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Level 4 Exemplar 1

2024-DSE
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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 *

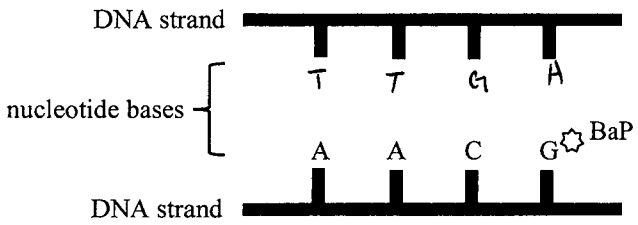
SECTION B

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	by receptor	by organ.
(b)	Transmission pathway	through nerves	through blood
(c)	Comparison of the time taken to induce responses	Nervous control require less time	

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)

Same amino acid is coded.

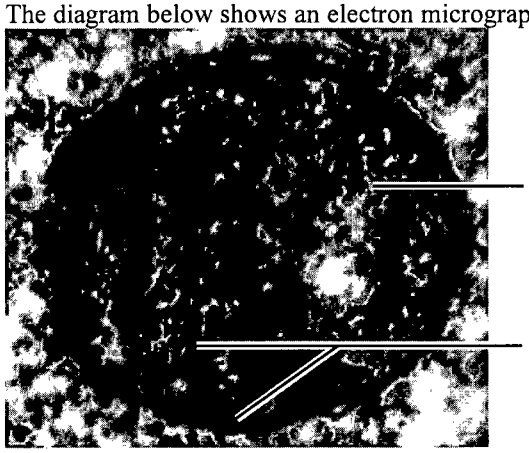
(c) If this type of mutation accumulates over time in the DNA molecules, there is a chance that it will affect the functioning of the protein formed and subsequently lead to tumour formation. Suggest which cellular process this protein controls. (1 mark)

Mitotic cell division.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

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



(a) Label X in the above diagram. (1 mark)

matrix

(b) Describe ***one*** observable feature of Y and explain how this feature is related to the functioning of mitochondria. (2 marks)

A large surface area. Provide more space for the process of aerobic respiration to generate more ATP.

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

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

aerobic respiration.

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

The rate of aerobic respiration decrease. The plant carry out anaerobic respiration, thus produce carbon dioxide and ethanol.

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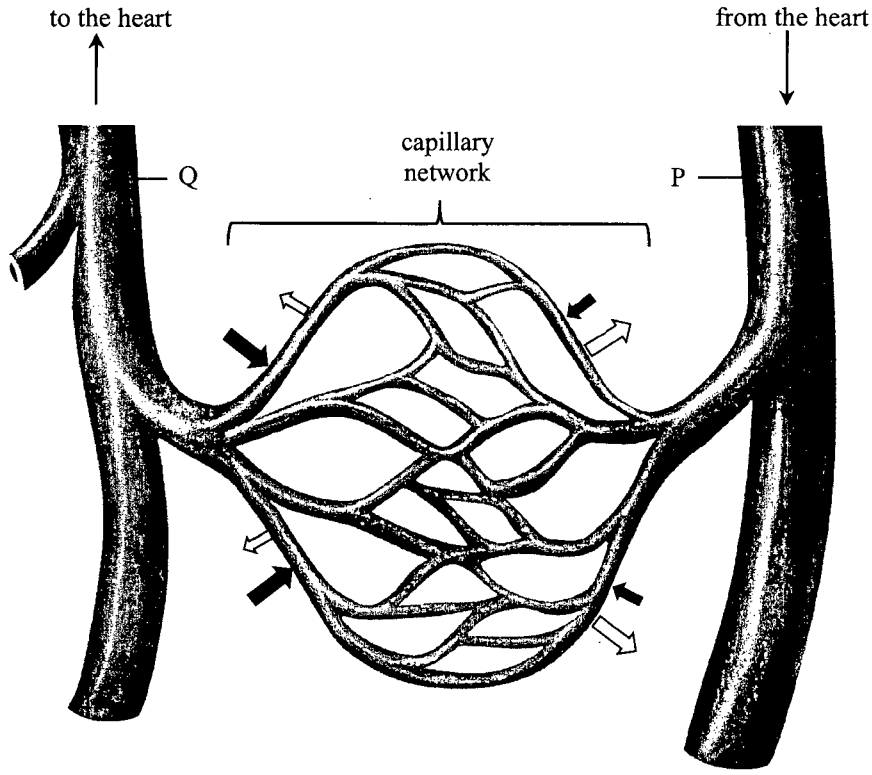
4. The schematic diagram below shows the arrangements of some blood vessels:



(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)

➡: The water potential of tissues higher than that of the capillaries.

⟹: The high hydrostatic pressure in capillaries.

(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)

When the capillaries that near P, they have higher concentration of nutrients and oxygen. So there are more nutrients and oxygen are forced out by hydrostatic pressure. The capillaries that near Q has a lower concentration of nutrients and oxygen, less nutrients are forced out by hydrostatic pressure.

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Answers written in the margins will not be marked.

(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	Excess amino acids will be converted to urea by deamination.

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Answers written in the margins will not be marked.

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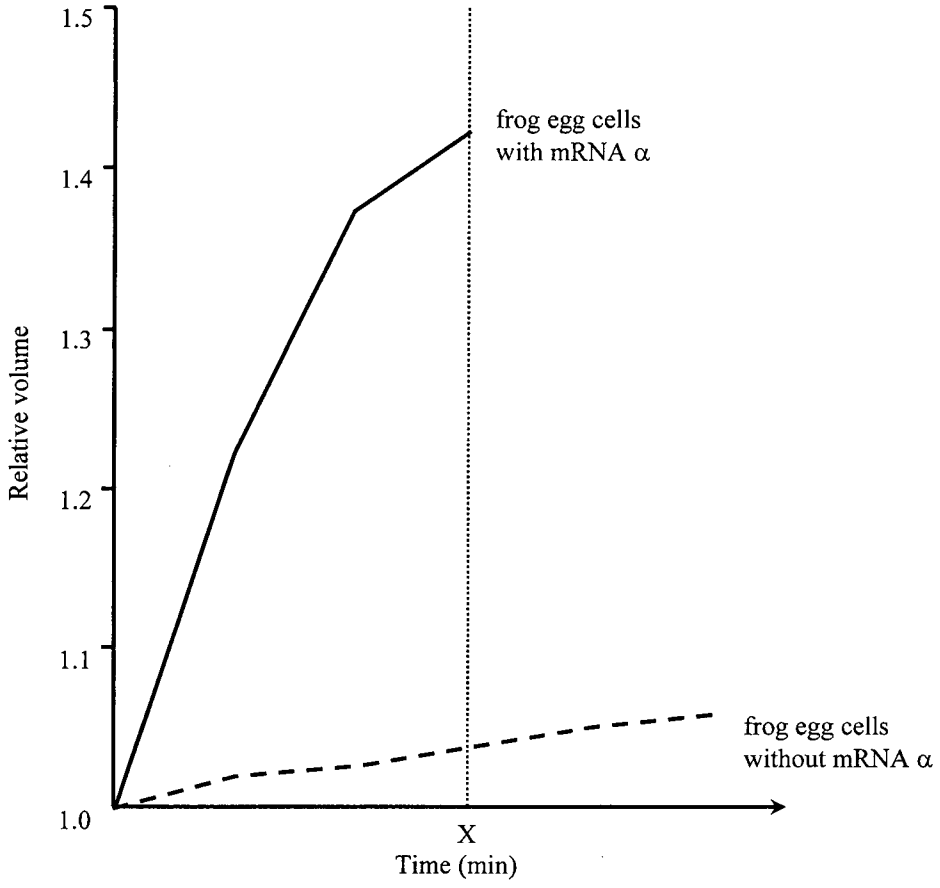
5. In an experiment, mRNA α was isolated from a mammalian cell and then injected into a frog egg cell. The expression of mRNA α eventually led to the presence of protein α on the cell membrane of the frog egg.

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

The tRNA molecules carry specific amino acids with anticodon bind to the codon by complementary base pairing in sequence. The bonds are formed between adjacent amino acids (1), thus polypeptide is formed. The polypeptide fold and recoil to form protein.

(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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Answers written in the margins will not be marked.

(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)

Pure water has a higher water potential than frog egg cells. Water is absorbed by frog egg cells by osmosis through the ~~at~~ differentiated permeable membrane along water potential gradient.

(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)

The relative volume of frog egg cells with protein α is much higher than the frog egg cells without protein α. This shows that a large amount of water is absorbed into the frog egg cells with protein α.

The function of protein α is absorbing water by active transport.

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

The egg cells become swell and burst finally.

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Answers written in the margins will not be marked.

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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)

The pancreatic amylase. The food supplement

(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 maintain the same volume in set-up I and II. Ensure that bean extract is the only factor affect the result of experiment.

(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)

Put the solution of set-up I and II into test tubes respectively, add benedict solution into test tubes and boil for 5 minutes. The test tube with brick-red precipate shows a higher rate of starch digestion.

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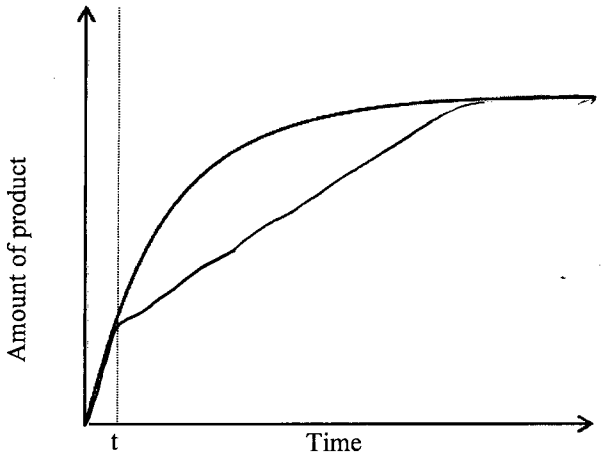
Answers written in the margins will not be marked.

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



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

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

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

(ii) Apart from monitoring the change in body weight of the mice, their professor suggested that they should take blood samples from the mice after the meals for analysis. Which component of the blood should they monitor? What would be the expected results of the control group and the experimental group if their ideas actually worked? (2 marks)

Insulin. The control group has a lower blood insulin concentration.

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

less insects are attracted by glucose.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

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)

Square quadrant

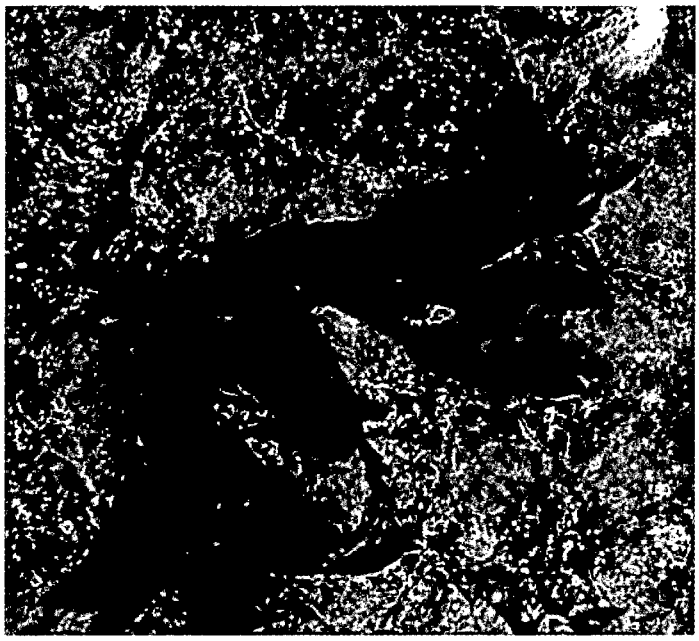
(ii) How could you use the equipment listed in (i) to collect the data needed for the study? (2 marks)

Count the number of different organisms that enclosed by square quadrant.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

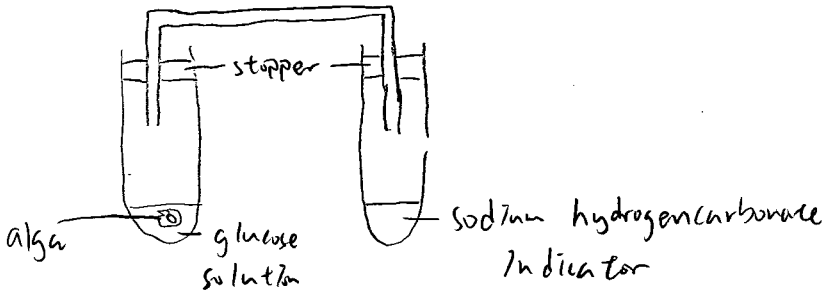
(b) In a field trip to a rocky shore, a student found a thin brown sheet lying on a rock. The student suspected that it was an alga. A small piece of the sample was taken back to school for further study.



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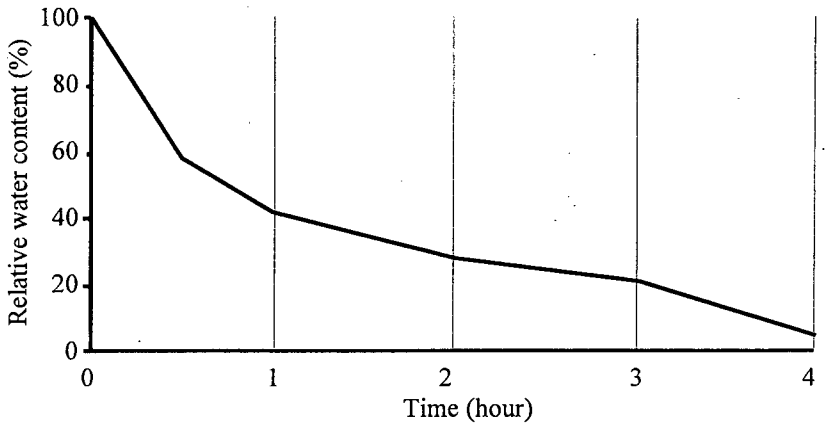
(c) Under normal circumstances, the level of free radicals in algal tissues is kept at a certain level as a result of homeostasis. In response to dehydration, algal tissues will be stimulated to produce free radicals which can cause damage to the cell components if there is an accumulation.

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)

Relative water content decrease more rapidly when time increases.

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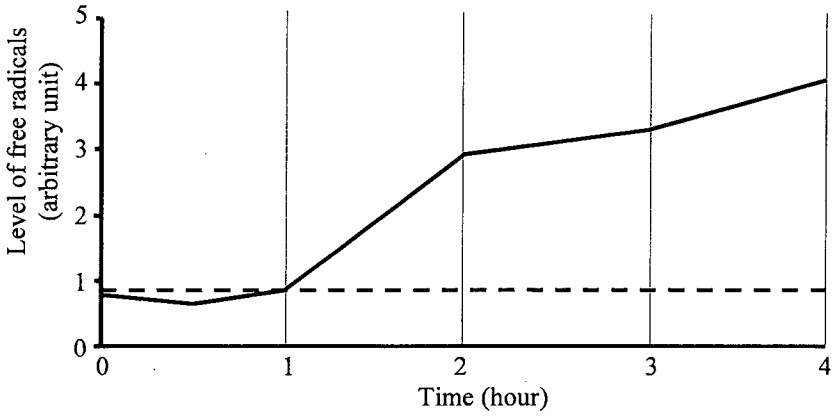
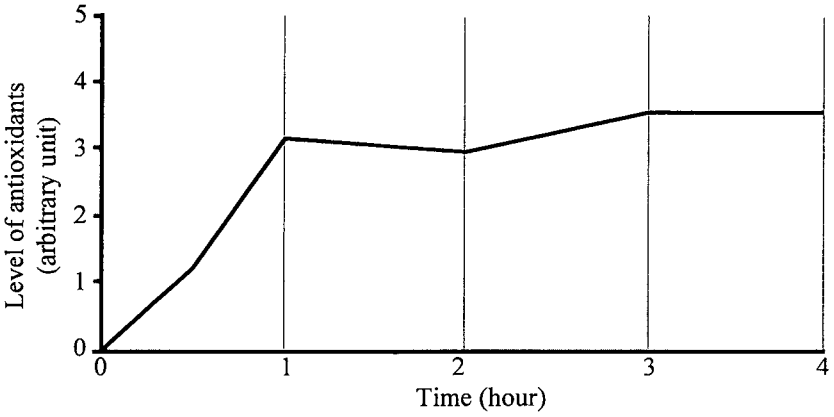
Answers written in the margins will not be marked.

(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)

They encounter the free radicals, prevent accumulation of free radicals. From graph II and III, when the level of free radicals increase, the level of antioxidants remain in a high level.

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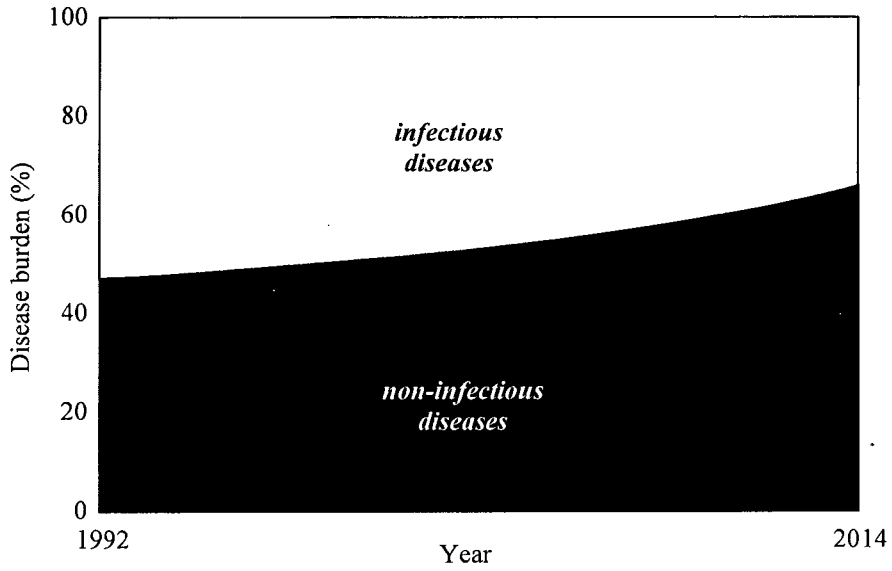
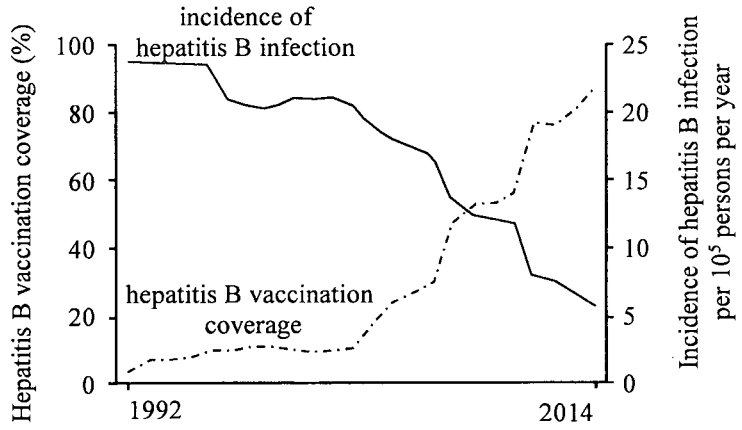
8. Disease burden is a measure of population health that aims to quantify the potential loss of lifespan and health outcomes due to illness as compared to the ideal of living to a ripe old age and in good health. The graph below shows the percentage share of disease burden caused by infectious diseases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

Disease burden of non-infectious increased gradually and become higher than that of infectious disease.

(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)

When the hepatitis B vaccination coverage is low, the incidence of hepatitis B infection is high. Because patients need time to produce antibody to kill the pathogen of hepatitis B.

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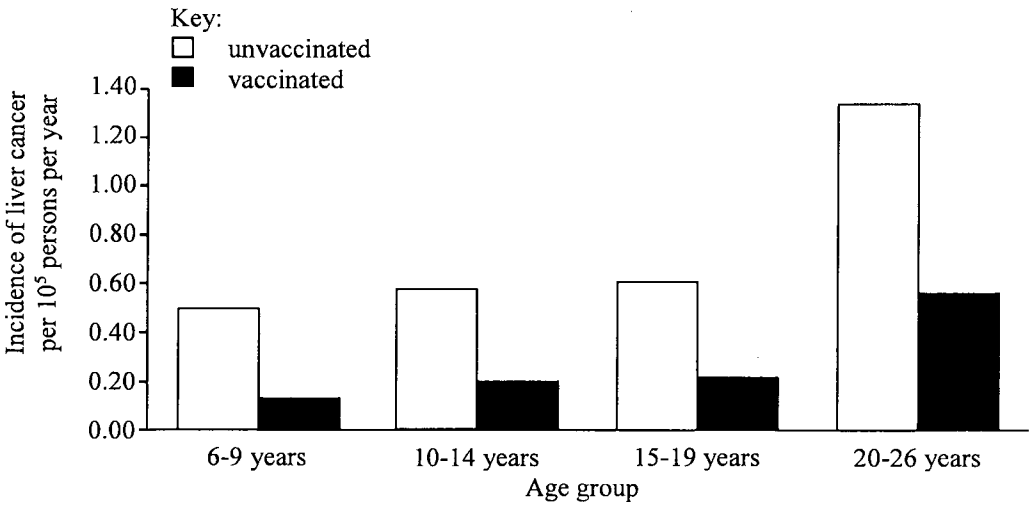
Answers written in the margins will not be marked.

The high hepatitis B vaccination coverage leading to the low incidence of hepatitis B. The patients have the memory B cells that recognised the antigen of pathogens, a large amount of antibodies will be produced in shorter time to kill pathogens.

(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)

Vaccination decrease the incidence of infectious disease.

(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)

The vaccination has a low effectiveness against liver cancer compared to hepatitis B. The vaccinated people of all the age groups still have a higher incidence rate than hepatitis incidence.

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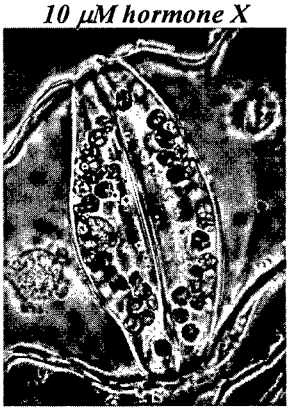
Answers written in the margins will not be marked.

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)

The stomata of cell in 10 μM hormone X is much smaller. The prevene the water loss, plant P will not lose its turgidity.

(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

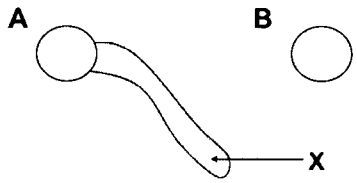
Which variety will have a higher level of hormone X produced? Explain your answer. (3 marks)

Variety A. The decreased percentage of fress mass of variety B is much higher than Variety A. Therefore plant variety B has a much higher water loss than a. This shows that less hormone X is produced in variety B, the size of stomata remain large. Rate of diffusion of water vapour out of leaves is high.

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

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)

A ~~can~~ can develop X, so A must have inherited at least one gene of developing X from parent. However, B cannot develop X, so B must have inherited at least one gene of not-developing X from parent. Parent consist two types of allele are the same time. The genotype of parent is 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 can develop the pollen tube. The pollen tube with male gametes could secrete enzyme to digest ~~the~~ the tissue of style and pass through ovule. The male gametes can fertilize the ovum.

(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%

Answers written in the margins will not be marked.

Answers written in the margins will not be marked.

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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)

Practising a mixed diet require a longer food chain. The animals carried out respiration to growth, a large amount of carbon dioxide is released during respiration. Practising a vegetarian diet require a shorter food chain. Energy available to us increase. Energy available to us decrease.

Do not turn on air-conditioner frequently, the operated air conditioner require less of electricity. We need to generate more electricity by burning a large amount of carbon. Thus decrease the time of turning on air conditioner leads to decreased emission of carbon dioxide.

Travelling by public transport vechicle more frequently. This lower the amount of use of fuels. Therefore less fossil fuels will be used, less carbon dioxide is produced.

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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

試題編號 Question No.

1	2	3	4	5	6	7	8	9	10	11	12	
☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
13	14	15	16	17	18	19	20	21	22	23	24	≥25

由考生填寫 To be filled in by the candidate	
試題編號 Question No.	A
	∨

試題編號 Question No.

1	2	3	4	5	6	7	8	9	10	11	12
X											

13	14	15	16	17	18	19	20	21	22	23	24	≥25

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

寫於邊界以外的答案，將不予評閱。
Answers written in the margins will not be marked.

(a)(i) The contraceptive pills make the concentration of LSH become lower than the normal level. The follicle will not develop.
The contraceptive pills also make the concentration of LH become lower, the low concentration of LH will not trigger ovulation.

(a)(ii) Progesterone. Progesterone will have a negative feed back on FSH and LH.

(a)(iii) The thickness of uterine lining is too thin, will not allow the implantation.

(a)(iv) The oestrogen concentration is much higher than normal and inhibit the release of FSH, the follicle cell will not develop. No progesterone to release from yellow body to maintain thickness of uterine lining.

(b)(i) Accumulated volume = volume of solution absorbed - urine.

(b)(ii) The accumulated volume of fluid retained of the group which consumed water is much lower than that of the group which consumed salt solution. Drinking water leading to a higher increase of water potential in blood. Then high water potential in blood is detected by osmoreceptors in hypothalamus. less ADH is released into blood and the wall of collecting duct is less permeable to water. less water is reabsorbed.

(b)(iii) Heat is continuously generated. Retaining more water can provide more water to produce more sweat. Rate of evaporation of sweat increases, the heat loss increases. The runners have a lower chance to suffer from heat stroke.

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每題另起新頁作答。
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(b)(iv) Increase the temperature and provide less volume of all solutions.

(b)(v) Provide more energy to runners.

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4ai, Plasmid, the container of desirable gene.

4aii(1), GM-B. $3 \times 150 \div 3 = 150$ arbitrary unit. GM-B has the highest yield of PUFAs per month.

4aii(2), Amino acids are universal. The same base sequence of DNA will code for same amino acid in all organisms.

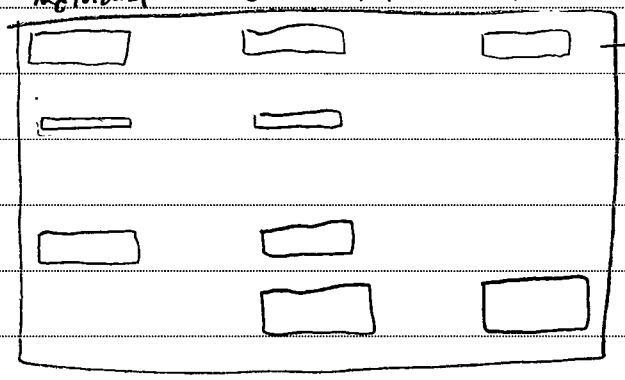
4aiii(1), The GM crop may out competed the wild relative.

4aiii(2), Culture the GM crop and wild relative together, and also culture them seperately. To compare the growth rate of GM crop and wild relative in the two conditions.

4bi, They had gene mutation. The primer does anneal to to the position 295.

4bii, P, It is far from the point of mutation.

4biii, normal individual; carrier of the mutation; individual with high risk



4biv, Anode, DNA is negatively charged. DNA fragments will migrate to positive pole.

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Level 4 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 *

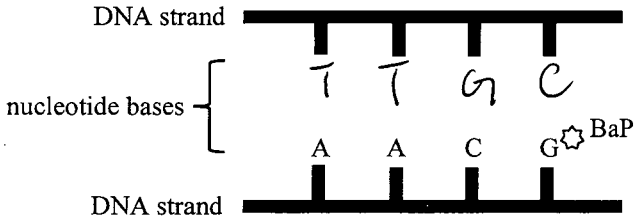
SECTION B

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	nerve impulse	hormone.
(b)	Transmission pathway	neurones	blood.
(c)	Comparison of the time taken to induce responses	The nervous control is faster than that of 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)

The codon that with G be misread as T still codes for the same amino acid as the original one due to the degenerate nature of the codes.

(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)

cell divisson.

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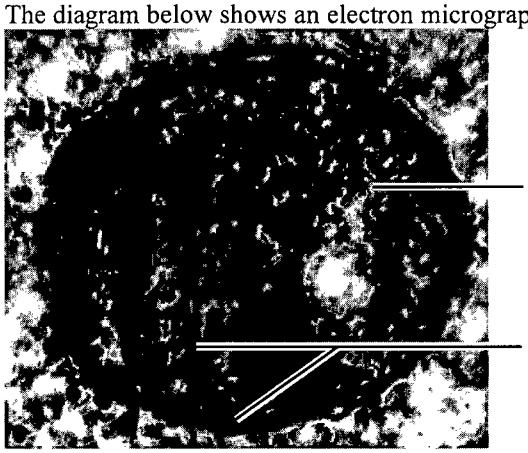
3. The diagram below shows an electron micrograph of a mitochondrion:



(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-foled, this provide large surface area to pack more enzyme for the respiration.

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

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

bridge between glycolysis and the Kerb cycle. ~~the formation of axyte to~~

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

When chemical Z inbibit the coenzyme-A in X, no* axyte coenzyme A can be formed and enter the Kerb cycle to produce FADH and NADH which will be used in the oxidative phosphorylation.

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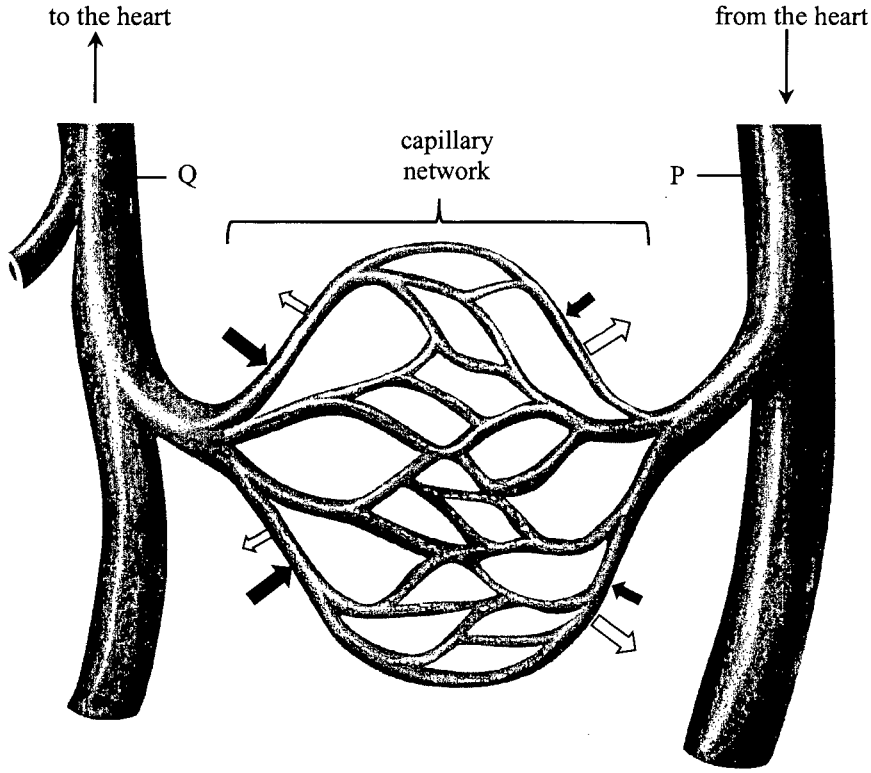
4. The schematic diagram below shows the arrangements of some blood vessels:



(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)

➡: The concentration gradients of molecules between the blood and the fluid

⇨: The difference in ~~pressure~~ between the fluid and the blood.

(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)

As the blood pressure of blood from ~~P~~ P (from the heart) is higher than that of the Q due to the pumping action of heart, the difference in pressure between blood here and the fluid is greater than near the venule end, so the larger hydrostatic pressure difference cause greater magnitudes of movement near P.

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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	urea is form by the liver when it carry out deamination, amino acid is broken down into urea.

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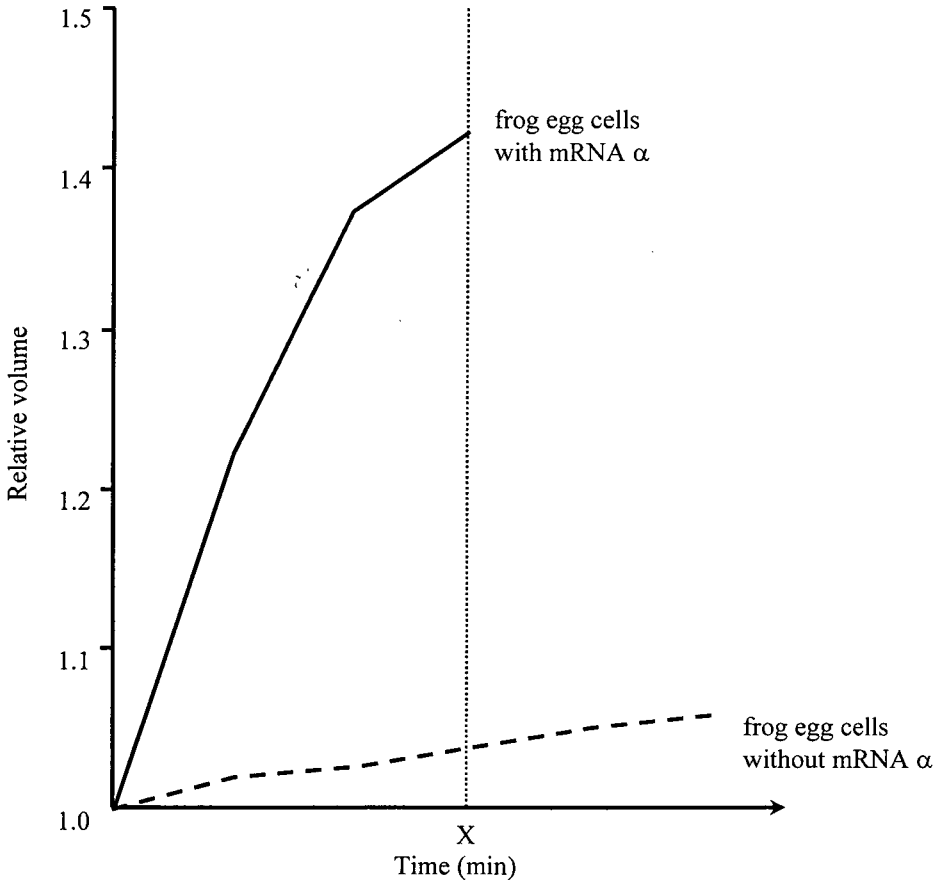
5. In an experiment, mRNA α was isolated from a mammalian cell and then injected into a frog ~~egg~~ cell. The expression of mRNA α eventually led to the presence of protein α on the cell membrane of the frog egg.

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

The mRNA carry genetic codes that codes for the protein α. When it present in the frog egg cell, translation occur. tRNA ~~turning~~ carrying ~~that~~ ~~carry~~ anti-codons that is complementary to the codon on mRNA carries amino acid to the mRNA. Ribosome catalyse the binding of tRNA and mRNA and the joining of amino acid, protein α thus produced.

(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)

Because the cell is enlarged as ~~the~~ the vacuoles and cytoplasm gain more water.

(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)

The graph shows that the relative volume of frog egg cell increase faster than that of without mRNA α and the relative volume is higher than that without mRNA α. The protein α is produce in cells with mRNA α while it absent in cells without mRNA α, so the protein may increase the tensoin of cell membrane.

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

The cell may brust ~~de~~ due to osmosis.

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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 food substance stay present in small intestine and under the action of pancreatic amylase for a long time, while the food only stay in Pancreatic amylase can break down polysaccarides to disaccarides and monosaccarides while salivary amylase only breaks them to disaccarides.

(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 a same volume of solution with set-up II. To determine whether the Amylase

(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)

iodine solution can show the required rate.

Use iodine test to test to starch concentration of the solution in different time, the higher the degree of blue-black colour, the fewer the starch is digested. Measure the time taken for the solution with no change in colour after adding

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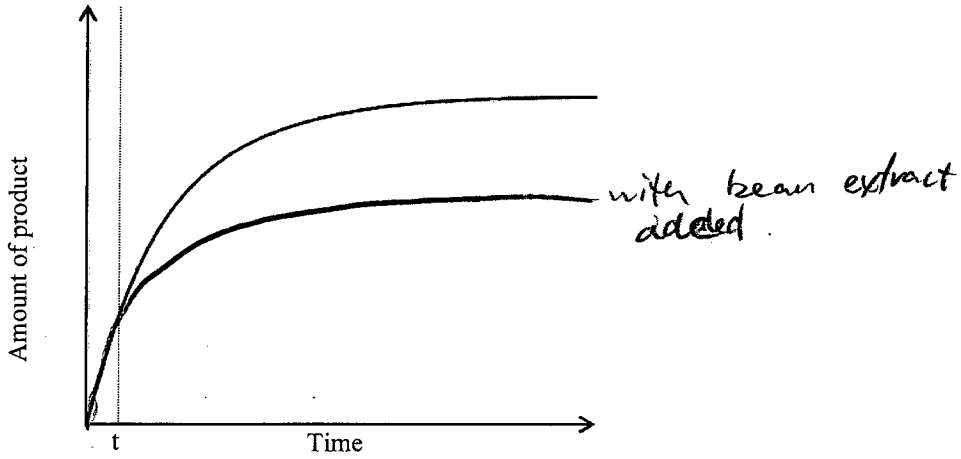
(c) The graph below shows the amount of product formed over time when amylase is working normally:



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 in vivo experiment can manipulate the digestion of human better than that of in vitro.

(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 level in blood. The level will drop in experimental group while that in the control group will increase.

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

It reduce the supply of glucose for insect as food.

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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.

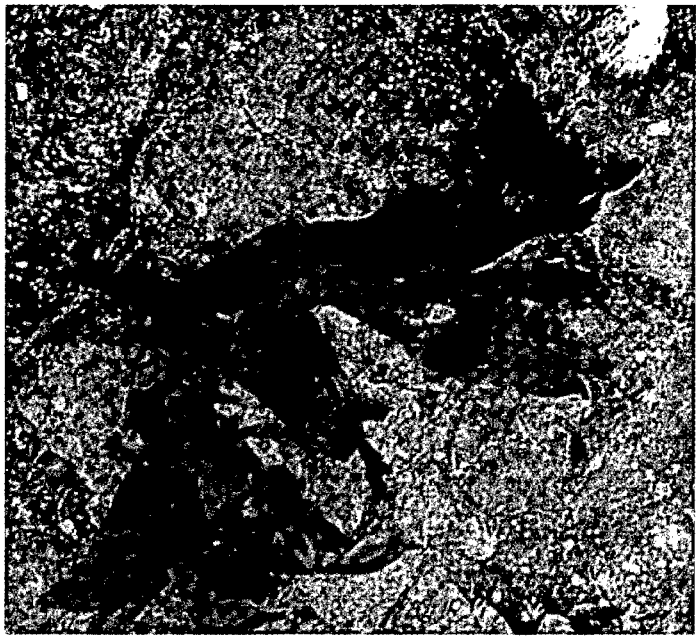
(i) List the ***two*** pieces of essential equipment for the study. (1 mark)

thermometer.

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

Thermometer is used to record the sea temperature of the rocky shore.

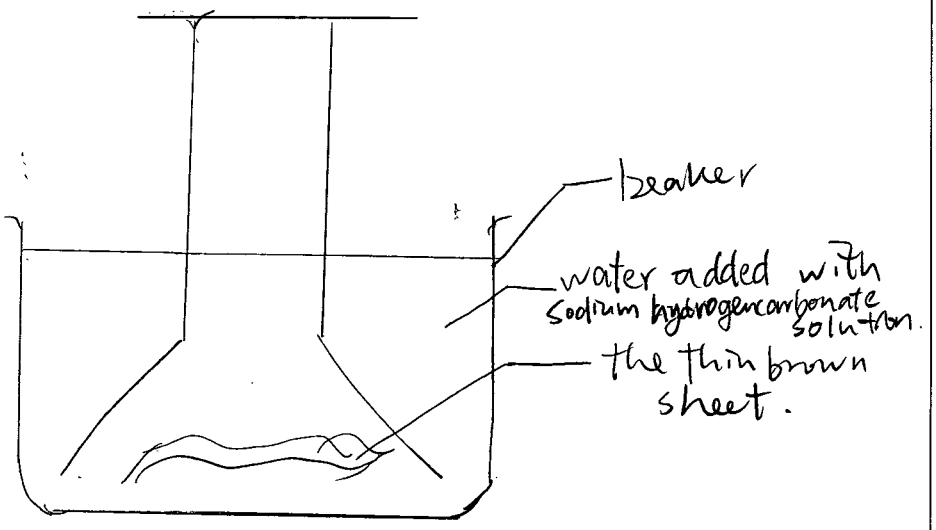
(b) In a field trip to a rocky shore, a student found a thin brown sheet lying on a rock. The student suspected that it was an alga. A small piece of the sample was taken back to school for further study.



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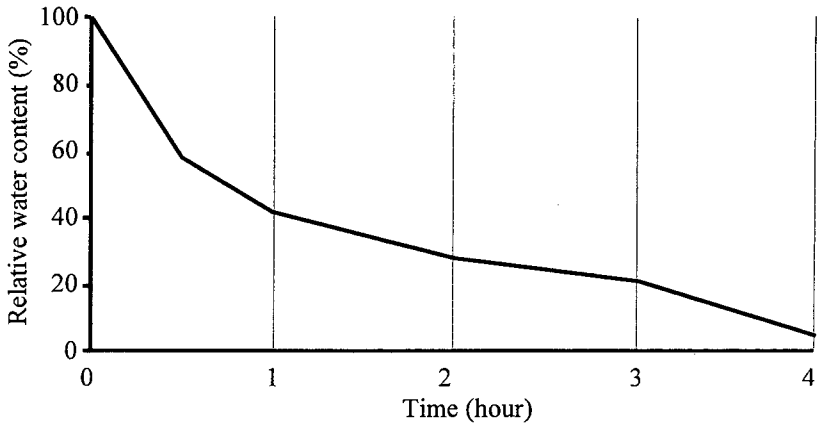
(c) Under normal circumstances, the level of free radicals in algal tissues is kept at a certain level as a result of homeostasis. In response to dehydration, algal tissues will be stimulated to produce free radicals which can cause damage to the cell components if there is an accumulation.

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 will increase.

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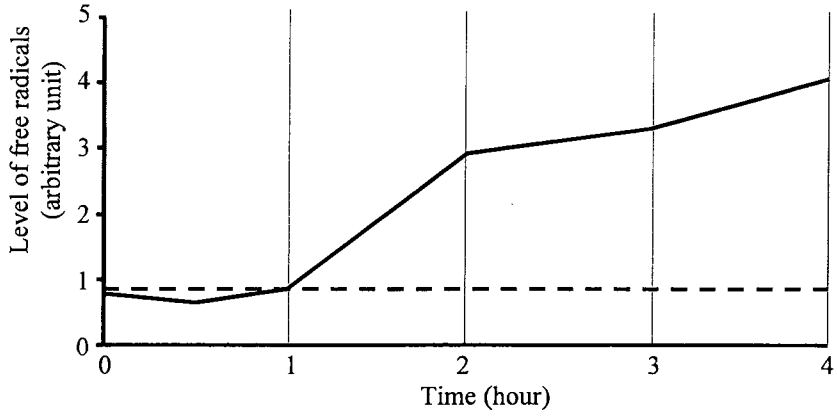
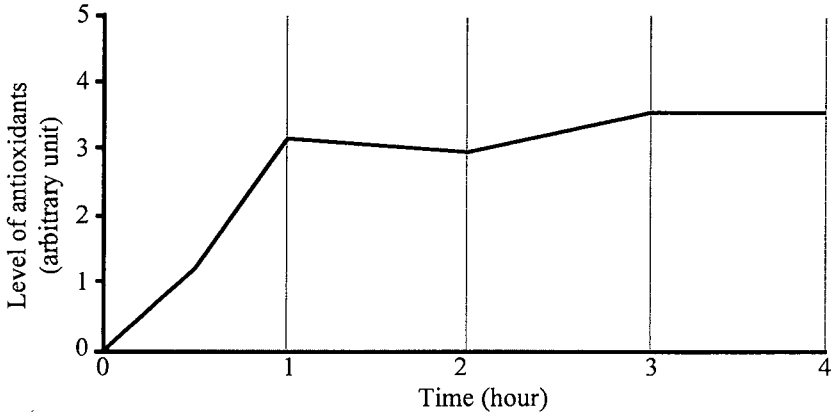
(d) Graph II and Graph III respectively show the actual change in the level of free radicals and the change in the level of antioxidants found in the algal tissue samples of the alga during the same period of dehydration:

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)

With low level of free radicals, the level of antioxidants increase during dehydration. the increase level of free radicals inhibit the formation of antioxdant.

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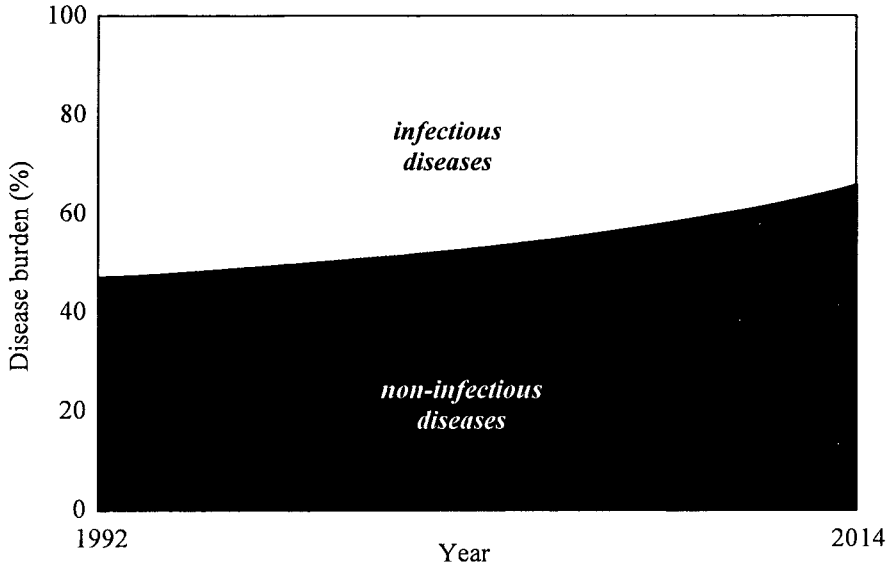
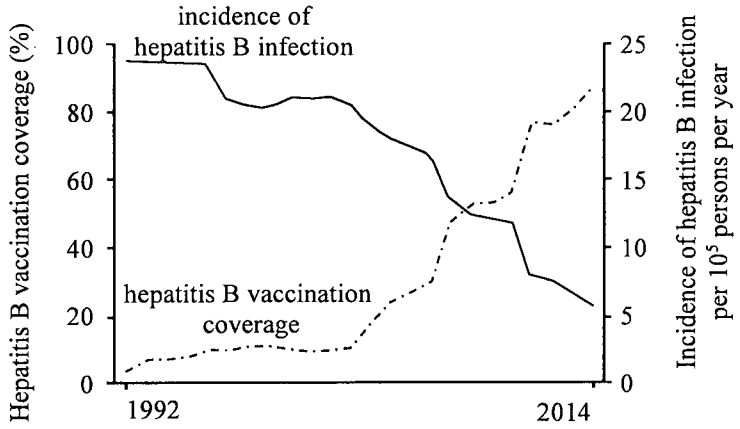
8. Disease burden is a measure of population health that aims to quantify the potential loss of lifespan and health outcomes due to illness as compared to the ideal of living to a ripe old age and in good health. The graph below shows the percentage share of disease burden caused by infectious diseases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

The ~~ratio~~ non-infectious diseases to infetious diseases had increased.

(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 ~~bar~~ larger the vaccination coverage, the lower the incidence of infection. This is because ~~the~~ more people gain immunity against hepatitis B through vaccination

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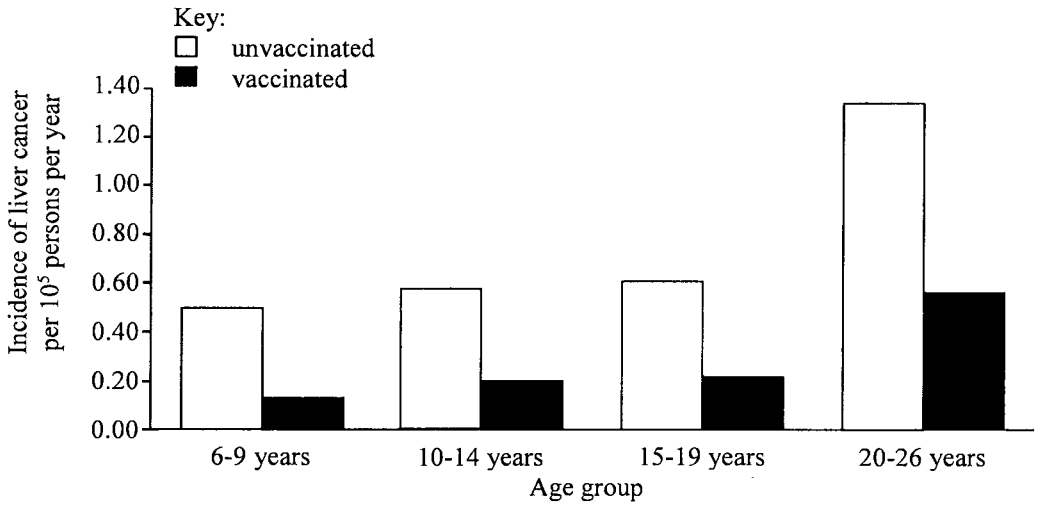
memory cells is produced. It can recognise the antigen of pathogen of hepatitis B quickly and allow people to carry out immune response ~~[illegible]~~ by producing plasma cell killer T cells and memory cell more quickly to act against the pathogen. So it will not cause disease in people. Therefor the incident of hepatitis B drop with more vaccination coverage.

(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)

Vaccination greatly reduce the incident of infections ~~de~~ disease.

(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)

People who expose to higher risk of infecting hepatitis B due to not taking vaccination ~~[illegible]~~ will have higher risk of having liver cancer.

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Go on to the next page

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 leads to closing of stoma, this reduce water ~~low~~ loss through transpiration under drought condition, so hormone X is important for the drought tolerance of 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)

A. As the difference between leaf fesh mass ~~in A~~ of control and draught treatment in A is smaller than that in B, ~~there is less water loss~~ drought tolerance ability of A is higher than that of B, so it have a higher level of hormone X.

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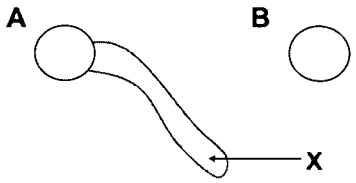
10. In an investigation, pollen grains collected from a single flower were cultured in an artificial medium. After 48 hours incubation, they were observed under a light microscope. Two types of pollen grains with different appearances were observed, as shown in the diagram below:



AB
HA AB

(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 parent plant is heterozygous. ~~A~~ pollen grains that carrying male gametes A is produced under meiotic cell division, so each male gamete will carry either maternal chromosome or paternal chromosome of the homologous chromosome of gamete-producing cell. As formation of structure X is controlled by a single gene and two types of pollen grains is shown, this indicates that the parent plant carry two different allele at a locus, so it is 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)

Type A. Fromation of structure X helps bringing the male gametes towards the ovum. structure X grow towards the ovum as the tissue of style is digested by enzyme secreted by pollen tube. The pollen tube brust when it reach the micropyle and release male gamete to ovum. Fertilization occurs.

(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 (%)	50	50	0

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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)

Eating a vegetarian diet rather than a mixed diet can reduce carbon footprint as less carbon dioxide and methane is ~~produce~~ release during the production process of ~~veg~~ plant ~~than~~ than that of meat.

During production of plant, farmer cultivate and plant crops. The crops would release carbon dioxide during ~~resp~~ respiration. And use of chemical fertilizer might ~~be~~ produce carbon dioxide and methane. The decomposition of farm waste will also release methane.

When the plant carry out photosynthesis, the crops absorb carbon dioxide.

During production of animal, ~~the~~ carbon ~~be~~ dioxide is release during ropiration. Methane is released during digestion process. Also, ~~a~~ animal are ~~feede~~ fed by crops like soybean and grass, cultivation of pastureland and growing soybean is needed. This leads to ~~extra~~ emission

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of carbon dioxide.

Therefore, agricultural process of livestock rearing lead to longer emission of carbon dioxide and methane.

Besides, as the weight of meat is heavier than that of plants and vegetables, transporting meat release more carbon dioxide by vehicles. More energy is required on transporting meat.

Therefore eating vegetarian meal can reduce carbon footprint.

Apart from eating vegetarian meal, consuming food that is locally produce can reduce emission of carbon dioxide. As the transporting time required for local food is lower than that of imported food, less energy is used in transportation, so the action reduce energy consumption and reduce burning of fossil fuel. Less carbon dioxide is emitted during burning fossil fuel.

Also, recycling in order to reduce waste can reduce carbon footprint. As decomposition of waste will release carbon dioxide and methane, le

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END OF PAPER

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

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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

由考生填寫 To be filled in by the candidate	
試題編號 Question No.	1 4

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.

1.(a)(i) The pill contain hormones. It inhibit the secretion of FSH and LH. With low level of FSH and LH, the development of follicle is hindered, the ovulation is prevented. With no mature follicle and ovulation, no ovum is released for fertilization.

(a)(ii) Progestorones. it inhibit the secretion of FSH and LH by ~~pp~~ pituitary gland.

(a)(iii) Thin uterine lining can prevent implantation of the embryo.

(a)(iv) As the level of oestrogen is lower than ~~for~~ normal, it cannot thicken the uterine lining.

(b)(i) Volume of water drunk - volume of urine.

(b)(ii) The accummulated volume of fluid retained in the body of group that drinking sports drink with salt is more than that of ~~dr~~ drinking water only. ~~As~~ the water potential of sports drink with salt is

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

close to that of blood, while the water potential of water is higher than that of blood, ~~the less ADH is release from pituitary gland to act on second coiled tubule and the collecting duct of group of people who drink~~ the concentration gradient salt gradient between blood and filtrate is more steep in group that drinked sport drink, ~~so~~ so larger amount of salt is reabsorbed in second coiled tubules by diffusion and more water is reabsorbed to the blood by osmosis as well.

(b)(iii) As exercise increase body temperture, it is important to retain water to replenish the water in body when water is lost by sweating. ~~Note:~~ This retain the blood flow thus the supply of oxygen and glucose by blood and removal of carbon dioxide by blood.

(b)(iv) Ask three group of people to run ~~same speed and~~ for same period of time. Measure the running pace

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(iv) of the people at intervals.

(b)(v) glycerol can diffuse ~~a~~ across the cell membran ✎ t

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(a) (i) plasmid. It act as vector which can be recombinated with gene of interest. And it is transforaed to the host for expression.

(a) (ii) (1) GM-B, this crop have the highest seed yield and required shortest time to reach seed harvest stage. It is efficient to plant GM-B for PUFAs production.

(a) (ii) (2) The gene encoding enzyme responsible for the production of PUFAs is also extracted from the same type of plant. So the PUFAs produced is the same with the plant that originally produce without genetic modification.

(a) (iii) (1) It leads to gene pollution.

(2) Grow GM crop in the proposed area and study the DNA content of the wild relative after a period of time.

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4(b)(i) Observe the pattern of bands shown in the gel electrophoresis between different DNA samples. The mutated DNA result in longer DNA fragment and swim slower and closer to the negative pole. The normal DNA is shorter and closer to the positive pole. The present of mutated DNA is determined by comparing the length of DNA fragments.

(b)(ii) P. DNA extension is not start from position 135.

(b)(iii)

normal individual	carrier of the mutation	individual with high risk.
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(b)(iv) cathode, the DNA fragments are swim from negative pole to positive pole.

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