

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2024

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.**

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.

1. Fertilisers usually contain nitrogen and phosphorous compounds. They can be used by plants for the synthesis of

- (1) cell walls.
 - (2) chlorophyll.
 - (3) cell membranes.
- A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

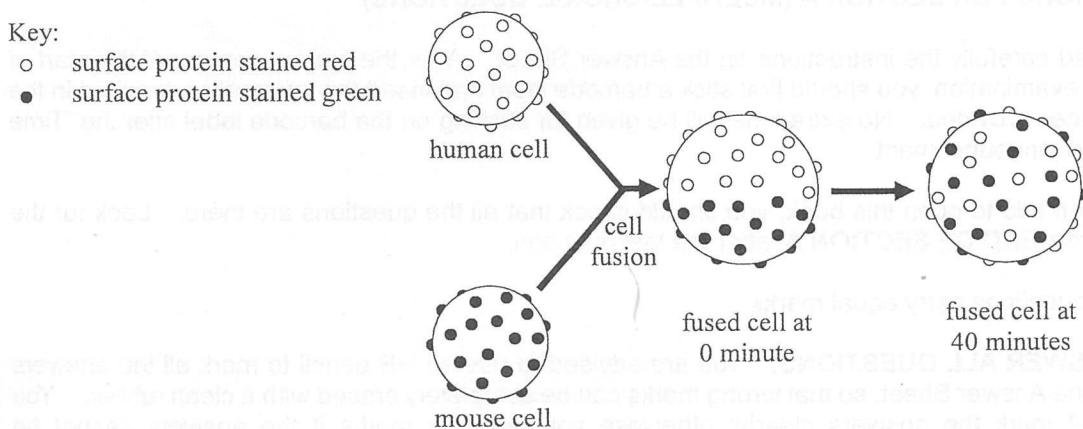
2. The genetic material of a virus contains 1966 adenine (A), 2343 guanine (G), 1749 thymine (T) and 2368 cytosine (C). Based on this information, which of the following combinations of the genetic material for this virus is correct?

	<i>Nucleic acid</i>	<i>Pentose</i>
A.	single-stranded	deoxyribose
B.	single-stranded	ribose
C.	double-stranded	deoxyribose
D.	double-stranded	ribose

3. The schematic diagram below shows an investigation into cell membranes. The cell surface proteins of a human cell were labelled with a red dye while those of a mouse cell were labelled with a green dye. The two cells were then fused. The distribution of the cell surface proteins at 0 minute and 40 minutes are shown below:

Key:

- surface protein stained red
- surface protein stained green



Which of the following properties of the cell membrane can be used to explain the change in the distribution of the surface proteins of the fused cell shown in this investigation?

- (1) A cell membrane is fluid in nature.
 - (2) A cell membrane is differentially permeable.
 - (3) A cell membrane is an asymmetric structure.
- A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

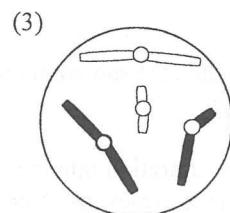
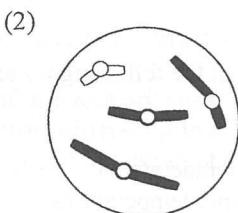
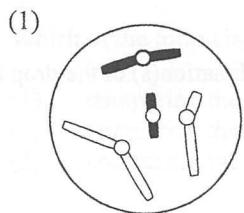
Directions: Questions 4 to 6 refer to the diagram below, which shows the appearance of chromosomes in a cell at the early stage of meiotic cell division:



4. If the amount of DNA in this cell is β , what is the amount of DNA in a non-dividing somatic cell of this organism?

- A. $\frac{1}{4}\beta$
- B. $\frac{1}{2}\beta$
- C. β
- D. 2β

5. Which of the following diagrams show the possible combinations of the chromosomes in the daughter cells?



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

6. Mendel's law can be used to explain the combinations of chromosomes in the daughter cells in Question 5. Which of the following correctly shows the corresponding Mendel's law and the stage of meiotic cell division as described by the law?

Mendel's law

- A. Law of segregation
- B. Law of segregation
- C. Law of independent assortment
- D. Law of independent assortment

Stage

- first meiotic cell division
- second meiotic cell division
- first meiotic cell division
- second meiotic cell division

7. Which of the following combinations about the stages of photosynthesis is correct?

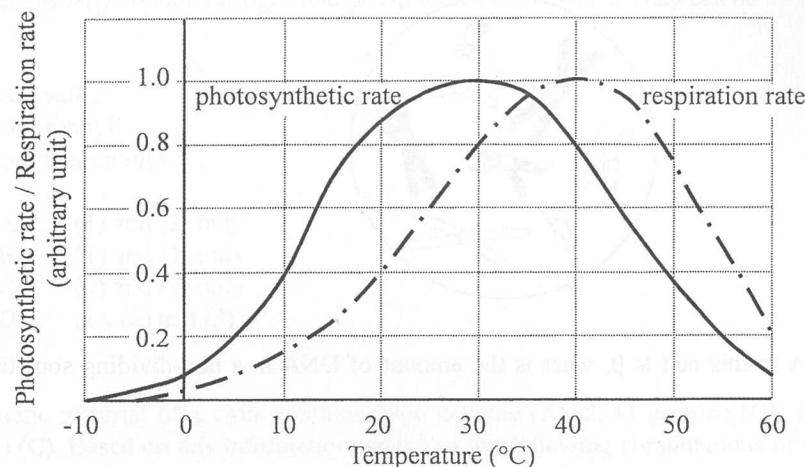
Photochemical reactions

- A. produces oxygen
- B. requires carbon dioxide
- C. occurs in stroma
- D. light is the energy source

Calvin cycle

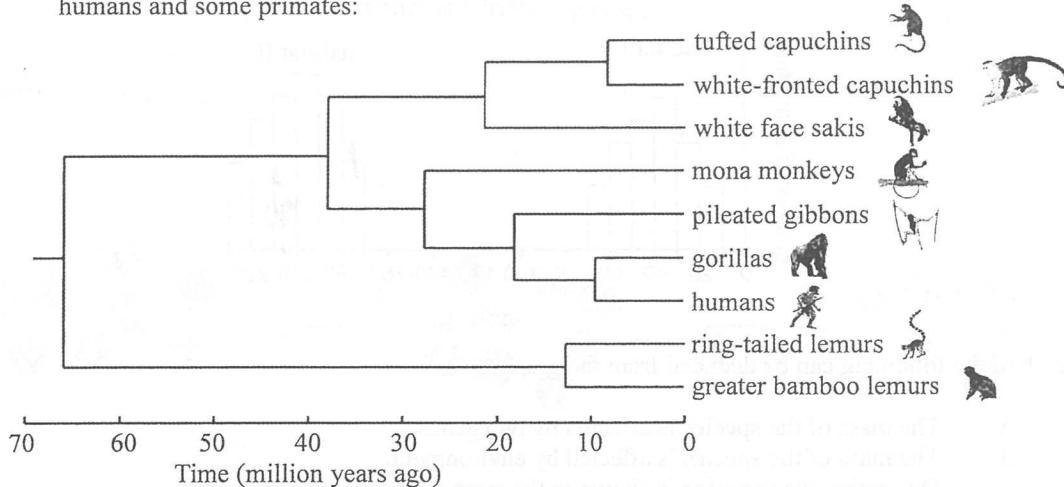
- produces water
- requires NADPH
- occurs in grana
- ATP is the energy source

Directions: Questions 8 and 9 refer to the graph below, which shows the changes in the photosynthetic rate and respiration rate of a rice crop at different temperatures while the light intensity and concentration of carbon dioxide were kept constant:

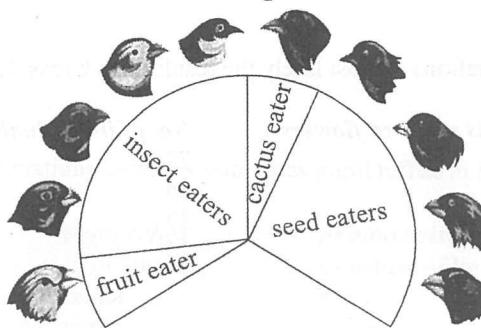


8. Which of the following interpretations about the graph is correct?
- A. The crop has maximum growth at 30°C.
 - B. The crop does not absorb water at 40°C.
 - C. The crop reaches compensation point at 35°C.
 - D. The crop has greatest net production of food at 20°C.
9. Based on the data shown in the graph, which of the following is / are possible explanation(s) of the drop in the two rates?
- (1) Transpiration rate increases at higher temperatures.
 - (2) The enzymes involved denature at higher temperatures.
 - (3) The two processes take place at different organelles of the cell.
- A. (1) only
 - B. (2) only
 - C. (1) and (3) only
 - D. (2) and (3) only
10. Lactic acid is produced during the anaerobic respiration in humans. Which of the following combinations correctly describes the metabolism of the lactic acid produced?
- | | |
|---|---|
| the location where lactic acid is broken down <ul style="list-style-type: none"> A. muscle B. muscle C. the liver D. the liver | the period involved <ul style="list-style-type: none"> during vigorous exercise after vigorous exercise during vigorous exercise after vigorous exercise |
|---|---|
11. Sharks are considered ‘living fossils’ because their appearance closely resembles shark fossils from millions of years ago. Which of the following is the most likely reason for the close resemblance?
- A. Sharks have few predators.
 - B. Sharks have a wide range of prey.
 - C. A shark’s body is well-adapted to the ocean environment.
 - D. A shark’s body is most advanced as compared to other species in oceans.

Directions: Questions 12 and 13 refer to the diagram below, which shows the phylogenetic relationships between humans and some primates:



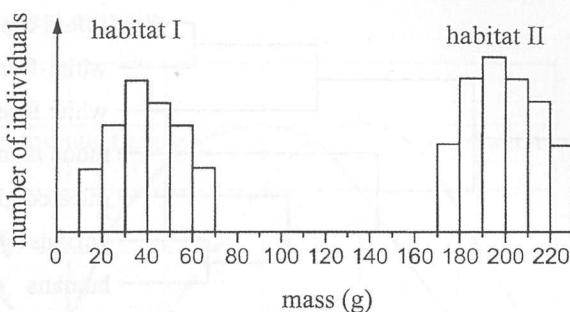
12. Which of the following statements about these primates is correct?
- A. Pileated gibbons share a common ancestor with gorillas and humans.
 - B. Gorillas have a closer relationship with ring tailed lemurs than white face sakis.
 - C. White face sakis are the common ancestor of tufted capuchins and white-fronted capuchins.
 - D. The difference between gorillas and humans is the same as that of ring-tailed lemurs and greater bamboo lemurs.
13. Which of the following methods can be used to construct the above phylogenetic relationships of the primates?
- (1) comparing the fossil records of different primates
 - (2) comparing the DNA samples from different primates
 - (3) comparing the key protein samples from different primates
- A. (1) and (2) only
 - B. (1) and (3) only
 - C. (2) and (3) only
 - D. (1), (2) and (3)
14. Darwin's finches are a group of small birds isolated on the Galapagos Islands. These birds show variations in forms and function of their beak as shown in the diagram below:



What is the significance of these variations to the survival of Darwin's finches on the Galapagos Islands?

- A. The variations promote natural selection.
- B. They can distinguish each other by their beaks.
- C. They interbreed to produce offspring with more variations.
- D. They have different ecological niches to reduce competition.

15. The graph below shows the masses of the same plant species grown in two different habitats:



Which of the following can be deduced from the graph?

- A. The mass of the species is affected by two genes.
- B. The mass of the species is affected by environment.
- C. Discontinuous variation is shown in the mass of the species.
- D. The mass of the species in habitat II is more affected by environment than that in habitat I.

Directions: Questions 16 to 18 refer to the table below, which shows the results of some crosses in one type of plants. This type of plant produces individuals either bearing male flowers with stamens only or female flowers with carpels only. The colour of the flower is controlled by a single gene.

<i>Cross</i>	<i>Male parent</i>	<i>Female parent</i>	<i>Offspring</i>
1	white flowers	white flowers	all white flowers
2	red flowers	white flowers	all red flowers
3	white flowers	red flowers	all red flowers
4	red flowers	white flowers	some red flowers, some white flowers
5	?	red flowers	some red flowers, some white flowers

16. It is known that the sex determination of this plant is similar to that of humans. Which of the following combinations correctly describes the allele for white flower in this plant?

- | | <i>Dominant or recessive</i> | <i>Location of the allele</i> |
|----|------------------------------|-------------------------------|
| A. | dominant | autosome |
| B. | dominant | sex chromosome |
| C. | recessive | autosome |
| D. | recessive | sex chromosome |

17. Which of the following combinations is most likely the result from Cross 4?

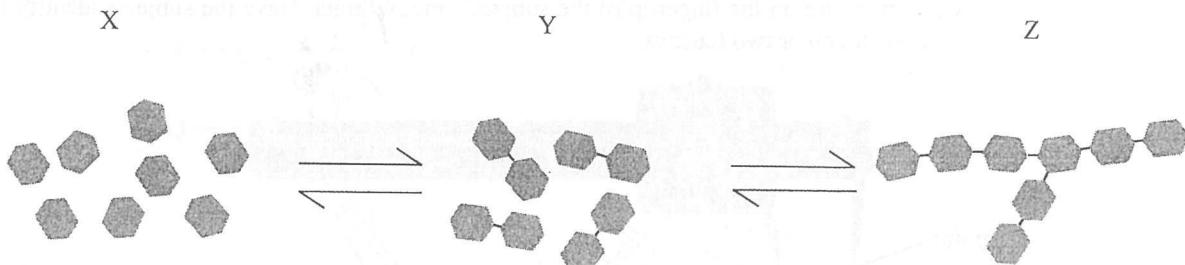
	<i>No. of individuals with red flowers</i>	<i>No. of individuals with white flowers</i>
A.	26	73
B.	48	46
C.	69	37
D.	71	25

18. Which of the following statements about Cross 5 is correct?

- A. The female parent could be a homozygote.
- B. The male parent could be a homozygote with red flowers.
- C. The male parent could be a homozygote with white flowers.
- D. The male parent could be a heterozygote with white flowers.

Directions: Questions 19 and 20 refer to the diagram below, which shows interconversion of three types of compounds catalysed by enzymes in a living organism:

Key:  six-carbon sugars



19. If the organism is a plant, which of the following statements is *incorrect*?

- A. X is the major form of carbohydrate transported through phloem
- B. The conversion of Z to X takes place in a germinating seed.
- C. X can be the raw materials for synthesis of cell wall.
- D. The conversion of X to Z takes place in chloroplast.

20. If the organism is a human, which of the following statements are correct?

- (1) Conversion of Z to Y takes place in the stomach.
 - (2) Conversion of X to Z takes place in the liver.
 - (3) Z is present in muscle.
- A. (1) and (2) only
 - B. (1) and (3) only
 - C. (2) and (3) only
 - D. (1), (2) and (3)

21. Patients who have had their gall bladder removed should eat less oily food. This is because they are *unable* to

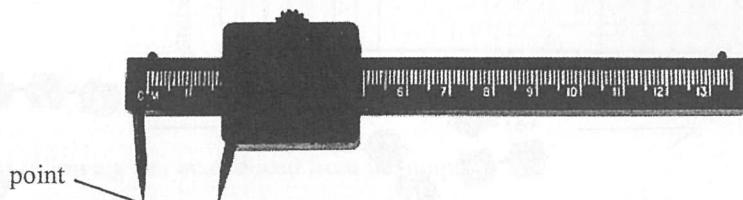
- A. store bile.
- B. store lipase.
- C. produce bile.
- D. produce lipase.

22. Which of the following combinations correctly compares pupil reflex in humans and phototropism in plants?

	<i>pupil reflex</i>	<i>phototropism</i>
(1) stimulus	light intensity	direction of light
(2) location of receptors	retina	shoot tip
(3) effector	pupil	shoot
A. (1) and (2) only		
B. (1) and (3) only		
C. (2) and (3) only		
D. (1), (2) and (3)		

Directions: Questions 23 to 25 refer to a two-point discrimination test on the human skin by following the procedure shown below:

1. Blindfold the subjects (tested persons).
2. Set the calipers (shown below) at a distance of 30 mm. Apply the two points of the calipers with equal pressure on the fingertip of the subject's index finger. Have the subjects identify if they feel one touch or two touches.

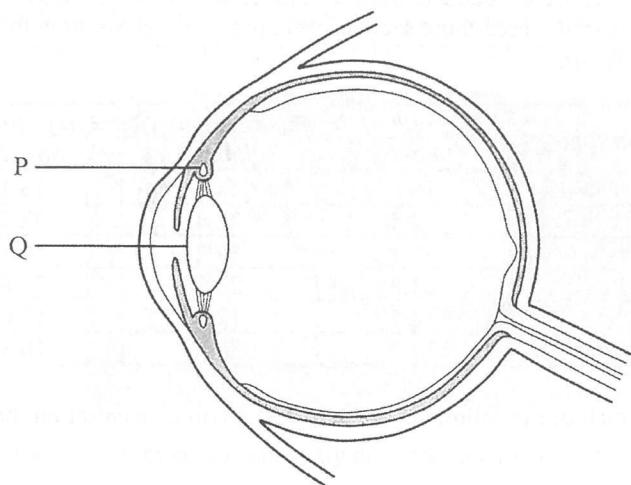


3. Repeat step 2 by using a progressively shorter distance (e.g. 28 mm, 26 mm, 24 mm) between the two points until the subject feels one touch. Record the distance.
 4. Repeat steps 2 and 3 by touching the palm of the hand, the back of the hand and the upper arm.
 5. Over the course of the experiment, randomly use the caliper set at 0 mm for every couple of trials. It is important to make sure that the subjects tell you that they only feel one touch when the caliper is set at 0 mm.
23. Based on the procedure given, how many independent variable(s) is/are being studied in this investigation?
- A. 1
 - B. 2
 - C. 3
 - D. 4
24. The investigation was designed to show the density of the touch receptors of the skin. What is the assumption of this investigation?
- A. The subjects do not cheat by peeking out of the blindfold.
 - B. The fingertip is more sensitive than the other parts of the body.
 - C. A closer distance means that the density of the touch receptors is higher.
 - D. The two-touch sensations are produced by two separated touch receptors without overlapping.
25. Which of the following correctly explains the importance of Step 5 in this investigation?
- A. It ensures the validity of the measurement.
 - B. It checks the accuracy of the measurement.
 - C. It improves the reliability of the measurement.
 - D. It reduces the random error of the measurement.

26. Which of the following parts of the brain are responsible for coordination when one is speaking?

- (1) cerebellum
 - (2) motor area
 - (3) sensory area
 - (4) association area
- A. (2) and (4) only
 - B. (1), (2) and (3) only
 - C. (1), (2) and (4) only
 - D. (1), (3) and (4) only

Directions: Questions 27 and 28 refer to the diagram below, which shows a section of a human eyeball:



27. Ken and Jane are looking at a bird flying away from them. Which of the following combinations correctly describes the conditions of structures P and Q of their eyeball?

	<i>Structure P</i>	<i>Structure Q</i>
A.	relaxing	becoming thinner
B.	relaxing	becoming thicker
C.	contracting	becoming thinner
D.	contracting	becoming thicker

28. When the bird flies away to a certain distance, Ken can still see it clearly but Jane cannot. Ken has normal eyesight. Which of the following combinations correctly describes Jane's condition?

	<i>Eyeball</i>	<i>Position of image</i>
A.	too long	focused behind the retina
B.	too long	focused in front of the retina
C.	too short	focused behind the retina
D.	too short	focused in front of the retina

29. Study the following two statements:

- I: Not all copulations lead to fertilisation and pregnancy.
II: Fertilisation occurs when a sperm enters the ovum at the oviduct.

Which of the following descriptions about the two statements is correct?

- A. Both I and II are correct and II correctly explains I.
B. Both I and II are correct but II does not explain I.
C. I is correct but II is incorrect.
D. I is incorrect but II is correct.

Directions: Questions 30 and 31 refer to an investigation about the effects of auxins on the growth of shoots. 10 mm sections of shoots were obtained from a number of seedlings. Auxin solutions of different concentrations were prepared. Three shoot sections were put into each solution for two days. The results are shown in the table below:

Auxin concentration (ppm)	Length of the shoot section after 2 days (mm)		
	Shoot 1	Shoot 2	Shoot 3
0	15.0	14.5	15.1
0.1	32.5	32.4	32.2
1	37.1	37.2	10.1
10	24.0	23.9	23.8
100	12.5	12.5	13.0
1000	10.0	9.8	10.3

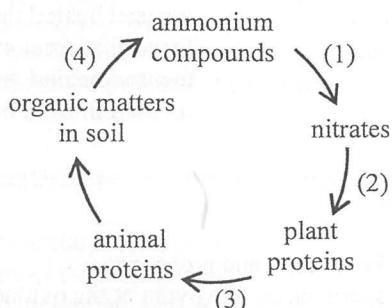
30. Based on the above results, which of the following is the lowest auxin concentration that inhibits the growth of the shoots?

- A. 0.1 ppm
- B. 10 ppm
- C. 100 ppm
- D. 1000 ppm

31. Which of the following best explains the result of Shoot 3 in 1 ppm auxin concentration solution?

- A. This datum is anomalous.
- B. It is an error which should be deleted.
- C. It is due to variations in individual differences.
- D. The shoot section is likely taken from the region of cell differentiation.

Directions: Questions 32 and 33 refer to the diagram below, which shows the conversion of some nitrogenous compounds in nature:



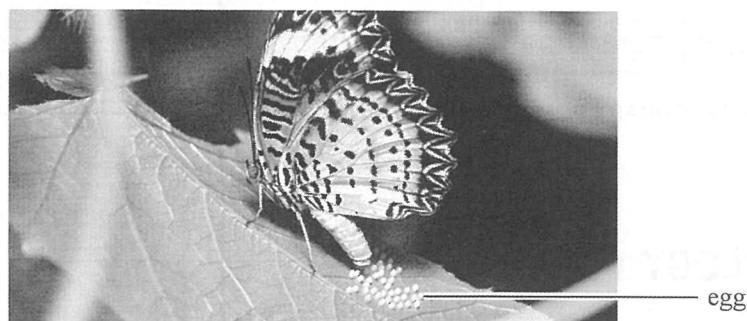
32. Which of the following statements about the conversions is correct?

- A. Process (1) involves nitrogen fixing bacteria.
- B. Process (2) is anabolic in nature.
- C. Process (3) is catabolic in nature.
- D. Process (4) involves denitrifying bacteria.

33. Which of the following process(es) involve(s) assimilation?

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

Directions: Questions 34 and 35 refer to some information about the interaction among three organisms: butterflies, plant species X and ants. Butterflies lay eggs on the leaf surfaces of plant species X. When caterpillars hatch from the eggs, they feed on the leaves. Plant species X secretes a sugary solution on their leaves. Ants are attracted to feed on the sugary solution and the eggs.



34. Which of the following combinations correctly describes the relationship between the organisms mentioned?

Plant species X and ant

- A. mutualism
- B. mutualism
- C. commensalism
- D. commensalism

Ant and butterfly

- competition
- predation
- competition
- predation

35. It is believed that the ancestors of plant species X did not possess the structure to secrete a sugary solution on their leaves. Which of the following are the possible reasons that could have led to the emergence of this structure in plant species X?

- (1) Spontaneous mutations of leaf cells of the ancestors.
- (2) Gene mutation during meiotic cell division of the ancestors.
- (3) Individuals with this structure survived better than those without this structure.

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

36. Which of the following are examples of non-specific defence in humans?

- (1) tear glands
- (2) phagocytes
- (3) epithelial tissue

- 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

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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.



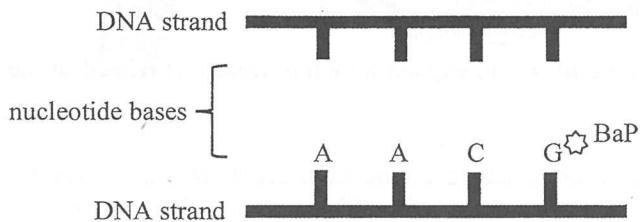
SECTION B

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

1. Fill in the table below to compare the characteristics of nervous and hormonal controls. (3 marks)

		<i>Nervous control</i>	<i>Hormonal control</i>	
(a)	Signalling molecule			
(b)	Transmission pathway			
(c)	Comparison of the time taken to induce responses			

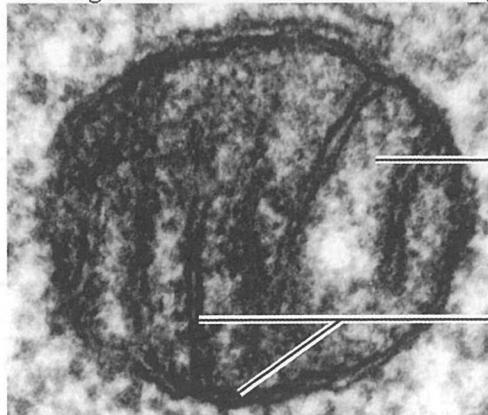
2. BaP is a carcinogenic chemical which is commonly found in grilled meats. It can attach randomly to the nucleotides of DNA molecules. When it is attached to guanine (G), this G will be misread as thymine (T). The diagram below shows part of nucleotide sequence of one strand of a DNA molecule with BaP attached to a G:



- (a) On the above diagram, write down the nucleotide sequence found in the opposite strand of the DNA when misreading happens. (1 mark)
- (b) Suggest *one* reason why this type of mutation may *not* affect the functioning of the protein formed. (1 mark)
-
- (c) If this type of mutation accumulates over time in the DNA molecules, there is a chance that it will affect the functioning of the protein formed and subsequently lead to tumour formation. Suggest which cellular process this protein controls. (1 mark)
-
-

Please stick the barcode label here.

3. The diagram below shows an electron micrograph of a mitochondrion:



X: _____

Y

50 nm

- (a) Label X in the above diagram. (1 mark)
- (b) Describe *one* observable feature of Y and explain how this feature is related to the functioning of mitochondria. (2 marks)

- (c) Chemical Z can inhibit an enzyme found in X.

- (i) Which key process of respiration would be inhibited? (1 mark)

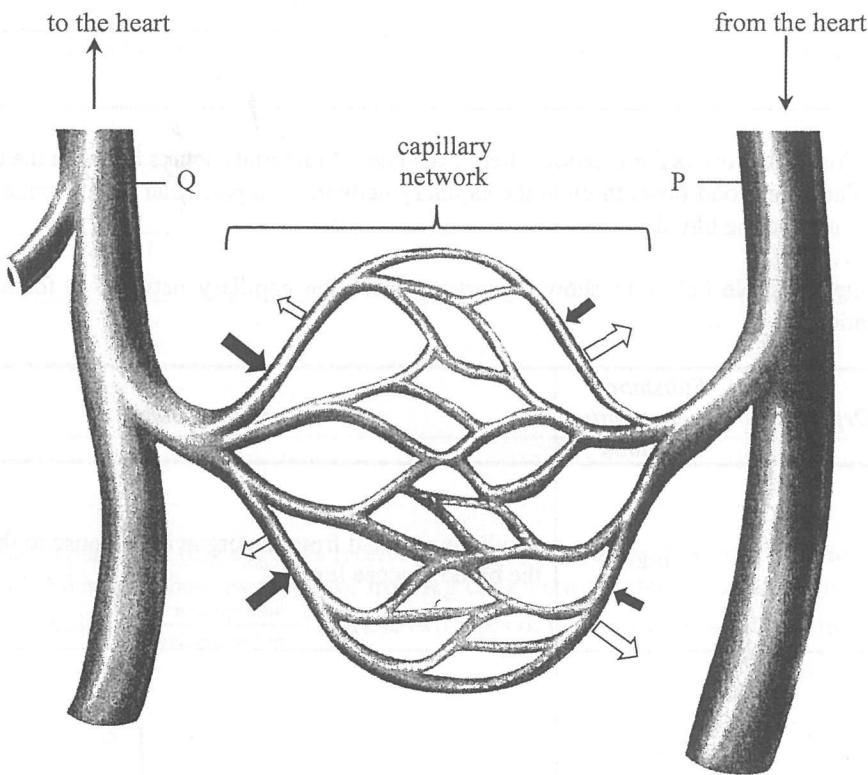
- (ii) If chemical Z is added to a plant cell culture, how would this affect the respiratory pathway? (3 marks)

Answers written in the margins will not be marked.

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Answers written in the margins will not be marked.

4. The schematic diagram below shows the arrangements of some blood vessels:



- (a) The two types of arrows (black and white) represent two factors which govern the movement of fluid into or out of the capillary network. Identify these two factors. (2 marks)

→ :

↔ :

- (b) The sizes of the arrows in the above diagram represent the magnitudes of the factors. Explain the change in the factors denoted by \Rightarrow as the blood flows from P to Q. (3 marks)

Please stick the barcode label here.

- (c) The capillary network is the location where exchange of materials occurs between the blood and tissue fluid. When the blood flows through the capillary network of a particular organ, some substances will be taken up into the blood.

Complete the table below to show the organ where the capillary network is found. Provide your explanation. (3 marks)

<i>Organ</i>	<i>Substance taken up into the blood</i>	<i>Explanation</i>
(i)	insulin	Insulin is secreted from the organ in response to the change of the blood glucose level.
(ii)	urea	

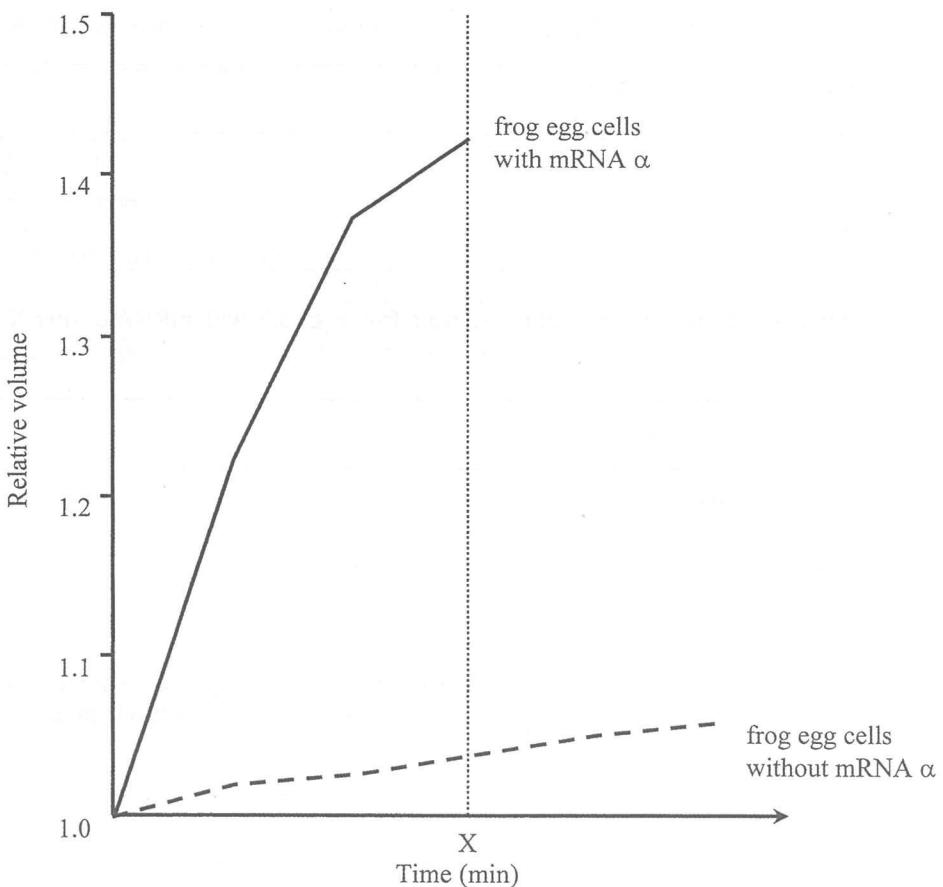
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Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

5. In an experiment, mRNA α was isolated from a mammalian cell and then injected into a frog egg cell. The expression of mRNA α eventually led to the presence of protein α on the cell membrane of the frog egg.
- (a) Describe how the injected mRNA α led to the presence of protein α on the cell membrane of the frog egg. (3 marks)

- (b) In another experiment, frog egg cells received an injection of a fixed amount of water with or without mRNA α . After that, these two types of frog egg cells were transferred to pure water. The changes in the relative volumes ($\frac{\text{new volume}}{\text{original volume}}$) of these two types of frog egg cells are shown in the graph below:



Please stick the barcode label here.

- (i) Explain why there was an increase in the relative volume of the frog egg cells without mRNA α after they were transferred to pure water. (2 marks)

- (ii) Based on the difference shown in the results of the two types of frog egg cells, deduce the function of protein α on the cell membrane. (3 marks)

- (iii) Suggest why no data were obtained from frog egg cells with mRNA α after X minutes. (1 mark)

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

6. Shirley came across an article about some beans containing an amylase inhibitor as a defence against insects. She wondered if the amylase inhibitor would also work in the human body and if it did, whether it could be used as a food supplement for weight management. She discussed the idea with her classmate Johnson. They had different ideas:

Shirley: I think we should test if the bean extract can inhibit pancreatic amylase.

Johnson: Perhaps we can use salivary amylase instead of pancreatic amylase.

- (a) With reference to the process of digestion, which amylase would produce more valid results for developing a food supplement that targets weight management? Explain your answer. (3 marks)

- (b) The table below shows the reaction mixtures prepared for the investigation:

<i>Solution</i>	<i>Volume of solution used in each set-up (mL)</i>	
	<i>Set-up I</i>	<i>Set-up II</i>
1% starch solution	15	15
Amylase solution	5	5
Bean extract	0	5
Buffer solution (to maintain the pH)	5	5
Water	5	0

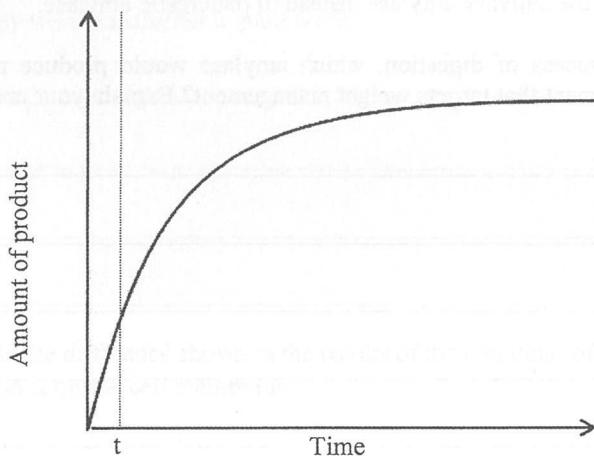
- (i) Explain the purpose of adding water to set-up I. (2 marks)

- (ii) Suggest **one** method to determine the rate of starch digestion and state clearly the measurement taken to show the rate of starch digestion. (2 marks)

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Starch consists of a chain of glucose units joined together by glycosidic bonds. Amylase is an enzyme that splits starch into glucose. If it has been stored and never used it may become inactive. This is because the protein structure will change and the active site may no longer be available.

- (c) The graph below shows the amount of product formed over time when amylase is working normally:



The experiment was repeated with the addition of bean extract at time t . If the bean extract can inhibit the amylase being studied, what will be the change in the amount of product formed? On the above graph, sketch a line to show the results. (1 mark)

- (d) Shirley and Johnson shared their ideas with their professor. Their professor suggested that they should conduct an *in vivo* experiment using mice with the control group fed with starchy food and the experimental group fed with a mixture of starchy food and bean extract.

- (i) Explain why the result of an *in vivo* experiment is more valid than that of *in vitro* experiment in this case. (1 mark)

-
-
- (ii) Apart from monitoring the change in body weight of the mice, their professor suggested that they should take blood samples from the mice after the meals for analysis. Which component of the blood should they monitor? What would be the expected results of the control group and the experimental group if their ideas actually worked? (2 marks)
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- (e) Suggest how the amylase inhibitor helps the bean defend against insects. (1 mark)
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7. The following photograph was generated by an artificial intelligence programme using the following sentence:

'A photograph capturing Hong Kong students on a field trip to a rocky shore, studying the distribution and abundance of organisms along the shore.'



- (a) The photograph does not truly reflect the requirement in the sentence because two pieces of essential equipment are missing.
- (i) List the *two* pieces of essential equipment for the study. (1 mark)

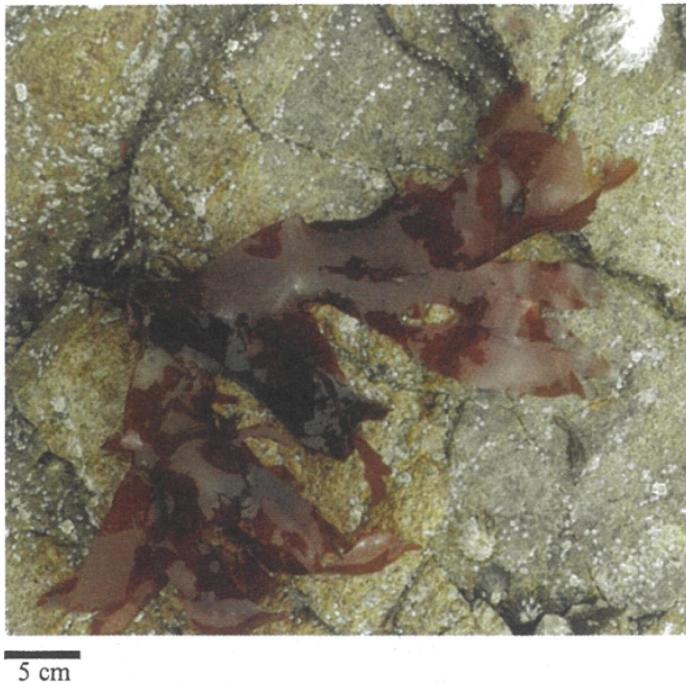
- (ii) How could you use the equipment listed in (i) to collect the data needed for the study? (2 marks)

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- (b) In a field trip to a rocky shore, a student found a thin brown sheet lying on a rock. The student suspected that it was an alga. A small piece of the sample was taken back to school for further study.



Using apparatus and reagents available in a school laboratory, design a set-up which can be used to show whether the sample of this thin sheet can undergo respiration. In the space below, draw a simple labelled diagram of this set-up. (3 marks)

Title: A set-up for demonstrating if respiration occurs in the sample

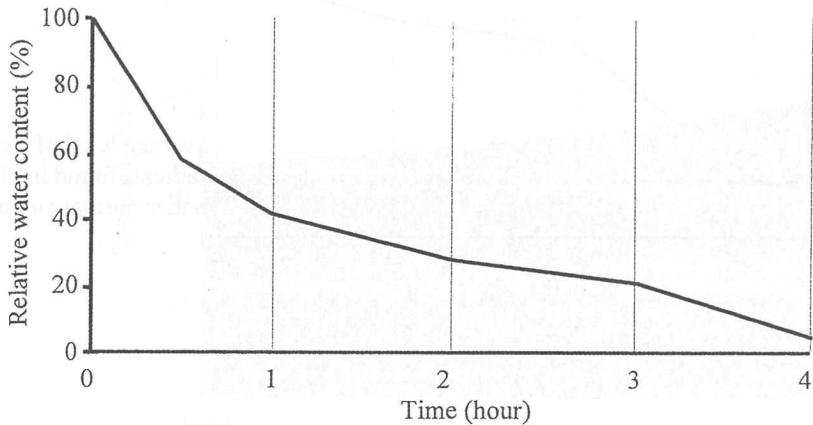
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- (c) Under normal circumstances, the level of free radicals in algal tissues is kept at a certain level as a result of homeostasis. In response to dehydration, algal tissues will be stimulated to produce free radicals which can cause damage to the cell components if there is an accumulation.

Graph I shows the change in relative water content of algal tissue samples during a period of four hours of dehydration:

Graph I



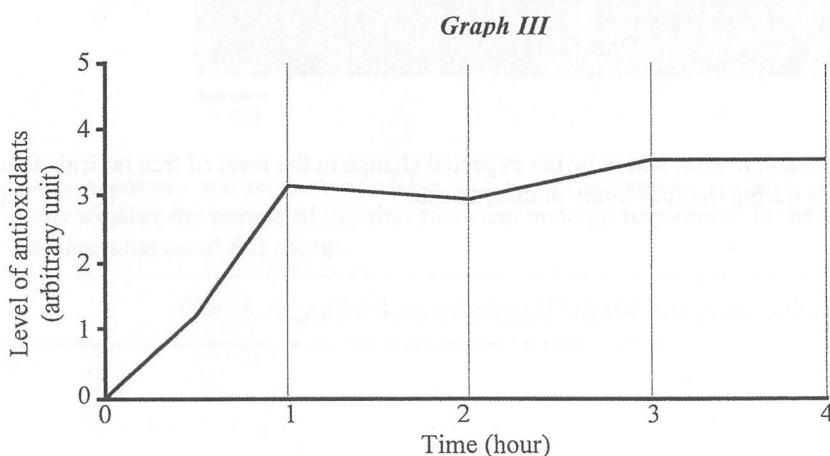
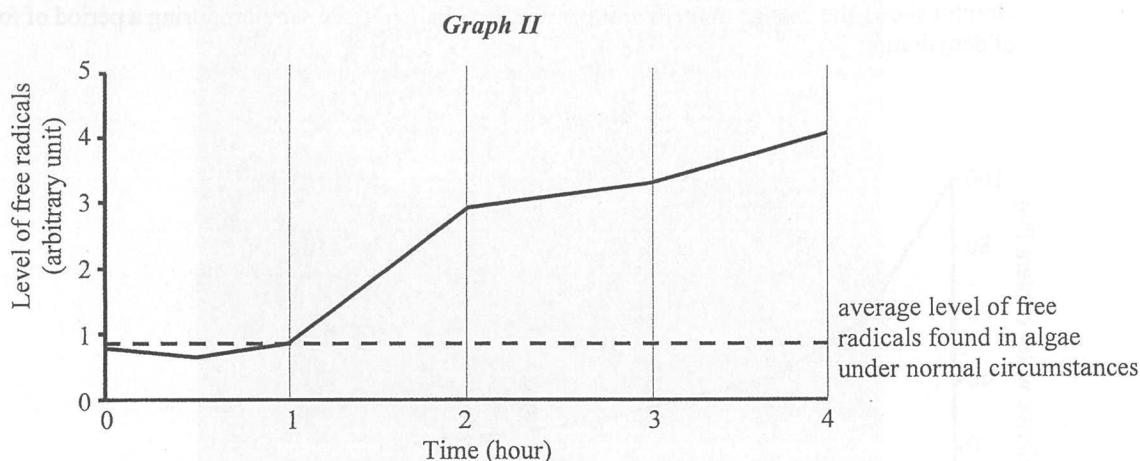
With reference to Graph I, what would be the expected change in the level of free radicals found in the algal tissue samples during the four hours of dehydration? (1 mark)

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- (d) Graph II and Graph III respectively show the actual change in the level of free radicals and the change in the level of antioxidants found in the algal tissue samples of the alga during the same period of dehydration:



Based on your answer in (c) and the data shown in Graph II and Graph III, suggest the role of antioxidants in helping the algae to cope with the dehydration. Give **two** pieces of evidence from the data shown.
(3 marks)

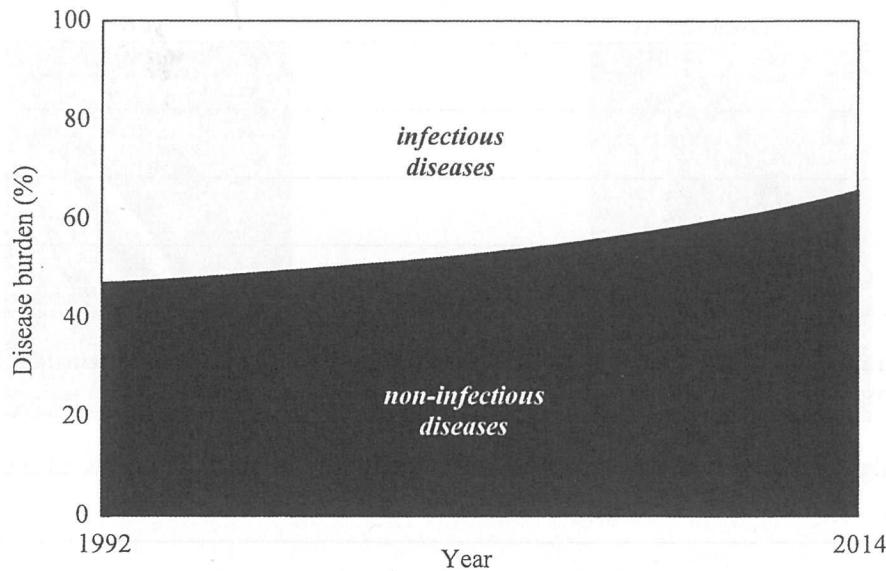
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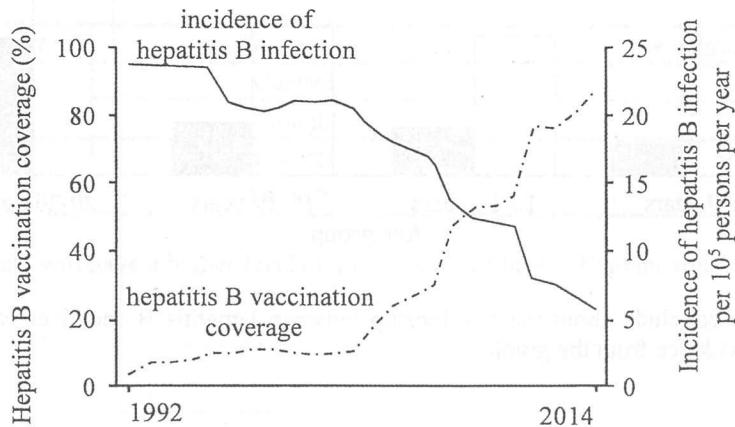
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8. Disease burden is a measure of population health that aims to quantify the potential loss of lifespan and health outcomes due to illness as compared to the ideal of living to a ripe old age and in good health. The graph below shows the percentage share of disease burden caused by infectious diseases and non-infectious diseases in Country X from 1992 to 2014:



- (a) Describe the change in the percentage shares of the disease burden of Country X from 1992 to 2014.
(1 mark)

- (b) The graph below shows the impact of hepatitis B vaccination on the incidence of hepatitis B infection in Country X from 1992 to 2014:



With reference to the principle of vaccination, explain the relationship shown in the above graph.
(4 marks)

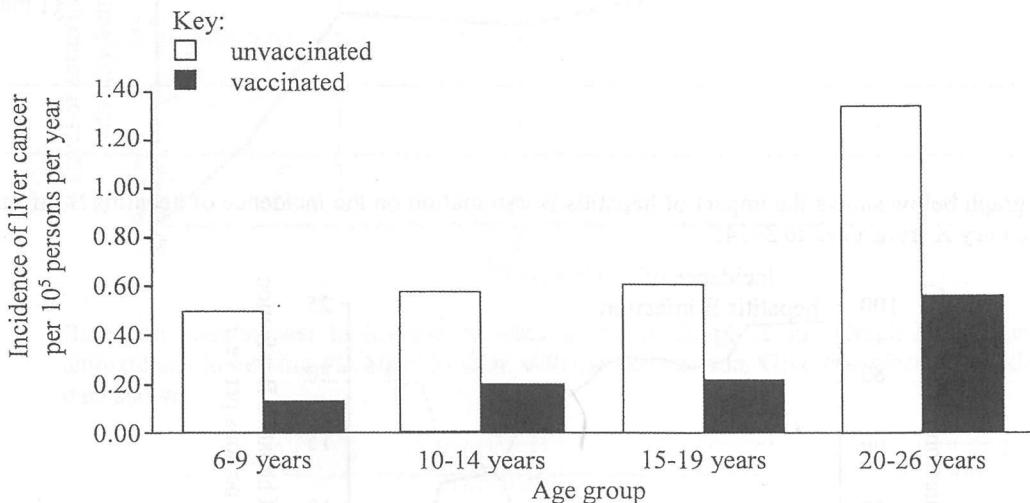
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- (c) With reference to the information from (a) and (b), suggest the role of vaccination in the change of disease burden in Country X. (1 mark)

- (d) The graph below shows the incidence of liver cancer among different age groups who have or have not been vaccinated against hepatitis B in Country X:



What can you conclude about the relationship between hepatitis B and liver cancer? Support your answer with evidence from the graph. (2 marks)

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9. Hormone X is a plant hormone which is produced in leaves of plant P when water supply is inadequate. A student detached some leaves from plant P and placed them in either water or a $10 \mu\text{M}$ solution of hormone X. After two hours, the student examined the lower epidermis of the leaves under a light microscope. The photomicrographs below show the images obtained:



- (a) Based on the above information, explain the importance of hormone X to the drought tolerance in plant P. (2 marks)

- (b) In nature, there are varieties of plant P which produce different amounts of plant hormone X in response to drought stress. The student measured the fresh leaf masses of two different varieties (A and B) of plant P after drought treatment for two weeks. The results are shown in the table below:

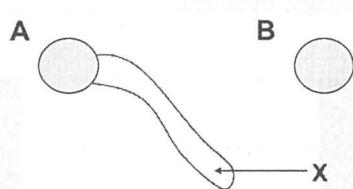
<i>Plant variety</i>	<i>Treatment</i>	<i>Leaf fresh mass (g)</i>
A	Control	0.20
	Drought	0.18
B	Control	0.21
	Drought	0.08

Which variety will have a higher level of hormone X produced? Explain your answer. (3 marks)

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10. In an investigation, pollen grains collected from a single flower were cultured in an artificial medium. After 48 hours incubation, they were observed under a light microscope. Two types of pollen grains with different appearances were observed, as shown in the diagram below:



- (a) The number of each type of pollen grains is approximately the same. It is known that the formation of structure X is controlled by a single gene. Deduce the genotype of the parent plant producing these two types of pollen grains. (4 marks)

- (b) If these two types of pollen grains land on a stigma of the flower of the same species, which type of pollen grains will lead to formation of seed? Explain your answer. (3 marks)

- (c) 100 seeds were collected from the parent plant in (a) after self-pollination. According to your answer in (b), complete the following table to show the proportion of genotypes in these seeds. (1 mark)

Genotype	Homozygous dominant	Heterozygous	Homozygous recessive
Proportion (%)			

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You are required to present your answer to the following question in essay form. Criteria for marking will include relevant content, logical presentation and clarity of expression.

11. Carbon footprint is an estimation of the total amount of greenhouse gases (including carbon dioxide and methane) generated by our actions, e.g. our choice of food. For instance, skipping meat one day per week will help to reduce the carbon footprint.

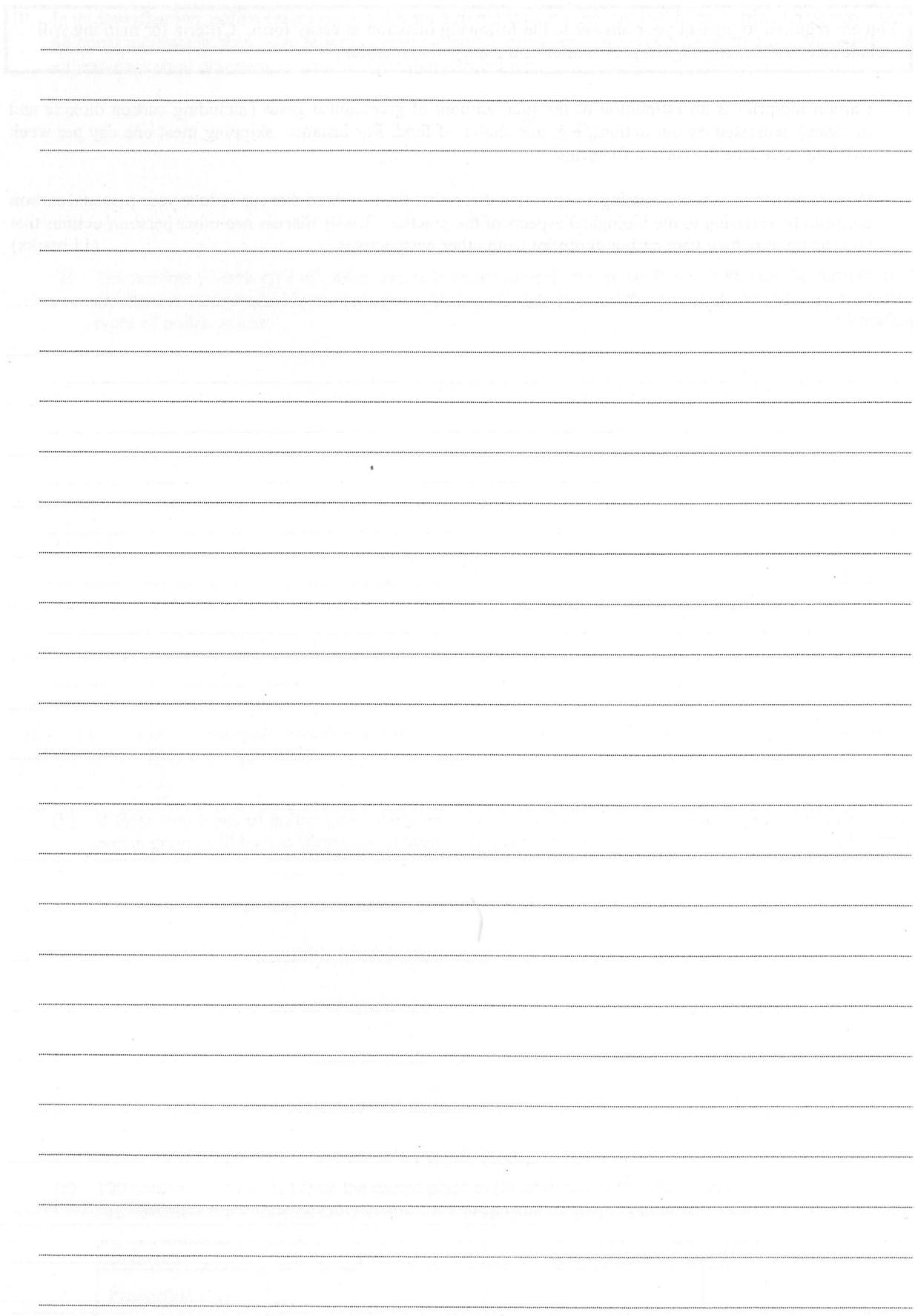
Discuss why the practice of eating a vegetarian diet rather than a mixed diet can reduce your personal carbon footprint by referring to the biological aspects of the practice. Briefly discuss *two* other personal actions that you can do to reduce your carbon footprint from other perspectives. (11 marks)

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END OF PAPER

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

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