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2021-DSE
BIO
PAPER 1B

B

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2021

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.

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2021-DSE-BIO 1B-1

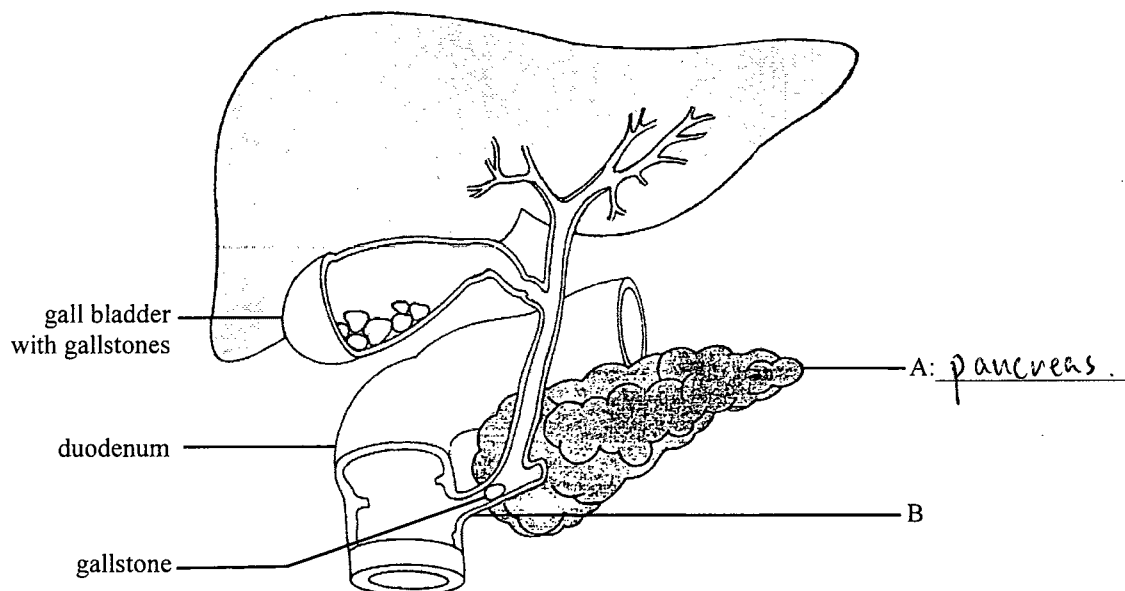
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SECTION B

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

1. The diagram below shows the presence of gallstones in some parts of the human digestive system:



- (a) Label structure A. (1 mark)
- (b) With reference to *two* components of the secretion released from duct B, explain how the condition shown in the above diagram would lead to a decrease in the rate of fat digestion. (4 marks)

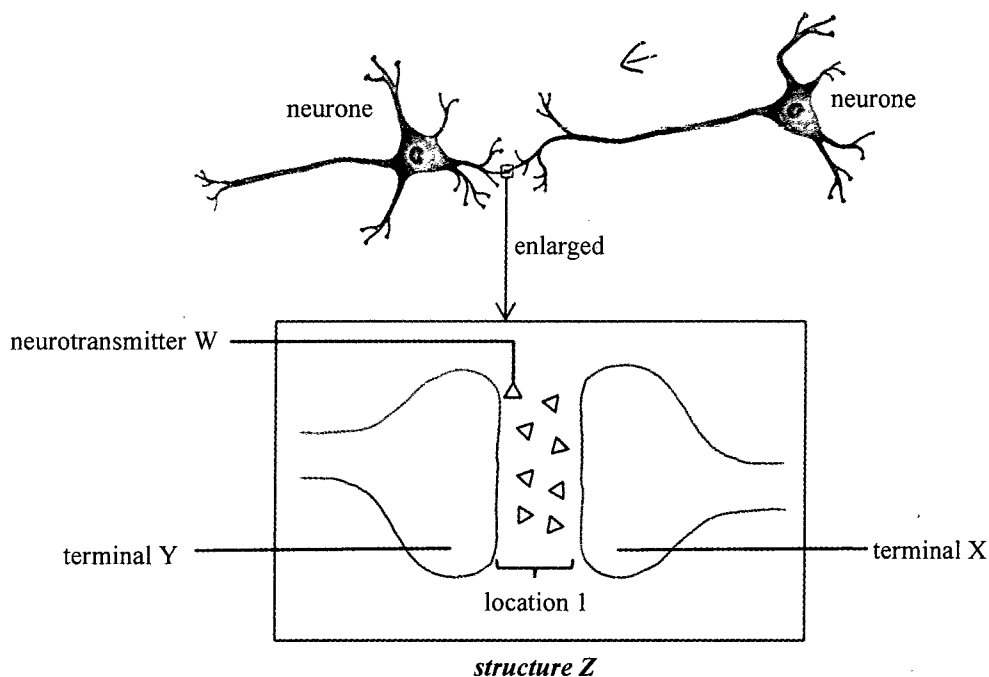
Bile with bile salt is released through duct B. Bile salt can emulsify fat into small oil droplets which increase the surface area for lipase to act on, so that fat digestion is facilitated by bile salt. ~~After duct B is blocked, the bile cannot be released into duodenum~~ Lipase is released from pancreas to duodenum through duct B as well. It is an enzyme which catalyse break down of lipids into glycerol and fatty acids, which is the digestion of fat. After duct B is blocked, both bile with bile salt and lipase could not enter the duodenum and have contact with food particles so that they could not perform the mentioned function. Thus rate of fat digestion decrease.

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2. The diagram below shows two adjacent neurones. When a nerve impulse arrives at structure Z, the amount of neurotransmitter W at location 1 increases.



- (a) Name structure Z. (1 mark)

synapse

- (b) (i) Neurotransmitter W at location 1 is released from one of the terminals of structure Z. Which terminal (X or Y) releases neurotransmitter W? (1 mark)

terminal X.

- (ii) Describe how the neurotransmitter W at location 1 can bring about the transmission of nerve impulses at structure Z. (2 marks)

As nerve impulse arrives at X, X secretes neurotransmitter W from synaptic vesicles, the W then diffuse across location 1 to reach the membrane of the next neurone, W binds with receptors on membrane of Y, then stimulate Y to generate a nerve impulse to continue the transmission.

- (c) What is the significance of the process in (b) to the transmission of nerve impulses? (1 mark)

It ensures that nerve impulses only travel in one direction.

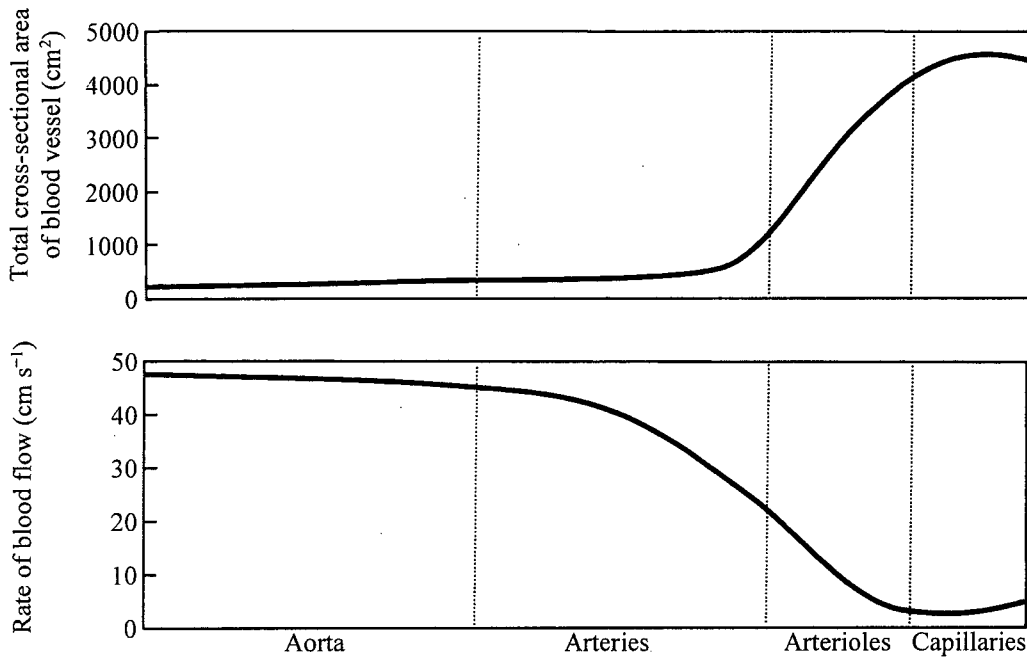
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3. (a) The graph below shows the total cross-sectional area and the rate of blood flow of different types of blood vessels:



- (i) Describe the overall relationship between the total cross-sectional area of blood vessels and the rate of blood flow. (1 mark)

The higher the total cross-sectional area of blood vessels the lower the rate of blood flow.

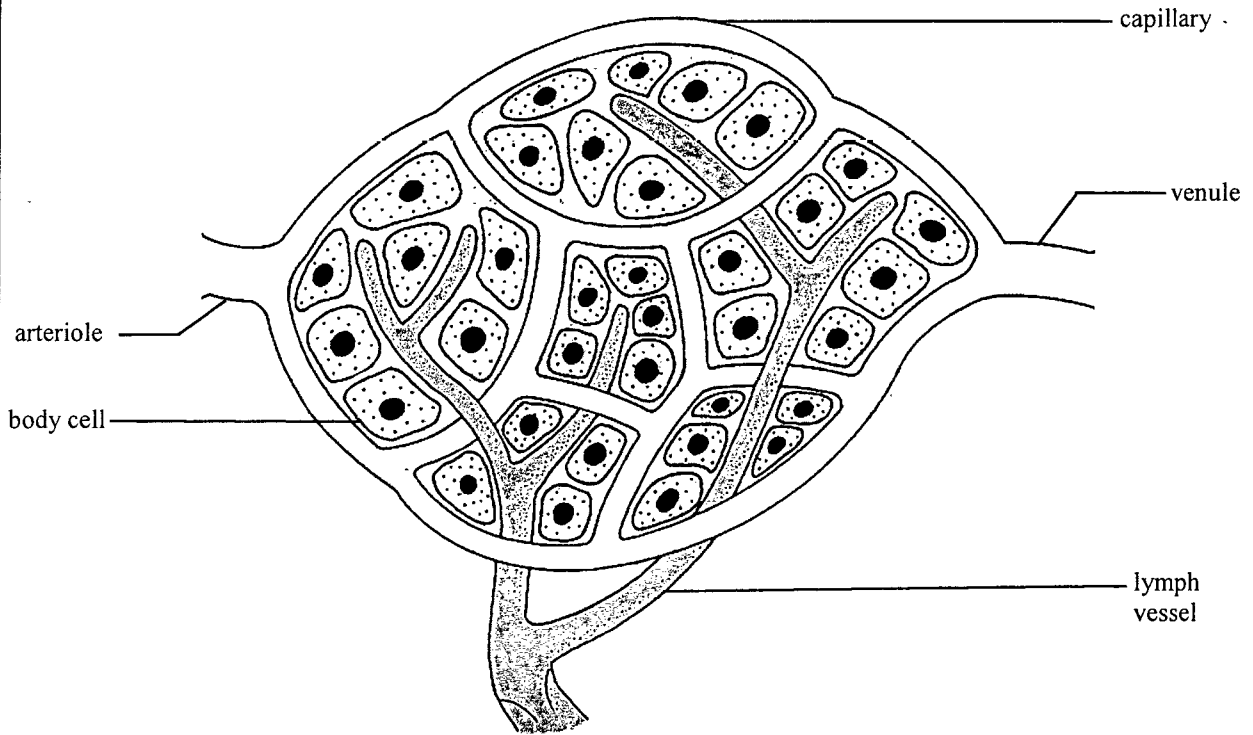
- (ii) Explain how the relationship described in (i) can facilitate the material exchange that takes place in the capillaries. (2 marks)

Capillaries are highly branched to form a ~~capillary~~ capillary network, so that ~~there are~~ ^{capillaries have} very high total cross-sectional area, thus blood flows very slowly in capillaries so that more time is allowed for material exchange to occur, and completion of material exchange can be enhanced, thus facilitated material exchange.

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(b) The following schematic diagram illustrates a capillary network and the associated structures:



With reference to two features of the capillary network illustrated in the above diagram, explain the importance of these features to the material exchange in the capillary network. (4 marks)

<i>Features illustrated in the diagram</i>	<i>Importance to the material exchange</i>
highly branched	To provide larger surface area to facilitate material exchange.
In close contact with body cells.	To shorten distance between blood and body cells, to facilitate material exchange.

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4. Glycogen and a disaccharide named trehalose are two common types of energy reserve found in insect species A. An experiment was conducted to study the energy reserve used for flying in this insect species. Three groups of insect species A were respectively injected with equal volumes of physiological saline, an inhibitor of trehalose-digesting enzyme and an inhibitor of glycogen-digesting enzyme. The insects were then stimulated to fly until they were exhausted. The flight time of each individual was recorded in the following table:

Solution injected	Samples of insect species A	Flight time (s)	Mean flight time (s)
physiological saline	1	150	165.6
	2	138	
	3	168	
	4	210	
	5	162	
inhibitor of trehalose-digesting enzyme	6	42	85.2
	7	78	
	8	114	
	9	90	
	10	102	
inhibitor of glycogen-digesting enzyme	11	132	163.2
	12	192	
	13	174	
	14	162	
	15	156	

- (a) Complete the above table by calculating the mean flight time (to the nearest 1 decimal place) for the groups injected with the respective inhibitors. (1 mark)
- (b) With reference to the aim of the experiment, what conclusions can you draw from the data? Explain your answer. (4 marks)

Mean flight time after injected with inhibitor of trehalose-digesting enzyme is much lower than that of the control (injected with physiological saline), while that after injected with inhibitor of glycogen-digesting enzyme is very similar to the control. That when insect A cannot use trehalose effectively, the flight time decrease, and when digestion of glycogen is inhibited, that it cannot use glycogen effectively, the time is not affected. So the insect species A use trehalose energy reserve for flying.

- (c) Among individual insects, suggest *one* difference which led to different flight times within each group. (1 mark)

Strength of muscles which responsible for flapping wings to fly.

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5. A student prepared cells of an onion root tip for observing cell division under a light microscope.

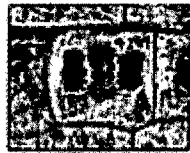
(a) What type of cell division is likely to take place in the root tip of an onion? Explain your answer. (2 marks)

mitotic cell division, as the root tip is not a reproduction organ where which is production site for gamete production. Instead the root tip contains the apical meristem, where mitotic cell division is carried out for primary growth.

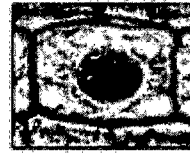
(b) Suggest one necessary step to make the chromosomes observable under a light microscope. (1 mark)

stain it with coloured dye.

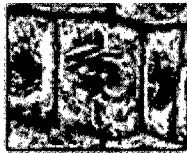
(c) Some events of the cell division are randomly shown in the following photomicrographs:



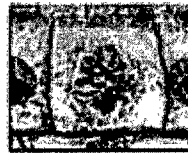
V



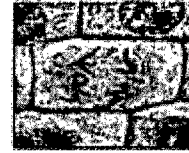
W



X



Y



Z

(i) Starting with photomicrograph W, arrange the photomicrographs in the correct order to show the sequence of events in cell division. (1 mark)

W → Y → X → Z → V

(ii) A normal onion root cell has 16 chromosomes. Complete the following table to show the number of chromosomes and chromatids in photomicrographs Y and Z. (2 marks)

Photomicrograph	Number of chromosomes	Number of chromatids
Y	16	32
Z	16	32

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6. Pathogen X is a pathogen that infects humans. Research has discovered an antigen Y present on the surface of pathogen X. Using recombinant DNA technology, antigen Y can be produced and serves as a vaccine to induce immunity against pathogen X.

(a) Explain how the injection of antigen Y can induce immunity against pathogen X. (4 marks)

Upon injection of antigen Y, the immune system is stimulated to produce a primary response and memory cells to remember the particular antigen (Y). When the individual is infected with pathogen X, antigen Y enters the body, and when memory cells encounter and its receptors bind with the same antigen (antigen Y) again, a secondary response is resulted, that they multiply and differentiate rapidly into plasma cells which produce antibodies against antigen Y specifically. Thus, antibodies are produced in large amount for a short time, and pathogen X can be eliminated quickly, that individual has immunity against X.

(b) Other than the use of recombinant DNA technology, suggest another way to produce a vaccine. (1 mark)

Extract pathogen X and weaken it, so that the weakened pathogen X which will stimulate immune response.

(c) Refer to the codon table below, answer the questions that follow:

UUU	Phe	UCU	Ser	UAU	Tyr	UGU	Cys
UUC		UCC		UAC		UGC	
UUA	Leu	UCA		UAA	STOP codon	UGA	STOP codon
UUG		UCG	UAG	STOP codon	UGG	Trp	
CUU	Leu	CCU	Pro	CAU	His	CGU	Arg
CUC		CCC		CAC		CGC	
CUA		CCA		CAA	Gln	CGA	
CUG		CCG		CAG	Gln	CGG	
AUU	Ile	ACU	Thr	AUU	Asn	AGU	Ser
AUC		ACC		AAC		AGC	
AUA		ACA		AAA	Lys	AGA	Arg
AUG	Met	ACG	AAG	AGG			
GUU	Val	GCU	Ala	GAU	Asp	GGU	Gly
GUC		GCC		GAC		GGC	
GUA		GCA		GAA	Glu	GGA	
GUG		GCG		GAG		GGG	

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- (i) The starting sequence of the coding strand of the gene which encodes antigen Y is shown below:

U U UU UU
ATG GCC ATA AAT TGC TGT

Referring to the codon table, write the corresponding amino acid sequence of the coding strand shown above. (2 marks)

Met - Ala - Ile - Asn - Cys - Cys.

- (ii) Over the years, mutation has occurred in the gene encoding antigen Y in different strains of pathogen X. The variations in the starting sequence of this gene are shown below:

original strain: ATG GCC ATA AAT TGC TGT

strain P: ATG GCC ATA AAT TGC TGC X

strain Q: ATG GCC ATA AAT TGA TGT ? ✓

strain R: ATG GCT ATA AAC TGC TGT

One of these strains has the ability to infect people who have been injected with the vaccine containing antigen Y. With reference to the codon table, which strain (P, Q or R) will that be? Explain your answer. (4 marks)

strain Q. As mutated ^{codons} in P and R are regenerated, that they codes for the same amino acid as the original codon, ~~so~~ so the ^(antigen Y) protein produced will have the same amino acid sequence as the original strain, and there will be no change in the shape of antigen Y produced. While in the strain Q, the mutated gene ~~now~~ codes for a different amino acid than with the original strain, STOP codon instead of Cys. So there will be a change in the shape of the protein ~~protein~~ produced from strain Q, as the codons after the stop codon will not be read. So there will be a change in shape in the antigen Y produced, that it can no longer bind to the receptor of the memory cells against antigen Y, thus can infect ~~with~~ people injected with vaccine containing antigen Y.

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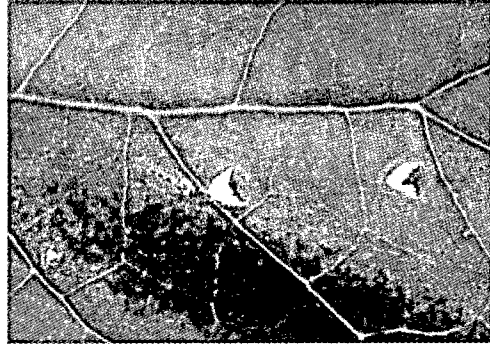
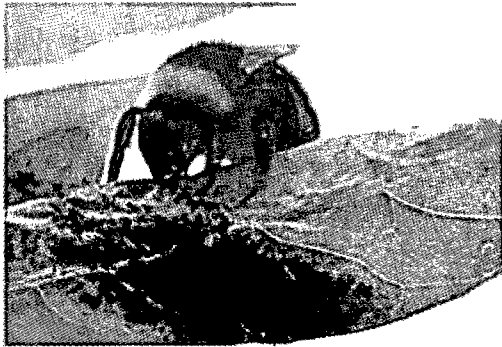
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7. (a) In flowering plants, environmental stress (i.e. under adverse conditions) in general can induce flowering. Explain why this flowering response can increase the chance of survival of flowering plants. (3 marks)

By flowering, the plant can carry out sexual reproduction with other plants, so that the plant can reproduce offspring with more genetic variation, given by meiotic cell division (independent assortment and crossing over) and random fertilization. With more genetic variation, plants can better cope with changes and adversity in the environment. Also by seed dispersion, plants could colonize new areas to escape from adversity and competition, so increase chance of survival.

(b) Recently, scientists observed that bees cut tiny holes in leaves with their mouthparts (as shown in the photographs below) but did not consume or transport the leaf fragments:



It has been hypothesised that bees induce flowering by imposing a mechanical stress on the flowering plants. To test this hypothesis, three groups of tomato plants at the same developmental stage (without floral buds) were subjected to the following treatments respectively:

1. Bees cut tiny holes in leaves (bee damage)
2. Similar holes in leaves were cut by using forceps (mechanical damage)
3. Intact leaves without treatment (no damage)

The time taken for flowering of each group of these tomato plants after the respective treatment was recorded.

- (i) If the above hypothesis is correct, what would be the predicted results? (1 mark)

plants in treatment 1 & 2 will need shorter time for flowering, than plant in treatment 3.

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- (ii) The table below shows the time taken for flowering of these tomato plants after the treatments:

	Bee damage	Mechanical damage	No damage
Average time taken for flowering after the treatment (days)	38	56	70

With reference to the data shown in the table, discuss if the data support the hypothesis that bees induce flowering by imposing a mechanical stress on the flowering plants. (4 marks)

Yes it support. As time taken for flowering decreased significantly after bee damage ^{and mechanical damage} than no damage.

However, the time taken after bee damage is in turn shorter than after mechanical damage, so there are also other ~~ways~~ changes made by bees to ~~start~~ ^{induce} flowering.

- (c) When bees establish a new colony, they will inflict more leaf damage to the surrounding flowering plants if the colony is in an area with insufficient supply of pollen. What is the advantage of this behaviour to the bees? (1 mark)

The plants flower more quickly, so more pollen and nectar can be obtained by bees, so they can have more food.

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8. The table below shows the average blade area, blade thickness and thickness of the palisade mesophyll of leaves collected from the upper and lower regions of a tree species:

Location of leaves	Average blade area (cm ²)	Average blade thickness (μm)	Average thickness of palisade mesophyll (μm)
Upper region	62	177	45
Lower region	72	152	33

- (a) Compare the average blade area of leaves from the upper region and that from the lower region. With respect to the difference in surface area, suggest *one* adaptive advantage of the leaves from the lower region. (2 marks)

The average blade area of leaves from upper region is lower than that ^{from} of the lower region. The leaves in lower region can cover larger area to capture escaped sunlight. ~~which is fewer than~~ so that it can utilize ^{more} sunlight.

- (b) (i) Compare the average thickness of the palisade mesophyll of leaves from the upper region and that from the lower region. (1 mark)

The average thickness of palisade mesophyll of leaves from upper is higher than that from the lower region.

- (ii) Between the two types of leaves, suggest *one* possible structural difference which would lead to the difference stated in (b)(i). (1 mark)

Leaves from lower region is thinner (i.e. have lower blade thickness) than that from upper region.

- (iii) How would you confirm your answer in (b)(ii)? (2 marks)

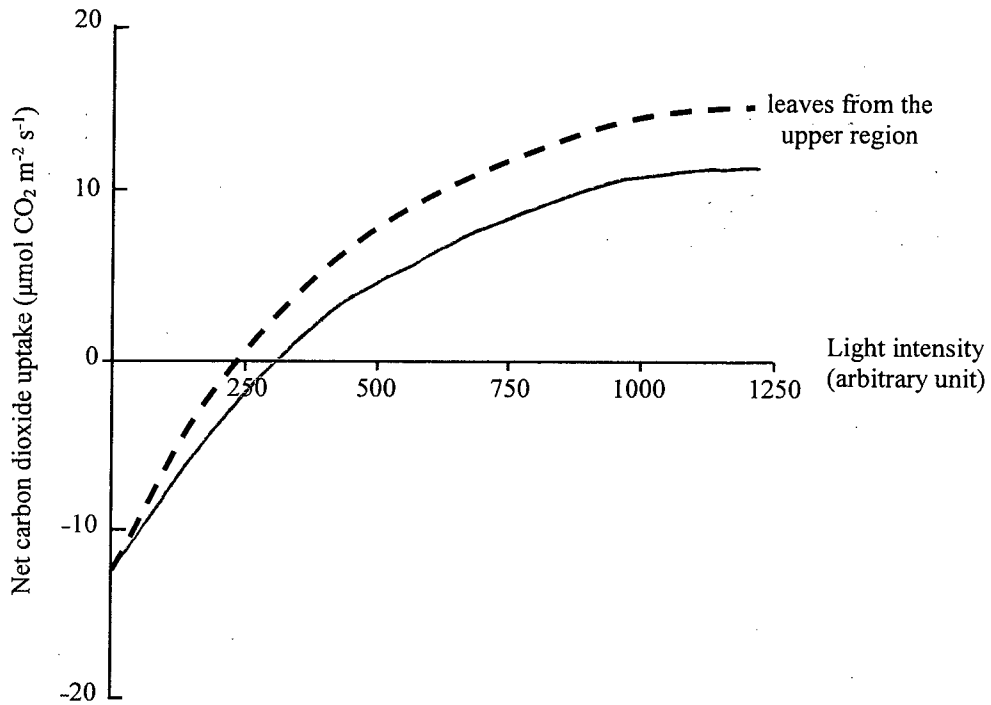
Measure thickness of spongy mesophyll ^{and} epidermis of the leaves (thickness of the leaf components other than palisade mesophyll), of ~~as~~ leaves from upper and lower region. So as to confirm the change of thickness in ^{leaves} ~~leaves~~ is contributed by change in thickness of palisade mesophyll.

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- (c) Leaves at different regions of a tree are adapted to different light intensities. The graph below shows the change in the net carbon dioxide uptake by leaves from the upper region of a tree at different light intensities:



- (i) Why are there negative values for net carbon dioxide uptake? (1 mark)

As there is insufficient light, so rate of respiration is higher than rate of photosynthesis, so more CO_2 is released than is taken up, i.e. net release of CO_2 , so value for net CO_2 uptake is negative.

- (ii) On the above graph, sketch a line to show the change in net carbon dioxide uptake by leaves from the lower region of a tree at different light intensities. (2 marks)
(Note: Neglect the difference in the average blade area between the two types of leaves when you sketch the line.)

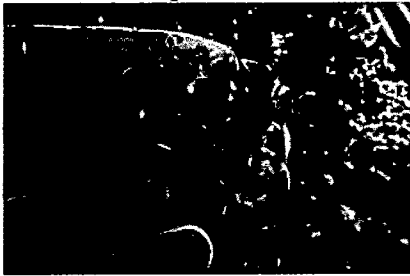
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9. The photographs below show the appearances of two species of free-floating, freshwater plants, Species 1 and Species 2:

Species 1



(0.58 X)

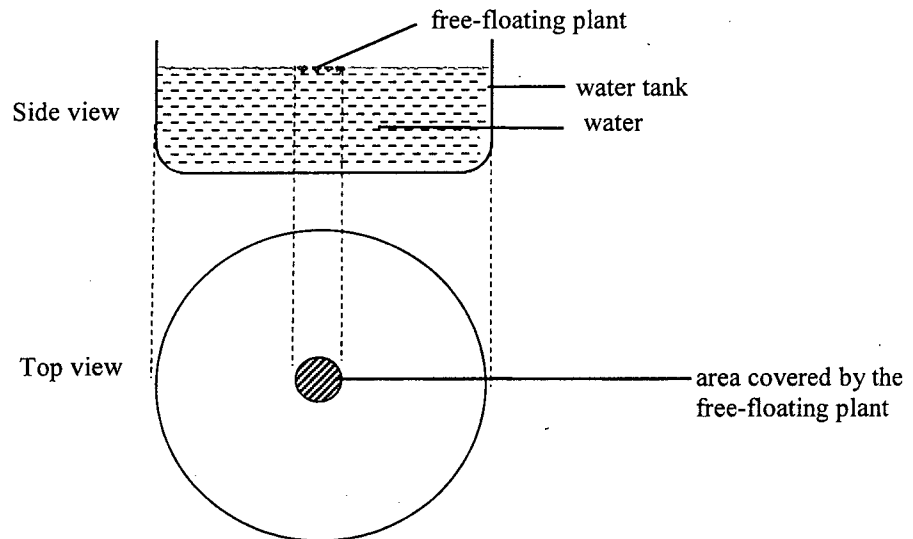
Species 2



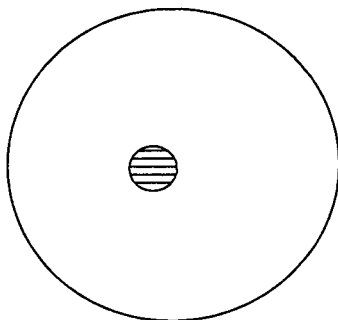
(1.5 X)

To study the interaction between these two plant species, each species was grown either alone or together with another species in a water tank for 50 days. Each species covered 10% of the area of water surface at the beginning of the experiment. The experimental set-up and design are shown in the following diagrams:

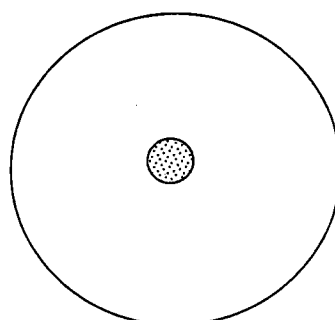
Experimental set-up:



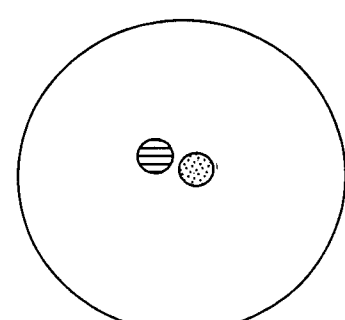
Experimental design (top view):



Species 1 grown alone



Species 2 grown alone



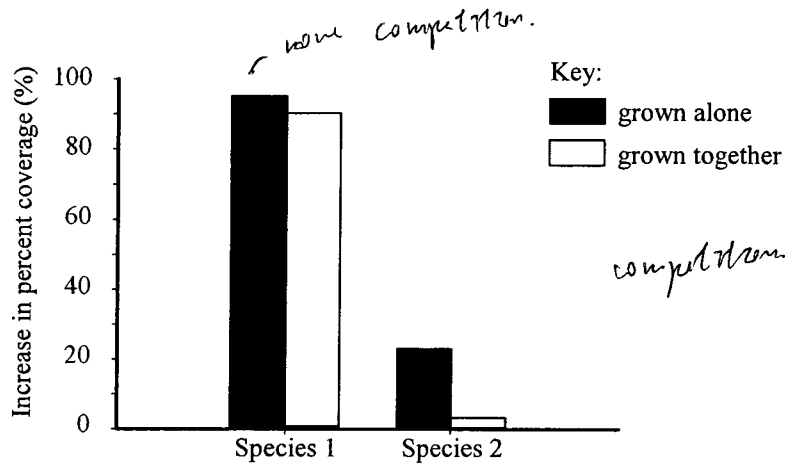
Species 1 and 2 grown together

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The percent coverage of each plant species was measured at the beginning and at the end of the experiment. The increases in the percent coverage are shown below:



- (a) With reference to the aim of the experiment, what conclusions can be drawn about the interaction between Species 1 and 2? Explain your answer. (4 marks)

Conclusion 1: They have competition with each other, as the increase in percent coverage for both species decreased when they are grown together, compared to when they are grown alone.

Conclusion 2: Species 1 is more competitive than species 2, as the increase in percent coverage is higher of species 1 is higher than that of species when they are grown together. And the decrease in data is less significant than 1 than 2.

- (b) With reference to the photographs of Species 1 and 2, suggest an explanation for the difference in the percent coverage of the two plant species when they were grown together. (2 marks)

Leaves of species 1 is larger than that of species 2. So 1 can absorb more light than 2. Also,

leaves of 1 can shade leaves of 2 and decrease light 2 can absorb. So 1 can have higher rate of photosynthesis to produce more food and grow faster, so have larger increase in percent coverage.

- (c) The table below shows two other methods of measuring plant growth and whether these methods would be feasible in this experiment. Complete the table by giving justifications for the feasibility of the methods. (2 marks)

Method	Feasibility	Justifications
Fresh weight	Feasible	It can measure amount of organic matter with water content accurately, without killing the plant.
Number of leaves	Not feasible	1 & 2 have leaves of different size, so under comparison.

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10. In humans, breast milk provides not only nutrients but also protective effects to infants. Recently, scientists discovered a new constituent of breast milk: short RNA fragments enclosed in vesicles. Scientists have very diverse views about the roles of these short RNA fragments. The following are two of the hypotheses:

Hypothesis 1: the short RNA fragments serve as food particles.

Hypothesis 2: the short RNA fragments regulate gene expression in infants

- (a) To test Hypothesis 1, scientists performed an experiment of *in vitro* digestion of breast milk. The method is shown below:

Method of *in vitro* digestion with 20 mL of fresh breast milk

Step 1	Addition of hydrochloric acid solution
Step 2	Addition of enzyme mixture 1
Step 3	Incubation at 37°C for 20 minutes
Step 4	Addition of sodium hydrogen carbonate solution
Step 5	Addition of enzyme mixture 2
Step 6	Incubation at 37°C for 30 minutes
Step 7	Incubation at 85°C for 3 minutes
Step 8	Measurement of the level of short RNA fragments and nucleotides

- (i) With reference to the digestion in the human body, what is the importance of Step 1 and Step 4 to the experimental design of this *in vitro* experiment? (3 marks)

To provide suitable pH value environment for enzyme to work efficiently. Step 1 provides a low pH environment similar to that in the stomach. Step 4 neutralize the acid added in step 1 to provide a ~~new~~ higher pH environment similar to that in the small intestine. Thus, digestion process of the human body can be simulated.

- (ii) What is the purpose of Step 7? (1 mark)

Denature all enzyme to stop ^{any further} the digestion of food catalyzed by enzyme.

- (iii) After the *in vitro* digestion, the level of short RNA fragments in the reaction mixture was similar to that of fresh breast milk and no nucleotides were detected. Explain why the results disprove Hypothesis 1. (2 marks)

As the short RNA fragments are not digested, that it remain as large and complex molecules that could not be absorbed into body in the small intestine.

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- (b) Scientists will ask scientific questions when designing experiments to test Hypothesis 2. Suggest **one** example of these scientific questions. (1 mark)

~~How does the short RNA fragment regulate gene~~

~~expression in~~ Is the ~~gene~~ regulation on gene expression in infants affected by ~~other factors~~ factors other than presence of the short RNA fragments.

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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. Variations are important to the continuity of a population. Discuss how these variations are brought about within a population and how variations can enable the population to cope with the diverse environmental conditions and environmental changes over time. (11 marks)

~~Various~~ Variations are brought by first, the mutation, that is a sudden permanent in DNA in ~~in~~ gamete producing cells, so that variations in DNA is produced and can be passed to offspring.

Second, brought by independent assortment and crossing over during meiotic cell division. By independent assortment, separation of one pair of chromosome is ~~not~~ independent from that of other pairs of chromosome, so different combination of chromosome can be formed in different gametes. And by crossing over, fragments of DNA ~~be~~ are exchanged between non-sister chromatids of the same pair of chromosome, so new combinations of gene in a chromosome is formed.

Third, brought by random fertilization, gametes with different ~~was~~ genetic variation is combined and ~~the~~ fertilized to form new plants with different combination of ~~chromosome~~ genes, so new variations arise.

With more genetic variation within a population, individuals of the population ~~time~~ will have more different ~~and~~ phenotypes and characteristics which can provide different benefits in different environmental conditions, so that when some individuals could not survive in

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a condition, some other individuals can. So, the whole population can survive in diverse environmental conditions and changes ^{over time} in conditions.

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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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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.

1a1. The increasing intensity ~~time~~ leads to increase of both heart rate and blood lactate concentration.

211. During the exercise, there is a sudden increase need for energy for contraction of muscles. So ^{muscle} cells ~~carry~~ carry out anaerobic respiration to release extra energy for muscles to contract more strongly and rapidly. As the intensity of exercise increase, more ~~an~~ extra energy is needed to be released by anaerobic respiration. And as anaerobic respiration release lactic acid as product, the blood lactate concentration increase with the increasing ~~rate~~ exercise intensity.

211. During the exercise, muscle cells also carry out aerobic respiration to release energy for muscle contraction, with the release of CO₂. ~~As so ~~total~~ CO₂ concentration increases with increasing exercise intensity,~~ so as ~~the~~ intensity of exercise increase, cells carry aerobic respiration at a higher rate to release more energy for muscle contraction, and the rate of production of CO₂ increase, so ~~the~~ CO₂ concentration in blood increase.

The increase in CO₂ concentration in blood is detected by aortic bodies on ^{wall of} aorta and carotid bodies on ^{wall of} carotid artery, ~~the~~ they then are stimulated to send nerve impulse to the medulla oblongata. The medulla oblongata then secret more noradrenaline

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Start each question on a new page.

through the sympathetic nerve, which stimulate the SA node to increase activity and ~~stimulate~~ send signals more frequently, causing the cardiac muscles of heart to contract more frequently, thus increased heart rate.

a.w. The increase in heart rate and blood lactate concentration of Alice are less than that of Billy for the same intensity of exercise.

1.b. the thermoreceptor in skin is the receptor.
sweat gland in skin is the effector.

b.i.i. Negative feedback refers to when there is a change in the parameter, the effector work to oppose the change. In the above graph, as the mean body temperature increase, sweating rate increased, the sweat gland (effector) secret more sweat to increase rate of heat loss by evaporation of sweat to decrease the body temperature, i.e. oppose the change in the body temperature (the parameter).

b.ii. In the two hypertonic group, sweating rate only increase when mean body temp. reached 37.5°C , which is higher than that of the isotonic group (37.0°C). So, hypertonic condition inhibit

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the ~~test~~ negative feedback mechanism.

b.iv. the water potential of blood in the hyperbolic group is lower than normal, that the water content is lower. So ~~by inhibiting the negative feedback~~ the effect mentioned in (iii) can help retain water in the body, as less water is lost through sweating, so the effect is beneficial to reducing water loss and increase water content to normal, thus beneficial to water balance.

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2a1. The effectiveness is high, as ~~both~~ plants other than crops in within the farm⁽³⁾ is lower than that of organic farm⁽¹⁸⁾ where herbicides is not used. As plants other than crops decrease, there is less competition ^{for nutrients} for the crops, so the crops can have more nutrients and grow faster, thus increasing ~~crop crop~~ yield of ~~crop~~ crop production.

2a1. Effectiveness of ~~change~~ a chemical control is lower than biological control, as abundance of pest A in conventional farm where chemical control is used is 160 which is higher than in organic farm where biological control is used. The reason is that chemical control also kill the predators of A, as the population of predators of A decrease, population of A is not kept under control and increase rapidly.

It is supported by the data that abundance of predators of A within conventional farm is only 3 which is lower ^{than} 11 in organic farm.

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2a. ^{No. of species} Plants other than crops around organic farm is 28, which is higher than 7 of conventional farm, and that of pollinators is 10 around organic farm which is higher than 1 around conventional farm. So species richness around organic farm is higher than around conventional farms. So there will be higher species diversity, and the balance of ecosystem can be better monitored by more species, thus beneficial to sustainable development.

2b1. phosphate addition will increase population size of phytoplankton, as more nutrients is provided for the growth phytoplankton upon addition of phosphate.

2b2. After the addition of phosphate, population size of zooplankton remains unchanged ~~while~~ in Lake A, while that in Lake B increased significantly. So the ^{extra} nutrients provided is consumed by phytoplankton in B, so ~~and~~ less nutrients is left for growth of algae, so algae in B grows slowly even with addition of ^{more} nutrients, so lower frequency in B.

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2biii) As there is predator for fish 1 in B, population of 1 is lower than in A. They consume less zooplankton, and population of phytoplankton decrease due to more predator. So zooplankton in B feed on algae more frequently, since there is less phytoplankton. So when there is more nutrients and algae grow faster, zooplankton eats them, and control their population, thus higher biomass of zooplankton after phosphate addition.

biv). By algal bloom, population size of algae increase significantly. At night, they consume oxygen to carry out respiration, since there is no light, so the rate of respiration is higher than rate of photosynthesis, and there is a net uptake of oxygen. As they have large population, they used up oxygen in water and lead to depletion of dissolved oxygen in water.

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