

●  
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

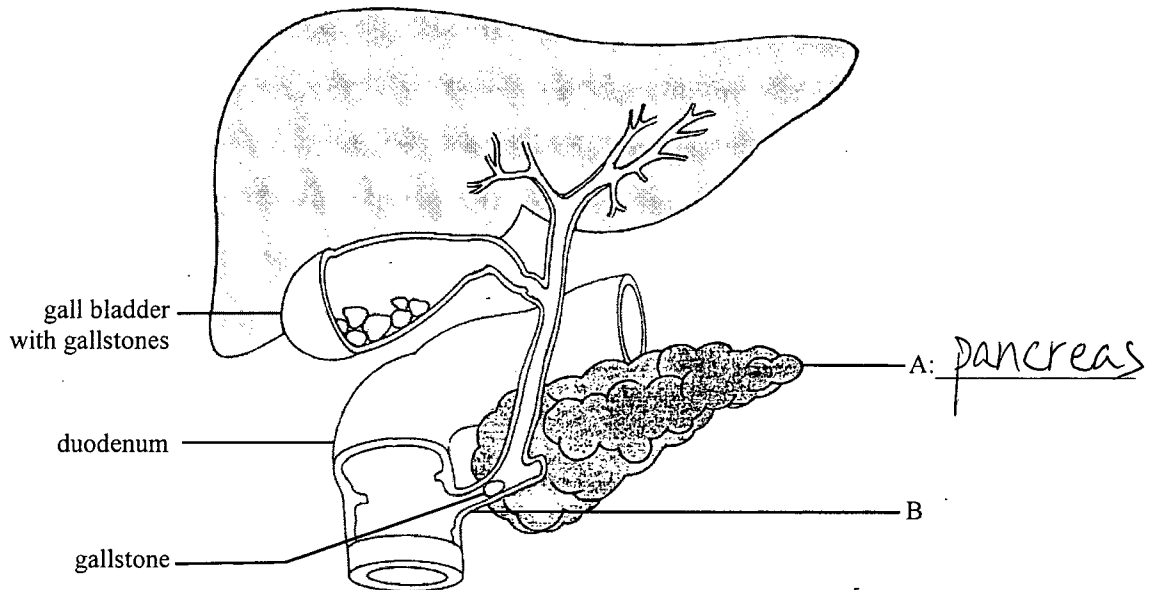
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SECTION B

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.

bile salt  
~~intestine~~

(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)

Gall bladder is responsible for the production of bile salt, which can help the digestion of fat by emulsifying it, it can break fat into smaller in physical way. Therefore, the surface area of fat for lipase from other organ to digest it increase. So without duct B, bile salt cannot deliver to small intestine to provide its function, so lipase need more time to digest it, so the rate decrease.

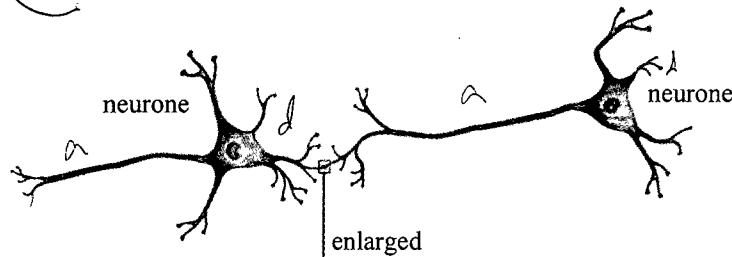
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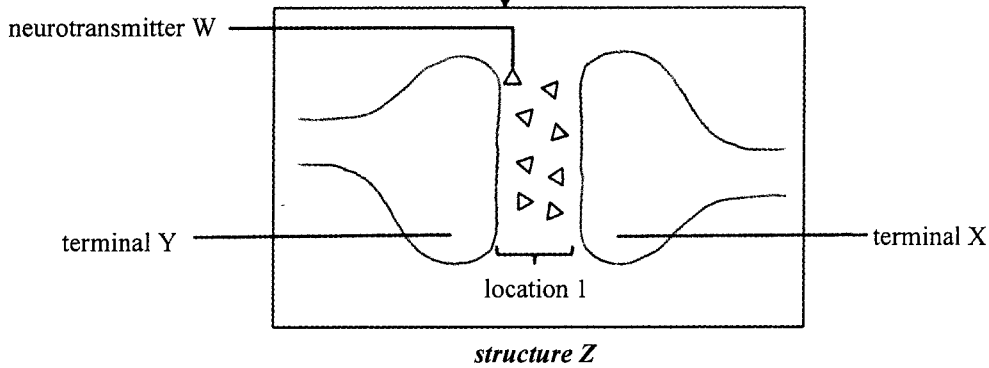
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2. The diagram below shows two adjacent neurons. When a nerve impulse arrives at structure Z, the amount of neurotransmitter W at location 1 increases.

motor



synaptic knob  
death!  
cleft



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

Synaptic knob

- (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)

The terminal release neurotransmitter W to location 1, it travel through to the other side of terminal and bind with the receptor of the <sup>other</sup> terminal to generate the electric impulse which is nerve impulse.

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

Help transport of signals in the nerve system.

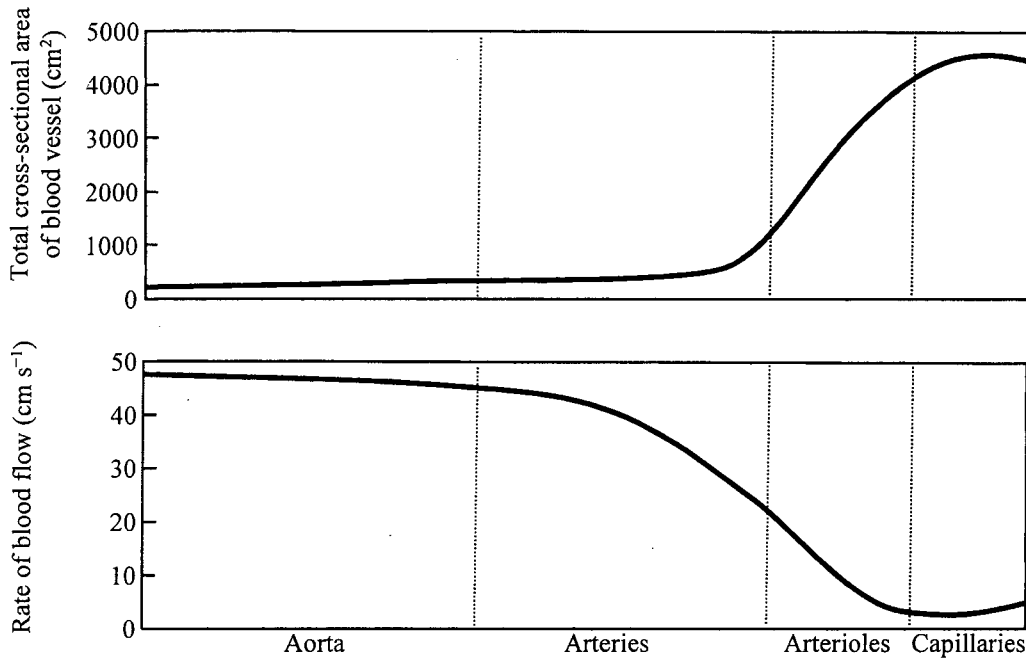
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3.

(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)

When the total cross-sectional area increase, rate of blood flow decrease, it reverse proportional to them.

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

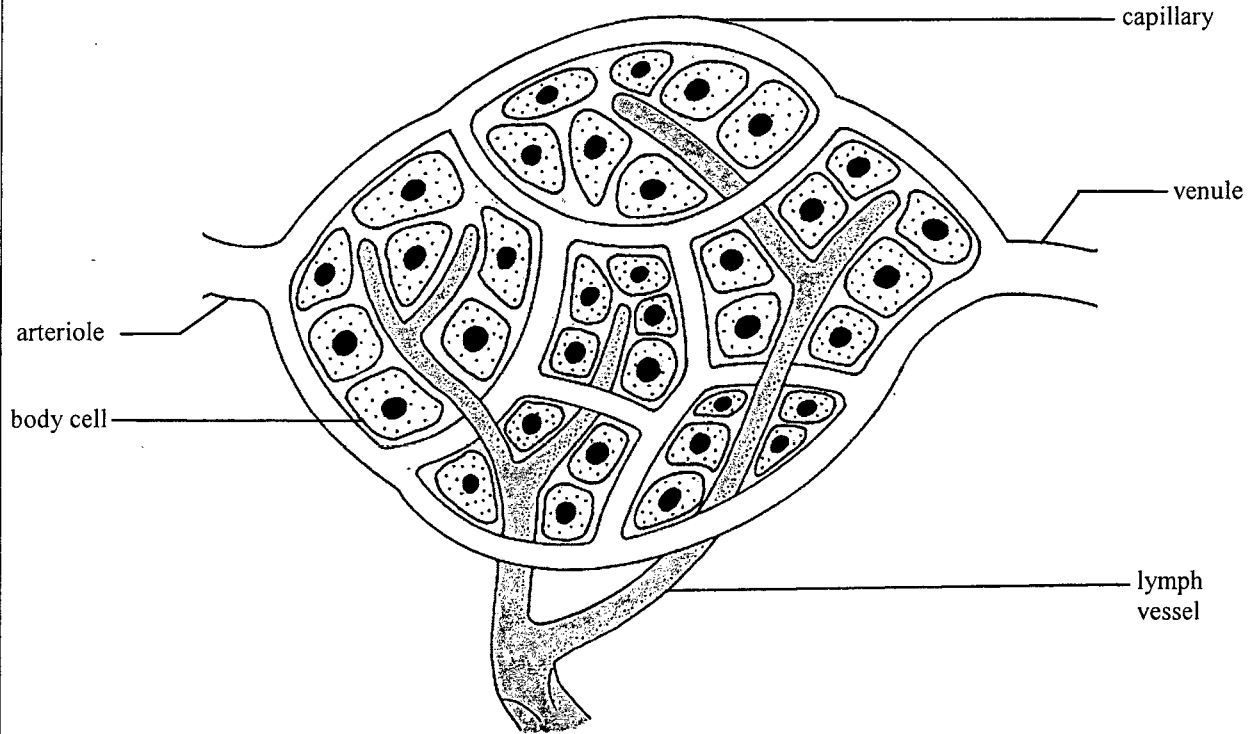
When the total cross-sectional area increase, it form a dense capillaries network. A steep concentration gradient between capillaries and tissue fluid facilitate the diffusion of materials.

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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)

Features illustrated in the diagram	Importance to the material exchange
highly branched, dense capillary network	maintain a steep concentration gradient between blood and tissue fluid.
narrow lumen	generate high hydrostatic pressure to push material from blood to body cell Blood travel slower to have more time for 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)

The aim of the experiment is to find the energy reserve of the insect used for fly. The insect reserve trehalose for fly is the conclusion as in the table, it shows the mean flight time of the insect have a significant drop when the inhibitor of trehalose digesting enzyme is added. It prove that the flight time of the insect will affected by the digestion and storage of trehalose and fly in less time. Other two didn't show any significant difference so they may be independent to the energy reserve for fly.

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

size of the insect

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

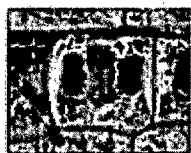
(a) What type of cell division is likely to take place in the root tip of an onion? Explain your answer. (2 marks)

Mitotic cell division, As no sexual reproduction occur in root of plant and no gamete cell in there.

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

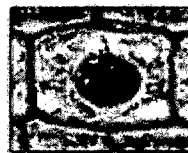
Adding suitable dye or indicator.

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



tele

V



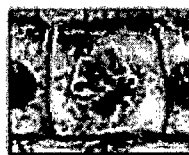
inter

W



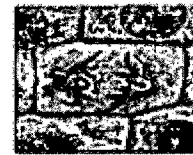
meta

X



pro

Y



ana

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	0
Z	0	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)

Antigen Y that is not harmful to human is injected to human body. The immune system detect foreign antigen, so it activate the B cell in white blood cell in lymph. The B cell activate T cell to help and produce plasma with antibody specific to antigen Y. The memory B and T cell will memorise the antigen Y, when the next invasion occur, it will identify it can produce <sup>quicker</sup> larger amount of antibody to help.

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

Extract antibody from recovered animal.

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

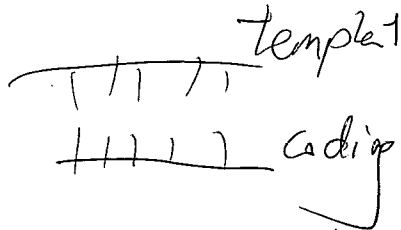
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~~UUC CGG UUU~~



A → T → U  
C → G

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

UUA

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)

Tyr - Arg - Tyr - Leu - Thr - Thr

- (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 ... .. ~~ACG~~

strain Q: ATG GCC ATA AAT TGA TGT ... .. ~~AXU~~

strain R: ATG GCT ATA AAC TGC TGT ... .. ~~LGA~~ ~~DUG~~

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 R, as after the mutation, the mutated triplet code will produce different type of amino acid, so the sequence will be different from before, the antigen may ~~change~~ change in structure so the immune system cannot identify it again, so the people vaccinated still got infected.

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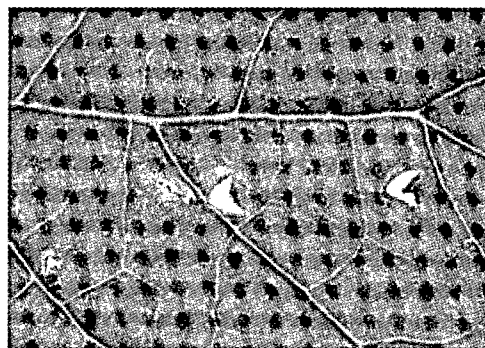
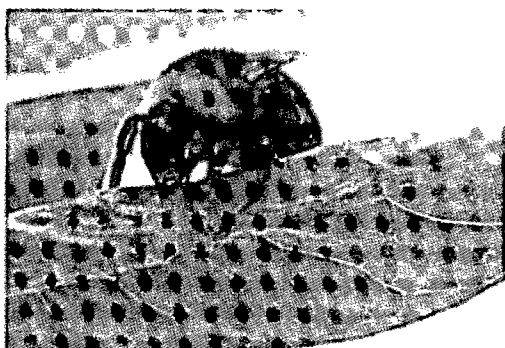
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7. (a) In flowering plants, environmental stress (i.e. under adverse conditions) in general can induce flowering. Explain why this flowering response can increase the chance of survival of flowering plants. (3 marks)

The flowering can help seed of the plant spread further away from the stress and grow in a better place, flowering also preserve the genetic information so it can grow when the stress is gone.

- (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 the treatment~~ was recorded.

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

Treatment 1 and 2 will occur the induce flowering while 3 will not.

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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)

The data cannot support the hypothesis. As if the bee help induce flowering by imposing mechanical stress, the result of bee damage and mechanical damage should be similar. While they have a large different of days needed. So we cannot deduce the bee only give mechanical damage to plant although both bee damage and mechanical damage show a decrease of day of 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)

More supply of food as inducing flowering will increase supply of pollen.

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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 <sup>2</sup> )	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)

Upper region have less area while lower region have more area. To maximize the absorb of 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)

Upper region has thicker palisade mesophyll.

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

It can absorb more sunlight as contact surface area is more.

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

Increase the light intensity to the lower region.

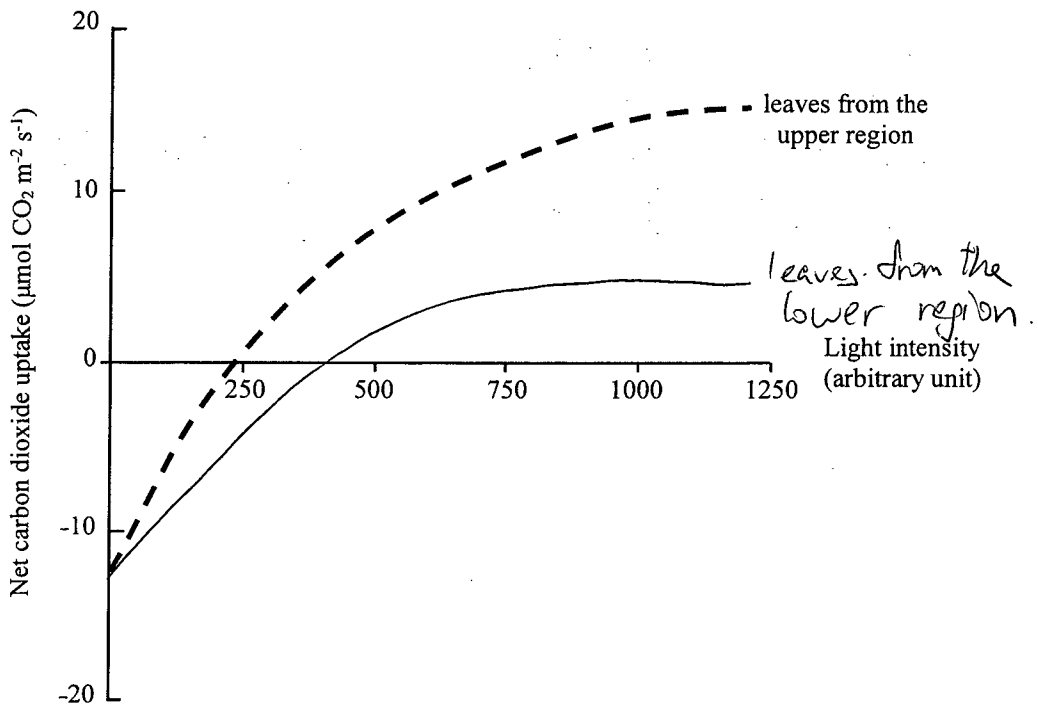
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- (c) Leaves at different regions of a tree are adapted to different light intensities. The graph below shows the change in the net carbon dioxide uptake by leaves from the upper region of a tree at different light intensities:



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

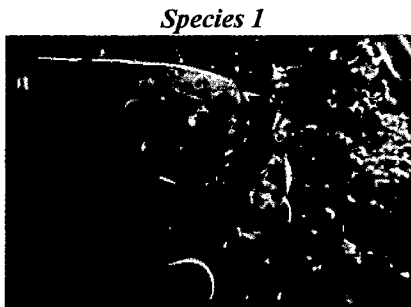
As carbon dioxide is taken for photosynthesis

- (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:



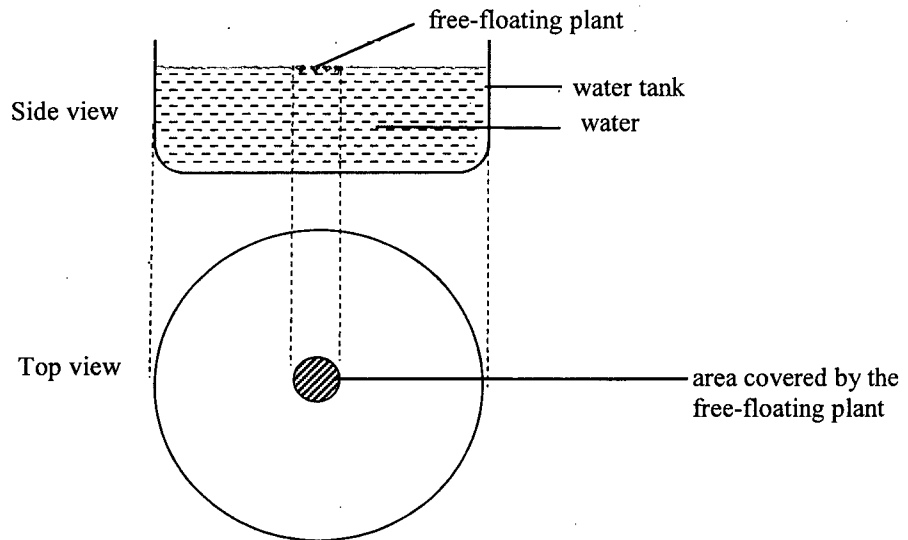
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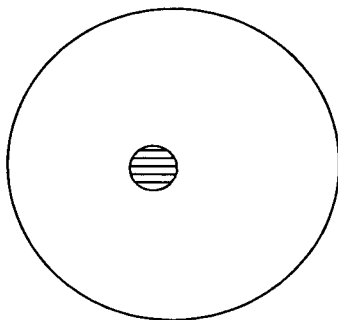
(1.5 X)

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:

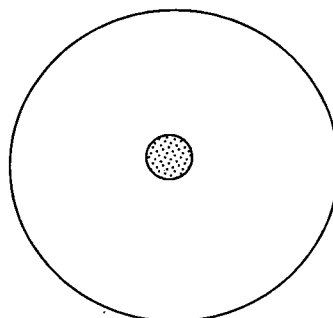
Experimental set-up:



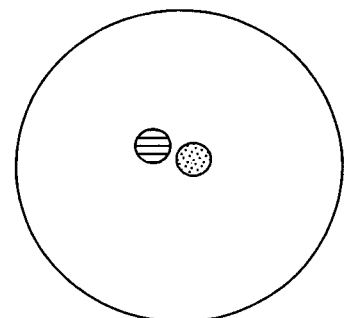
Experimental design (top view):



Species 1 grown alone



Species 2 grown alone



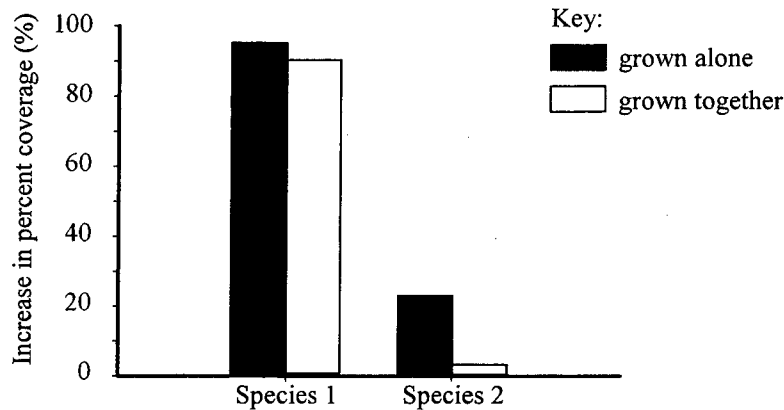
Species 1 and 2 grown together

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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: Species 1 is the dominant type species. As it has higher percentage coverage no matter ~~if~~ grow alone or together.

Conclusion 2: Species 1 is dominant while 2 is recessive as 1 have less drop of coverage when competing.

- (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)

The competition of nutrient and resources so they both get less resources to grow.

- (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	can be measure the weight difference by electrical <del>balance</del> balance
Number of leaves	Not feasible	hard to count, <del>at</del> least size different.

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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)

As the enzyme may need a acidiz environment to facilitate the enzyme activity. In human body we can secrete by ourselves but it is absent in vitro so need to add.

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

denature the 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)

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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 the short RNA fragment regulate the gene expression

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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)

The variations is brought by these. Firstly, genetic variations occur when sexual reproduction of organism in gamete cell, crossing over or dominant and recessive allele create variations of offspring. Then mutation occur in different organism to create variation and the survive one be the fittest. Next, speciation will make 1 species having variations,

The variations help cope with diverse environmental conditions as different variation will increase the diversity of the species, when the condition changed, the variations that can survive the best can be reproduce, so the species will not extinct easy if all species will dead,

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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.

# 2021 DSE (C)

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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(見下列)，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.												
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(a)(i) The increase intensity of exercise will increase both heart rate and blood lactate concentration.

(a)(ii) During the exercise, anaerobic respiration occur so there are lactic acid formed as product in blood. As the intensity of exercise increase, rate of anaerobic respiration increase to produce more energy, as the result more lactic acid form in blood as usual.

(iii) During the exercise, the chemoreceptor will detect the change of blood, so the sympathetic nerve will generate neurotransmitter to stimulate the rate and depth of the heart pumping. As the result, the heart pump in a faster rate and pump more blood at once in order to transport more oxygen to muscle and remove waste.

(iv) Firstly, the <sup>of Alice</sup> heart rate is slower than Billy at rest and during exercise. It may prove that as a athlete, regular exercise strengthen the heart muscle of Alice so it can pump more blood

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1(a)(iv) at one pump. Therefore Alice required less number of pump to transport the blood. <sup>so she has a lower heart rate</sup> then, blood lactate concentration is higher in Alice after exercise, it prove that more energy is used and respiration rate and efficiency is higher in Alice.

(b)(i) receptor is hypothalamus, effector is pituitary gland.

(ii) Under high temperature, the sweat gland will secrete more sweat, the evaporation of the sweat on the skin will take heat away from the body, so the amount of sweat increase to cool down the body.

(iii) The hypertonic condition of blood can help tolerate higher temperature without increase sweating.

(iv) It can prevent too much water loss from the body under high temperature, It may cause dehydration and make cell died.

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4(a)(i) First, the suitable cell should be able to differentiate to the desired cell type. Then, the cell should not be repelled by the immune system.

(ii) Binding the antibiotic resistance gene in it. The successful cell will survive under the antibiotic in agar plate, so we can identify the suitable cell. The advantage is it can identify the needed cell that successfully insert the gene, the disadvantage will be creating an antibiotic resistance that may reduce the effect of antibiotic afterward.

(iii) He will pass the defective gene to his offspring. As the gene therapy only focuses on the somatic cell of the body, although it can cure the patient, the gamete cell with defective genetic information is still here and will pass to the offspring.

(iv) Gene therapy may only help the adverse condition of human so it can be considered as a therapy, while transgenic animals may be normal and people perform

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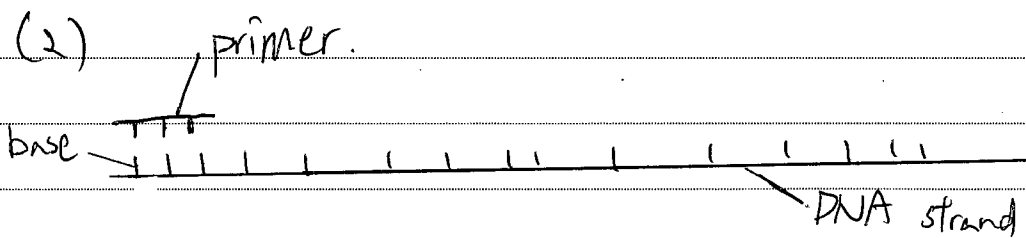
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4(a)(iv) recombinant of DNA to modify it for better human usage. People will doubt that human has no right to modify gene as it god's work. Also amount of transgenic animals is larger that may cause the genetic pollution to the nature.

4(b)(i) (1) O represent annealing. As highest temperature is performed in denaturation at start to break the coil of DNA, then lowest temperature <sup>65°C</sup> is used at annealing to help primer attach to the DNA strand. So O is annealing as it is the lowest temperature. Lastly the temperature rise again to help nucleotide bind to DNA strand.



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4(b)(ii) Primer II

(iii) Use the same restriction enzyme to cut the fragment of gene X and PCR product, then put them under the negative pole of gel electrophoresis and let them migrate at required time. If PCR product is gene X, it will show similar or identical bandings travel distance in the gel.

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