

Please write clearly in	า block capitals.
Centre number	Candidate number
Surname	
Forename(s)	
Candidate signature	I declare this is my own work.

A-level **BIOLOGY**

Paper 1

Time allowed: 2 hours

Materials

For this paper you must have:

- · a ruler with millimetre measurements
- a scientific calculator.

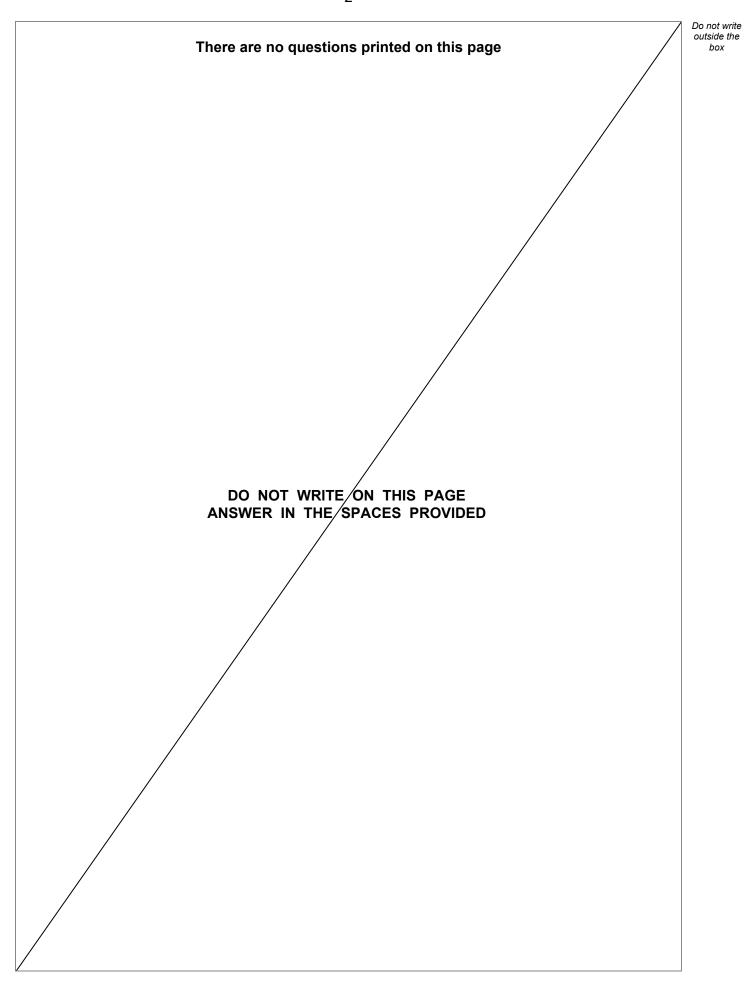
Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer all questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Show all your working.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for the questions are shown in brackets.
- The maximum mark for this paper is 91.

For Examiner's Use			
Question	Mark		
1			
2			
3			
4			
5			
6			
7			
8			
9			
TOTAL			





	Answer all questions in the spaces provided.	
0 1.1	Describe the structure and function of the nucleus.	[4 marks]
	Question 1 continues on the next page	
	Question i continues on the next page	



0 1 . 2	Name the main polymer that forms the	e remembring com mamer	[1 mar
	Plant cell wall		
	Fungal cell wall		
	Scientists investigated the effect of the diversity of plant species.	e number of fungal species in so	il on the
	Table 1 shows their raw data for soil of	containing 14 fungal species.	
	Table	e 1	
	Plant species	Total shoot biomass / g m ⁻²	
	Poa compressa	2	
	Achillea millefolium	4	
	Aster cordifolius	5	
	Aster novae-angliae	7	
	Chrysanthemum leucanthemum	15	_
	Daucus carota	36	
	Fragaria virginiana	51	
1 . 3	Suggest one reason the scientists use of each plant species when collecting		
1.3	Suggest one reason the scientists use		
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1.3	Suggest one reason the scientists use		



0 1.4

The scientists used this equation to calculate the plant species index of diversity.

$$d = 1 - \sum \left(\frac{n}{N}\right)^2$$

where n = shoot biomass of each plant species and N = total shoot biomass of all plant species

Use this equation to calculate the index of diversity for the data in **Table 1**.

[2 marks]

Index of diversity

Question 1 continues on the next page



Figure 1 shows the plant species index of diversity the scientists calculated when the soil contained 0, 1, 2, 4 and 8 fungal species.

Figure 1

Figure 1 not reproduced here due to third-party copyright restrictions

0 1.5	Sometimes farmers stop growing crops on an area of land to allow the natural ecosystem to recover. The plant species index of diversity of these areas previously used to grow crops is different from nearby land that has never been used to grow crops.
	Suggest and explain how the plant species index of diversity would be different in these areas previously used to grow crops.
	Use Figure 1 and your knowledge of the effect of farming on biodiversity in your answer.
	[2 marks]

10



0 2 . 1	Clostridium difficile is a bacterial species that causes disease in humans.
	Antibiotic-resistant strains of <i>C. difficile</i> have become a common cause of infection acquired when in hospital.
	Explain how the use of antibiotics has led to antibiotic-resistant strains of bacteria becoming a common cause of infection acquired when in hospital.
	[3 marks]
0 2.2	Scientists suggested that factors, other than antibiotic use, led to the increase in antibiotic-resistant <i>C. difficile</i> infections. One suggested factor is people eating more trehalose in their diet.
	Trehalose is a disaccharide formed from two glucose molecules.
	Name another disaccharide formed from two glucose molecules. [1 mark]
	Question 2 continues on the next page

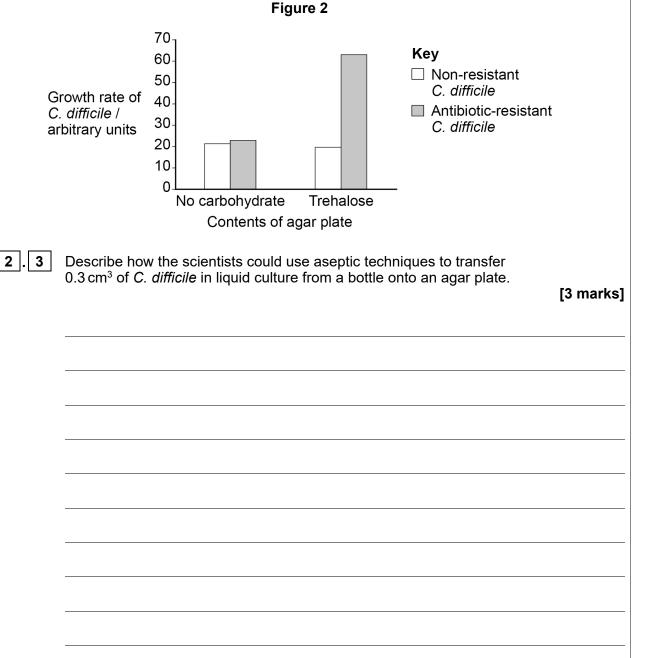


Scientists investigated the effect of trehalose on the growth rate of *C. difficile*. They grew populations of non-resistant and antibiotic-resistant *C. difficile* on separate agar plates with:

- · no carbohydrate added
- trehalose added.

They measured the growth rate of the *C. difficile*.

Figure 2 shows the scientists' results.





Do not write outside the box

0 2 . 4	Use Figure 2 to evaluate whether more trehalose in the diet could be a factor in the increased number of antibiotic-resistant <i>C. difficile</i> infections.	outsid b
	[3 marks]	
		10
	Turn over for the next question	
	rum over for the next question	



0 3.1	Give two features of all prokaryotic cells that are not fe	atures of eukaryotic cells. [1 mark]
	1	
	2	
	Many multicellular organisms produce antimicrobial polythem against prokaryotes. Figure 3 shows how one type of AP acts on the cell-surprokaryotes.	
	Figure 3	
	nicrobial peptide	The APs attach to
		the outside of the cell-surface membrane of the prokaryote
mem	surface brane of aryote	Several APs come
		together and enter the membrane making a channel in the cell-surface membrane of the prokaryote
0 3.2	This AP has a secondary structure in a helical shape.	
	Tick (\checkmark) the box to show which type of bond maintains to polypeptide.	
		[1 mark]
	Disulfide	
	Hydrogen	
	Ionic	
	Peptide	

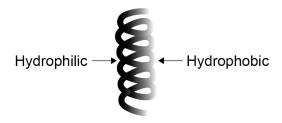


The amino acids on one side of each AP helix have hydrophobic properties.

The amino acids on the opposite side of each helix have hydrophilic properties.

Figure 4 shows this.

Figure 4

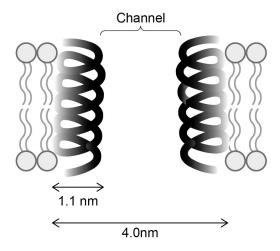


membrane (as shown in Figure 3) and make a channel through which ions can pass		
	~ <u>,</u>	

Question 3 continues on the next page

Figure 5 shows further information about a channel formed in the cell-surface membrane by the APs.

Figure 5



Use **Figure 5** to calculate the cross-sectional area of the channel through which ions can pass.

Assume the cross-sectional area is circular.

Use π = 3.14 in your calculation. Give your answer in nm² **and** to 1 decimal place.

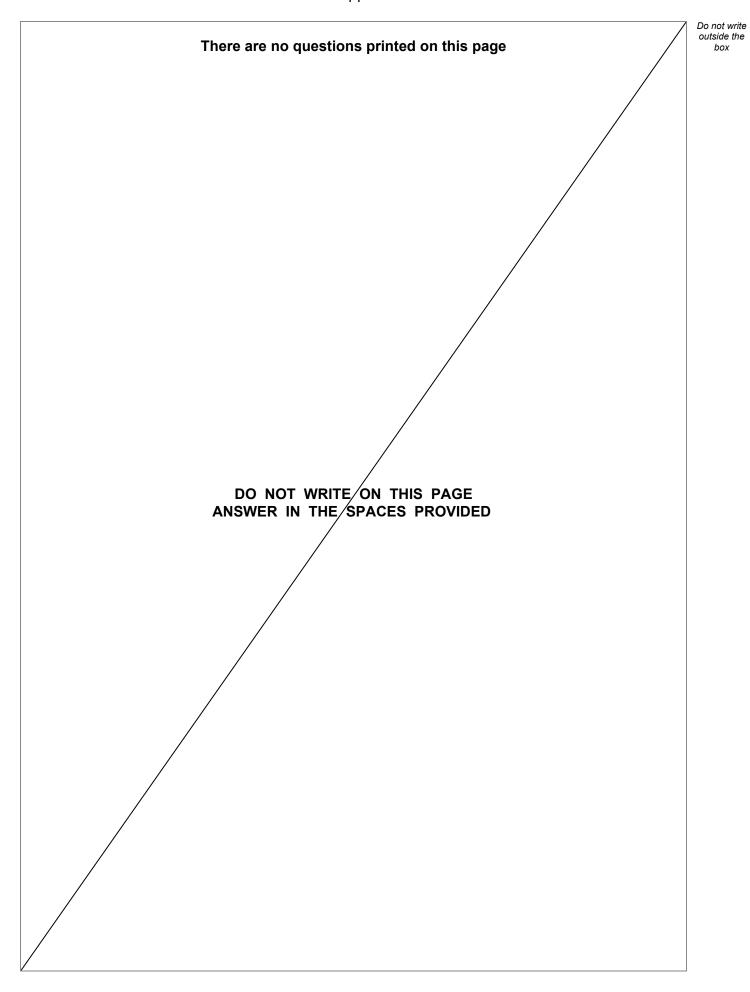
[2 marks]

Answer	nm²
Allswei	[][]



0 3 . 5	The APs damage prokaryotic cells but do not damage the eukaryotic cells in the organisms that produce them. Prokaryotic cell membranes do not contain cholesterol.	ΟL
	Assess why the APs do not damage the eukaryotic cells of the organisms that produce them.	
	[2 marks]	
0 3.6	Scientists observed these APs on prokaryotes using a transmission electron microscope. They stained the APs using a monoclonal antibody with gold attached to it.	
	Suggest how these techniques allowed observation of APs on prokaryotes. [3 marks]	
		_







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0 4 . 1	Describe viral replication.	
	្រុវ ៣	narks]
0 4 . 2	Complete Table 2 by putting a tick (\checkmark) where the feature is part of a cell cycle involving mitosis or a cell cycle involving binary fission.	
	[2 n	narks]

Table 2

Facture	Cell cycle involving:	
Feature	mitosis	binary fission
Replication of linear		
DNA		
Replication of circular		
DNA		
Produces 2 daughter		
cells		
Produces 4 daughter		
cells		
Happens in prokaryotic		
cells		
Happens in eukaryotic		
cells		

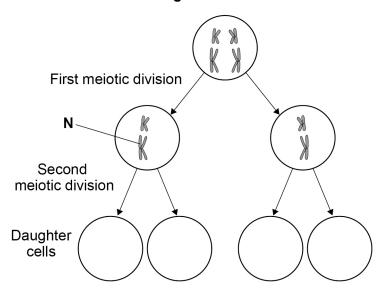
Question 4 continues on the next page



Figure 6 represents a cell undergoing meiosis. It shows the chromosomes in the parent cell and in the two cells formed after the first meiotic division.

The second division of meiosis proceeds normally except that non-disjunction occurs in the chromosome labelled ${\bf N}$.

Figure 6



0 4. 3 Complete **Figure 6** to show the chromosomes inside the daughter cells formed after the second meiotic division.

[2 marks]



Doctors studied babies born with a mutation caused by chromosome non-disjunction during gamete formation in their mother.

They determined each mother's age at the time of childbirth and whether the non-disjunction happened in the first meiotic division (MM1 error) or in the second meiotic division (MM2 error).

Figure 7 shows the doctors' results.

Figure 7

Figure 7 not reproduced here due to third-party copyright restrictions

0 4 . 4 A student concluded that there were more mothers of age >37 with MM2 errors than with MM1 errors.

Using Figure 7 and suitable calculations show why this conclusion is **not** valid.

[2 marks]

9



0 5	Two enzymes, ${\bf P}$ and ${\bf Q}$, are proteins with quaternary structure which catalyse the same reaction, but they have different amino acid sequences.
0 5.1	Define the quaternary structure of a protein. [1 mark]
0 5.2	Explain how two enzymes with different amino acid sequences can catalyse the same reaction. [2 marks]
	Scientists investigated the effect of pH 8.4 and pH 7.5 on the activity of enzymes
	P and Q. Figure 8 shows their results. Figure 8
of subs	ntration of substrate of substr



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0 5.3	Describe what the scientists should place in the control tubes in this investigation.
	[3 marks]
0 5.4	Give three conclusions you can make from Figure 8.
	[3 marks]
	1
	2
	3





	 -
0 6	Mangrove trees grow near the sea. Sea water surrounds the lower parts of the trees at high tide. Scientists investigated the rate of transpiration in a mangrove tree.
	Figure 9 shows the scientists' results.
	Figure 9
Rate of transpira / cm ³ hr	0.55
	↑ Time of day ↑ Sunrise Sunset
0 6.1	Explain the rate of transpiration between 5 am and midday shown in Figure 9 . [4 marks]



		_
0 6 . 2	Use Figure 9 to calculate the percentage increase in the rate of transpiration from 1 pm to 2 pm.	Do no outsio
	[2 marks]	
	Percentage increase in rate of transpiration %	
0 6 . 3	The higher rate of transpiration at high tide shows that the mangrove tree is absorbing water from the sea water surrounding its roots.	
	Describe an experiment that you could do to investigate whether the mangrove root cells have a lower water potential than sea water.	
	You are given:	
	a piece of fresh mangrove rootsea water	
	access to laboratory equipment. [4 marks]	
	_	
		10

Turn over ▶



0 7 . 1

Complete **Table 3** to give **three** differences between DNA molecules and tRNA molecules.

[3 marks]

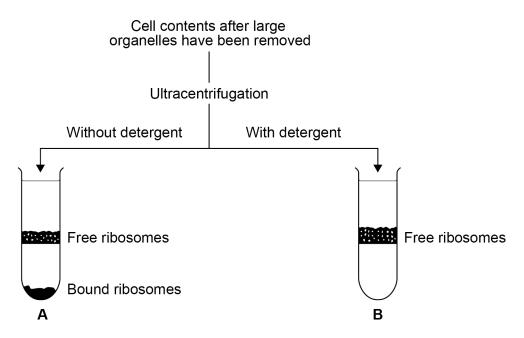
Table 3

DNA molecules	tRNA molecules

Scientists investigated ribosomal RNA in liver cells.

Figure 10 shows the method they used to isolate the ribosomes from the liver cells. The detergent dissolves lipids.

Figure 10





0 7.2	The scientists broke open the cells to produce a suspension of cell contents.	outsia bo
	Describe how the scientists would remove large organelles from this suspension of cell contents.	
	[2 marks]	
0 7.3	Explain the position of the bands of ribosomes in tubes A and B in Figure 10 . [3 marks]	
	A	
	В	
		8
	Turn over for the next question	
	rum over for the next question	



0 8	Figure 11 shows images of gills from two fish as seen through an optical micro	scope.
	Image C shows gills from a fish with healthy gills.	
	Image D shows gills from a fish with damaged gills.	
	Figure 11	
•	Figure 11 not reproduced here due to third-party copyright restrictions	
0 8.1	To observe the fish gills with the optical microscope, the scientists used two difference. The first stain binds to DNA; the second stain binds to the red blood cell. Explain why a second stain would be needed to stain the red blood cells. Suggest which molecule the stain could bind to in the red blood cells.	
	Explanation	urkaj
	Molecule	



0 8 . 2

Using **Figure 11**, the scientists calculated the surface area to volume ratios for each gill filament in these two fish. Some of their results are shown in **Table 4**.

Complete **Table 4**. State your calculated volume and surface area:volume ratio to 2 significant figures.

[2 marks]

Table 4

Fish gill	Surface area / µm²	Volume / μm³	Surface area:volume ratio
Healthy	7.4 × 10 ³	2.3 × 10 ⁴	
Damaged	1.1 × 10 ⁴		0.13:1

0 8 . 3	The damage to the gills causes uncontrolled cell division in the cells around the capillaries in the gill filaments.
	Other than surface area:volume ratio, describe one way this uncontrolled cell division changes the gills, as shown in Figure 11 .
	Explain how this difference would affect gas exchange. [3 marks]
	Difference

Question 8 continues on the next page

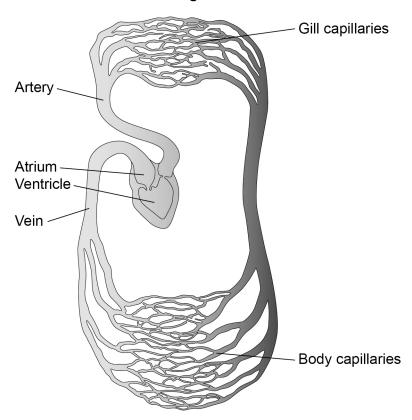
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Explanation

Figure 12 shows the general pattern of blood circulation in fish.

Figure 12



Use **Figure 12** to complete **Table 5** to show **two** differences between the circulation of blood in fish and the circulation of blood in a mammal.

[2 marks]

Table 5

Difference	Circulation of blood in fish	Circulation of blood in mammal
1		
2		

9



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0 9 . 1	Describe the transport of carbohydrate in plants.	[5 marks]
	Question 9 continues on the next page	





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0 9 . 2	Compare and contrast the structure of starch and the structure of cellulose.	[6 marks]

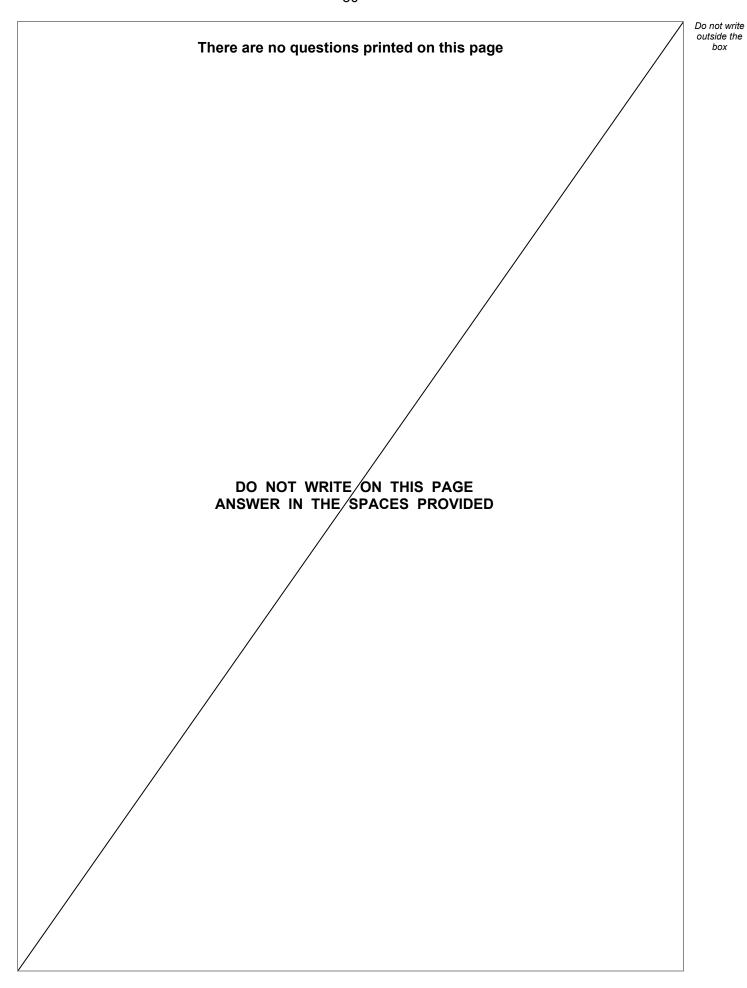


9.3	Describe the complete digestion of starch by a mammal.	
		[4 marks]

END OF QUESTIONS



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Question number	Additional page, if required. Write the question numbers in the left-hand margin.
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