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Level 5 Exemplar 1

2024-DSE
BIO
PAPER 1B

B

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2024

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.

* A 1 3 0 E 0 1 B *

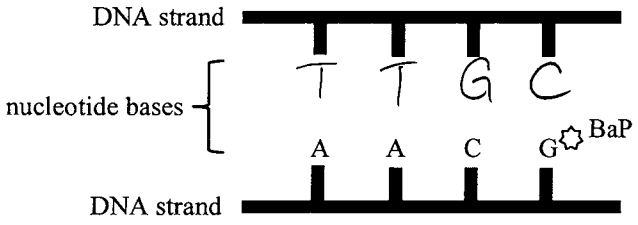
SECTION B

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)

		Nervous control	*Hormonal control*
(a)	Signalling molecule	Neurotransmitter (Protein)	Proteins or lipid
(b)	Transmission pathway	neurones	Blood stream
(c)	Comparison of the time taken to induce responses	Nervous control is faster while Hormonal control is slowers	

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)

Because the mutated base also code for the same amino acid and do not change the shape of protein

(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)

Transcription

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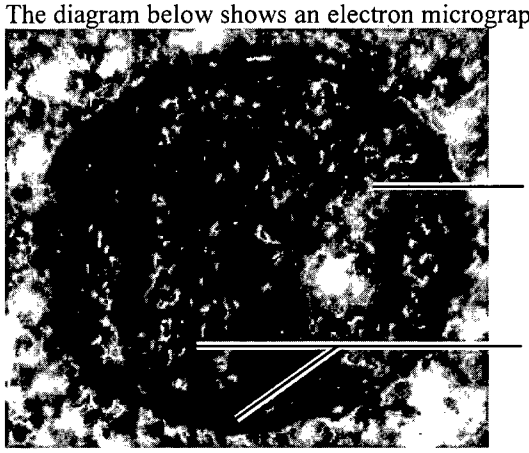
3. The diagram below shows an electron micrograph of a mitochondrion:



(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)

Y is highly folded. It can increase its surface area to pack more enzymes for respiration

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

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

Kerb cycle

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

If Z is added, kerb cycle cannot operate. No ATP, NADH, FADH are formed, oxidative phosphorylation stopped to occur. Plant cell carries anaerobic respiration to produce ethanol. (in the cycle, pyruvate accumulates)

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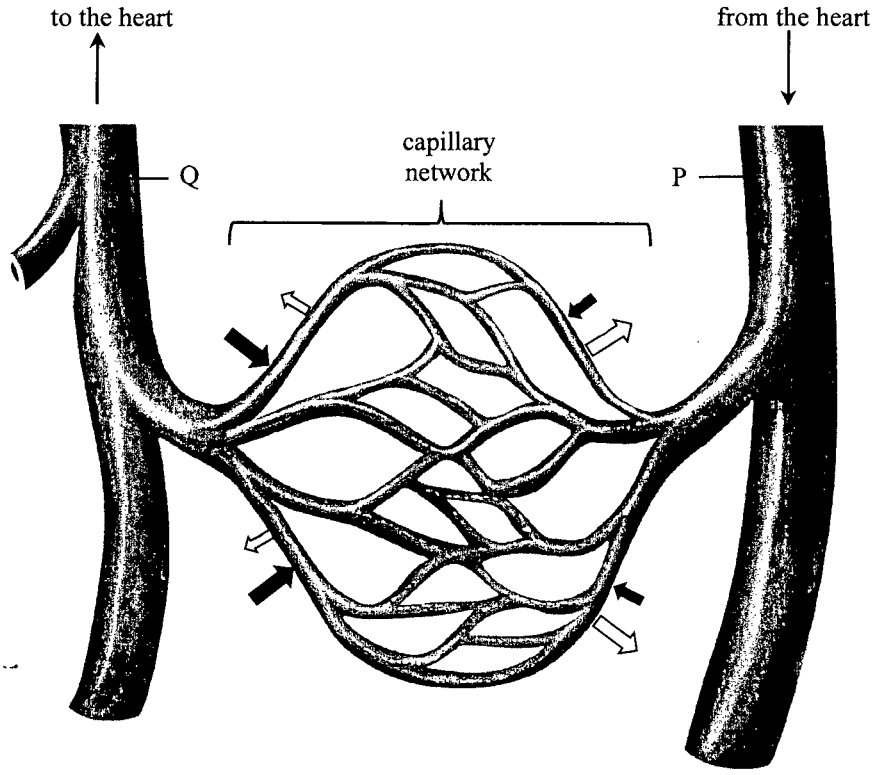
4. The schematic diagram below shows the arrangements of some blood vessels:



(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)

➡ : water potential

⇨ : Hydrostatic pressure

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

The size of the arrows decrease from P to Q. Because blood has overcomed great resistance in capillary when traveling from P to Q, the blood pressure is greatly reduced from P to Q. Blood pressure near Q is lower and hence hydrostatic pressure is lower. Less force can force out fluid near Q.

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(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)

	Organ	*Substance taken up into the blood*	*Explanation*
(i)	Pancreas	insulin	Insulin is secreted from the organ in response to the change of the blood glucose level.
(ii)	Liver	urea	Deamination of protein occurs there. amine group of proteins will turn into Urea, urea enter blood and travel to kidney for removal

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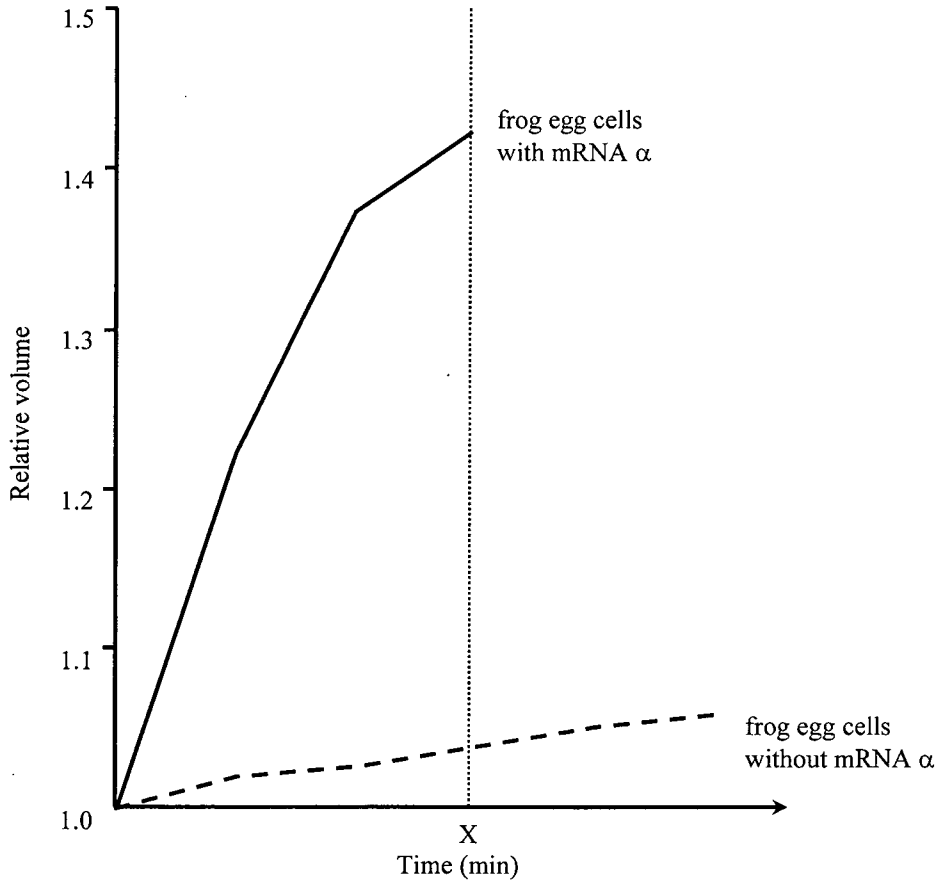
5. In an experiment, mRNA α was isolated from a mammalian cell and then injected into a frog egg cell. The expression of mRNA α eventually led to the presence of protein α on the cell membrane of the frog egg.

(a) Describe how the injected mRNA α led to the presence of protein α on the cell membrane of the frog egg. (3 marks)

mRNAα enters cytoplasm of frog egg cell. Translation of the mRNAα occurs at the ribosomes of frog egg cell. tRNA bring the amino acids to ribosomes and do complementary base pairing with mRNA to form polypeptide. polypeptide coils and folds to form proteins. Proteins then move to cell membrane of frog egg for functioning.

(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:



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(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)

Water potential of the cell content of frog egg cells without mRNA α is lower than that of pure water. Water molecules enter frog egg cells by osmosis, causing an increase in volume of frog egg cells.

(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)

Relative volume of frog egg cells (with mRNA α) is much higher than that without mRNA α, showing that frog egg cells with mRNA α obtain larger volume of water. Protein may be a carrier protein, it carries additional volume of water into the frog egg cells against water potential gradient by active transport using energy.

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

the frog egg cells with mRNA α burst after X minutes

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starch → maltase

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)

Pancreatic amylase should be targeted. In Digestion, food only retain in mouth cavity for short time and go to stomach containing acid which denature salivary amylase. Reaction time between salivary amylase and food is short which do not complete break down starch. In small intestine, pancreatic amylase can have more time to breakdown of starch as small intestine is highly folded and long, hence, pancreatic amylase account more the digestion of starch

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

Solution	*Volume of solution used in each set-up (mL)*	
	Set-up I	*Set-up II*
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)

To keep the volume of reaction mixture the same and to show that the change in set-up II due to Bean extract.

(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)

same volume of

Using iodine solution. Extract reaction mixture at every 3 minutes interval. Drop iodine solution to it. Presence of starch will cause iodine turn to blue black from brown. The faster the iodine remains brown, the higher the rate of starch digestion

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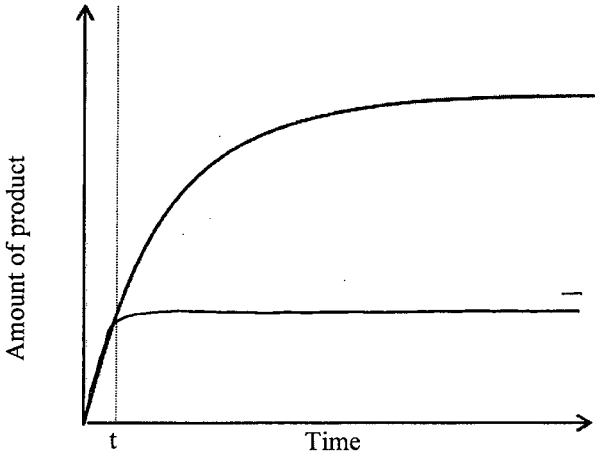
(c) The graph below shows the amount of product formed over time when amylase is working normally:



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)

Because the body temperature and pH are also taken into account in an in vivo experiment.

(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)

Glucose should be monitored. Blood glucose level should be higher in the control group while blood glucose level should be lower in the experimental group.

(e) Suggest how the amylase inhibitor helps the bean defend against insects. (1 mark)

It prevent starch breaking down into maltose. No sweet taste is formed and hence no insects are attracted to feed on the plants.

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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)

line transect and quadrat

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

Place line transect infront of the sea to the dry area at the back to obtain the distribution of organism. Place quadrat at regular interval next to the line transect to obtain the abundance of organisms along the transect.

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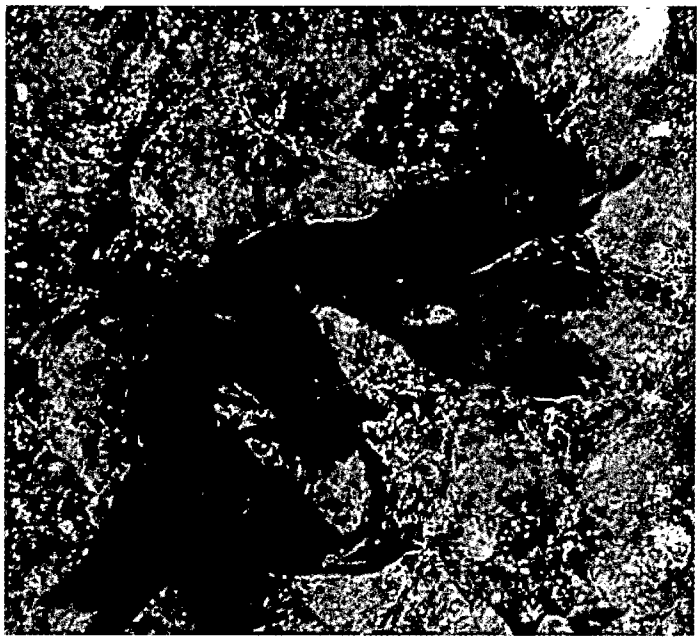
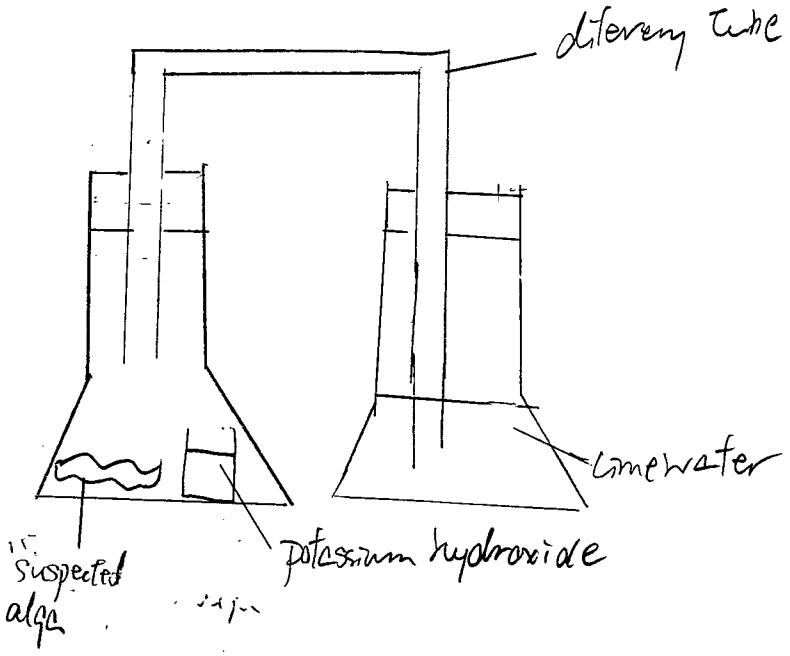
(b) In a field trip to a rocky shore, a student found a thin brown sheet lying on a rock. The student suspected that it was an alga. A small piece of the sample was taken back to school for further study.



5 cm

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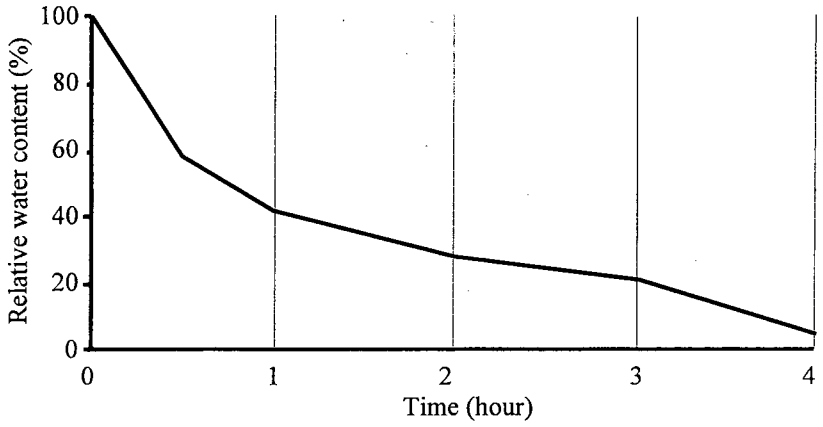
(c) Under normal circumstances, the level of free radicals in algal tissues is kept at a certain level as a result of homeostasis. In response to dehydration, algal tissues will be stimulated to produce free radicals which can cause damage to the cell components if there is an accumulation.

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)

The level of free radicals increases

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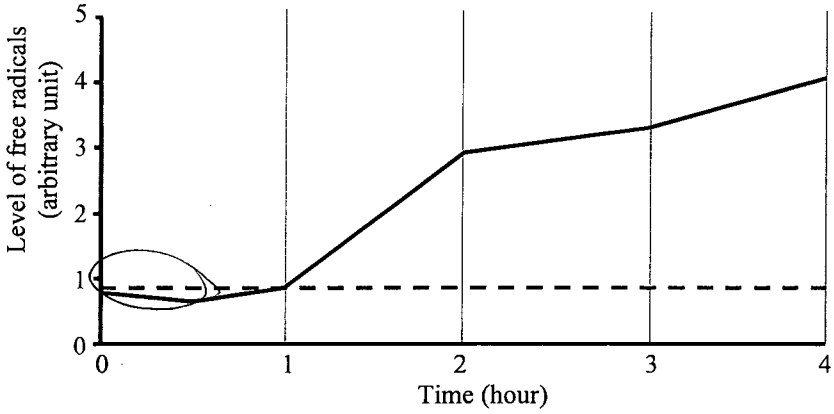
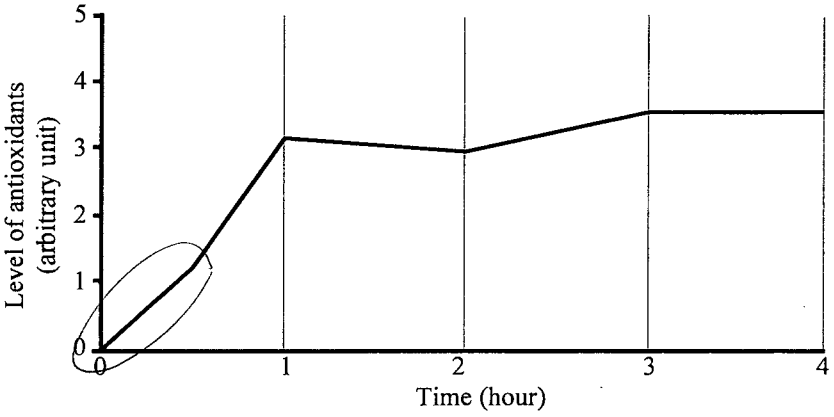
(d) Graph II and Graph III respectively show the actual change in the level of free radicals and the change in the level of antioxidants found in the algal tissue samples of the alga during the same period of dehydration:

Graph II



Graph III



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)

Antioxidants are used to metabolize free radicals into other substances, preventing accumulation. At the beginning, when level of antioxidants increase, the level of free radical drop. When (level of) antioxidants drops from 1-2 (hours), level of free radicals increases rapidly. The water content decrease, level of free radicals should increases more and more ~~rapid~~ rapid. However, the rate of ~~free~~ free radicals formation becomes slower at 2-3 (hour) when antioxidant level is higher

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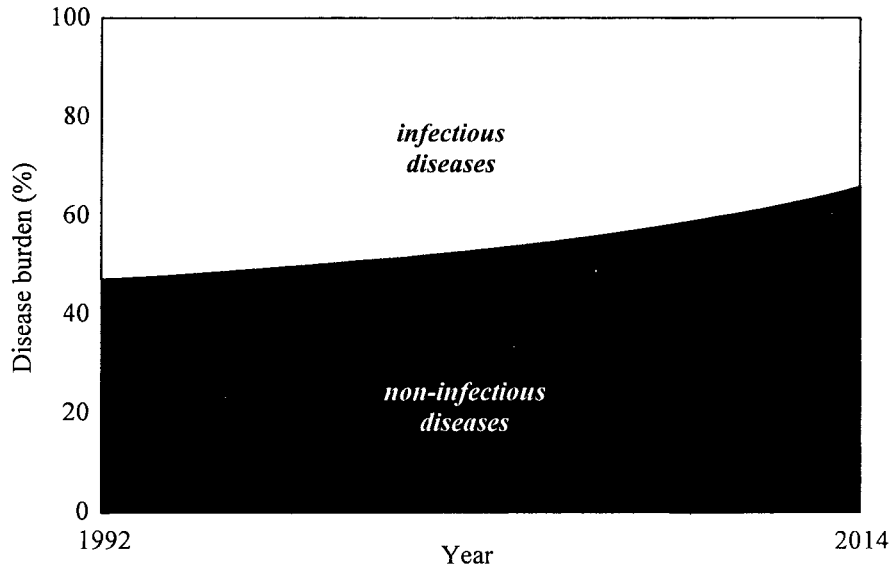
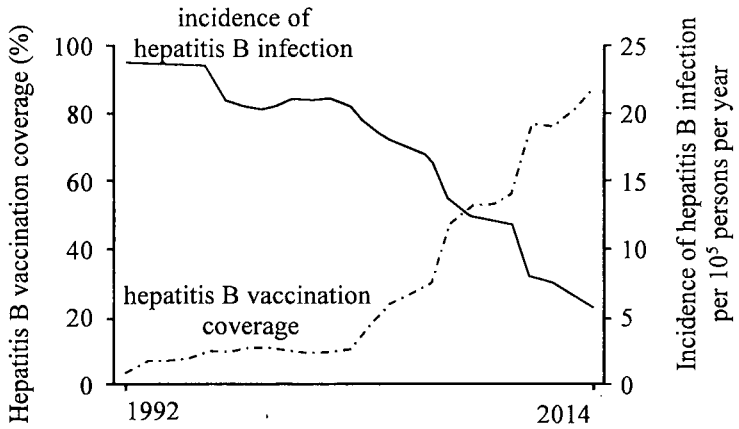
8. Disease burden is a measure of population health that aims to quantify the potential loss of lifespan and health outcomes due to illness as compared to the ideal of living to a ripe old age and in good health. The graph below shows the percentage share of disease burden caused by infectious diseases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

percentage of non-infectious decrease increase while that of infectious diseases increase

(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)

The higher the hepatitis B vaccination coverage, the lower the incidence of hepatitis B infection. After vaccination, primary response is triggred

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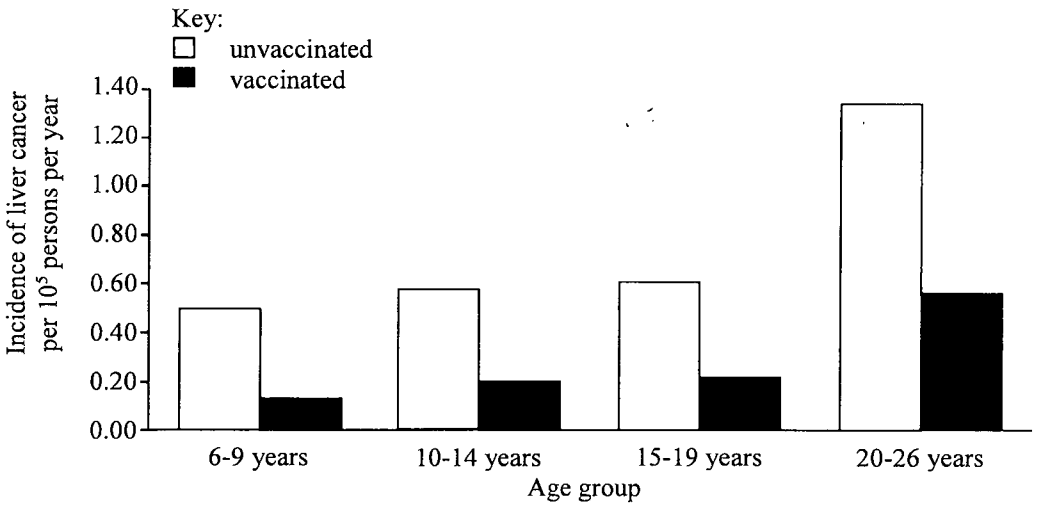
to produce memory cells which can remember antigen of hepatitis B. When antigen enter body again. Memory cells recongnize it quickly, divide, differentiate to form more Killer T cells, plasma cells and memory cells. Hence, larger amount of antibodies, killer T cells can be formed in shorter time to act against hepatitis B.

(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)

It decreases number of cases of infectious diseases.

(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)

Getting hepatitis B has higher chance to get liver cancer. Those unvaccinated has higher chance to get hepatitis B, Number of unvaccinated getting liver cancer is much higher than those vaccinated which will not get hepatitis B

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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 μM 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:

Water

10 μM hormone X

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

hormone X cause stomata to close. Closing of stomata can lower the rate of transpiration to lose water, more water is retained in plant P.

(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:

Plant variety	*Treatment*	*Leaf fresh mass (g)*
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)

Plant A has a higher level of hormone X. The leaf fresh mass only drop little bit while the leaf fresh mass of B drop greatly, showing that the water loss of A is smaller than that of B. It means that there is higher level of X in A for better stomata closure.

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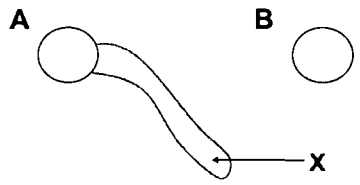
Rr rr

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)

One of the parent is homozygous recessive while the other one is heterozygous dominant. Given that the number of each pollen grains are equal, formation percentage of them should be equal. Gametes of these parents can have genotype of homozygous recessive and heterozygous dominant, hence they have 50% for producing phenotype like A and 50% for producing phenotype like B.

(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)

pollen grains A will lead to fromation of seed. Because it can form pollen tube to digest the tissue of style using enzyme and bring the mate gamete down to ovary. Then X structure grows through micropyle and release male gamete into ovule to fuse with ovum for fertilisation, zygote formed and seed is produced

(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 (%)	0	50	50

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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)

In the essay, reasons of why eating a vegetarian diet can reduce more personal carbon footprint, and two personal actions to reduce carbon footprint will be discussed.

First, nurturing animals requires more energy than veggies. Animals are at the higher trophic level than veggies, there will be a vast energy loss during the energy transfer from each trophic level. More resources are required for rising animals, more wastes will be produced and cause more carbon emission. Secondly, some animals will fart and it contains greenhouse gases such as methane and carbon dioxide. While plants absorb carbon dioxide and produce oxygen in photosynthesis, reducing carbon emission. Also, plants are autotrophic, they do not requires many resources from humans for growth and hence reduce carbon emissions. Further more, plants are at the bottom of trophic level, there will not be any energy lass.

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For commuting, we should ride bicycle more frequenty and reduce using ~~for~~ public transport. Because public transport requires energy to operate and burning fuel will produce carbon dioxide. For living, we should buy furnitures and electronic devices with high energy efficiency. Hence they consume less electricity to operate, less fuel is needed to be burnt to generate electricity and less carbon dioxide is emitted

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Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

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.

Answers written in the margins will not be marked.

2024 DSE (C)

香 港 考 試 及 評 核 局
HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

香 港 中 學 文 憑 考 試
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

答 題 簿
ANSWER BOOK

考生須知

(一) 宣布開考後，考生須首先在第 1 頁之適當位置填寫考生編號，並在第 1、3 及 5 頁之適當位置貼上電腦條碼。

(二) 每題(非指分題)必須另起新頁作答，並須在每一頁的相應試題編號方格填畫「X」號，以表示選答的題號(見下例)，並在第一頁之適當位置填寫作答的試題編號。

(三) 紙張兩面均應使用，並應每行書寫。不可在各頁邊界以外位置書寫。寫於邊界以外的答案，將不予評閱。

(四) 如有需要，可要求派發方格紙及補充答題紙。每一紙張均須填寫考生編號、填畫試題編號方格、貼上電腦條碼，並用繩縛於**簿內**。

(五) 試場主任宣布停筆後，考生不會獲得額外時間貼上電腦條碼及填畫試題編號方格。

INSTRUCTIONS

(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 and 5.

(2) Start each question (not part of a question) on a new page. Put 'X' in the corresponding question number box on each page to indicate the appropriate question number (see the example below), and write the question number(s) of the question(s) attempted in the space provided on Page 1.

(3) Write on both sides using each line. Do not write in the margins. Answers written in the margins will not be marked.

(4) Graph paper and 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 book.

(5) 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.

例 **Example:**

試題編號 Question No. = 3

試題編號 Question No.

1	2	3	4	5	6	7	8	9	10	11	12	
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每題另起新頁作答。
Start each question on a new page.

1ai) Both levels of FSH and LH remain lower level than normal when taking the contraceptive pill. With low FSH, no follicle can be stimulated to develop. With low level of LH, no ovulation occurs to release ovum. No ovum is produced and sperm cannot meet ovum, no fertilisation.

1aii) Progestrone, it inhibits secretion of LH, FSH, no follicle can be stimulated to develop. Hence the level of oestrogen is lower when taking pills as no developing follicle is produced

1aiii) When uterine lining is thinner, implantation of embryo is difficult to occur

1aiv) the level of oestrogen level is lower than normal. lower oestrogen stimulate the thickening of uterine lining poorly. Henle the uterine lining becomes thinner. ✓

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1b)i) Accumulated volume of fluid = Total volume fluid intake - urination.

1b)ii) Drinking salt water will only increase water potential slightly while drinking water only will lead to greater increase in water potential. Osmorecepter in hypothalamus is more stimulated by the increase in water potential in blood, stimulating pituitary gland to release less ADH. Collecting tube is less permeable to water. Smaller proportion of water is reabsorbed and larger volume of urine is produced. Hence accumulated volume of fluid intake retained in body for those drinking water only is lower than those drinking salt water.

1b)iii) Respiration to produce energy for muscle contraction releases heat in body. With more water retaining in body. Sweat production can occur continuously, evaporation of sweat can lose heat from marathon runners' body, preventing them from overheating.

1b iv) collect the data of ther volume of sweat of three different drinks. Collect the data of the body temperature (tell them to run, and only drink the drinks at the beginning)

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(b)(iv) glycerol provides energy for marathon runners :

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Start each question on a new page.

2a)i) Urbanization

ii)1) Both average number of birds and number of bird species increased after habitat management. For average number of birds, it increased from 2005 to 2012 and then dropped slightly from 2015 to 2014, and increased again from 2014 to 2015. For number of bird species, it increased gradually from 2005 to 2015. It allows more species to come to stay and it has not enough resources for large ~~eee~~ number of birds to stay

ii)2) First it provides various types of food and habitat for birds such as Marsh, water flea pond, Lotus pond, Fish pond. As biodiversity increases, more species of birds are attracted to stay. Secondly, as the wet farmland and Dry farmland are restored, they provide more corps or more insects near the corps for birds to feed on. Hence it attracts larger number of birds to stay.

2bi) because movable organisms can travel long distance, it is diffcult for humans to find them again. Also, immovable organisms stay at one place for long time and they can collect more MPs at that location

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2bii) Species C should be chosen. It appears at many places according to the table, showing that it can tolerate many environmental conditions - Hence it can be used to monitor MPs pollution at various places.

2biii) Species R should be used, given that it can collect MPs of all sizes from 10 to 5000. While other cannot. Using it can let us know percentage of all kinds of MP in the water, it is more comprehensive for us to know the MP pollution.

2biv) 1) YES, because over 70% of larvaes still survive to becoming pupae.

2) Efficiency of their degrading plastics. Because if they degrade plastics in a very 慢 slow rate, plastic pollution ~~could be~~ cannot be slowed (Rate of pollutant formation is higher than Rate of plastic degradation rate)

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Level 5 Exemplar 2

2024-DSE
BIO
PAPER 1B

B

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2024

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.

* A 1 3 0 E 0 1 B *

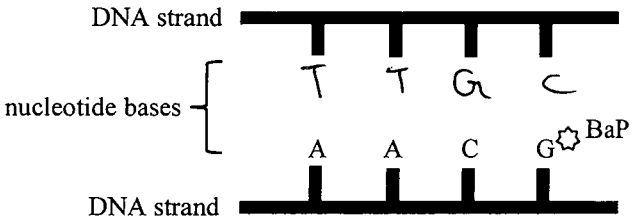
SECTION B

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)

		Nervous control	*Hormonal control*
(a)	Signalling molecule	receptor	hormone-secreting cell
(b)	Transmission pathway	neurones	blood stream.
(c)	Comparison of the time taken to induce responses	Nervous control is faster than hormonal control.	

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)

Codon has degenerate nature. Different codon may code for the same amino acid.

(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)

mitotic cell division

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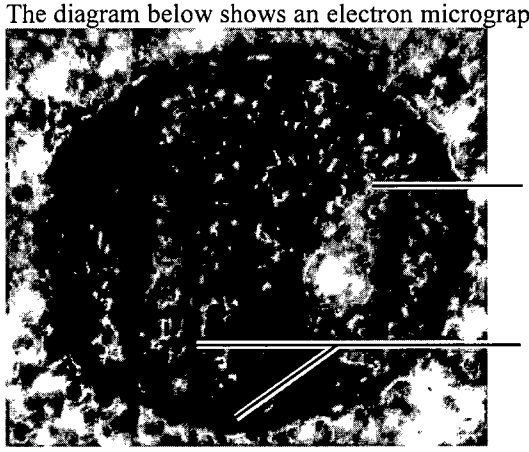
3. The diagram below shows an electron micrograph of a mitochondrion:



(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)

Y is highly folded, to increase surface area for process of electron transport chain to produce more ATP.

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

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

Krebs cycle

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

When Krebs cycle is halted, plant produce much less NADH and FADH for production of ATP in electron transport chain. Product of glycolysis (pyruvate) accumulates as it cannot be converted to CO_2

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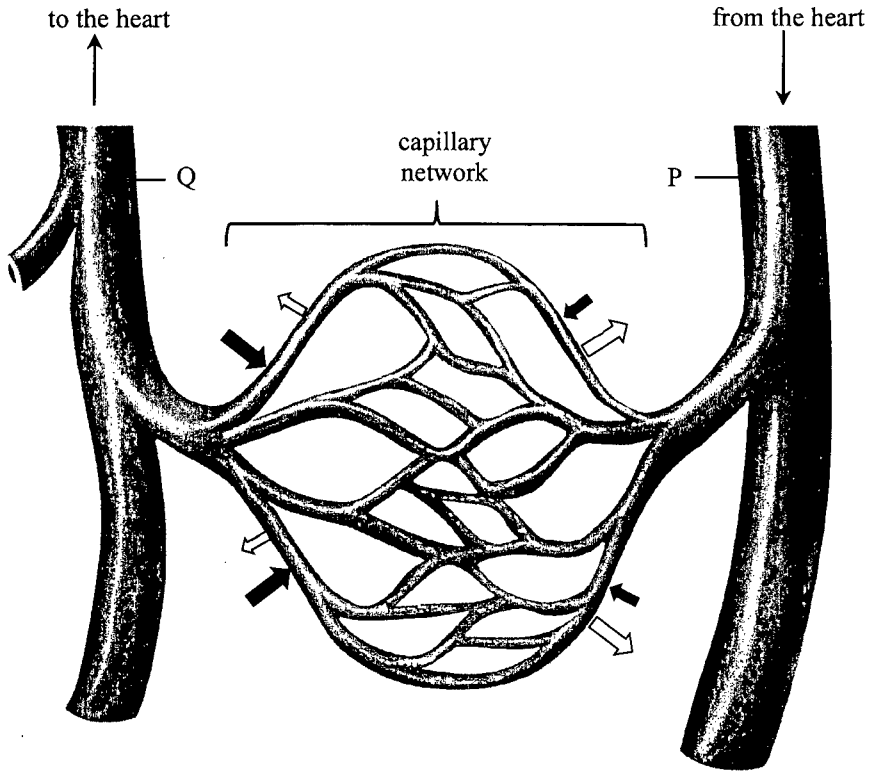
4. The schematic diagram below shows the arrangements of some blood vessels:



(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)

➡ : water potential.

⇨ : blood pressure

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

Capillaries near arteriole end has higher blood pressure due to pumping action of heart. High pressure force plasma in blood through blood vessel wall into tissue space. At venule end, blood pressure is lower, thus less plasma is forced out.

(But not blood cells and blood proteins)

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(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)

	Organ	*Substance taken up into the blood*	*Explanation*
(i)	pancreas	insulin	Insulin is secreted from the organ in response to the change of the blood glucose level.
(ii)	Liver	urea	Liver undergo deamination to break down excess amino acid into urea

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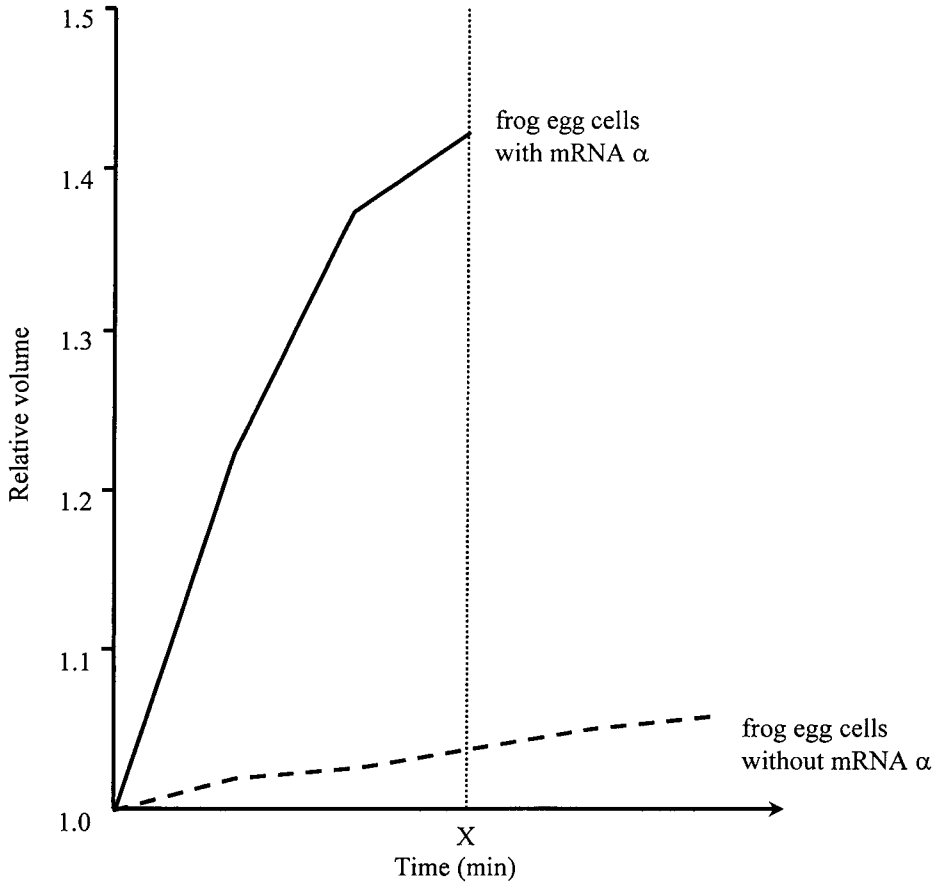
5. In an experiment, mRNA α was isolated from a mammalian cell and then injected into a frog egg cell. The expression of mRNA α eventually led to the presence of protein α on the cell membrane of the frog egg.

(a) Describe how the injected mRNA α led to the presence of protein α on the cell membrane of the frog egg. (3 marks)

mRNA α entering frog cell and bind with ribosome, where translation occurs. tRNA complimentary to codon carrying amino acid bind onto mRNA α, forming polypeptide. Polypeptide fold to give 3D structure, forming protein α

(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:



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(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)

Water potential of frog egg cell is lower than pure water. There is net water movement from water to egg cell by osmosis.

(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)

Increase in volume of frog egg cell with mRNA α is much greater than that without mRNA α meaning frog egg cell with mRNA take up more water than that without mRNA. Protein α produced may be channel protein that allows water movement across phospholipid bi-layer

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

The frog egg cell swell and burst.

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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)

Pancreatic amylase. As pancreatic amylase is secreted in duodenum, where most digestion takes place. Time of food remaining in mouth cavity is much shorter. Pancreatic amylase breaks down more starch into glucose for absorption. It plays a more deciding role in nutrient absorption and weight gain.

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

Solution	*Volume of solution used in each set-up (mL)*	
	Set-up I	*Set-up II*
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)

To make volume of solution in each set-up the same for fair comparison. Proving the results is due to bean extract but not difference in volume of water.

(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)

At 5 minute intervals, add 5 mL of solution into Benedict's solution and heat. record amount of brick red precipitate formed

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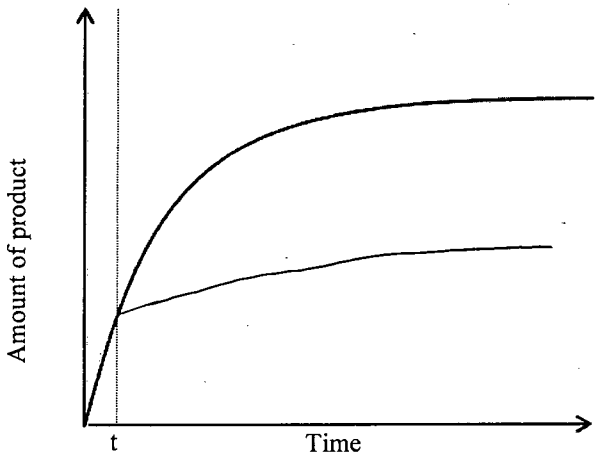
(c) The graph below shows the amount of product formed over time when amylase is working normally:



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)

In vivo experiment can stimulate the condition of digestive system

(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)

blood glucose level. The control group blood glucose increase, while the experimental group almost no increase

(e) Suggest how the amylase inhibitor helps the bean defend against insects. (1 mark)

Insects consuming beans cannot digest the starch due to the inhibition effect, thus cannot absorb the nutrients and die from starvation.

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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)

line transect . quadrant.

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

Lay the line transect along shore (beginning from water then away from water). Place quadrant at regular distance intervals and count number of organisms lying within.

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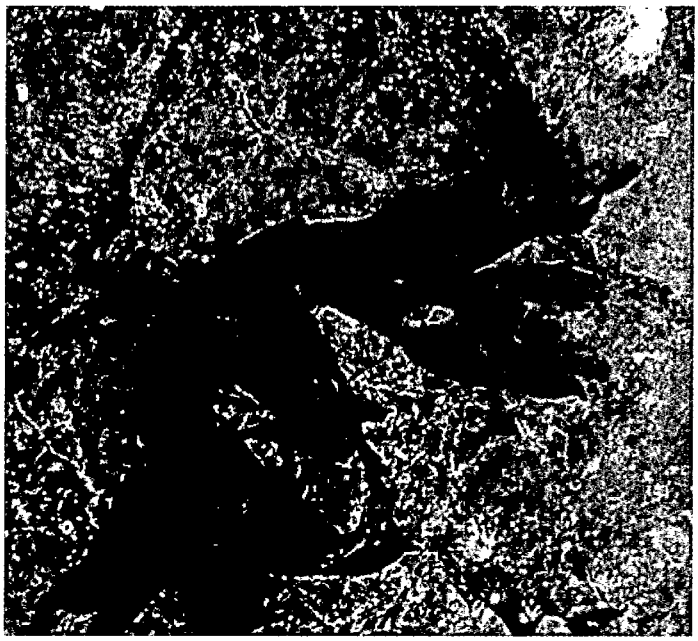
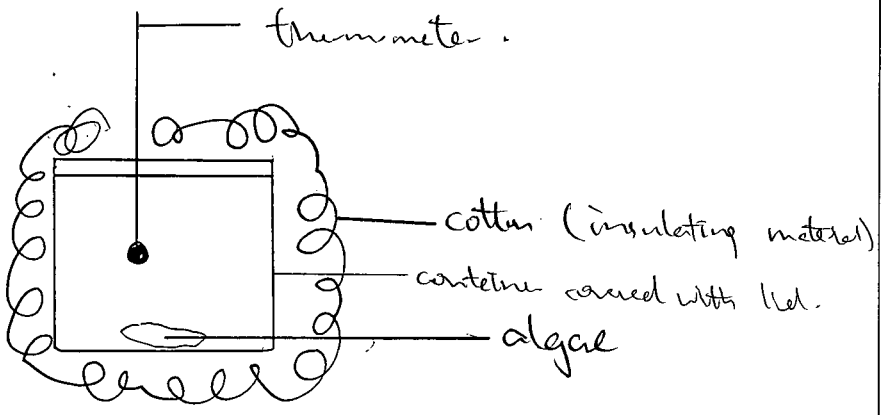
(b) In a field trip to a rocky shore, a student found a thin brown sheet lying on a rock. The student suspected that it was an alga. A small piece of the sample was taken back to school for further study.



5 cm

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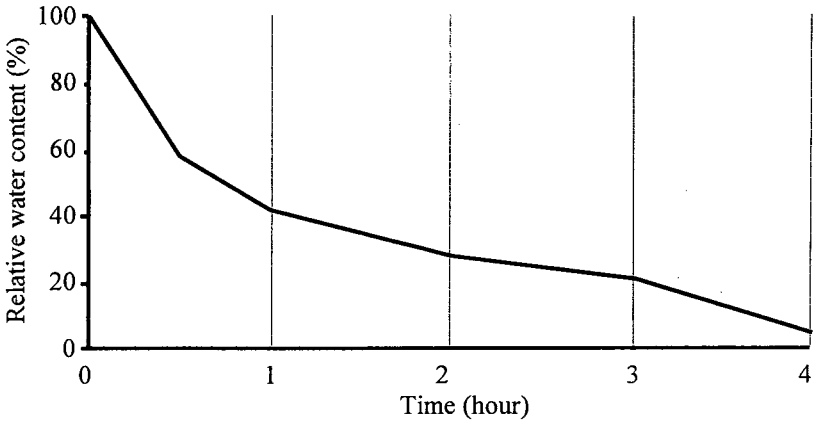
(c) Under normal circumstances, the level of free radicals in algal tissues is kept at a certain level as a result of homeostasis. In response to dehydration, algal tissues will be stimulated to produce free radicals which can cause damage to the cell components if there is an accumulation.

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)

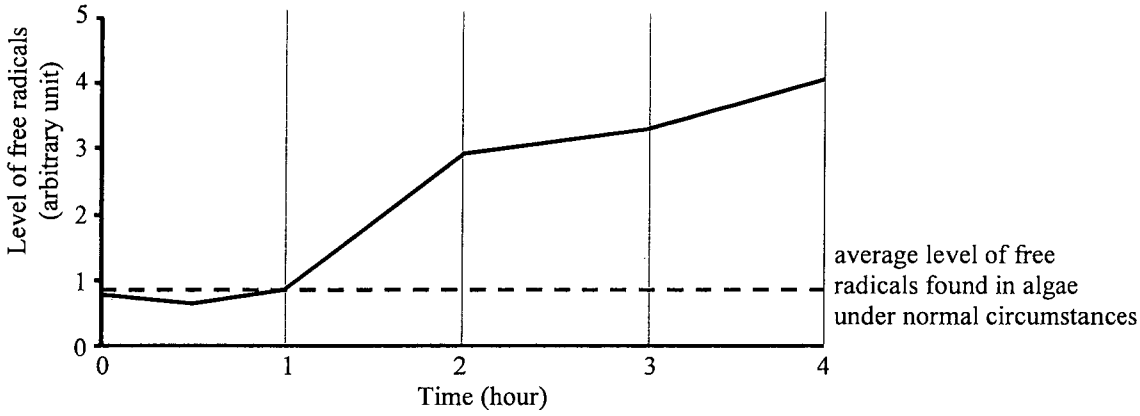
Increase in level of free radicals.

Answers written in the margins will not be marked.

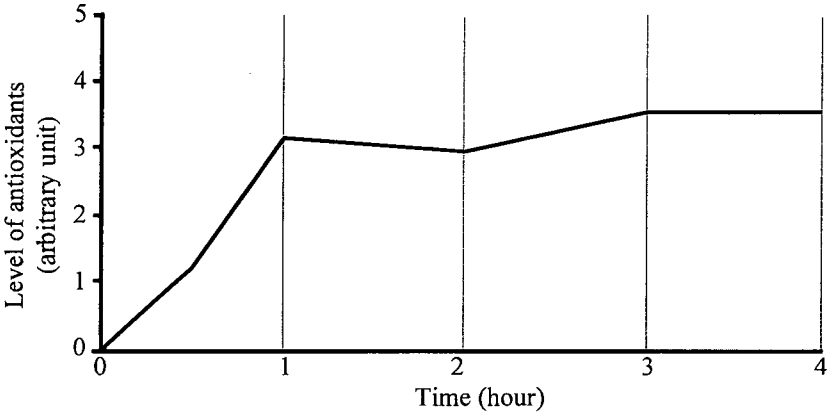
Answers written in the margins will not be marked.

(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:

Graph II



Graph III



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)

When algae begin to dehydrate, the level of radicals is expected to decrease, but remained stable for 1 hour, meanwhile level of antioxidant increase sharply. Level of antioxidant remain in high level when radicals level increase. Antioxidant can reduce the free radicals. when level of free radicals is higher than normal.

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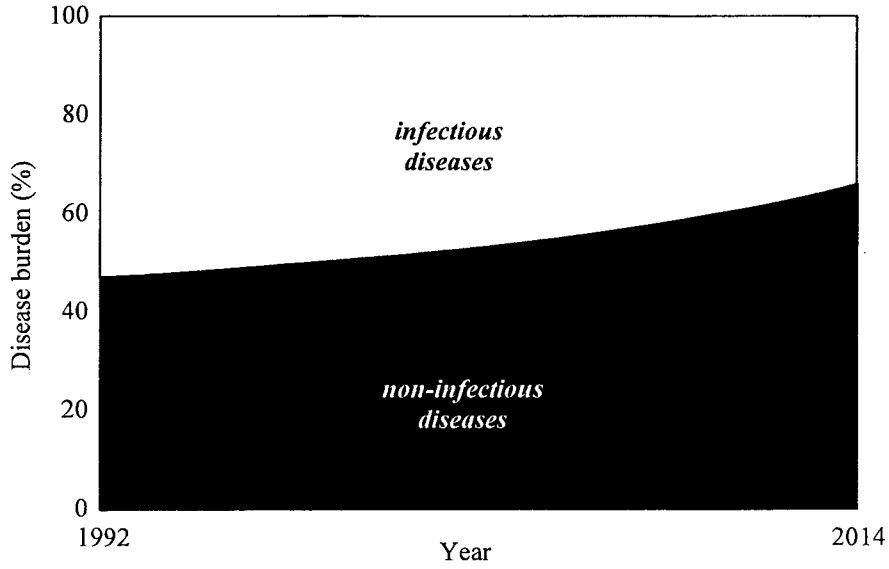
Go on to the next page

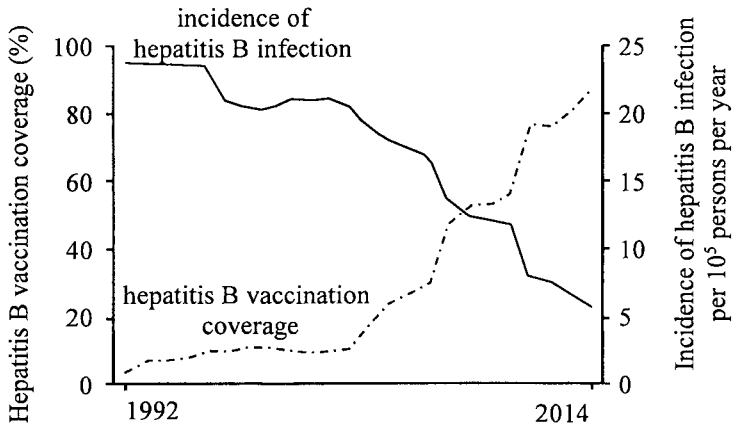
8. Disease burden is a measure of population health that aims to quantify the potential loss of lifespan and health outcomes due to illness as compared to the ideal of living to a ripe old age and in good health. The graph below shows the percentage share of disease burden caused by infectious diseases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

the proportion of non-infectious disease in Disease burden increases.

(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)

In vaccination, weakened or killed pathogens of hepatitis B with antigen is introduced into body. Lymphocytes (B cells) is stimulated

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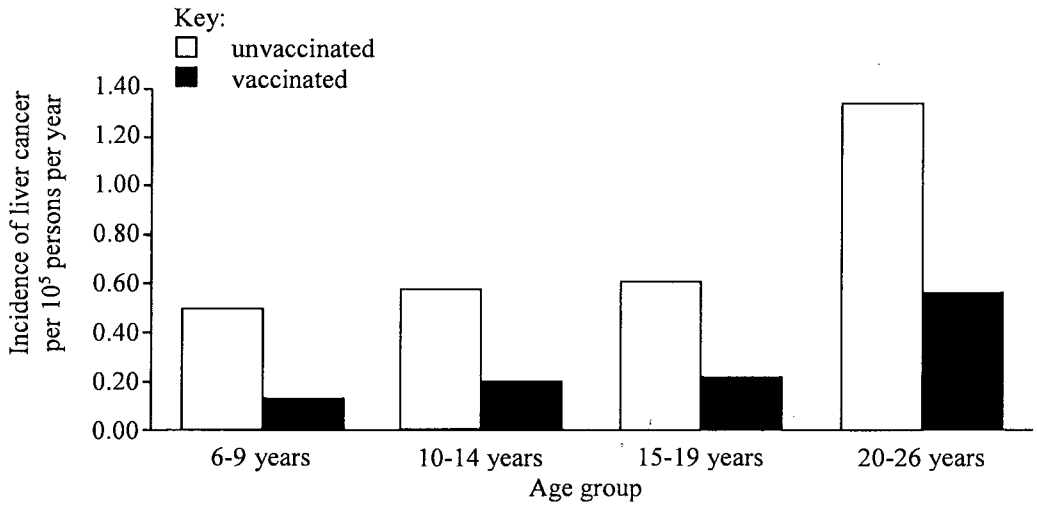
to develop specific memory on antigen by memory cells. When Hepatitis B pathogen enter body again, memory cell recognize antigen, stimulating plasma cells that produce antibodies rapidly and high amount with shorter response time to kill pathogens, person not infected. When more people is vaccinated, less people will be infected.

(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)

People are less likely to contract infectious disease, the proportion of infectious disease decrease.

(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)

Hepatitis B increase the likelihood of developing liver cancer, as unvaccinated people who are more likely to contract Hepatitis B have more incidents of liver cancer than vaccinated people

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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 μM 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:

Water

10 μM hormone X

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

Hormone X causes the guard cells to become flaccid and close stomata, which reduces water loss of plant through transpiration when water supply is low (drought)

(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:

Plant variety	*Treatment*	*Leaf fresh mass (g)*
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)

A, for similar control leaf fresh mass, the decrease in fresh mass of B is much more significant than A, indicating B lose more water. A produces more hormone X, thus A lose less water than B in drought conditions.

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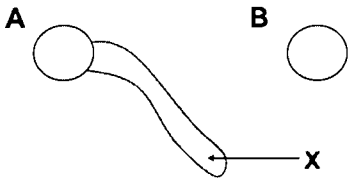
10. In an investigation, pollen grains collected from a single flower were cultured in an artificial medium. After 48 hours incubation, they were observed under a light microscope. Two types of pollen grains with different appearances were observed, as shown in the diagram below:



(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)

The ratio of two phenotypes in pollen grains is 1:1. A can produce pollen tube, indicating it must have inherited the allele of producing pollen tube. B cannot produce pollen tube, indicating it must have inherited the allele unable to produce pollen tube. Parent plant passed on both type of allele, meaning it must be heterozygous.

(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)

A. A produce pollen tube which grow into stigma and style, reaching the ovary. The pollen tube carrying male gamete bring male gamete to female gamete in ovule (in ovary). After fertilization, ovary develop in fruit containing seeds.

(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 (%)	25	50	25

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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)

The production of meat produces much greenhouse gases. Cows digest and absorb dietary fibre in grass, excreting methane gas. Cattles also only undergo respiration, producing CO_2 and consuming O_2. Meanwhile, plants of vegetarian diet can undergo photosynthesis, having a net CO_2 consumption that reduces carbon footprint by carbon fixation. Plants are producers, while cattle are consumers. Energy is lost along the food chain by excretion, respiration and death, which all produce CO_2. Eating meat ultimately leads to more CO_2 produced than plants.

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Personal action to reduce carbon footprint include: using public transportation instead of private vehicles, so that less fuel will be combusted (to CO_2) for same travelling distance.
Using the fan instead of air conditioner, as air conditioner uses much more energy produced by combusting coal in power station, producing CO_2.

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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.

Answers written in the margins will not be marked.

2024 DSE (C)

香 港 考 試 及 評 核 局
HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

香 港 中 學 文 憑 考 試
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

答 題 簿
ANSWER BOOK

考生須知

(一) 宣布開考後，考生須首先在第 1 頁之適當位置填寫考生編號，並在第 1、3 及 5 頁之適當位置貼上電腦條碼。

(二) 每題(非指分題)必須另起新頁作答，並須在每一頁的相應試題編號方格填畫「X」號，以表示選答的題號(見下例)，並在第一頁之適當位置填寫作答的試題編號。

(三) 紙張兩面均應使用，並應每行書寫。不可在各頁邊界以外位置書寫。寫於邊界以外的答案，將不予評閱。

(四) 如有需要，可要求派發方格紙及補充答題紙。每一紙張均須填寫考生編號、填畫試題編號方格、貼上電腦條碼，並用繩縛於**簿內**。

(五) 試場主任宣布停筆後，考生不會獲得額外時間貼上電腦條碼及填畫試題編號方格。

INSTRUCTIONS

(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 and 5.

(2) Start each question (not part of a question) on a new page. Put 'X' in the corresponding question number box on each page to indicate the appropriate question number (see the example below), and write the question number(s) of the question(s) attempted in the space provided on Page 1.

(3) Write on both sides using each line. Do not write in the margins. Answers written in the margins will not be marked.

(4) Graph paper and 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 book.

(5) 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.

例 **Example:**

試題編號 Question No. = 3

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每題另起新頁作答。
Start each question on a new page.

(a) from graph I and II, there are spikes in LH and FSH level, while the level of LH and FSH remain relatively stable when taking pill. The sharp increase in FSH and LH causes ovulation. The pill inhibits the release of FSH and LH so that ovulation cannot occur, no ovum is released to oviduct, thus no fertilization can occur.

(b)

~~Oestrogen Oestrogen is produced by follicles that normally inhibits the release of FSH, but at high levels stimulate~~

(i) Progesterone. Progesterone inhibits the release of LH and FSH so that LH and FSH remain at low level.

(ii) ~~[illegible] [illegible] embryo cannot be implanted on~~

thin uterine lining cannot support embryo implantation.

(c) Oestrogen level was lower when taking pills. Oestrogen cause thickening of uterine lining. Low level of oestrogen cause uterine lining remain thin.

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Answers written in the margins will not be marked.

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每題另起新頁作答。
Start each question on a new page.

~~fluid consumed - fluid excreted~~

b) i) ~~accumulated total fluid consumed - total fluid excreted~~

total volume of fluid consumed - total volume of fluid excreted = accumulated volume of fluid retained.

ii) salt solution has smaller water potential difference with blood than water with blood.

When water is consumed, osmoreceptors in hypothalamus detect (sharp) increase in water potential, stimulating less ADH released by posterior pituitary gland, thus permeability of distal convoluted tubule and collecting duct decrease. Smaller proportion of water is reabsorbed, thus more fluid is excreted for same volume of fluid consumed. Thus, there is less accumulated volume of fluid throughout experiment, as shown in graph. (For salt solution, the change in blood water potential is less)

iii) Marathon runners continuously produce heat in muscle contraction. When more water is retained, more sweat can be produced. Evaporation of sweat can take away body heat, to prevent overheating.

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Start each question on a new page.

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iv). The participants should be undergoing continuous exercise of medium intensity throughout experiment. The body weight should be measured instead of urine volume, so loss of water by sweat can also be measured.

v). Glycerol acts as energy reserve in humans. Higher glycerol level in blood mean when blood glucose level decrease, more glycerol can be readily converted to glucose by liver to produce more energy for muscle contraction

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Q17) plasmid. Target gene is inserted into plasmid, which will be expressed in agrobacterium to produce PUFAs.

Q18) For A, Content of PUFAs produced in each month per crop = $\frac{(50 \times 9)}{6}$ = 75 arbitrary unit per month.

B: $\frac{(100)(3)}{3}$ = 100 arbitrary unit per month.

C: $\frac{(100)(4)}{8}$ = 50 arbitrary unit per month.

∴ B is selected, as B produce most PUFAs per unit time

Q24) PUFAs produced by GM seeds are identical to those produced in fish oil, as they are ~~coded~~ by same gene undergoing transcription and translation.

Q(i)(ii) the pollen grains of GM crop may spread by wind or animal, and cause genetic pollution to wild relative (when male gamete of GM crop fuse with female gamete of wild relative to produce offspring)

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a)(ii)(2) ~~Place a GM crop and wild relative in environment simulating selected field (e.g. same distance, same wind speed, same species of animals). Transfer pollen grain of GM crop using pipette to stigma of wild relative. After fruit is produced, extract DNA in seed~~

Place GM crops and wild relatives in environment simulating selected field conditions. (same distance between crops, wind speed, animal species etc.) When fruit is produced by ~~each crop~~, wild relative due to pollination, ~~check~~ extract seed of fruit, and detect the presence of PURAs. If PURA is present, the argument is correct.

(at most site).

b)(i) Using the restriction enzyme, the DNA is cut ~~into smaller fragments~~. Place the mixture of DNA fragments into ~~see~~ wells of gel electrophoresis. Count the number of bands formed ~~by~~

As ~~restriction~~ ~~the~~ cut site of ~~mutation~~ the mutated DNA is destroyed, no. of bands of the individuals with mutation will have 1 ~~DNA fragment~~ ~~product~~ band only. While normal people have 2.

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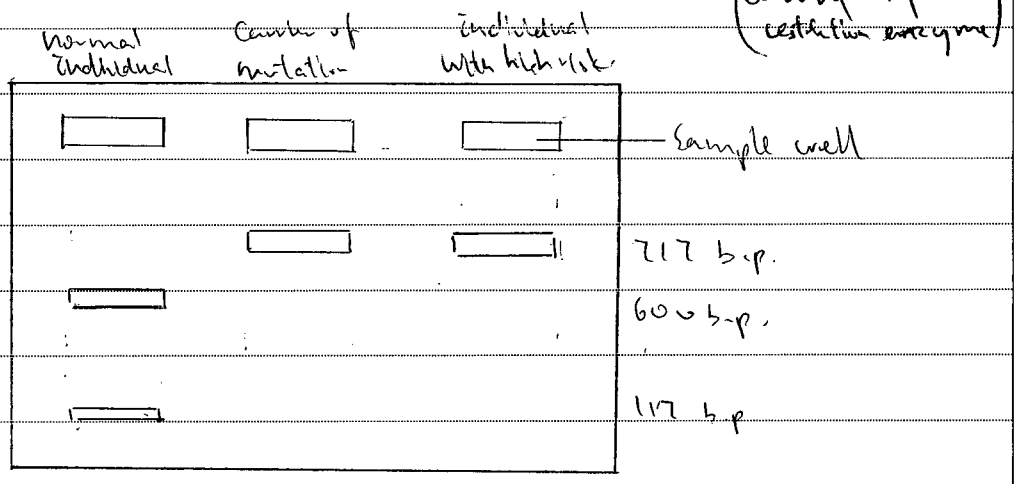
b(i) Q. As it is only 13 b.p away from [redacted] position 285, band cannot be produced in gel electrophoresis after q (cutting by restriction enzyme)

(ii)



(iii) Anode. As DNA molecules are slightly positively charged, they will migrate to negative pole (cathode)

[redacted]

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