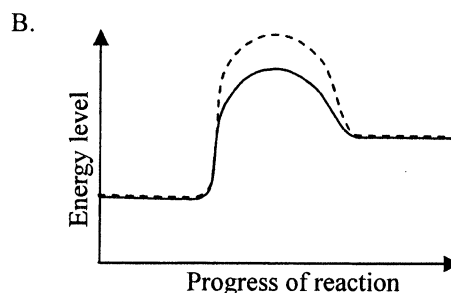
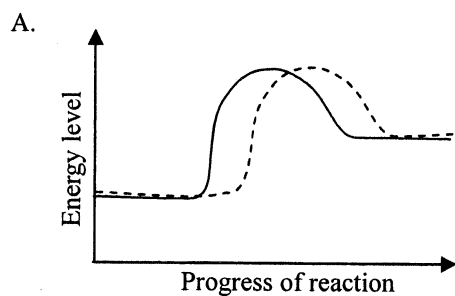
- Which cell type is found in the lining of the air sacs in the lungs?
  - P
  - Q
  - R
  - S
- Which cell type would you expect to be insulin-producing cells in the pancreas?
  - P
  - Q
  - R
  - S
- Which of the following carbohydrate(s) is/are likely to be found in cell type P?
  - starch
  - glucose
  - glycogen
  - (1) only
  - (2) only
  - (1) and (2) only
  - (2) and (3) only
- For different DNA nucleotides, the part that varies from one to another is the
  - base.
  - ribose.
  - deoxyribose.
  - phosphate group.
- Which of the following descriptions of the function of membrane proteins is *incorrect*?
  - Some membrane proteins serve as antigens for cell recognition.
  - Some membrane proteins serve as enzymes for cellular metabolism.
  - Some membrane proteins act as barriers which prevent the entry of some substances.
  - Some membrane proteins act as carriers which transport some substances across the membrane.

**Directions:**

Questions 6 and 7 refer to the graph below, which shows the energy levels of the reactant and product of a biochemical reaction in the presence of its enzyme:



6. The reaction shown in the graph is
- an anabolic process because energy is absorbed.
  - an anabolic process because energy is released.
  - a catabolic process because energy is absorbed.
  - a catabolic process because energy is released.
7. Which of the following graphs correctly shows the change in the energy level of the reaction if the enzyme involved is absent?  
 Key: \_\_\_\_\_ with the enzyme  
 ----- without the enzyme



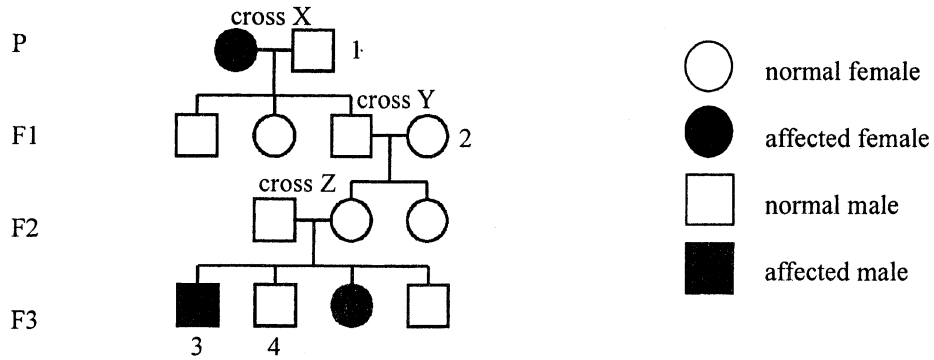
8. Which of the following processes in photosynthesis require energy input from ATP?
- fixation of carbon dioxide and the formation of 3-C compound
  - reduction of 3-C compound leading to the formation of glucose
  - regeneration of carbon dioxide acceptor
- (1) and (2) only
  - (1) and (3) only
  - (2) and (3) only
  - (1), (2) and (3)

- \* 9. Which of the following substances are produced in photochemical reactions of photosynthesis?
- (1) ATP  
 (2) oxygen  
 (3) NADPH
- A. (1) and (2) only  
 B. (1) and (3) only  
 C. (2) and (3) only  
 D. (1), (2) and (3)
10. Which of the following combinations best describes the processes involved in respiration?
- |    | <i>Oxygen is required</i>            | <i>Carbon dioxide is released</i> |
|----|--------------------------------------|-----------------------------------|
| A. | Conversion of pyruvate to acetyl CoA | Glycolysis                        |
| B. | Conversion of pyruvate to acetyl CoA | Krebs Cycle                       |
| C. | Oxidative phosphorylation            | Glycolysis                        |
| D. | Oxidative phosphorylation            | Krebs Cycle                       |
11. Which of the following statements about codons is correct?
- A. A codon may consist of bases A, C, G or T.  
 B. A codon is a triplet of bases on transfer RNA.  
 C. Most amino acids are coded by more than one codon.  
 D. All codons code for amino acids.
12. The DNA of a eukaryotic cell contains 20% adenine (A) bases. What is the percentage of cytosine (C) bases in this DNA?
- A. 60%  
 B. 40%  
 C. 30%  
 D. 20%
13. A man and his wife are heterozygous for blood type A and B respectively. What is the probability of their son having blood type AB?
- A. 0  
 B. 1/4  
 C. 1/2  
 D. 3/4
14. Which of the following consists of individuals that are genetically different from each other?
- A. seeds of the same fruit  
 B. stigmas of the same flower  
 C. petals of the same plant  
 D. buds of the same tuber

\* The item intended to test whether candidates can identify which of the three options are products of photochemical reactions. In the live paper, the word 'compounds' was used instead of 'substances'. However, oxygen is an element instead of a compound. Hence, the item might not be able to effectively assess candidates' ability and had been deleted. The question in this Examination Report and Question papers has been rectified.

**Directions:**

Questions 15 to 17 refer to the pedigree below, which shows the inheritance of a certain trait controlled by a pair of alleles located on an autosome (i.e. non-sex chromosome):



15. Which cross(es) can be used to deduce which phenotype is dominant?

- A. cross Y only
- B. cross Z only
- C. crosses X and Y only
- D. crosses X and Z only

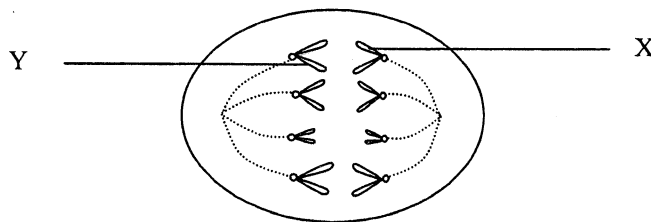
16. What are the probable genotypes of individuals 1 and 2?

- |    | <i>Individual 1</i>        | <i>Individual 2</i>        |
|----|----------------------------|----------------------------|
| A. | homozygous                 | homozygous                 |
| B. | homozygous                 | homozygous or heterozygous |
| C. | homozygous or heterozygous | homozygous                 |
| D. | homozygous or heterozygous | homozygous or heterozygous |

17. If individuals 3 and 4 are twins, which of the following conclusions can be drawn?

- A. They are developed from the same fertilised egg.
- B. They are developed from different fertilised eggs.
- C. They are genetically different for characters displaying continuous variation.
- D. They are genetically different for characters displaying discontinuous variation.

18. The diagram below shows a dividing cell which is forming an animal's egg cell:



What conclusion about the cell division can be drawn from the diagram?

- A. The diagram shows a mitotic cell division.
- B. The diagram shows the first meiotic cell division.
- C. X and Y are homologous chromosomes.
- D. Each daughter cell will have four chromosomes.

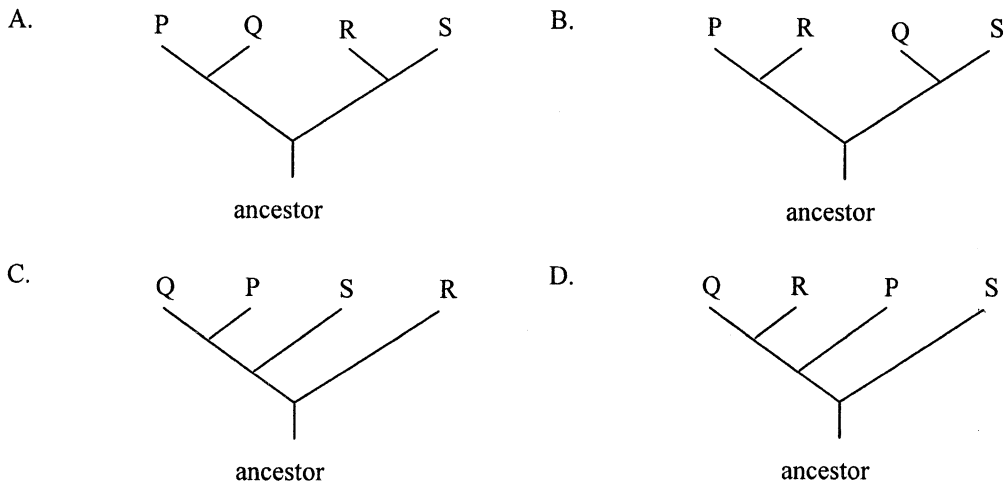
**Directions:** Questions 19 and 20 refer to the nucleotide sequence of a certain functional gene segment found in four different species of organisms P, Q, R and S:

AACGTCGAAA	(organism P)
AACCTCGAAA	(organism Q)
AGGCTAGAAA	(organism R)
AGGCTAGTAA	(organism S)

19. The differences in the sequences shown above are most probably caused by

- A. crossing over.
- B. gene mutation.
- C. random fertilisation.
- D. chromosomal mutation.

20. Based on the above information, which of the following diagrams best represents the evolutionary tree of organisms P, Q, R and S?



21. Which of the following combinations shows the correct information about Eubacteria and Protista?

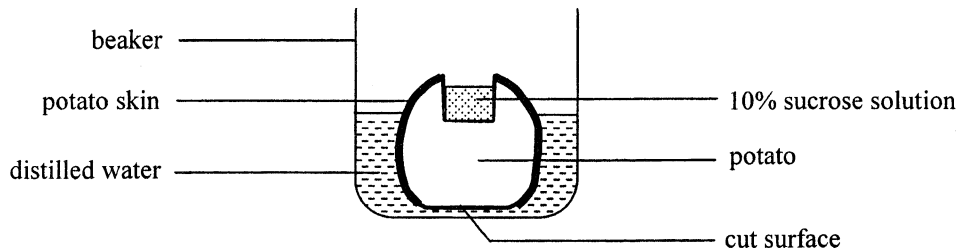
	<b><i>Eubacteria</i></b>	<b><i>Protista</i></b>
A.	bigger in size	smaller in size
B.	absence of cell wall	presence of cell wall
C.	presence of true nucleus	absence of true nucleus
D.	absence of mitochondria	presence of mitochondria

22. Which of the following observations is **not** related to the process of evolution?

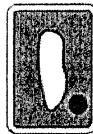
- A. Some variations are not inheritable.
- B. Organisms compete for resources to survive.
- C. Environmental changes give stress to organisms.
- D. Variations exist among different individuals of the same species.

**Directions:**

Questions 23 to 25 refer to the diagram below, which shows an experiment on osmosis using a potato tuber. A washed potato was cut to form a base. After that, a cavity was made and a 10% sucrose solution was added into the cavity. The whole potato was then placed into a beaker containing some distilled water. After 1 day, the level of sucrose solution rose.



23. The level of sucrose solution inside the cavity rose because osmosis has taken place, which means that
- A. water was drawn mainly from the cells in contact with the sucrose solution.
  - B. water was initially drawn from the cells in contact with the distilled water.
  - C. water moved from the distilled water along the cell wall of the potato cells to the cavity.
  - D. water moved from the distilled water through the cell membrane of the potato cells to the cavity.
24. The diagram below shows the appearance of a cell in contact with distilled water in the beaker at the beginning of the experiment:



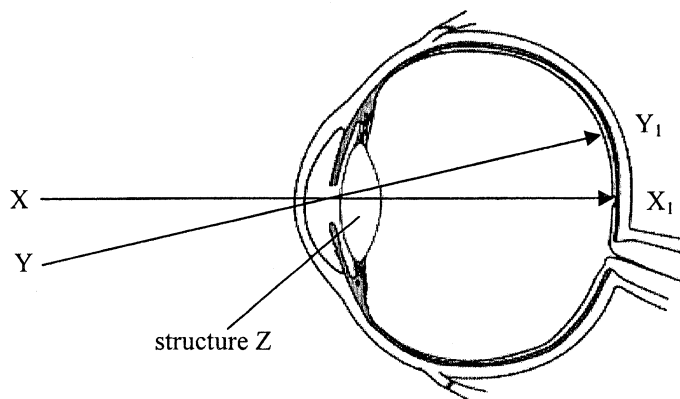
Which of the following diagrams correctly shows the appearance of the same cell at the end of the experiment?



25. Which of the following treatments will lead to a higher final level of the sucrose solution after 1 day?
- (1) using 5% sucrose solution instead of 10% sucrose solution
  - (2) using 20% sucrose solution instead of 10% sucrose solution
  - (3) peeling off all the potato skin instead of just cutting the bottom of the potato
- A. (1) only
  - B. (2) only
  - C. (1) and (3) only
  - D. (2) and (3) only

26. Which of the following nutrients enter the epithelial cells of the small intestine mainly by simple diffusion?
- amino acids
  - fatty acids
  - monosaccharides
  - nucleotides

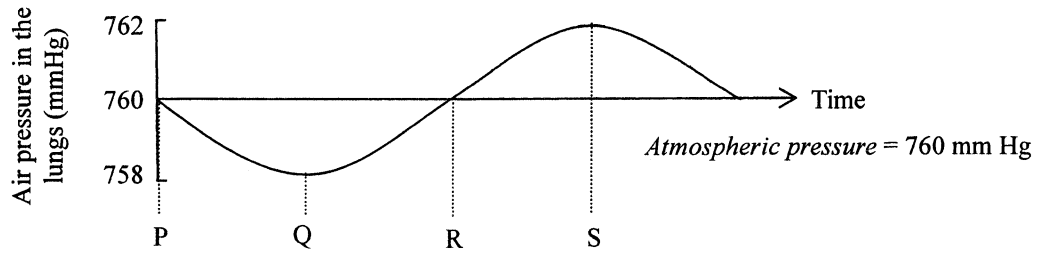
**Directions:** Questions 27 and 28 refer to the diagram below, which shows a section of the human eye and the positions  $X_1$  and  $Y_1$  where the images of two coloured objects X and Y are formed respectively on the retina:



27. Which of the following correctly describes a person's visual perception in day time?
- X appears brighter because cone cells are found at position  $X_1$ .
  - X appears sharper because cone cells are found at position  $X_1$ .
  - Y appears black and white because rod cells are found at position  $Y_1$ .
  - Y appears blurred because rod cells are found at position  $Y_1$ .
28. When a person ages, structure Z becomes less elastic. When this happens, a person will probably have difficulty focusing on
- a nearby object because structure Z cannot be thickened fully.
  - a nearby object because structure Z cannot be pulled thin fully.
  - a distant object because structure Z cannot be thickened fully.
  - a distant object because structure Z cannot be pulled thin fully.
29. Which of the following combinations correctly matches the structure of the human ear and its function?
- | <i>Structure</i> | <i>Function</i>                 |
|------------------|---------------------------------|
| A. ear flap      | protecting the ear              |
| B. ear drum      | amplifying sound waves          |
| C. ear bones     | transmitting vibrations         |
| D. round window  | setting the endolymph in motion |



30. The graph below shows the change in air pressure in the lungs of a person:



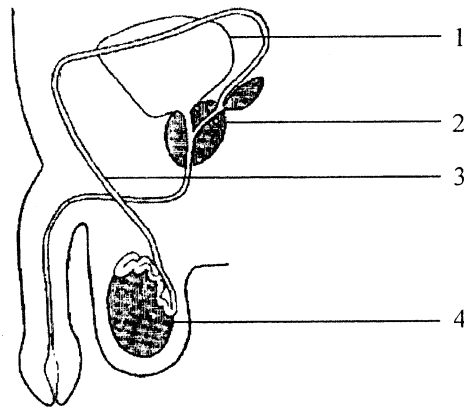
At which point of time on the graph is the volume of the lung the largest?

- A. P  
B. Q  
C. R  
D. S
31. Muscles are found in
- (1) arterioles.  
(2) capillaries.  
(3) veins.
- A. (1) and (2) only  
B. (1) and (3) only  
C. (2) and (3) only  
D. (1), (2) and (3)
32. Which of the following descriptions about antibiotics is correct?
- A. Antibiotics can engulf pathogens.  
B. Antibiotics can be produced by fungi.  
C. Antibiotics can bind to specific antigens.  
D. Antibiotics can be produced by lymphocytes.
33. A person has not taken any food for 24 hours. Which of the following will increase in concentration in the blood?
- A. glucagon  
B. glucose  
C. glycogen  
D. insulin

34. Which of the following information concerning the characteristics of insulin-dependent diabetes and non-insulin-dependent diabetes is correct?

<i>Insulin-dependent diabetes</i>	<i>Non-insulin-dependent diabetes</i>
A. accounts for the majority of diabetic cases	accounts for a small portion of diabetic cases
B. is mainly due to an unhealthy lifestyle	is mainly due to hereditary factors
C. requires regular injections of insulin	may be controlled through proper diet
D. body fails to respond to insulin	body produces a low level of insulin

**Directions:** Questions 35 and 36 refer to the diagram below, which shows the reproductive system of a man:



35. Which of the following structures are involved in the production of the content of semen?
- A. 1 and 3  
 B. 1 and 4  
 C. 2 and 3  
 D. 2 and 4
36. Which of the following may still occur after structure 3 on both sides of the body has been tied up and cut?
- (1) production of sperms  
 (2) erection of penis  
 (3) ejaculation
- A. (1) and (2) only  
 B. (1) and (3) only  
 C. (2) and (3) only  
 D. (1), (2) and (3)

**END OF SECTION A**

**Go on to Question-Answer Book B for questions on Section B**

## BIOLOGY PAPER 1

### SECTION B : Question-Answer Book B

This paper must be answered in English

#### INSTRUCTIONS FOR SECTION B

- (1) After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1, 3, 5 and 7.
- (2) Refer to the general instructions on the cover of the Question Paper for Section A.
- (3) Answer **ALL** questions.
- (4) Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.
- (5) Supplementary answer sheets will be supplied on request. Write your candidate number, mark the question number box and stick a barcode label on each sheet, and fasten them with string **INSIDE** this Question-Answer Book.
- (6) Present your answers in paragraphs wherever appropriate.
- (7) The diagrams in this section are **NOT** necessarily drawn to scale.
- (8) No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.

Please stick the barcode label here.

Candidate Number

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**SECTION B**

Answer **ALL** questions. Put your answers in the spaces provided.

1. For each of the brain parts listed in column 1, select from column 2 one phrase that matches it. Put the appropriate letter in the space provided. (3 marks)

Column 1

Cerebellum .....

Medulla oblongata .....

Cerebrum .....

Column 2

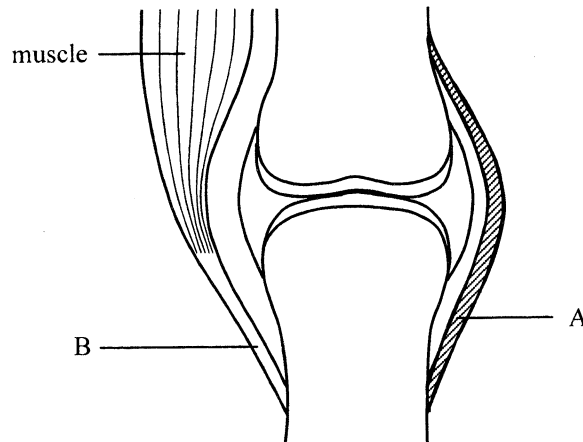
A. Damage causes inability to make decisions

B. Damage causes loss of body balance

C. Damage causes loss of control of breathing rate

D. Damage causes loss of withdrawal reflex

2. The diagram below shows the structures of a joint.



- (a) Name the type of joint shown and suggest an example of such a joint in the body. (2 marks)

Type of joint: .....

Example in the body: .....

- (b) Briefly describe how A and B work together to bring about movement at the joint shown. (4 marks)

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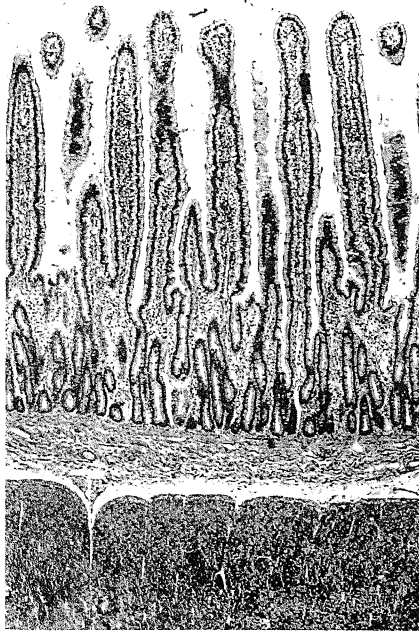
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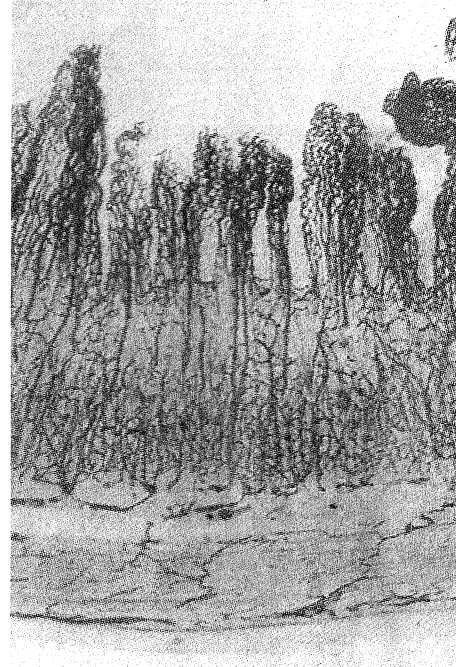
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3. Figure A shows a section of part of the human alimentary canal. Figure B shows another section of the same part with blood vessels stained.

*Figure A*



*Figure B*



- (a) Which part of the alimentary canal is shown in the figures? Support your answer with evidence. (2 marks)

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- (b) For each of the above figures, describe *one* observable feature and explain how it is related to the functioning of this part of the alimentary canal.

Figure A: (2 marks)

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Figure B: (3 marks)

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4. Red-green colour blindness is an X-linked recessive trait in humans. Peter is red-green colour blind while his daughter, Mary, is normal.

(a) Deduce Mary's genotype without using a genetic diagram. (4 marks)

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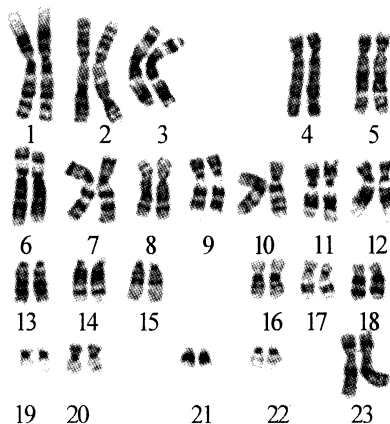
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(b) Mary is an expectant mother. The photomicrograph below shows the karyotype of her foetus:



(i) From the photomicrograph, can we deduce whether this foetus will be red-green colour blind or not? Explain your answer. (2 marks)

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(ii) Is the foetus a boy or a girl? Explain your answer with reference to the photomicrograph. (3 marks)

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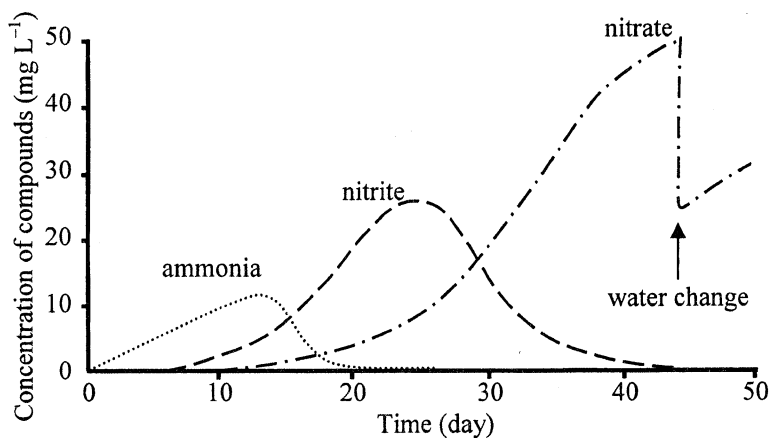
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5. Knowing that the nitrogen cycle is important to the healthy growth of fish, Tom purchased testing kits to monitor the levels of ammonia, nitrite and nitrate in his aquarium. He kept the aquarium aerated with an air pump. The graph below shows the changes in the concentrations of the three compounds over 50 days:



- (a) Name the process that led to the changes shown in the graph. (1 mark)

- (b) After three weeks, Tom observed a high concentration of nitrite in the water and the fish were showing symptoms of nitrite poisoning. Therefore, Tom added a suspension of a bacterial culture to the water to lower the nitrite concentration. Suggest the type of bacteria he added and explain how it lowered the nitrite concentration. (2 marks)

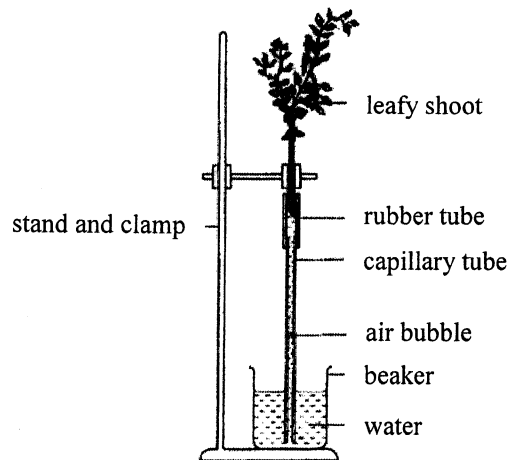
- (c) To prevent the accumulation of nitrate, Tom regularly replaced some water in the aquarium with fresh water. What else could Tom do to lower the nitrate concentration? (2 marks)

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6. The following set-up can be used to determine the transpiration rate of a leafy shoot:



(a) In setting up this experiment, the lower end of the shoot should be cut under water. Why? (1 mark)

(b) Give *one* assumption for using this set-up to measure the transpiration rate. (1 mark)

(c) Explain how the transpiration rate will change if the fan placed near the shoot is switched on. (4 marks)

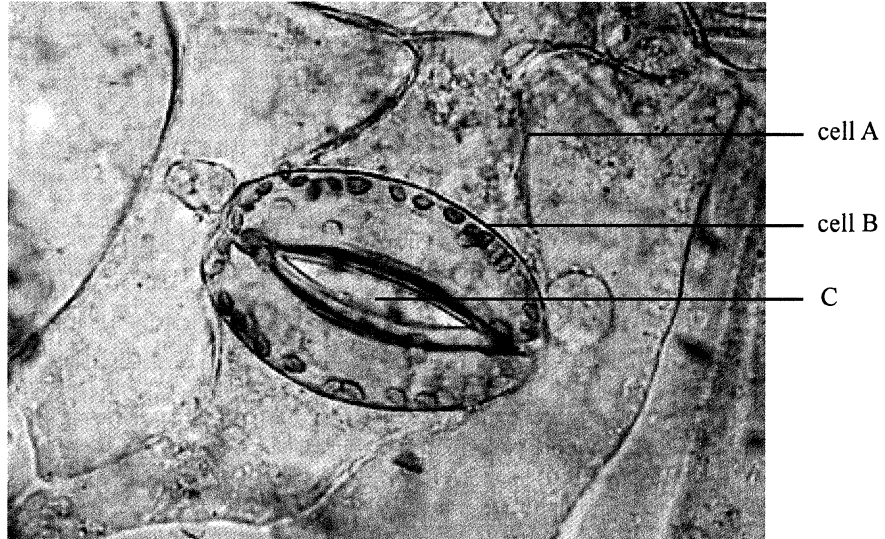
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(d) The photomicrograph below shows the appearance of the surface of a leaf during daytime:



(i) In terms of sub-cellular structure, state *two* differences between cell A and cell B. (2 marks)

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(ii) What will happen to the size of C at night? Discuss the functional significance of this change. (3 marks)

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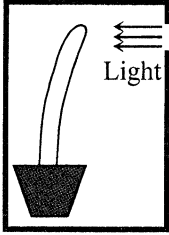
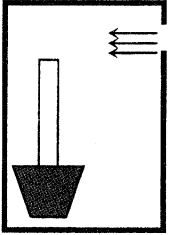
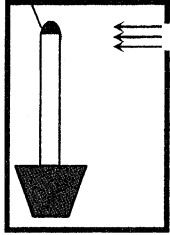
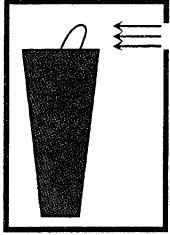
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7. In 1880, Darwin conducted an experiment to investigate the phototropism of plants. He placed some coleoptiles in dark boxes, each with a hole at one side to allow light to pass through. The results after various treatments of coleoptiles are shown in the diagrams below:

Set-up	I	II	III	IV
Treatment of the coleoptile	Intact coleoptile	Tip removed	Opaque cap placed on the tip	Buried in soil with tip exposed
Result	 <p>Growth with bending</p>	 <p>No growth and no bending</p>	 <p>Growth without bending</p>	 <p>Growth with bending</p>

(a) From the results of the experiment, which part of the coleoptile is responsible for detecting unilateral light? Support your answer with reasons. (3 marks)

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(b) Explain why it is necessary to have set-up III in the experiment. (1 mark)

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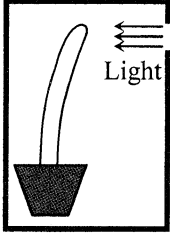
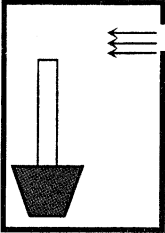
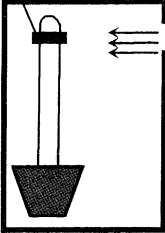
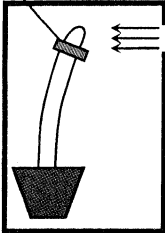
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Answers written in the margins will not be marked.

(c) In 1913, Boysen-Jensen performed some other experiments to study the nature of the signal transmission involved in phototropism. The diagram below shows his experimental set-ups:

Set-up	A	B	C	D
Treatment of the coleoptile	Intact coleoptile	Tip removed	Cut tip placed on a mica block	Cut tip placed on an agar block
Result	 <p>Growth with bending</p>	 <p>No growth and no bending</p>	 <p>No growth and no bending</p>	 <p>Growth with bending</p>

What conclusion can be drawn from Boysen-Jensen's experiment? (3 marks)

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(d) Which of the following statements about the nature of science are demonstrated in the above historical events? Put a '✓' in the space next to the statement and provide an explanation. The first one is an example for your reference. (4 marks)

Statement		Evidence from the historical events
Doing science requires creativity and imagination.	✓	Both Darwin and Boysen-Jensen used innovation and imagination to design their experiments.
Science is socially and culturally embedded.		
Science is based on evidence.		
Science knowledge is tentative and dynamic.		

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8. A study was carried out to investigate the distribution and abundance of animal species A and B on a rocky shore. The table below shows the results obtained from the back of the shore to the waterfront:

Distance from the back of the shore (m)	Abundance (number of individuals m <sup>-2</sup> )	
	Species A	Species B
1	10	0
2	25	2
3	40	8
4	38	10
5	20	20
6	18	35
7	15	33
8 (waterfront)	11	28

- (a) Using the graph paper on the opposite page, plot a graph to show the results. (5 marks)
- (b) Based on the information in the graph, suggest which species would have a higher tolerance to desiccation. Explain your answer. (4 marks)

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- (c) Briefly describe the sampling procedure used to obtain the above data. (3 marks)

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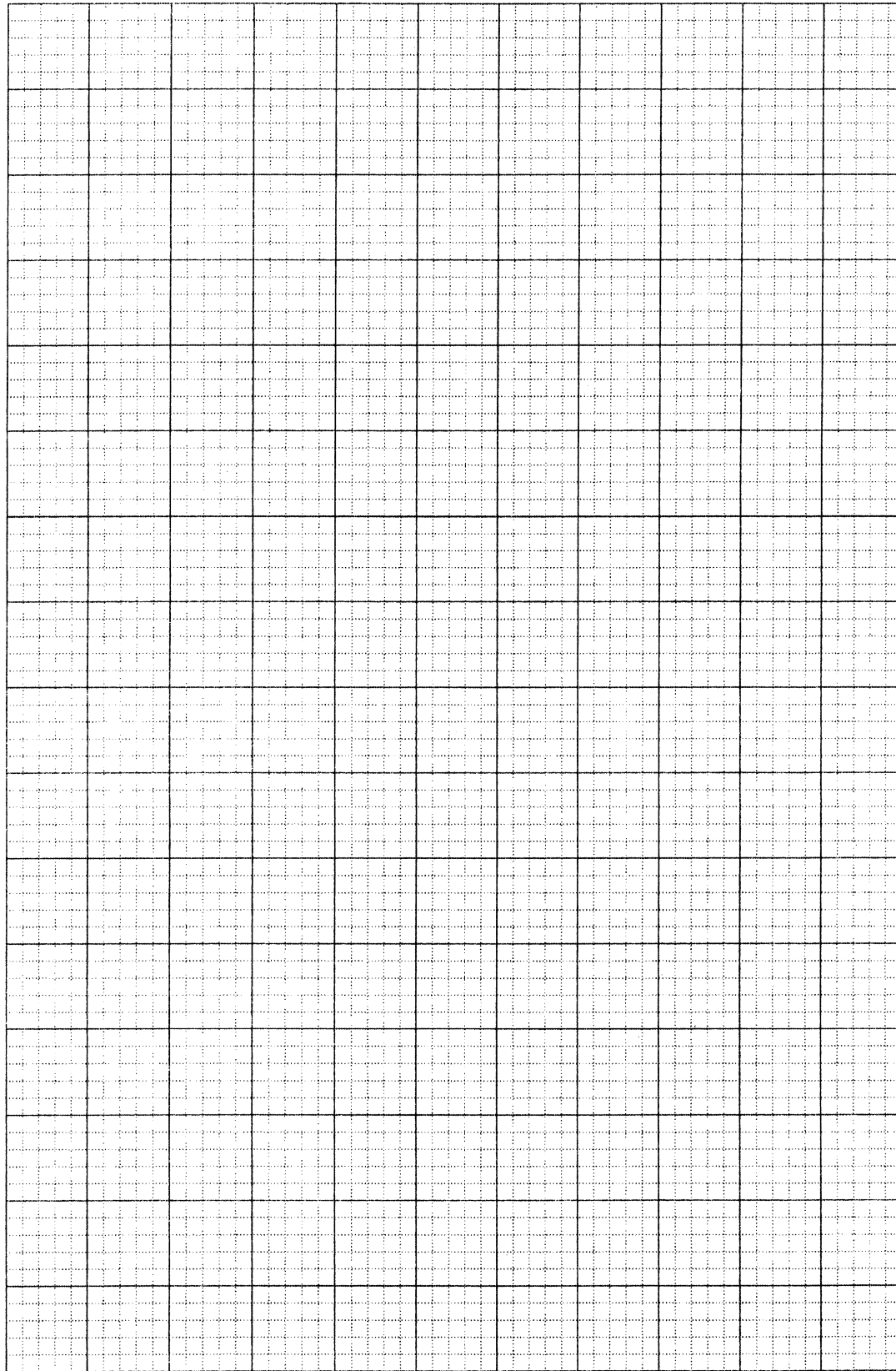
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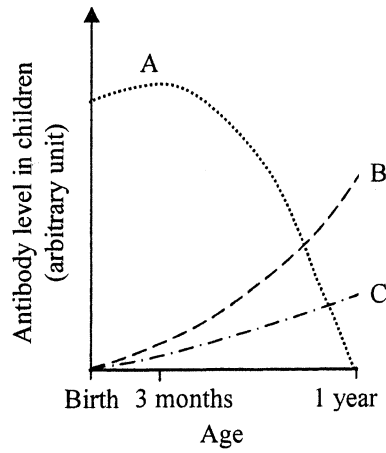
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9. (a) The following graph shows the change in levels of antibodies in children's bodies:  
 (A) antibodies from mother  
 (B) children's own antibodies with vaccination  
 (C) children's own antibodies without vaccination



- (i) State the types of immunity resulting from A, B and C. (3 marks)

A: \_\_\_\_\_

B: \_\_\_\_\_

C: \_\_\_\_\_

- (ii) Suggest *two* possible ways that newborns can acquire antibodies from their mother. (2 marks)

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\_\_\_\_\_

\_\_\_\_\_

- (b) Explain why children who have been vaccinated against diseases are better protected than those who have not. (4 marks)

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**END OF PAPER**

Sources of materials used in this paper will be acknowledged in the *Examination Report and Question Papers* published by the Hong Kong Examinations and Assessment Authority at a later stage.

Answers written in the margins will not be marked.