

PRACTICE PAPER BIOLOGY PAPER 1

(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 for Section B will be collected separately at the end of the examination.**

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.

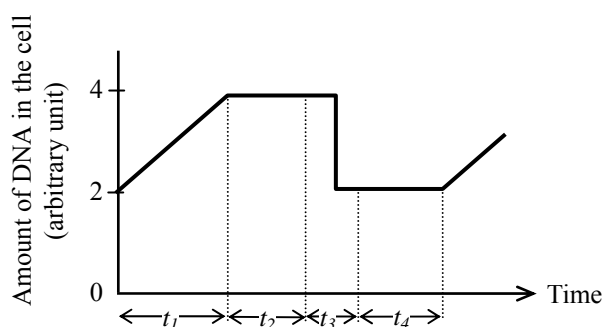
There are 36 questions in this section.

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

1. In a DNA molecule of yeast, 30% of the nitrogenous bases are guanine (G). What is the ratio of cytosine (C) to thymine (T) in this DNA molecule?

- A. 1:1
- B. 2:1
- C. 3:2
- D. 3:7

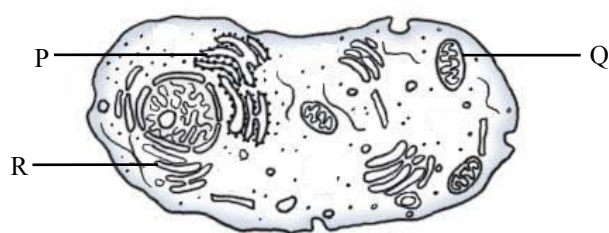
2. The graph below shows the change in the amount of DNA in a cell which is undergoing cell division:



Which of the following statements correctly describes the event that is taking place in the respective time period?

- A. During t_1 , the nuclear membrane disappears.
- B. During t_2 , the homologous chromosomes pair up.
- C. During t_3 , the homologous chromosomes separate.
- D. During t_4 , the synthesis of cell organelles takes place.

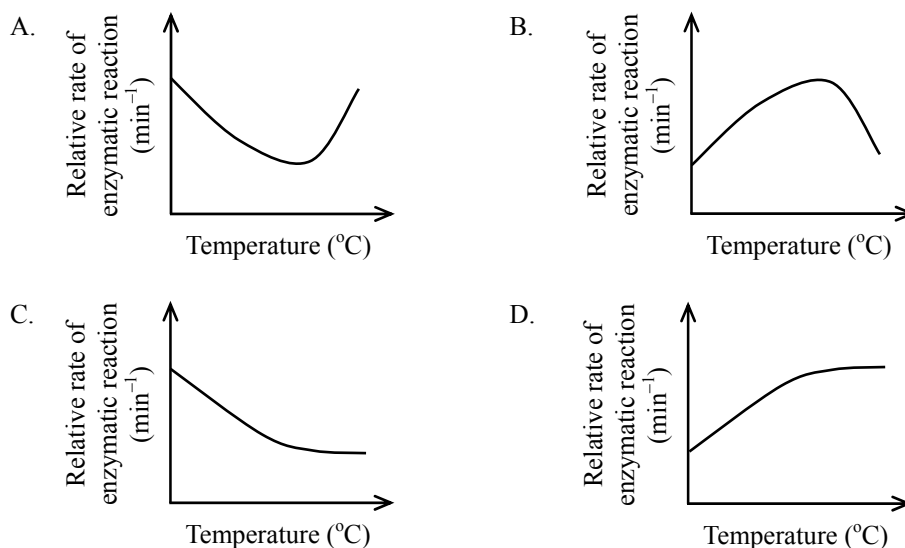
3. The following diagram shows an animal cell with some of its organelles:



Which of the labelled structures are particularly abundant in an enzyme-secreting cell?

- A. P and Q only
- B. P and R only
- C. Q and R only
- D. P, Q and R

4. In an experiment to investigate the effect of temperature on the activity of a digestive enzyme X, the time taken for the digestion of a fixed amount of substrate by this enzyme was recorded. Which of the following graphs shows the most likely results of the experiment?



5. The table below shows the ratios of initial mass to final mass of three fresh potato cylinders which have been immersed in sucrose solutions of three different concentrations for 30 minutes:

	Solution P	Solution Q	Solution R
Ratio of initial mass to final mass	0.9	1.4	1.2

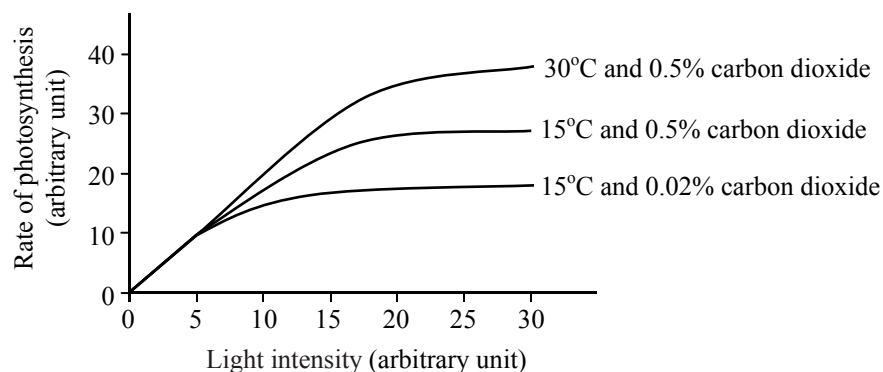
Which of the following can be deduced from the results?

- (1) The water potential of the potato cylinders is higher than that of solution P.
 (2) There is a net movement of water from the potato cylinders to solution Q.
 (3) Solution Q has a higher sucrose concentration than solution R.
- A. (1) only
 B. (2) only
 C. (1) and (3) only
 D. (2) and (3) only
6. In photosynthesis, photochemical reactions are essential for the carbon fixation that follows. This is because in photochemical reactions,
- (1) oxygen is liberated.
 (2) NADPH is generated.
 (3) the carbon dioxide acceptor is regenerated.
- A. (1) only
 B. (2) only
 C. (1) and (3) only
 D. (2) and (3) only

7. Which of the following correctly lists the substances formed in the Krebs cycle?

- A. water and NADH
- B. water and carbon dioxide
- C. carbon dioxide and NADH
- D. water, carbon dioxide and NADH

8. The graph below shows the rate of photosynthesis of a plant at different temperatures and carbon dioxide concentrations when light intensity increases:



Which of the following descriptions about the rate of photosynthesis of this plant can be deduced from the graph?

- A. Below 3 units of light intensity, light intensity is the factor limiting this plant's photosynthetic rate.
- B. At 25 units of light intensity and 0.02% carbon dioxide, temperature is the factor limiting this plant's photosynthetic rate.
- C. At 25 units of light intensity, 15°C and 0.5% carbon dioxide, carbon dioxide concentration is the factor limiting this plant's photosynthetic rate.
- D. At 25 units of light intensity, 15°C and 0.5% carbon dioxide, this plant's photosynthetic rate doubles when the temperature is doubled.

Directions: Questions 9 and 10 refer to the following table, which shows six codons and the corresponding amino acids translated from these codons:

mRNA codon	AAG	CUA	CCU	GUA	GAU	CAU
amino acid	lysine	leucine	proline	valine	aspartic acid	histidine

9. The sequence of amino acids in a certain part of a polypeptide is shown below:

—lysine—proline—histidine—aspartic acid—

Which of the following is the correct sequence of the nucleotides on the non-template DNA (coding DNA) for this part of the polypeptide?

- A. AAGCCTCATGAT
 B. TTCGGAGTACTA
 C. AAGCCUCAUGAU
 D. UUCGGAGUACUA
10. The following shows the nucleotide sequences of two mRNA molecules, the first one being transcribed from a normal allele and the second one from the mutated allele:

mRNA transcribed from the normal allele: CCUGAUCCUCUACCUCAU

mRNA transcribed from the mutated allele: CCUGAUCCUGUACCUCAU

Which of the following amino acids is absent in the polypeptide translated from the mutated allele?

- A. histidine
 B. aspartic acid
 C. valine
 D. leucine
11. A couple has two children. The son is of blood group B and the daughter is of blood group A. Which of the following is **not** a possible combination of genotypes of this couple?
 (Note: The alleles responsible for the production of antigen A, antigen B and not producing antigen A or B are represented by I^A , I^B and i respectively.)

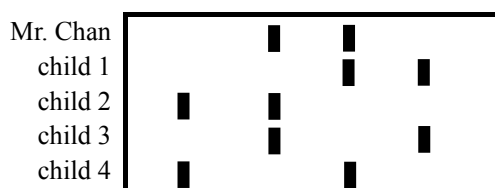
- A. $I^A i$ and $I^B i$
 B. $I^A I^A$ and $I^B i$
 C. $I^A I^B$ and $I^A I^B$
 D. $I^A I^B$ and $I^B i$

12. Which of the following processes may increase the variation of a particular character within a population?
- A. the mutation of genes
 B. the separation of homologous chromosomes during meiosis
 C. the independent assortment of homologous chromosomes during meiosis
 D. the random fertilisation of gametes

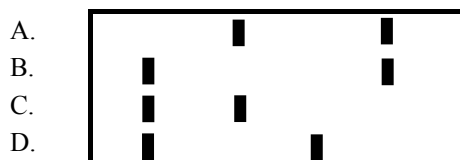
13. In guinea pigs, the genes for fur colour and hair length are located on different chromosomes. The alleles for black fur and long hair are recessive to the alleles for brown fur and short hair respectively. Guinea pigs which are heterozygous for both fur colour and hair length are allowed to breed. Of the 112 offspring produced, how many are expected to have black fur and short hair?

- A. 21
- B. 28
- C. 56
- D. 63

14. Mr. Chan and Mrs. Chan are the biological parents of four children. The DNA profiles of Mr. Chan and the four children are shown below:



Which of the following is likely to be the DNA profile of Mrs. Chan?



15. Which of the following combinations shows the correct classification of the organism according to the Three Domain System?

	<i>Organism</i>	<i>Kingdom</i>	<i>Domain</i>
A.	nitrifying bacteria	Archaeobacteria	Bacteria
B.	amoeba	Animalia	Eukarya
C.	yeast	Fungi	Archaea
D.	algae	Protista	Eukarya

16. Below are the scientific names of four species of shrimps:

- (1) *Leptochela japonicus*
- (2) *Metapenaeus japonicus*
- (3) *Metapenaeus joyneri*
- (4) *Metapenaeopsis dura*

Which two of the above species should have the closest phylogenetic relationship?

- A. (1) and (2)
- B. (1) and (4)
- C. (2) and (3)
- D. (3) and (4)

17. The following dichotomous key can be used to identify five species of amphibian:

- 1 (a) the skin is rough ----- 2
 1 (b) the skin is smooth ----- 3
- 2 (a) the dorsal side has coloured stripes ----- Species P
 2 (b) the dorsal side does not have coloured stripes ----- Species Q
- 3 (a) the toes have sticky pads ----- 4
 3 (b) the toes do not have sticky pads ----- Species R
- 4 (a) the limbs are spotted ----- Species S
 4 (b) the limbs are not spotted ----- Species T

Use the above key to identify the three amphibians in the following photographs.



Amphibian (1)



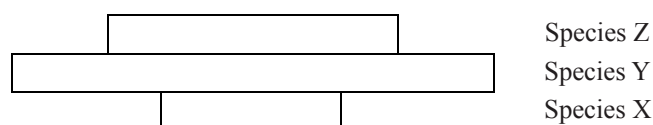
Amphibian (2)



Amphibian (3)

- | | <i>Amphibian (1)</i> | <i>Amphibian (2)</i> | <i>Amphibian (3)</i> |
|----|----------------------|----------------------|----------------------|
| A. | species R | species Q | species S |
| B. | species Q | species S | species R |
| C. | species T | species R | species P |
| D. | species T | species Q | species S |

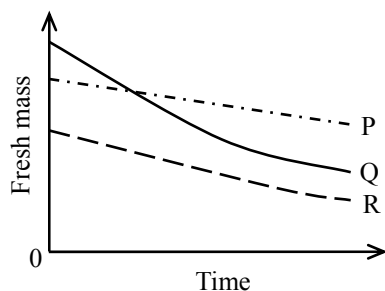
18. In an aquatic ecosystem, species X, Y and Z form a food chain. The following diagram shows the pyramid of biomass of this ecosystem:



With reference to the above pyramid of biomass, which of the following statements are correct?

- (1) Species Z is the secondary consumer in this food chain.
 (2) The body size of species X is larger than that of species Y.
 (3) There is an energy loss when energy flows from species Y to species Z.
- A. (1) and (2) only
 B. (1) and (3) only
 C. (2) and (3) only
 D. (1), (2) and (3)

19. Three types of seaweeds, P, Q and R, were collected from the intertidal zone (the zone between the high tide mark and the low tide mark) of a rocky shore. The distribution of these seaweeds in the intertidal zone is related to their ability to withstand exposure to air. The graph below shows the changes in the fresh mass of these seaweeds when they are left to dry in the laboratory:



Which of the following shows the most likely distribution of these seaweeds from the lower shore to the upper shore?

- A. P, Q, R
 B. P, R, Q
 C. Q, R, P
 D. R, Q, P
20. In the table below, P and Q represent two types of relationships between different species of organisms. The effect of each type of relationship on the species concerned is represented by the following symbols:

+ = gaining benefits
 — = being harmed

Type of relationship between species	Effect of the relationship on the species	
	Species 1	Species 2
P	+	+
Q	—	+

Which of the following combinations correctly shows the types of relationships represented by P and Q?

- | | <i>P</i> | <i>Q</i> |
|----|--------------|--------------|
| A. | competition | commensalism |
| B. | mutualism | competition |
| C. | commensalism | parasitism |
| D. | mutualism | predation |
21. Which of the following is **not** a limitation of the use of fossil records as evidence for evolution?
- A. Fossils are damaged and incomplete.
 B. Some organisms may not form fossils.
 C. Fossils are found in different sedimentary rock layers.
 D. Fossils present in inaccessible areas are not available to us for study.

22. Which of the following are necessary for speciation?

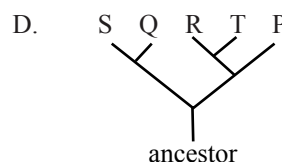
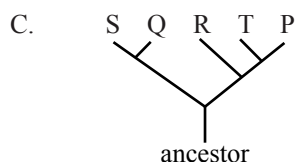
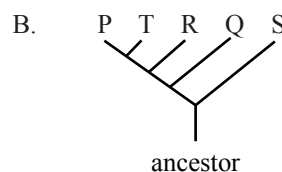
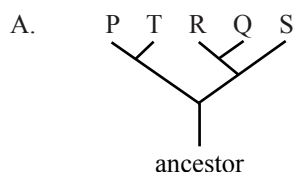
- (1) the competition within a species
- (2) the existence of variation within a species
- (3) different populations of a species being isolated for a long time

- A. (1) and (2) only
- B. (1) and (3) only
- C. (2) and (3) only
- D. (1), (2) and (3)

23. In constructing an evolutionary tree, it is assumed that the more similarities shared between two species, the closer is their phylogenetic relationship. The amino acid sequences of a certain protein in five species of organisms were analysed and compared. The following table shows the number of amino acid differences between the amino acid sequence of species P and that of each of the other four species:

Species	Q	R	S	T
The number of amino acid differences between the amino acid sequence of species P and that of the other species	31	16	36	1

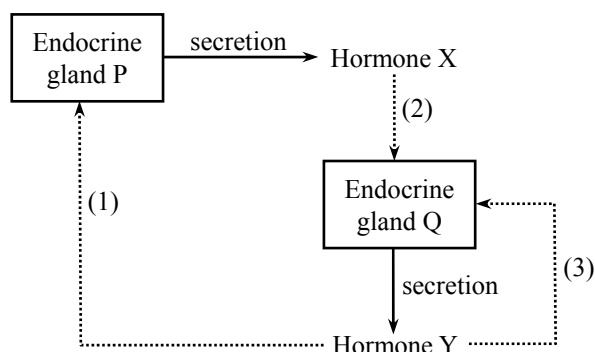
Assuming that these five species of organisms arose from the same ancestral stock, which of the following diagrams best represents the evolutionary tree constructed using the above information?



24. Which of the following descriptions about the regulation of the blood glucose level is correct?

- A. The chemoreceptor in the liver detects changes in the blood glucose level.
- B. The liver secretes more glucagon when the blood glucose level is low.
- C. More glycogen is converted to glucose when more glucagon is secreted.
- D. More glucose is taken up by cells when more glucagon is secreted.

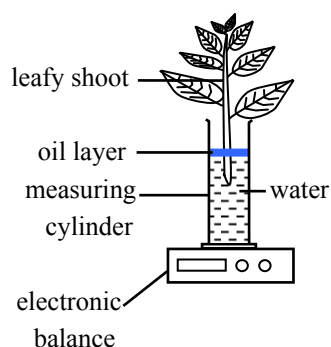
25. The flow chart below shows the interaction between the two endocrine glands and the hormones they secrete:



Which of the following combinations correctly shows the regulation of hormone Y by a negative feedback mechanism?

- | | (1) | (2) | (3) |
|----|-------------|-------------|-------------|
| A. | inhibition | stimulation | inhibition |
| B. | inhibition | inhibition | stimulation |
| C. | stimulation | stimulation | inhibition |
| D. | stimulation | inhibition | stimulation |
26. Which of the following parts of the human skin are responsible for preventing us from microbial infections?
- (1) sebaceous gland
 (2) epidermis
 (3) hair
- A. (1) and (2) only
 B. (1) and (3) only
 C. (2) and (3) only
 D. (1), (2) and (3)

27. The diagram below shows a weight potometer used in an experiment. The leafy shoot was left in the laboratory for 3 hours. The change in the reading of the electronic balance and the change in the volume of water in the measuring cylinder were recorded. The experiment was then repeated under the same environmental conditions with the upper surface of all the leaves of the shoot smeared with vaseline. The results are shown in the following table:



Treatment	Change in the reading of the balance (g)	Change in the volume of water in the measuring cylinder (mL)
(I) Leaves not smeared with vaseline	p	r
(II) Upper surface of all leaves smeared with vaseline	q	s

Note:

- p , q , r and s are numerical values
- mass of 1 mL of water = 1 g

From the results of the experiment, we can calculate the amount of

- water absorbed by the shoot in Treatment (I) from $p - r$.
 - water transpired by the shoot in Treatment (II) from $r - s$.
 - water retained by the shoot in Treatment (II) from $s - q$.
 - water transpired by the lower surface of the leaves of the shoot in 3 hours from $p - q$.
28. The photographs below show the appearances of a flower at different times of a day:



8:00 am

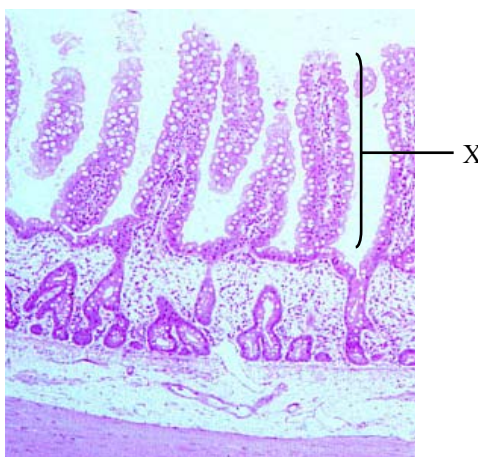


2:00 pm

With reference to the appearances of the flower at the times shown, which of the following can be concluded?

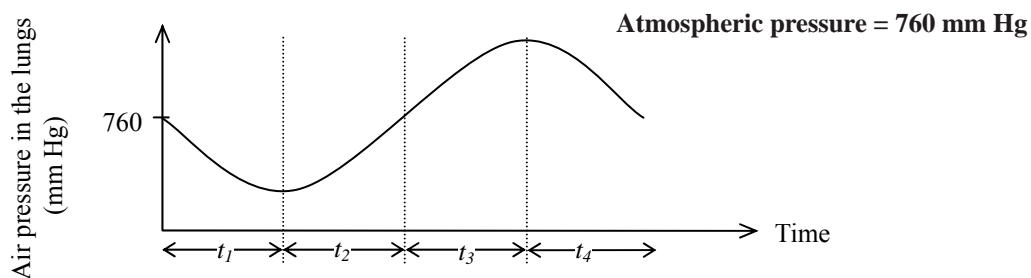
- The major support in the flower stalk is provided by the turgidity of the cells.
 - The rate of water uptake of the flower is higher than its rate of transpiration at 8:00 am.
 - The rate of water uptake of the flower is lower than its rate of transpiration at 2:00 pm.
- (1) only
 - (2) only
 - (1) and (3) only
 - (2) and (3) only

29. The following photograph shows a section of a part of the human intestine:



Which of the following is/are the function(s) of X?

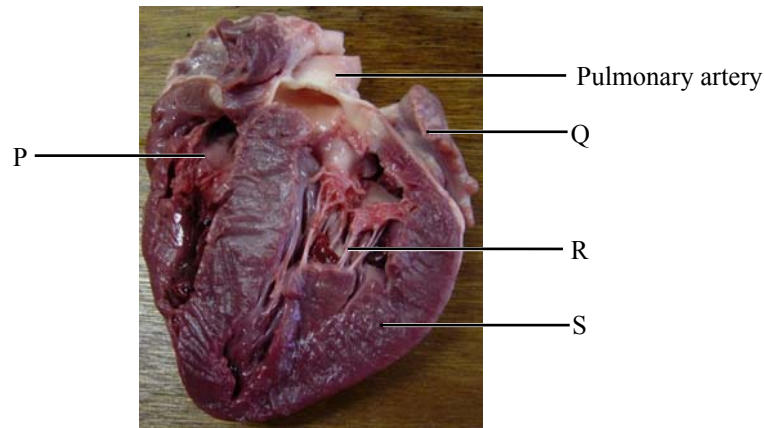
- (1) to move the food along the intestine by peristalsis
 - (2) to secrete enzymes for fat digestion
 - (3) to absorb digested food
- A. (1) only
- B. (3) only
- C. (1) and (2) only
- D. (2) and (3) only
30. The following graph shows the change in the air pressure inside the lungs within a period of time:



Which of the following correctly describes what happens at the specified time period?

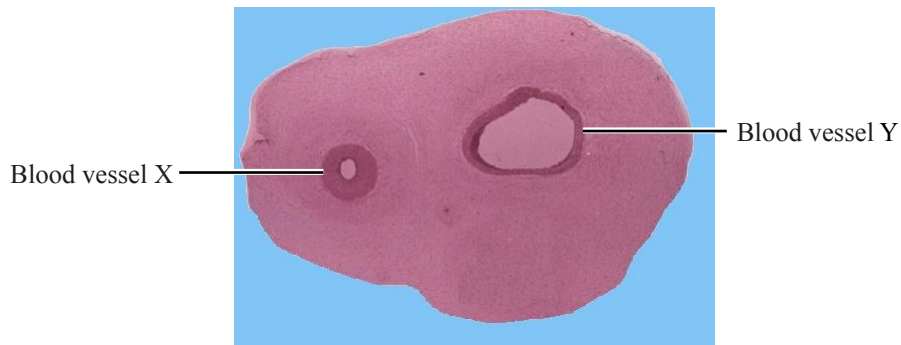
- A. During t_1 , air leaves the lungs.
- B. During t_2 , the intercostal muscles contract.
- C. During t_3 , the diaphragm is pulled flat.
- D. During t_4 , the rib cage is moved upwards and outwards.

31. The following photograph shows a dissected pig's heart:



Which of the following descriptions of the labelled structures is correct?

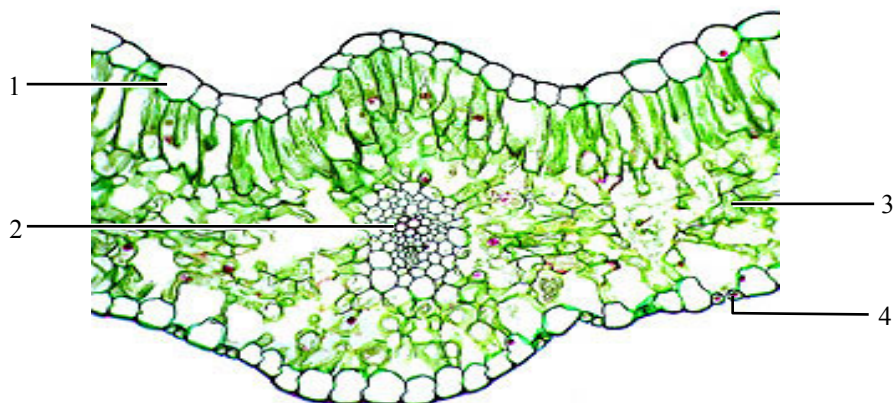
- A. Structure P contracts to deliver blood to various parts of the body except the lungs.
 - B. Structure Q receives blood from the pulmonary veins.
 - C. Structure R controls the opening and closing of the valve.
 - D. Structure S contracts to force the blood out of the heart through the pulmonary artery.
32. The photograph below shows the cross section of the umbilical cord of a foetus:



Which of the following descriptions about blood vessels X and Y are correct?

- (1) The blood pressure in blood vessel Y is lower than that in blood vessel X.
 - (2) There are valves along the length of blood vessel Y but not in blood vessel X.
 - (3) The blood in blood vessel Y has a lower oxygen content than that in blood vessel X.
- A. (1) and (2) only
 - B. (1) and (3) only
 - C. (2) and (3) only
 - D. (1), (2) and (3)

33. The photograph below shows the cross section of a leaf:



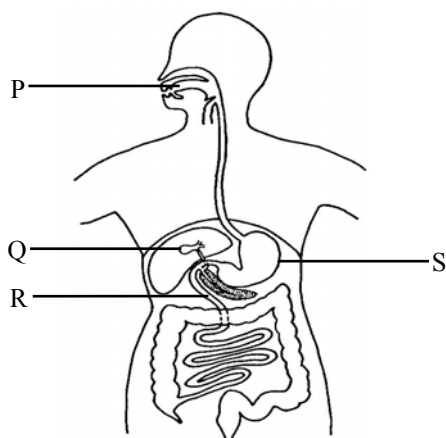
There is a gas released by the leaf when it is placed in darkness. From which of the labelled cells is this gas released?

- A. 1 and 2 only
 - B. 1 and 4 only
 - C. 2 and 3 only
 - D. 1, 3 and 4 only
34. The following shows a table listing the results of the food tests for a piece of food and a diagram of the human digestive system:

Food test	Result
Albustix paper	+
Benedict's test	+
Iodine test	-
Grease spot test	+

Key:

- + positive result
- negative result



In which of the labelled parts will this food be chemically digested?

- A. P and S only
- B. Q and R only
- C. R and S only
- D. Q, R and S only

Directions: Questions 35 and 36 refer to the following description of an experiment, which was carried out in the 1880s by a scientist, Christiaan Eijkman, for identifying the cause of the disease beriberi:

Group	Experimental conditions	Result after 5 weeks
I	chickens with beriberi and healthy chickens kept together; fed with unpolished rice	chickens with beriberi recovered, others remained healthy
II	healthy chickens injected with bacteria taken from chickens with beriberi; fed with unpolished rice	all chickens remained healthy
III	healthy chickens; fed with polished rice	all chickens developed beriberi
IV	healthy chickens; fed with unpolished rice	all chickens remained healthy

35. Which of the following can be concluded from this experiment?
- (1) Beriberi is not caused by the bacteria taken from chickens with beriberi.
 - (2) Beriberi is most likely non-infectious.
 - (3) Eating unpolished rice can prevent beriberi in healthy chickens.
- A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)
36. In light of the results of this experiment, Eijkman used prisoners for testing whether the same cause led to beriberi in humans. Which of the following should have been included in the experimental design so that he could make a valid conclusion?
- (1) The test should have been performed on healthy prisoners.
 - (2) The controlled variables should have included the sex, age and body mass of the prisoners.
 - (3) The prisoners chosen for the test should have been randomly assigned to the experimental and control groups.
- 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

PRACTICE PAPER
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, 7 and 9.
- (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 infectious diseases listed in Column 1, select **one** of the methods listed in Column 2 that helps to protect people from contracting the disease. Put the appropriate letter in the space provided. (2 marks)

Column 1

Cholera

Dengue fever

Column 2

- A. using serving chopsticks and spoons at meal times
- B. boiling water before drinking
- C. wrapping up rubbish properly before disposal
- D. wearing a face mask in crowded places
- E. getting rid of stagnant water

2. The following shows an electronmicrograph of a cell taken from a leaf:



- (a) Name the type of cell shown in the electronmicrograph. (1 mark)

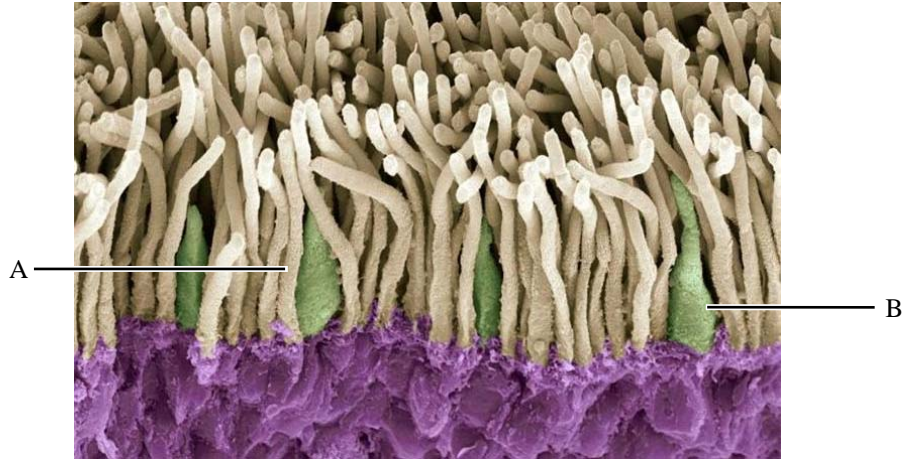
- (b) Using the letters in the electronmicrograph, fill in the table below to show the structures in which ATP is synthesised. State the process by which ATP is synthesised in each structure. (4 marks)

Structure	Process of ATP synthesis

Answers written in the margins will not be marked.

Please stick the barcode label here.

3. The electronmicrograph below shows two types of photoreceptors in the human eye:

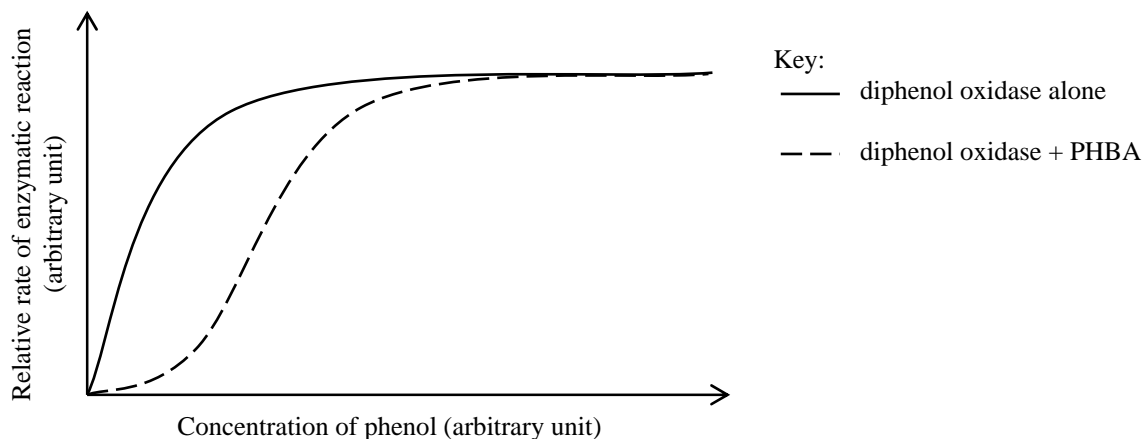


- (a) Name the part of the human eye where the photoreceptors are found. (1 mark)

- (b) A coloured object is perceived as being more colourful in bright light than in dim light. Explain this with respect to the functioning of photoreceptors A and B. (4 marks)

Answers written in the margins will not be marked.

4. When a slice of apple is exposed to air, it quickly turns brown. This is because the enzyme diphenol oxidase catalyzes the oxidation of phenols in the apple to dark-coloured products. In an experiment, the effect of a chemical, PHBA, on the rate of this enzymatic reaction was investigated. The experiment was carried out at the same temperature and the same concentration of diphenol oxidase was used. The results are shown in the graph below:



- (a) Deduce the relationship between PHBA and diphenol oxidase. (3 marks)

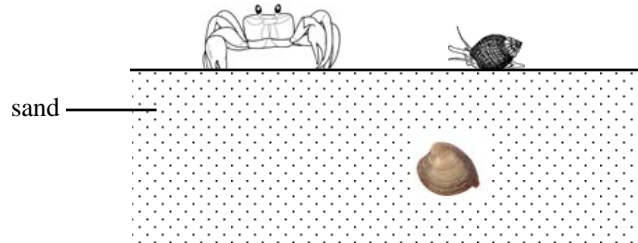
- (b) Draw a curve in the above graph to show the effect of PHBA on the rate of enzymatic reaction if a higher concentration of PHBA had been used. (1 mark)

- (c) Suggest one other factor that should be kept constant in this experiment. Explain how this factor may affect the activity of the enzyme. (3 marks)

Answers written in the margins will not be marked.

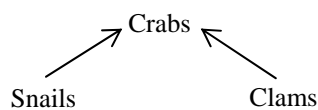
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5. A sandy shore community has three species: a burrowing clam, a snail, and a crab.



- (a) To determine the relative abundance of these species, a student placed a quadrat on the shore and collected all the individuals on the sediment surface inside the quadrat. After counting the number of individuals of each species collected from this quadrat, he determined their relative abundance. Give **three** reasons why the student's sampling method may not reflect the actual relative abundance of these organisms. (3 marks)

- (b) The feeding relationship of these three species is shown below:



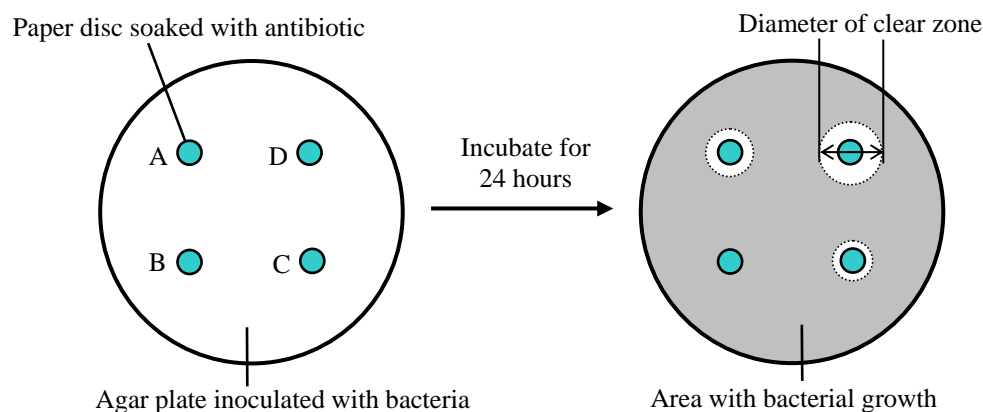
Suggest the effect on the population of crabs if a large number of clams are harvested by visitors to the shore. Explain your answer. (2 marks)
(Assume that the crabs have the same preference for snails and clams.)

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6. A test was carried out to investigate the effects of four antibiotics against a species of bacteria isolated from a patient. The bacteria were inoculated on the surface of an agar plate. Four filter-paper discs (each with a diameter of 5 mm) soaked with different antibiotics A, B, C and D were placed on the surface of the agar. The agar plate was then incubated to allow the growth of the bacteria. If bacterial growth is inhibited by an antibiotic, a clear zone surrounding the filter-paper disc soaked with the antibiotic will be observed after 24 hours. The results of the test are shown below:



The following table shows the diameter of the clear zone measured in each of the filter-paper discs:

Antibiotic	Diameter of the clear zone (mm)
A	13
B	5
C	10
D	21

- (a) Explain why the agar plate should be incubated at 37 °C. (1 mark)

- (b) (i) Based on the results, arrange the four antibiotics in descending order of effectiveness at inhibiting bacterial growth. (1 mark)

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(ii) Explain your reasoning in determining the order in (i).

(3 marks)

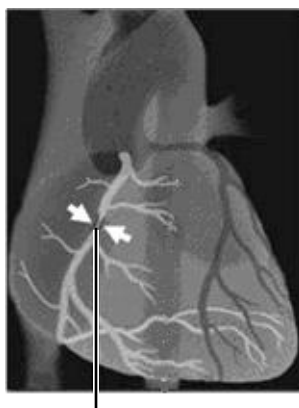
(c) Antibiotic B has been commonly used. It was the most effective antibiotic against the same bacteria a few years ago. Explain the result of antibiotic B in this test. (4 marks)

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7. Mr. Chan has been a smoker for more than 25 years. He has excessive rapid breathing and experiences chest pain during vigorous exercise. When consulting the doctor, he was advised to undertake an imaging of his heart for diagnosis. The image taken is shown below:



Narrowed artery X

- (a) (i) Identify artery X. (1 mark)

- (ii) Based on the condition shown in the above image, explain why Mr. Chan may suffer from a heart attack during vigorous exercise. (3 marks)

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- (b) The doctor advised Mr. Chan to quit smoking and to adopt a low-fat diet. With reference to Mr. Chan's health condition, give a reason for each piece of advice. (2 marks)

- (i) Quitting smoking

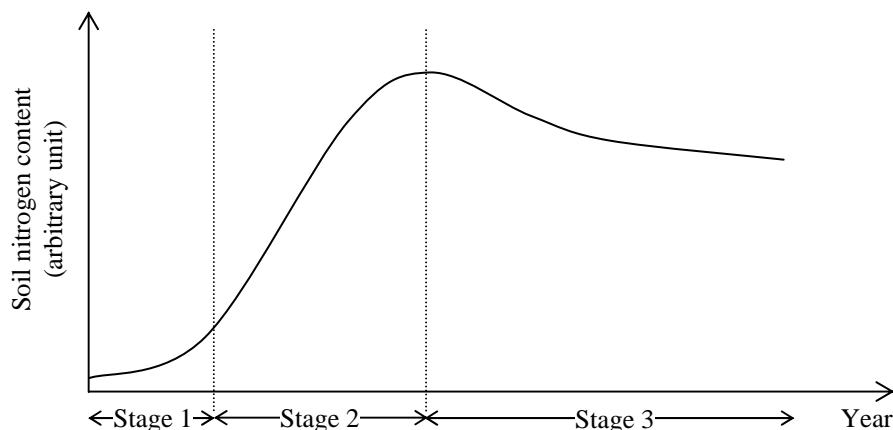
- (ii) Adopting a low-fat diet

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8. Graph 1 shows the change in the soil nitrogen content in an area over 200 years. At the beginning of Stage 1, the area was without vegetation. Table 1 shows the relative abundance of three plant species found in this area at the different stages:



Graph 1

Plant species	Relative abundance of the plant species at the end of each stage (%)		
	Stage 1	Stage 2	Stage 3
A	95	10	5
B	5	85	20
C	0	5	65

Table 1

- (a) With reference to Table 1, state the process that accounts for the change in the relative abundance of the plant species in this area. (1 mark)

- (b) (i) The bacteria living symbiotically with plant species A and species B played an important role in causing the increase in the soil nitrogen content in Stages 1 and 2.

- (1) Name the symbiotic bacteria living in plant species A and B. (1 mark)

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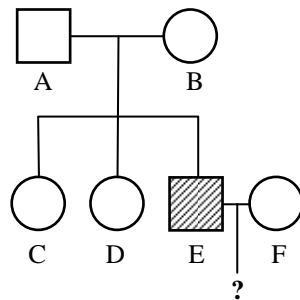
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- (2) Describe how the symbiotic bacteria and the two plant species caused the increase in the soil nitrogen content in Stages 1 and 2. (3 marks)

- (ii) Species C was absent in Stage 1 but became the dominant species in Stage 3. Explain the change in its relative abundance from Stage 1 to Stage 3. (3 marks)

9. A couple (A and B) does not have any family history of Down syndrome, but the female (B) has a family history of colour blindness. The two daughters of this couple do not have colour blindness, but one of them (C) has Down syndrome. The son (E) has colour blindness. The pedigree of this family is shown in the following diagram:



Key:

- Male with normal colour vision
- Colour-blind male
- Female with normal colour vision

- (a) Normal people have 23 pairs of chromosomes in the cell nucleus, but people with Down syndrome have an extra chromosome in the 21st pair of chromosomes. Explain how this couple could give birth to a Down syndrome child (C). (2 marks)

- (b) (i) In humans, colour blindness is a sex-linked trait. Based on the above pedigree, deduce the genotype of the mother (B) with respect to colour vision. (Marks will **not** be awarded for genetic diagrams.) (5 marks)

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- (ii) F is a carrier of the colour blindness allele. With the aid of a genetic diagram, find the probability of E and F giving birth to a colour-blind daughter. (5 marks)

Genetic diagram:

Probability of E and F giving birth to a colour-blind daughter: _____

Answers written in the margins will not be marked.

10. (a) Photograph 1 shows two groups of wheat flowers and Photograph 2 shows an enlarged wheat flower:



Photograph 1



Photograph 2

Suggest the agent for pollination of the wheat. Support your answer with reference to an observable feature in the above photographs. (2 marks)

- (b) Explain the importance of soaking wheat grains in water for germination. (2 marks)

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Answers written in the margins will not be marked.

(c) When wheat grains are sown on a piece of farmland which has been frequently sprayed with a pesticide X, the germination rate is poor. Design an experiment to investigate whether pesticide X affects germination of the wheat grains. (4 marks)

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11. Digested food is absorbed into the epithelial cells of the villi.

(a) With reference to the structure of the cell membrane as illustrated by the fluid mosaic model of cell membrane, explain the following:

(i) Fatty acids (non-polar molecules) can diffuse across the cell membrane into the epithelial cell. (2 marks)

(ii) Amino acids (polar molecules) can be taken up from the intestinal lumen into the epithelial cell but cannot diffuse across the epithelial cell membrane back to the lumen. (3 marks)

(b) Name a mechanism for transporting glucose across the cell membrane. State a difference between this mechanism and diffusion. (2 marks)

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For question 12, candidates are required to present their answers in essay form. 7 marks will be allocated to biological knowledge, and 3 marks to logical presentation and clarity of expression.

12. Being able to respond to external stimuli is very important for the survival of organisms. Illustrate this with reference to **one** tropic response in flowering plants. Contrast the nature and process of this type of response with that involved in reflex action in humans. (10 marks)

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