YIO CHU KANG SECONDARY SCHOOL PRELIMINARY EXAMINATION 2024 SECONDARY FOUR EXPRESS



BIOLOGY

Paper 2

6093/02 1 hour 45 minutes

No Additional Materials are required.

9 September 2024 (Monday)

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the cover page. Write in dark blue or black ink. You may use a soft pencil for any diagrams or graphs. Do not use staples, paper clips, glue or correction fluid.

Section A

Answer all questions in the spaces provided.

Section B

Answer **one** question in the spaces provided.

The use of an approved scientific calculator is expected, where appropriate. The number of marks is given in brackets [] at the end of each question or part question.

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Section A	/ 70
Section B	/ 10
Total	/ 80

SECTION A

Answer **all** questions in this section in the spaces provided.

1 Fig. 1.1 shows a diagram showing the pathway of water into a plant. The arrows show the direction of water movement.





(a) (i) State the name of cell A and describe how it is adapted for absorption of water.

(b) A student investigated the rate of transpiration in a plant.

1

Fig. 1.2 is a diagram of the apparatus used in the investigation.





- The student watered the plant before the investigation started.
- She measured the mass of water lost every five minutes.
- The mass of water lost represents the rate of transpiration.
- She took measurements in still air and with moving air surrounding the plant.
- She plotted her results on a graph with lines labelled **B** and **C**.

Fig. 1.3 shows the results.



Fig. 1.3

(b)	(i)	Identify the set-up which represents graph B and C .
		set-up with still air: graph
		set-up with moving air: graph [1]
	(ii)	Explain the results in Fig. 1.3.
		[3]

(c) Aphids have been used to investigate the translocation of sucrose in phloem tissue. While they are feeding on phloem sap, aphids excrete a sucrose-rich fluid known as honeydew.

In an investigation, two groups of four aphids were placed at intervals along the stem of a young willow plant, as shown in Fig. 1.4.



Fig. 1.4

The leaves were enclosed in an airtight glass chamber. A special form of carbon dioxide gas that contained radioactive carbon-14 (^{14}C) was supplied to the leaves for a short period of time.

Samples of honeydew were collected at intervals from the two groups of aphids. The time taken for sucrose containing ¹⁴C to travel the distance between group **A** and group **B** was recorded.

The investigation was repeated twice using a fresh stem and different groups of aphids for each trial. The results are shown in Table 1.1.

4

(c)

1

(i) Complete Table 1.1 by calculating the rate of movement of 14 C in trial 3.

trial distance between group A and group B on the stem/mm		time taken for ¹⁴ C to travel between group A and group B /minutes	rate of movement of ¹⁴ C / mm per hour
1	650	120	325
2	340	75	272
3	630	150	

Table 1.1

[1]

(ii) Outline how ¹⁴C in carbon dioxide gas becomes incorporated into the sucrose molecules that are translocated in the phloem.

[3] [Total: 12] 2 Fig. 2.1 shows part of the alimentary canal and some of the associated organs.



Fig. 2.1

(a) State the letter that represents the organ which produces bile.

.....

[1]

(b) A student investigated the effect of bile on the digestion of fat in milk.

He set up three different test-tubes:

- test-tube 1 contained milk and bile
- test-tube 2 contained milk and lipase
- test-tube 3 contained milk, lipase and bile.

He used an indicator that is pink in alkaline solutions and colourless in acidic solutions. He added the same volume of indicator to each test-tube.

The student observed and recorded the colour of the contents of each test-tube at 0 minutes, 20 minutes, and 40 minutes.

Table 2.1 shows the results of the investigation.

Table 2.1

toot tubo	indicator colour observed			
lesi-lube	0 minutes	20 minutes	40 minutes	
1	pink	pink	pink	
2	pink	pink	colourless	
3	pink	colourless	colourless	

2	(b)	(i)	Explain the results for test-tubes 2 and 3 in Table 2.1.
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[3]

(ii) Explain the purpose of test-tube 1 in Table 2.1.

[1]

(c) The action of lipase is affected by temperature.

Fig. 2.2 shows the axes for a graph of the effect of temperature on the activity of lipase.

Complete the graph by:

- drawing a line graph to show the expected effect of temperature on the activity of lipase
- adding a label line and a label to show the point at which all the lipase has been denatured.

enzyme activity	
	temperature

Fig. 2.2

3 Myopia is an eye condition. If a person has myopia, near objects can be seen clearly but not those that are far away.

It can happen when the eyeballs grow slightly too long as shown in Fig. 3.1.





(a) Explain how parts of the eye are involved in producing a clear image of a near object.

(b) Suggest why individuals with long eyeballs cannot see far-away objects clearly. You may draw on the diagram of the eye in Fig. 3.1. [1] [Total: 4]

- 4 Urea is a waste product formed in an organ.
 - (a) (i) Describe how urea is formed in the organ.
 [1]
 (ii) Describe the route taken by a molecule of urea formed in the organ to the kidneys.
 Your answer should include all the blood vessels and organs involved.
 - (b) Kidneys are involved in the excretion of urea in urine.

Fig. 4.1 shows a drawing of a nephron in the human kidney and associated blood vessels.



Fig. 4.1

(b) (i) Describe how structures K and L in Fig. 4.1 produce urine.	(b) (i)	4
[2]		
(ii) Explain how anti-diuretic hormone (ADH) affects structure N to produce urine with a high concentration of urea.	(ii)	
[2]		
[Total: 8]		

- 5 The discovery of antibiotics is a breakthrough in modern medicine.
 - State one way how antibiotics is effective against bacteria. (a)

(b) Antibiotic resistance is an increasing problem worldwide.

Erythromycin is an antibiotic.

Fig. 5.1 shows the daily doses of erythromycin per 1000 people over a 13-year period.

The number of bacterial infections resistant to erythromycin per 1000 people is also shown.



key

daily doses of erythromycin per 1000 people number of bacterial infections resistant to erythromycin per 1000 people

- Fig. 5.1
- (i) Calculate the percentage change in the number of bacterial infections resistant to erythromycin per 1000 people between 1993 and 1995.

Give your answer to two significant figures.

Show your working.

[2]%

(b)	(ii)	Describe the data shown in Fig. 5.1.
	(iii)	Suggest reasons for the change in the number of bacterial infect resistant to erythromycin from 1993 to 1995 shown in Fig. 5.1.
(c)	The c	liscovery of vaccines is another breakthrough in modern medicine.
	Sugg antibi	est one reason why the use of vaccine is more effective than the use otics.
		ITota

(a) Fig. 6.1 shows the stages involved in the production of insulin hormone.





(a) (i) State the names of the parts labelled **X**, **Y** and **Z** in Fig. 6.1.

Χ..... Υ..... [3] Ζ..... (ii) With reference to Fig. 6.1, describe how an insulin hormone is produced. [2] (iii) Suggest what determines the sequence of the amino acids in the insulin hormone that is produced.[1] The stages involved in the production of insulin hormone is similar to the (iv) production of proteins. Suggest why the sequence of amino acids is important in the production of

[2]

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antibodies.

(b) Fig. 6.2 shows the stages involved in the formation of a recombinant plasmid before it is inserted back into a bacterium.



Explain what happened at stages ${\boldsymbol{\mathsf{T}}}$ and ${\boldsymbol{\mathsf{S}}}$ to form a recombinant plasmid.

[2]
[4]
[Total: 10]

7 A scientist monitored the changes in the pH in muscles of a student before, during and after two minutes of vigorous exercise, for a total of 30 minutes.

Tables 7.1a and 7.1b show the	e changes in pH in muscles.
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Table 7.1a

Table 7.1b

time / minutes	pH in muscles	time / minutes	pH in muscles
0	7.07	16	6.94
2	6.55	18	6.97
4	6.65	20	6.99
6	6.72	22	7.00
8	6.77	24	7.02
10	6.82	26	7.03
12	6.87	28	7.05
14	6.91	30	7.06

(a) (i) The data in Table 7.1b has been plotted in Fig. 7.1. Complete the line graph by plotting the data in Table 7.1a on the same axes on Fig. 7.1.





7 (a)	(ii)	With reference to Fig. 7.1, explain the changes in pH in muscles for		
			0 to 2 minutes, and		
			[3]		
			2 to 30 minutes.		

(b) A scientist monitored the changes in the pH in muscles of another student, who is fitter.

On Fig. 7.1, draw a graph to show the changes in pH in the muscles of this student during and after two minutes of vigorous exercise.

[1]

[Total: 8]

8 Fig. 8.1 shows a town next to a freshwater river.

Between 1941 and 1963, an increasing amount of untreated sewage polluted the river.





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(a) The disposal of untreated sewage in the river resulted in eutrophication.

17

Explain the effect of eutrophication on the river ecosystem.

[3]

Between 1963 and 1968, new sewage treatment facilities were constructed.

By 1968, the amount of untreated sewage entering Lake Washington was reduced to zero.

Fig. 8.2 shows how the transparency of water in the lake has changed over time.

Water transparency is a measure of how far light travels through water.





(b) Calculate the percentage increase in water transparency between 1957 and 1968.

.....% [1]

8 (c) One species of fish that lives in Lake Washington is the Three Spined Stickleback.

Fig. 8.3 shows three different distribution patterns of armour plates on the skin of these fish.



low number of armour plates



median number of armour plates



many armour plates

Fig. 8.3

Table 8.1 shows how the distribution patterns of armour plates on the skin of Three Spined Sticklebacks have changed over time.

Table 8	8.1
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	percentage of fish with each distribution					
year	low number of armour plates	median number of armour plates	many armour plates			
1957	91	9	0			
1968	69	25	6			
1975	25	35	40			
2005	16	35	49			

(i) Use data from Table 8.1 to describe how the distribution patterns of armour plates have changed over time.



(c)

(ii) Armour plates on the skin of a Three Spined Stickleback protect it from predators.

With reference to Fig. 8.2 and 8.3, explain how the process of natural selection may have caused these changes in the distribution of plates over time as shown in Table 8.1.

[5] [Total: 12]

SECTION B Answer only **one** question in this section in the spaces provided.

9 Fig. 9.1 shows the parts of two flowers from two different plants of the same species.



Fig. 9.1

Within the same species of flower, there are variations in the size of the petals.

Fig. 9.2 shows the relationship between the size of petals and the chance of successful cross pollination by bees in this species of flower.



(b) Suggest why the rate of pollination increased as the size of petals increased from 5 to 20 mm.

[1]

- (c) Suggest why the rate of pollination remained constant as the size of petals increased from 20 to 30 mm.
 -[1]
- (d) Two flowers were cross pollinated.

Fig. 9.3 shows the number of offspring produced by the two parent plants.



Fig. 9.3

(i) State the phenotype and genotype of the parent plants in Table 9.1.

Table 9.1

	parent plant 1	parent plant 2
phenotype		
genotype		

9 (d) (ii) With reference to Fig. 9.3, explain how you derived your answer in (d)(i).

10 The percentage of successful fertilisation in humans varies throughout a typical 28-day menstrual cycle.

Fig. 10.1 shows the percentage of successful fertilisation in humans relative to ovulation on day 14.



10	(C)	Explain the percentage of successful fertilisation show	n in Fig.	10.1
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[3]

(d) The Rhesus (Rh) factor is a protein that is found on the surface of red blood cells in some people. If the protein is present, then the individual is Rh positive. If the protein is absent, then the individual is Rh negative.

The allele for the presence of the Rh factor is dominant and is represented by the letter \mathbf{D} . The recessive allele is represented by the letter \mathbf{d} .

A Rh negative mother and a heterozygous Rh positive father have a child.

Complete the genetic diagram **and** determine the probability of the child being Rh positive.

parental phenotype	:	Rh negative mother	х	heterozygous Rh positive father
parental genotype	:		x	
gametes	:		x	
F1 genotype	:			
F1 phenotype	:			
			••••	
F1 phenotype ratio	:			
Probability of Rh positive child:				
				[4]

[Total: 10]