

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2014

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. Which of the following is a catabolic process?
 - A. Conversion of glucose to glycogen
 - B. Absorption of glucose
 - C. Emulsification of fat
 - D. Digestion of starch

2. Which of the following events **does not** involve the functioning of membrane proteins?
 - A. Transmission of nerve impulses across a synapse
 - B. Absorption of glucose in the small intestine
 - C. Transport of oxygen by haemoglobin
 - D. Recognition of pathogens

Directions:

Questions 3 to 5 refer to the following study:

A student wants to use an ordinary light microscope to observe the binary fission of a photosynthesizing protist under high magnification. A temporary mount of the protist is placed on the stage of the microscope.

3. Below are some steps in using a light microscope:
 - (1) Focus with 10X objective
 - (2) Focus with 40X objective
 - (3) Search the field with 10X objective
 - (4) Search the field with 40X objective
 - (5) Move the slide until the protist is located in the centre of the field
 - (6) Adjust light intensity if necessary

Which of the following is the most reasonable sequence of steps for the above study?

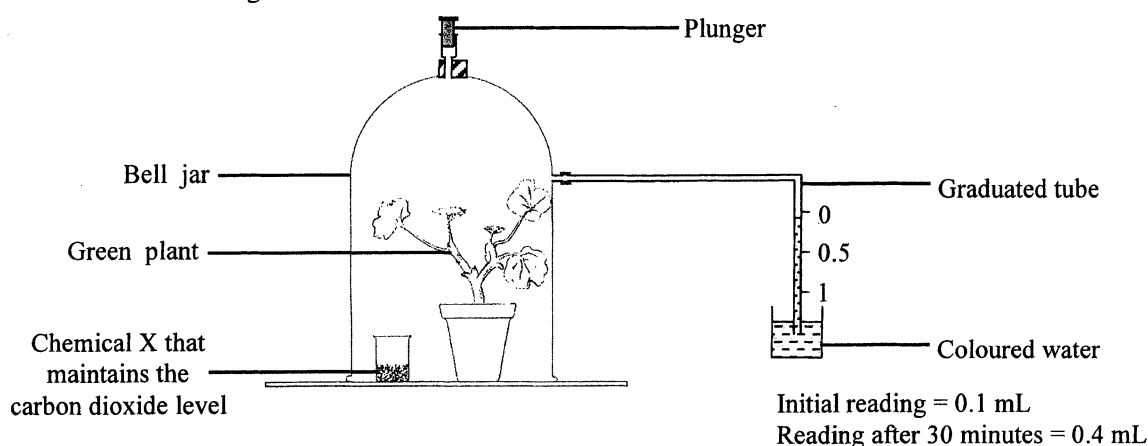
- A. (1), (3), (5), (6)
 - B. (2), (6), (4), (5)
 - C. (1), (2), (4), (5), (6)
 - D. (1), (3), (5), (2), (6)

4. Which of the following correctly describes binary fission of the protist?
 - A. The amount of organelles in the daughter cell is the same as that in the mother cell.
 - B. The number of chromosomes in the daughter cell is half of that in the mother cell.
 - C. The alleles found in the daughter cells are different from each other.
 - D. The sizes of the daughter cells are similar to each other.

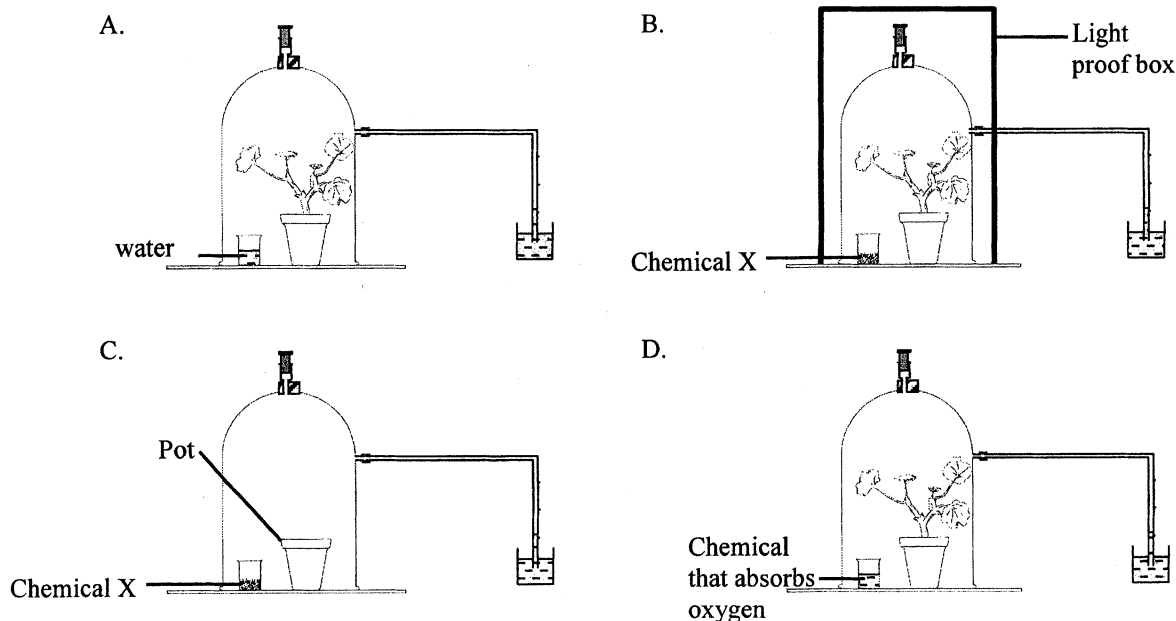
5. Which of the following structures would be observable in the above study?
 - A. Ribosome
 - B. Chloroplast
 - C. Mitochondrion
 - D. Endoplasmic reticulum

Directions:

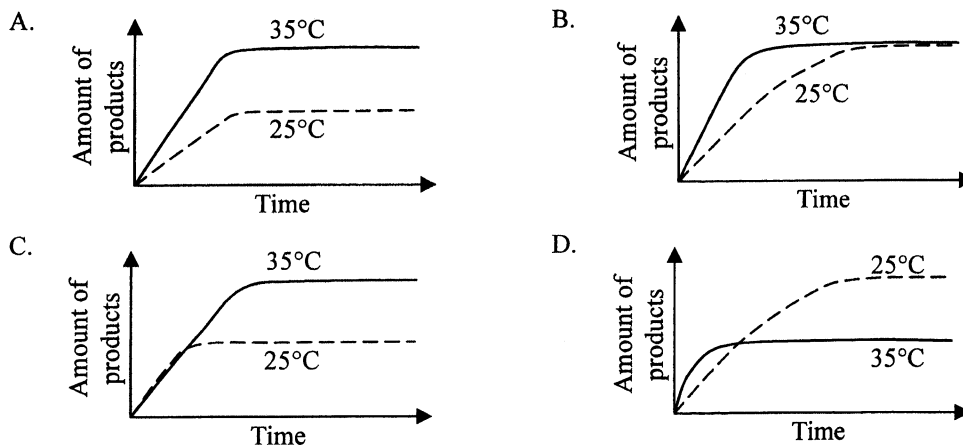
Questions 6 to 8 refer to the diagram below, which shows a set-up used to determine the rate of photosynthesis of a green plant. During the study, the position of the plunger remained unchanged.



6. Based on the results, what was the rate of photosynthesis of this plant?
- 0.6 mL oxygen released per hour
 - 0.3 mL oxygen released per hour
 - 0.6 mL carbon dioxide absorbed per hour
 - 0.3 mL carbon dioxide absorbed per hour
7. The rate obtained was lower than the actual rate of photosynthesis of the plant. Which of the following is the most probable reason for this?
- The plant also carried out respiration during the study.
 - The plant also carried out transpiration during the study.
 - The air temperature might have increased during the study.
 - The atmospheric pressure might have decreased during the study.
8. Which of the following set-ups can be used as a control for the above study to find out the actual rate of photosynthesis?



9. Which of the following graphs correctly shows the changes in the amount of products in a reaction catalyzed by a human enzyme at different temperatures?



Directions:

Questions 10 and 11 refer to the following two crosses of fruit flies. In fruit flies, males are the heterogametic sex (XY) and the wing shape (normal wing or cut wing) is controlled by a single gene.

Cross I

Parents	Normal wing female x Cut wing male
F ₁	12 normal wing females 11 normal wing males
F ₂	71 normal wing females 34 normal wing males 35 cut wing males

Cross II

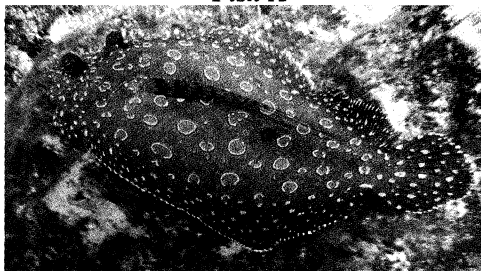
Parents	Cut wing female x Normal wing male
F ₁	11 normal wing females 11 cut wing males
F ₂	32 normal wing females 33 cut wing females 36 normal wing males 38 cut wing males

10. Which of the following observations from Cross I best supports the conclusion that normal wing is the dominant phenotype?
- All the F₁ individuals are normal wing.
 - The ratio of normal wing individuals to cut wing individuals in F₂ is 3:1.
 - There are more normal wing individuals than cut wing individuals in the F₂.
 - Normal wing males are more or less the same in number as cut wing males in the F₂.
11. From Cross II, we can conclude that
- the gene for the wing shape is located on the X-chromosome because the cut wing phenotype was passed from the female parent to the F₁ males.
 - the law of independent assortment was demonstrated because new phenotypes, including normal wing females and cut wing males, were found in F₂.
 - the normal wing male parent is heterozygous because four combinations of phenotypes were observed in F₂.
 - the gene for the wing shape is located on an autosome because a ratio of 1:1:1:1 was shown in F₂.

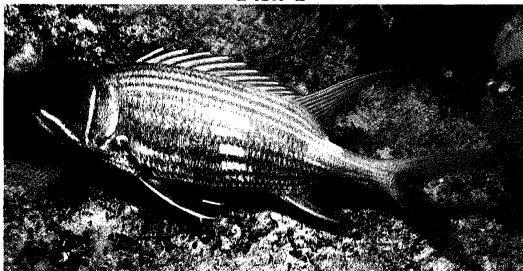
12. Which of the following combinations of blood groups of parents may produce offspring with blood group AB?
- (1) A x B
 - (2) AB x O
 - (3) AB x AB
- A. (1) and (2) only
 - B. (1) and (3) only
 - C. (2) and (3) only
 - D. (1), (2) and (3)
13. The average height of men in a developed country rose by 10 cm between 1890 and 1980. Which of the following is the most probable reason for this observation?
- A. Chemical pollution induced mutations leading to the increase in height.
 - B. Spontaneous mutation resulted in a shift to taller height.
 - C. The better nutrition supply promoted growth.
 - D. A taller height had a better chance of survival.
14. Which of the following processes produce ATP?
- (1) Glycolysis
 - (2) Krebs cycle
 - (3) Conversion of pyruvate to lactic acid
- A. (1) and (2) only
 - B. (1) and (3) only
 - C. (2) and (3) only
 - D. (1), (2) and (3)
15. Which of the organisms below belong to the domain Eukarya?
- (1) Yeast
 - (2) Amoeba
 - (3) Mouse
- A. (1) and (2) only
 - B. (1) and (3) only
 - C. (2) and (3) only
 - D. (1), (2) and (3)
16. Which of the following biomolecules are associated with transcription?
- (1) DNA
 - (2) mRNA
 - (3) amino acid
- A. (1) and (2) only
 - B. (1) and (3) only
 - C. (2) and (3) only
 - D. (1), (2) and (3)

Directions: Questions 17 and 18 refer to the following photographs of two different fish:

Fish X



Fish Y



17. Using the dichotomous key below to identify the fish:

- 1a Both eyes on the top of the head 2
- 1b One eye on each side of the head 3

- 2a Has long whip-like tail *Aetobatus narinari*
- 2b Has short, blunt tail *Bothus mancus*

- 3a Has spots on its body surface 4
- 3b Does not have spots on its body surface..... 5

- 4a Has chin whiskers *Pseudupeneus maculatus*
- 4b Does not have chin whiskers *Sphoeroides spengleri*

- 5a Has stripes on its body surface *Holocentrus rufus*
- 5b Does not have stripes on its body surface *Parapriacanthus guentheri*

- | | Fish X | Fish Y |
|----|---------------------------|----------------------------------|
| A. | <i>Bothus mancus</i> | <i>Pseudupeneus maculatus</i> |
| B. | <i>Bothus mancus</i> | <i>Holocentrus rufus</i> |
| C. | <i>Aetobatus narinari</i> | <i>Parapriacanthus guentheri</i> |
| D. | <i>Aetobatus narinari</i> | <i>Sphoeroides spengleri</i> |

18. Which of the following allow further study of the phylogenetic relationship between the two fish?

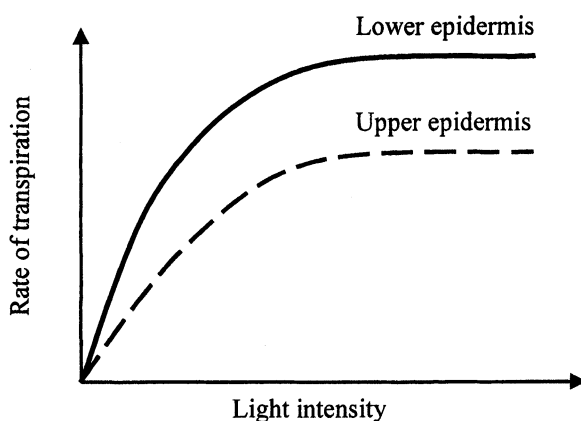
- (1) Compare the amino acid sequences of their functional proteins
- (2) Compare their internal body structure
- (3) Compare their living habitats and behaviours

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

19. Which of the following is **not** an application of DNA fingerprinting?

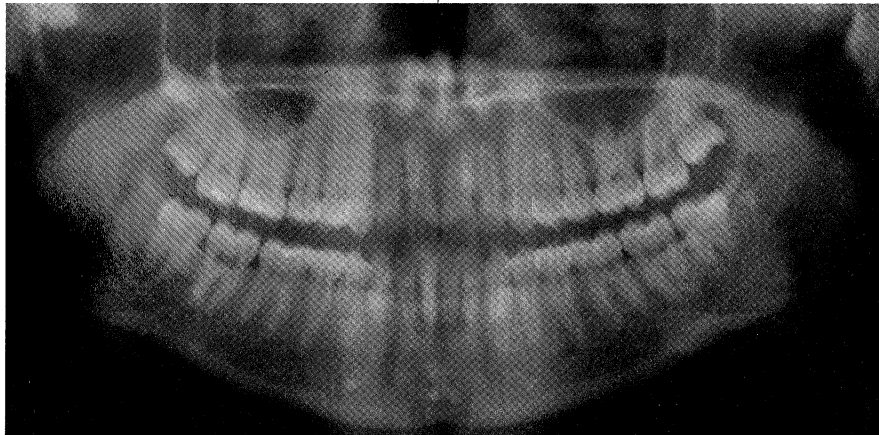
- A. Forensic science
- B. Screening for genetic diseases
- C. Sequencing of the human genome
- D. Identification of Chinese medicines

Directions: Questions 20 and 21 refer to the graph below, which shows how the transpiration rates through the upper and lower epidermis of a leaf vary with light intensity:



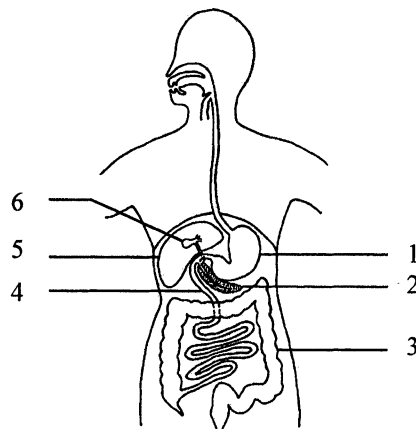
20. Which of the following accounts for the difference in the transpiration rates through the upper and lower epidermis shown above?
- The mesophyll layer near the lower epidermis has more air spaces.
 - The upper epidermis is more exposed to light.
 - The air temperature below the leaf is lower.
 - The upper epidermis has fewer stomata.
21. Which of the following methods can be used to measure the rate of transpiration through the upper and lower epidermis of the leaf?
- Peel the upper epidermis of the leaf and count the number of stomata under a microscope, and then repeat with the lower epidermis.
 - Put the leaf into warm water and then count the number of bubbles that appear on each side of the leaf in a fixed period of time.
 - Shine light on the upper epidermis of the leaf and measure the rate of water absorbed using a bubble potometer, and then repeat with the lower epidermis.
 - Smear the upper epidermis of the leaf with vaseline and measure the rate of water loss using a weight potometer, and then repeat with the lower epidermis.
22. The transpiration rate of a tree is much higher than that of a herbaceous plant because the tree
- is much taller than the herbaceous plant.
 - has many more roots than the herbaceous plant.
 - has many more leaves than the herbaceous plant.
 - has much more xylem than the herbaceous plant.
23. Which of the following cell types has the highest density of mitochondria?
- Root hair cells
 - Leaf epidermal cells
 - Spongy mesophyll cells
 - Palisade mesophyll cells

24. Which of the following dental formulae best represents the dentition shown in the photograph of the X-ray?



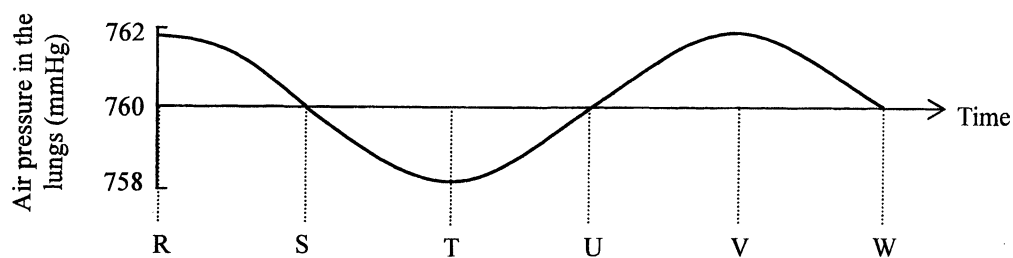
- | | |
|------------------------|------------------------|
| A. $\frac{2123}{2123}$ | B. $\frac{2132}{2132}$ |
| C. $\frac{3212}{3212}$ | D. $\frac{2312}{2312}$ |

Directions: Questions 25 and 26 refer to the diagram below, which shows the human digestive system:



25. Physical digestion takes place at
- | |
|----------------|
| A. 1 and 3. |
| B. 1 and 4. |
| C. 3 and 4. |
| D. 1, 3 and 4. |
26. Which of the following structures are responsible for producing digestive juices that help the digestion of fat?
- | |
|---------------|
| A. 2 and 5 |
| B. 2 and 6 |
| C. 5 and 6 |
| D. 2, 5 and 6 |

27. The graph below shows the change in air pressure in the lungs of a man:

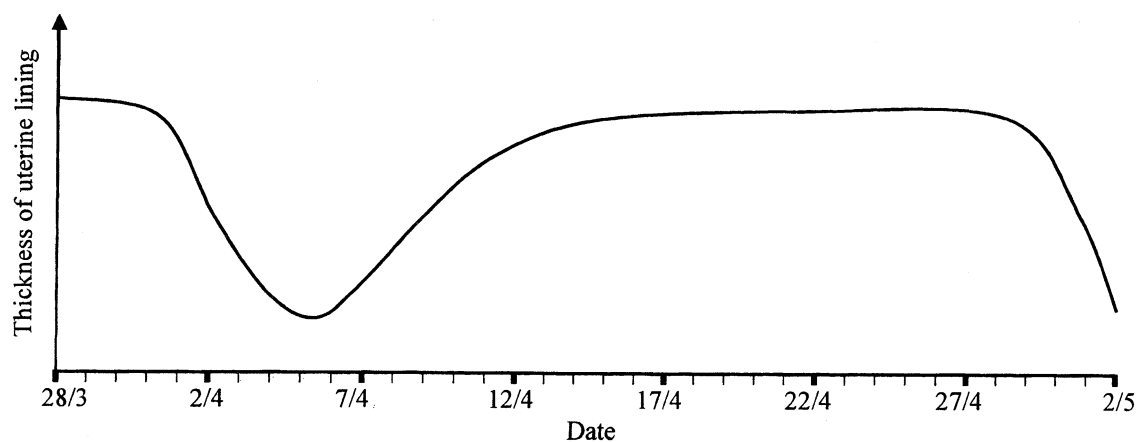


Atmospheric pressure = 760 mm Hg

His diaphragm muscles are in a state of contraction during the period

- A. RT.
- B. SU.
- C. TV.
- D. UW.

28. The diagram below shows the changes in the uterine lining of a woman:



During which of the following periods would the woman most likely get pregnant after copulation?

- A. 28/3 to 1/4
- B. 4/4 to 8/4
- C. 11/4 to 15/4
- D. 18/4 to 21/4

29. During foetal development, the placenta has functional roles similar to

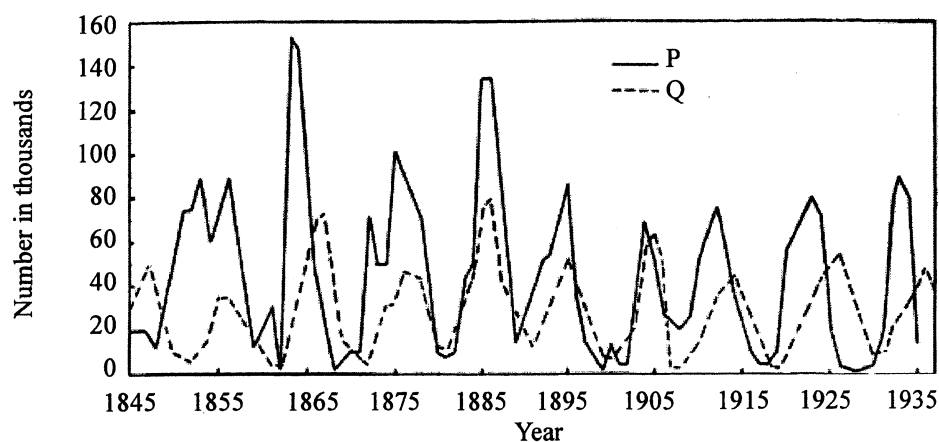
- (1) the bone.
- (2) the lungs.
- (3) the small intestine.

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

30. Some environmental protection groups claim that the vegetarian diet is good for our environment. This is probably because

- A. vegetables grow faster than animals.
- B. it protects endangered species as less animals are killed for food.
- C. growing vegetables can produce oxygen but rearing animals only consumes oxygen.
- D. it reduces the emission of carbon dioxide associated with rearing animals for food.

31. The graph below shows the changes in the populations of two organisms that exhibit a predator-prey relationship in a habitat:



Which of the following statements about the identity of the organism is correct?

- A. P is the predator because its number fluctuates more than that of Q.
- B. P is the predator because its lowest number is lower than that of Q.
- C. Q is the predator because its number fluctuates less than that of P.
- D. Q is the predator because its highest number is lower than that of P.

32. Infants can obtain antibodies from breast feeding. Which of the following combinations correctly describes this type of immunity in infants?

Type of immunity	Explanation
A. active	the antibodies are produced from white blood cells
B. active	the antibodies attack pathogens bearing foreign antigens
C. passive	the antibodies do not trigger the production of memory cells
D. passive	the antibodies work only when there is re-entry of the same pathogen

33. Which of the following processes releases nitrogen-containing compounds from organisms back into the environment?

- A. Nitrification
- B. Decomposition
- C. Denitrification
- D. Nitrogen fixation

Directions: Questions 34 and 35 refer to Diagram I and Diagram II below. Diagram I shows a yoga instructor in a yoga posture. Diagram II shows some of the muscles associated with her left leg.

Diagram I

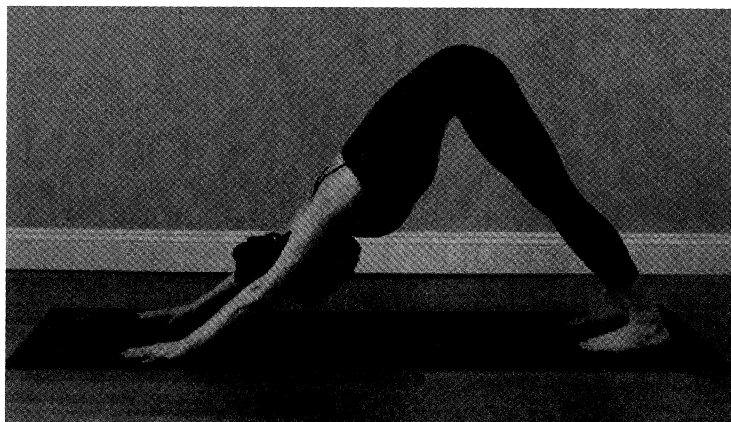
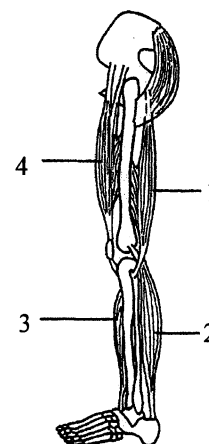
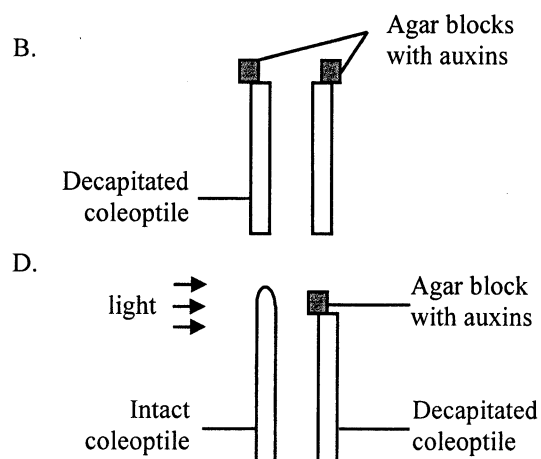
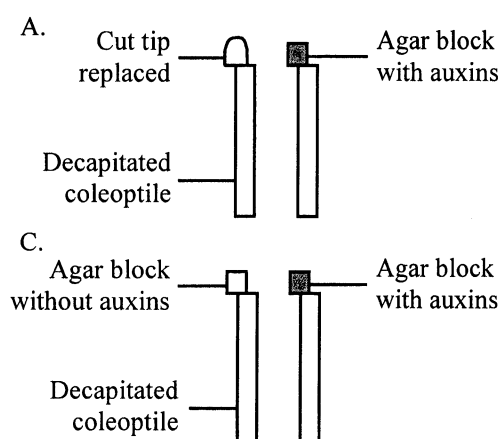


Diagram II



34. Which muscles of the left leg of the yoga instructor are contracting when she maintains the posture shown in diagram I?
- A. 1 and 2
B. 1 and 3
C. 2 and 4
D. 3 and 4
35. Which muscles of the left leg are flexors?
- A. 1 and 2
B. 1 and 3
C. 2 and 4
D. 3 and 4
36. Which of the following pairs of set-ups can be used to test the hypothesis that auxins are growth-promoting substances in oat coleoptiles?



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, 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



SECTION B

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

1. For each of the biomolecules 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

NADPH _____

pyruvate _____

NAD _____

Column 2

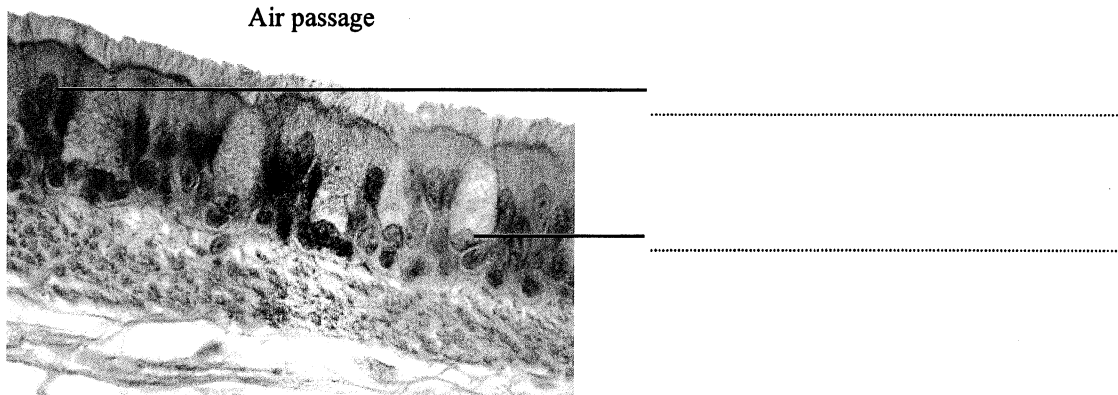
A. a product of oxidative phosphorylation

B. a product of photochemical reactions

C. a product of carbon fixation

D. a product of glycolysis

2. The photomicrograph below shows a section of the inner wall of the human trachea:



(x 400)

- (a) In the spaces provided, label the cells shown in the photomicrograph. (2 marks)
- (b) With reference to the features of the inner wall shown in the photomicrograph, describe how the inner wall of the trachea can protect our body against bacterial invasion. (3 marks)

Answers written in the margins will not be marked.

3. Before the early 20th century, scientists generally held the belief:

“Cell division resulted in the loss of genetic material so that each cell in a multicellular organism would contain only the genetic material specific to its particular cell type.”

In 1902, Hans Spemann performed one of the earliest experiments on animal cloning. He used a fine hair to separate the cells of a two-celled amphibian embryo, and found that each cell was able to develop into a complete organism.

- (a) Why did Spemann’s experiment disprove the early belief about cell division? (1 mark)

- (b) Elaborate on how the above example can be used to demonstrate the two aspects of the nature of science listed in the table below. (2 marks)

<i>Nature of Science</i>	<i>Elaboration</i>
Scientific knowledge is tentative and subject to change.	
Interpretation of observations is guided by our prior understanding of other theories and concepts.	

- (c) Using the current understanding about cell division, explain how genetic material is preserved in mitosis. (3 marks)

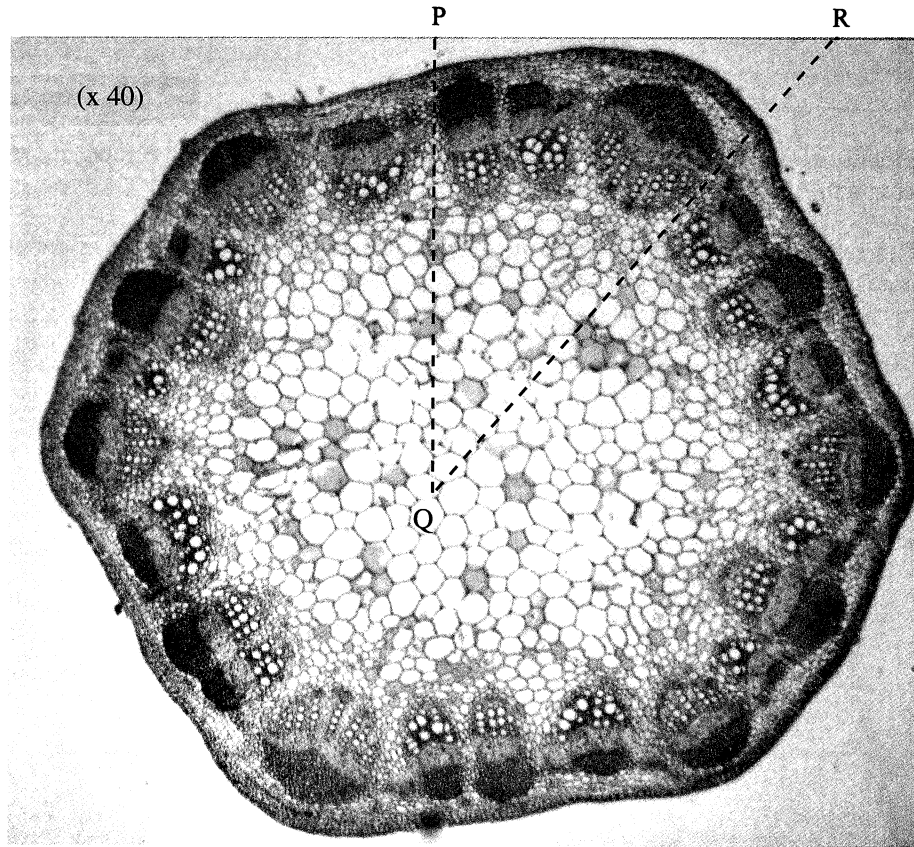
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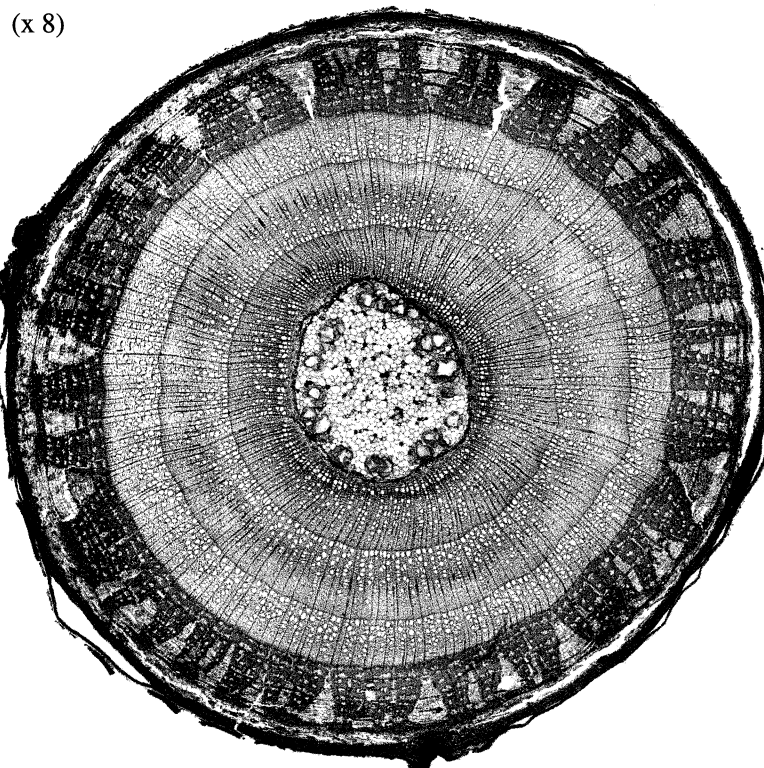
Answers written in the margins will not be marked.

4.

Photomicrograph A – Stem of plant A



Photomicrograph B – Stem of plant B



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.

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4. Cross sections of the stems from two different dicotyledonous plants, A and B, are shown in Photomicrograph A and Photomicrograph B on the opposite page.

- (a) With reference to Photomicrograph A, draw a labelled low-power diagram of sector PQR in the space below. (5 marks)

- (b) With reference to the photomicrographs, deduce the major means of support in plants A and B. (4 marks)

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.

5. In a study, a plot of land was burnt by fire. After this, the vegetation on this land, classified into herbs and woody plants, was monitored for 8 years. The percentage cover of each type of vegetation is shown in the graph below:



- (a) Which type of succession is shown in the above case? Explain your answer. (2 marks)

- (b) (i) Describe briefly how the dominant community of vegetation changes with time after the fire. (2 marks)

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(ii) Explain the changes in the dominant community described in (i).

(4 marks)

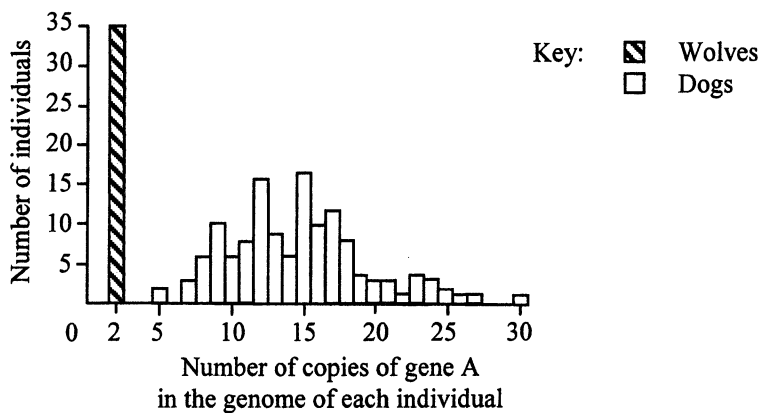
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Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

6. It is generally believed that domestic dogs evolved from ancient wolves. A recent study comparing the genomes of wolves and dogs suggests that genes with key roles in starch digestion were selected during the domestication of wolves into dogs. One of these genes was gene A, which codes for amylase. This gene may exist in many copies in a genome. The following graph shows the number of individuals having different numbers of copies of gene A in 35 wolves and 136 dogs:



- (a) Based on the data above and the gene expression processes, explain why the amylase activity in dogs is generally higher than that in wolves. (3 marks)

- (b) It is hypothesized that in ancient times, wolves might have been attracted to waste dumps near early human settlements and consumed human food waste. Suggest how the domestication of wolves would have led to the selection of multiple copies of gene A. (5 marks)

[illegible]

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Answers written in the margins will not be marked.

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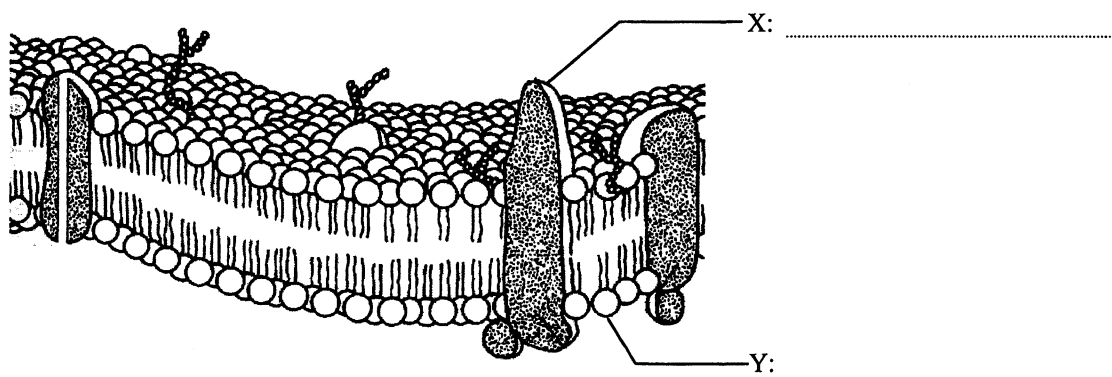
- (c) Describe an experiment which can compare the different amylase activities of wolves and dogs. (4 marks)

Answers written in the margins will not be marked.

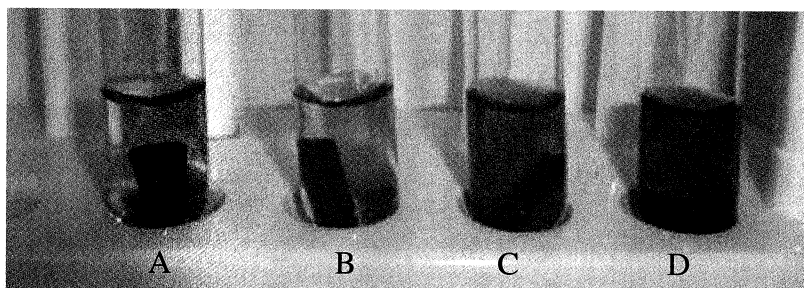
Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

7. (a) The following is a schematic diagram of a cell membrane. In the spaces provided, label membrane components X and Y. (2 marks)



- (b) The vacuoles of beetroot cells contain a red pigment which will be released from the cells if the cell membrane and vacuole membrane are damaged. In an investigation, Gary placed identical cylinders of beetroot tissues into four test tubes. Each tube contained the same volume of alcohol at different concentrations. The following photograph shows the appearance of the solutions bathing the beetroot cylinders after 30 minutes:



- (i) From the result of the above investigation, deduce which test tube contained the highest concentration of the alcohol. (4 marks)

Answers written in the margins will not be marked.

- (ii) After three hours, Gary found that the colour intensity of the solutions of all the test tubes became the same. Suggest an explanation for this. (2 marks)

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Answers written in the margins will not be marked.

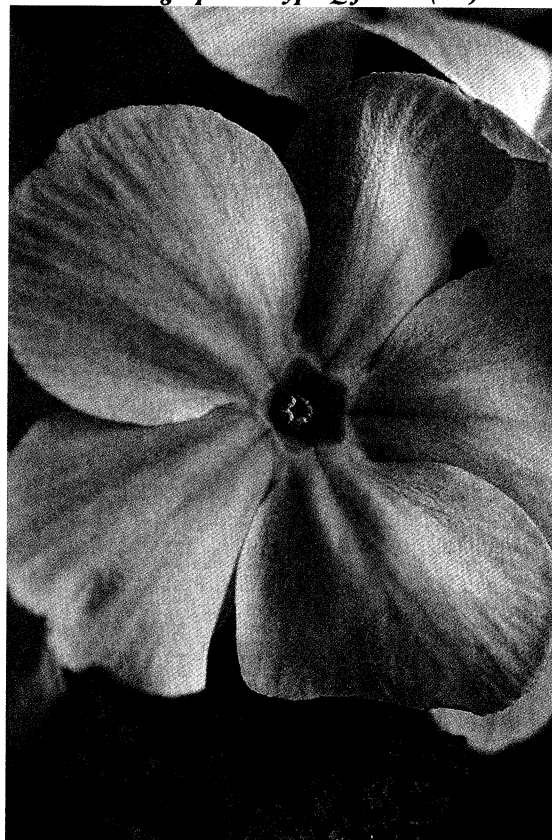
Answers written in the margins will not be marked.

8. A primrose plant is a flowering plant that has two different types of flowers. Photograph I and Photograph II show the appearances of the two types of flowers (P and Q) and Photograph III and Photograph IV show the sections of the flowers respectively. Each primrose plant produces either type P flowers or type Q flowers.

Photograph I: Type P flower (x 4)



Photograph II: Type Q flower (x 4)



Photograph III: Section of type P flower (x 4)



Photograph IV: Section of type Q flower (x 4)



nectary

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.

- (a) Apart from the presence of nectaries, give *two* observable features of type P flowers which support the claim that the primrose is an insect-pollinated plant. (2 marks)

- (b) Butterflies collect nectar from flowers using a mouth structure in the form of a long sucking tube.

- (i) When a butterfly visits a type P flower, which part of the sucking tube will the pollen grains stick to? (1 mark)

- (ii) When the same butterfly visits another flower, which type of flower will be more readily pollinated? Why? (2 marks)

- (iii) What is the advantage of having the different positioning of anthers and stigmas in the primrose? (2 marks)

9. Table I shows the number of deaths in Hong Kong caused by certain diseases. The deaths are categorised according to sex and age.

Table I

Cause of death	Sex	Age Group						
		All ages	0	1-4	5-14	15-44	45-64	≥65
Heart disease	Male	3352	1	2	2	104	679	2564
	Female	2981	2	2	0	20	146	2811
Diabetes mellitus	Male	213	0	0	0	2	43	168
	Female	246	0	0	0	10	19	217
Colon cancer	Male	725	0	0	0	16	177	532
	Female	627	0	0	0	8	131	488

- (a) Rank the diseases in the descending order of mortality (death rate). (1 mark)

- (b) From the data above, generalize a trend of mortality that is exhibited by all the diseases. (1 mark)

- (c) Table II shows the relative proportions of males and females in the above table who had particular lifestyles:

Table II

Lifestyle	Male	Female
Smoking daily	78.9%	21.1%
Never smoked	36.9%	63.1%
≥4 servings of processed meat per week	57.7%	42.3%

For the following diseases, explain how these lifestyles of the males and females are related to the number of deaths in Table I.

Heart disease: (3 marks)

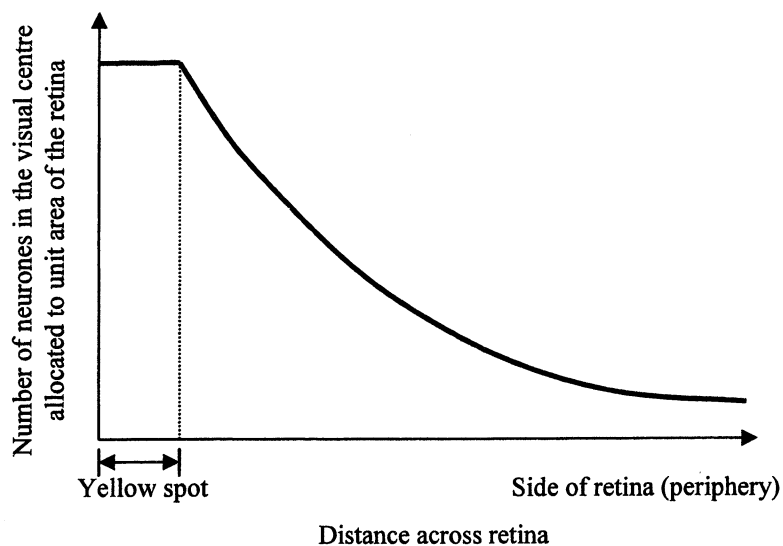
Colon cancer: (3 marks)

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10. The visual centre of the brain is responsible for processing nerve impulses from the retina. The number of neurones in the visual centre allocated to receiving impulses from a unit area of the retina is shown below (only half of the retina is shown):



- (a) With reference to the types of photoreceptor cells and their distribution on the retina, explain why more neurones in the visual centre are allocated to unit area of the yellow spot. (4 marks)

- (b) After the perception of what we 'see', what it means to us depends on other parts of the brain. Explain how this works. (2 marks)

Answers written in the margins will not be marked.

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

11. Recently, some people have adopted a diet rich in lean meat in order to lose weight and build muscle. They may be able to achieve these aims but there are some health problems associated with this diet. Discuss the pros and cons of this controversial diet with regard to the nutritional needs of our body and protein metabolism. (12 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.