Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number | Candidate Number

Time 1 hour 45 minutes

Paper reference **9BI0/01**

Biology B

Advanced

PAPER 1: Advanced Biochemistry, Microbiology and Genetics

You must have:
Calculator, HB pencil, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Show your working in any calculation questions and include units in your answer where appropriate.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You may use a scientific calculator.
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- Good luck with your examination.

Turn over

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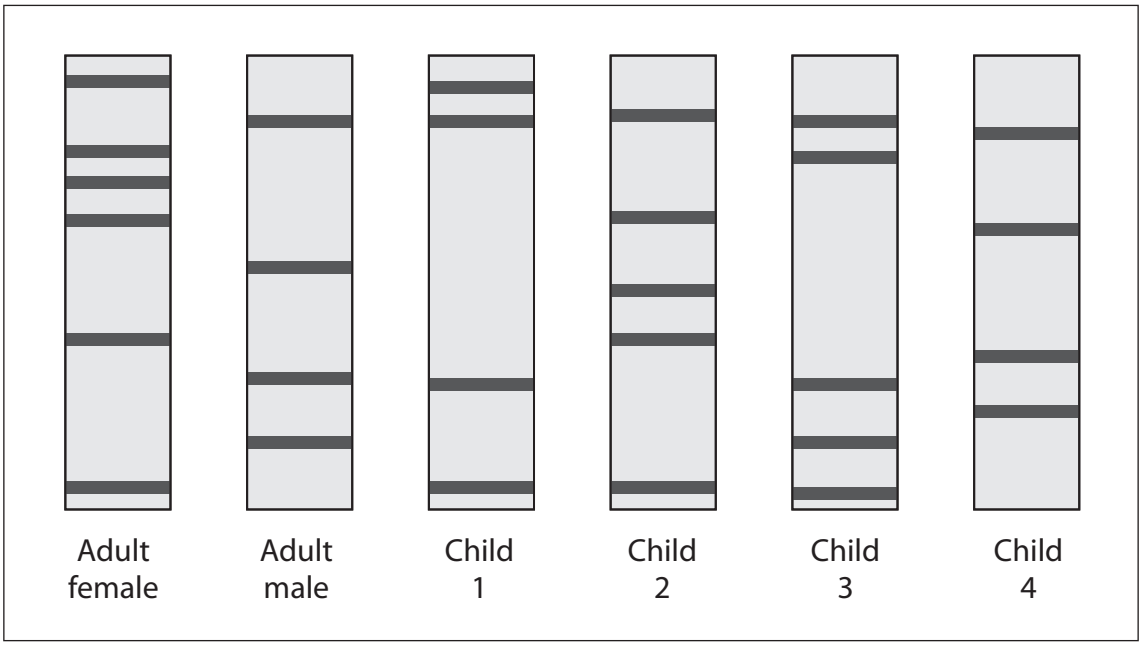
Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 The polymerase chain reaction (PCR) and gel electrophoresis are used to produce DNA profiles.

The diagram shows DNA profiles, from an adult female, an adult male and each of four children.



(a) Explain why PCR is used before gel electrophoresis to produce these DNA profiles.

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(b) Explain why gel electrophoresis produces individual DNA profiles.

(2)

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(c) Which of the children have both of these adults as their parents?

(1)

☒ **A** child **1** and child **2**

☒ **B** child **1** and child **3**

☒ **C** child **2** and child **3**

☒ **D** child **2** and child **4**

(Total for Question 1 = 5 marks)

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2 An investigation was carried out to compare the aerobic respiration of different sugars by yeast.

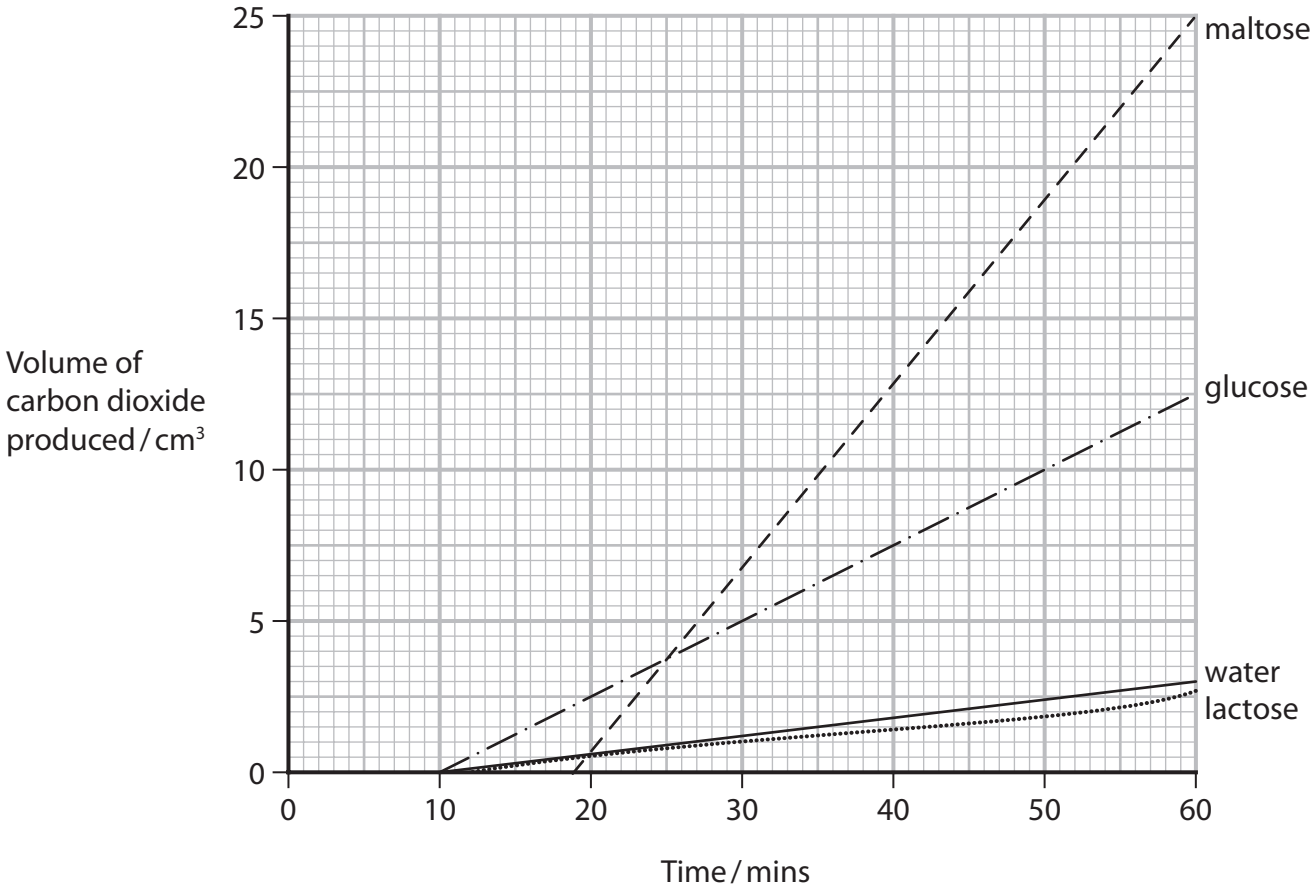
A suspension of yeast was used to produce three cultures, each one with a different sugar.

A control was set up that had a suspension of yeast cultured with water only.

The volume of carbon dioxide produced was measured.

The mass of yeast and the concentration of each sugar were controlled.

The graph shows the results of this investigation.



(a) (i) Give one difference between the structure of glucose and the structure of maltose.

(1)

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(ii) Explain the results for the yeast cultured with glucose and the yeast cultured with maltose.

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(b) Explain the results for the yeast cultured with lactose.

(2)

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(Total for Question 2 = 5 marks)

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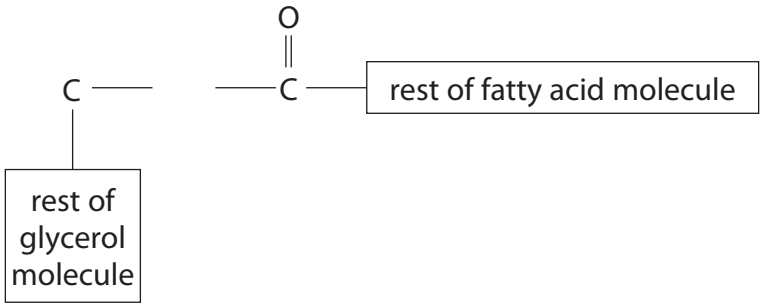
3 The structure of a lipid relates to its role in living organisms.

(a) Triglycerides are lipids.

(i) The diagram shows part of a glycerol molecule and part of a fatty acid.

Complete the diagram to show the ester bond joining the fatty acid to the glycerol molecule.

(1)



(ii) The table shows the relative atomic mass of some elements.

Element	Relative atomic mass
carbon	12
hydrogen	1
nitrogen	14
oxygen	16

A triglyceride is made from a glycerol molecule and three fatty acids.

The molecular mass of the glycerol is 92 and the total molecular mass of the three fatty acids is 362.

Which is the molecular mass of this triglyceride?

(1)

☒ **A** 400

☒ **B** 436

☒ **C** 448

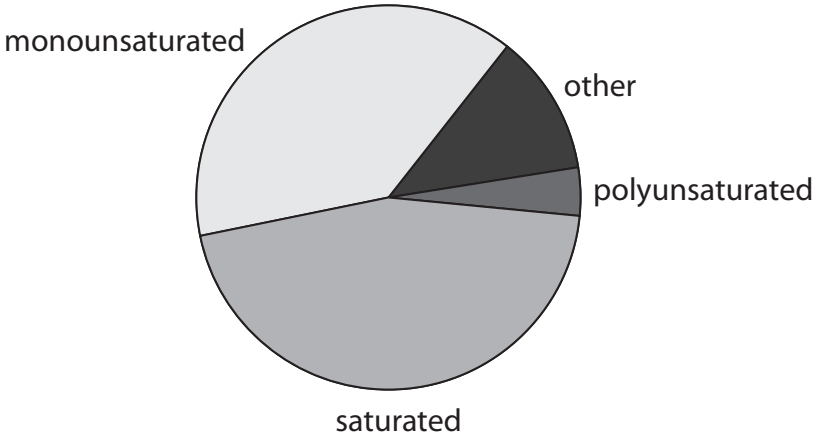
☒ **D** 454

(b) The type of lipid in the diet of a person can affect their risk of developing atherosclerosis.

The table shows the percentage content of different lipids in some products used to cook food.

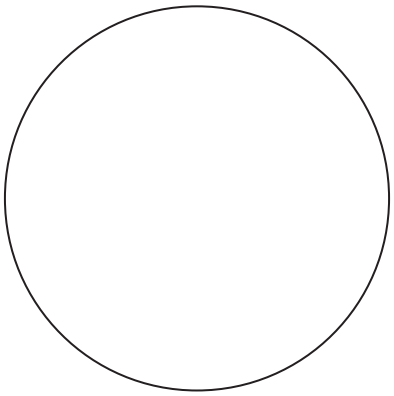
Product	Source of product	Saturated lipids	Monounsaturated lipids	Polyunsaturated lipids		Other lipids
				Omega-6	Omega-3	
Beef fat	animal	45	39	3	1	12
Butter	animal	52	24	2	1	21
Rapeseed oil	plant	7	59	20	9	5
Safflower oil	plant	10	15	75	0	0

(i) The pie chart shows the approximate ratio of the lipids in beef fat.



Complete the pie chart to show the approximate ratio of the lipids in safflower oil.

(1)



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(ii) Calculate the difference in mass of polyunsaturated lipid in 500 g of safflower oil and 500 g of beef fat.

(2)

Answer ..... g

(iii) Explain why cooking food using plant products rather than animal products could lower the risk of developing atherosclerosis.

(2)

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(c) Cell membranes contain lipids that have a phosphate group attached to the glycerol, instead of one of the fatty acids.

Explain the importance of the phosphate group in these lipids.

(2)

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(Total for Question 3 = 9 marks)

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4 Transpiration moves water and mineral ions from the roots to the leaves of plants.

(a) Which box in the table shows the mineral ions needed to make an amino acid and which box shows those needed to make DNA?

(2)

Molecule	Mineral ions needed to make the molecule			
	nitrate ions only	**phosphate ions only**	**both nitrate and phosphate ions**	**neither nitrate nor phosphate ions**
amino acid	☒	☒	☒	☒
DNA	☒	☒	☒	☒

(b) Water enters the root hair cells and moves through the root tissues by the apoplastic and symplastic pathways.

(i) Root hairs have a large surface area that increases the rate of uptake of water.

The surface area of a root hair is rounded up to $3.14 \times 10^5\ \mu m^2$.

Which is the actual surface area of this root hair?

(1)

☒ **A** $31\,460\ \mu m^2$

☒ **B** $314\,600\ \mu m^2$

☒ **C** $313\,900\ \mu m^2$

☒ **D** $3\,139\,000\ \mu m^2$

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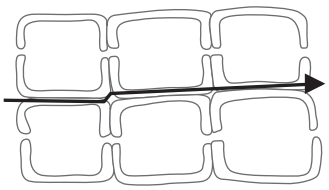
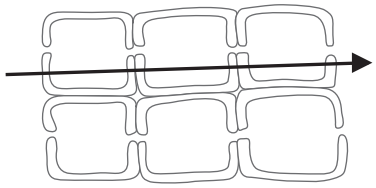
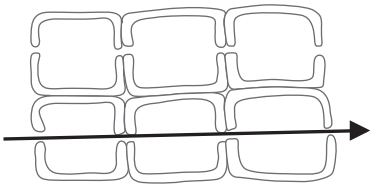
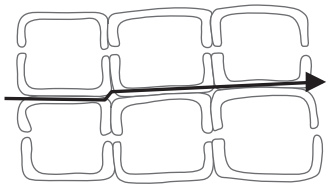
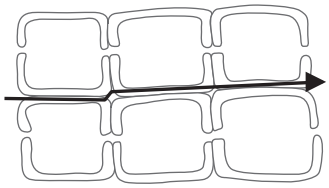
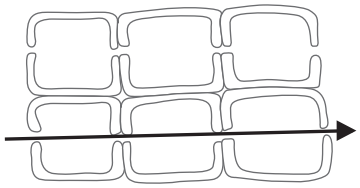
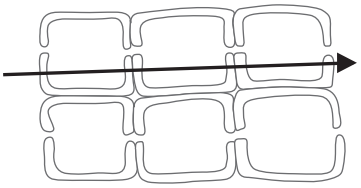
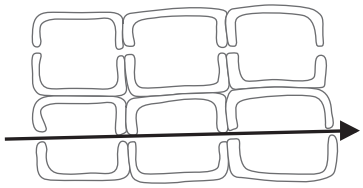
(ii) Which row of the table shows the movement of water through the apoplastic and symplastic pathways?

(1)

	Apoplastic pathway	Symplastic pathway
☒ **A**		
☒ **B**		
☒ **C**		
☒ **D**		

(iii) Water moves through the root tissue due to a difference in water potential between one cell and the next cell.

Which row of the table describes this movement?

(1)

	Direction of water movement with respect to water potential	Direction of water movement with respect to concentration of solutions
☒ **A**	higher to lower	concentrated to dilute
☒ **B**	higher to lower	dilute to concentrated
☒ **C**	lower to higher	concentrated to dilute
☒ **D**	lower to higher	dilute to concentrated

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(c) Explain how transpiration depends on the dipole nature of water.

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(Total for Question 4 = 8 marks)

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5 Some antibiotics work by inhibiting the production of ribosomes in bacteria.

The structure of ribosomes in bacteria is similar to the structure of ribosomes in mitochondria.

(a) (i) Describe the structure of a ribosome.

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(ii) Describe the role of ribosomes in protein synthesis.

(2)

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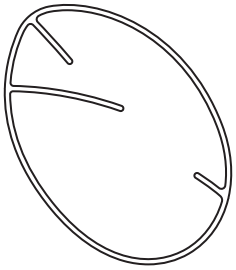
(b) These antibiotics can destroy cancer cells in humans.

The diagram shows the membranes of a mitochondrion from a cancer cell treated with these antibiotics.



(i) Give one difference in the membranes of this mitochondrion compared with the membranes of a mitochondrion from an untreated cancer cell.

(1)

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(ii) Some cancer cells depend on oxidative phosphorylation for ATP production.

Explain why the antibiotics that inhibit the production of ribosomes prevent oxidative phosphorylation when used to treat cancer cells.

(2)

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(iii) Some scientists suggested that inhibiting both glycolysis and mitochondrial respiration may be an effective way of treating cancer cells.

Explain why this suggestion may be an effective way of treating cancer cells.

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(Total for Question 5 = 9 marks)

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6 Macroalgae and microalgae are photosynthetic organisms.

Seaweeds are macroalgae that live attached to rock in coastal areas.

Some seaweeds are green, some are brown and some are red.

The colour of seaweeds depends on the photosynthetic pigments contained in their cells.

Green seaweeds contain chlorophyll, brown seaweeds contain chlorophyll and fucoxanthin and red seaweeds contain chlorophyll and phycoerythrin.

(a) (i) Explain why these seaweeds have different absorption spectra and action spectra.

(3)

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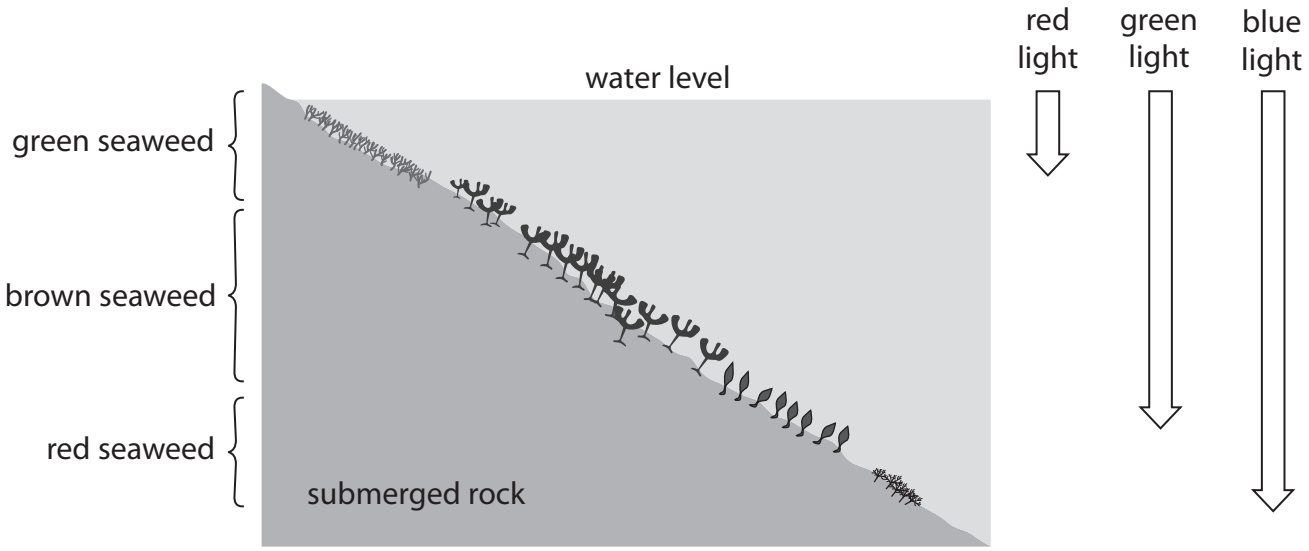
(ii) The diagram shows the position that these seaweeds occupy on submerged rock and the depth to which different wavelengths of light penetrate into the water.



Explain why the seaweeds occupy different positions on the submerged rock.

(3)

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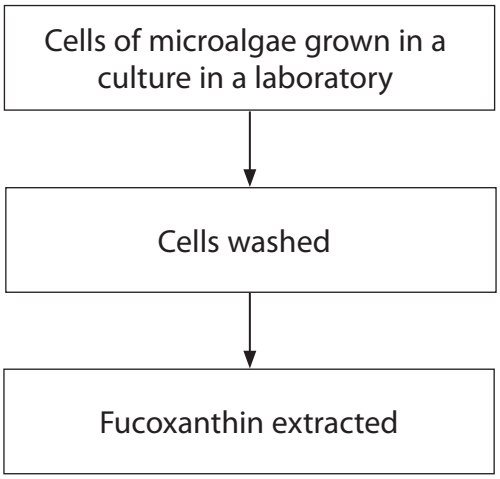
(b) Fucoxanthin is found in both macroalgae and microalgae.

Fucoxanthin has anti-inflammatory, anti-tumour, anti-diabetes, anti-malarial and anti-obesity activity in humans.

The diagram outlines the steps taken to extract fucoxanthin from microalgae.



The table shows three methods used for washing the cells and extracting the fucoxanthin.

Method	Liquid used for washing cells	Chemical used to extract fucoxanthin
A	water	ethanol
B	culture media	ethanol
C	culture media	water

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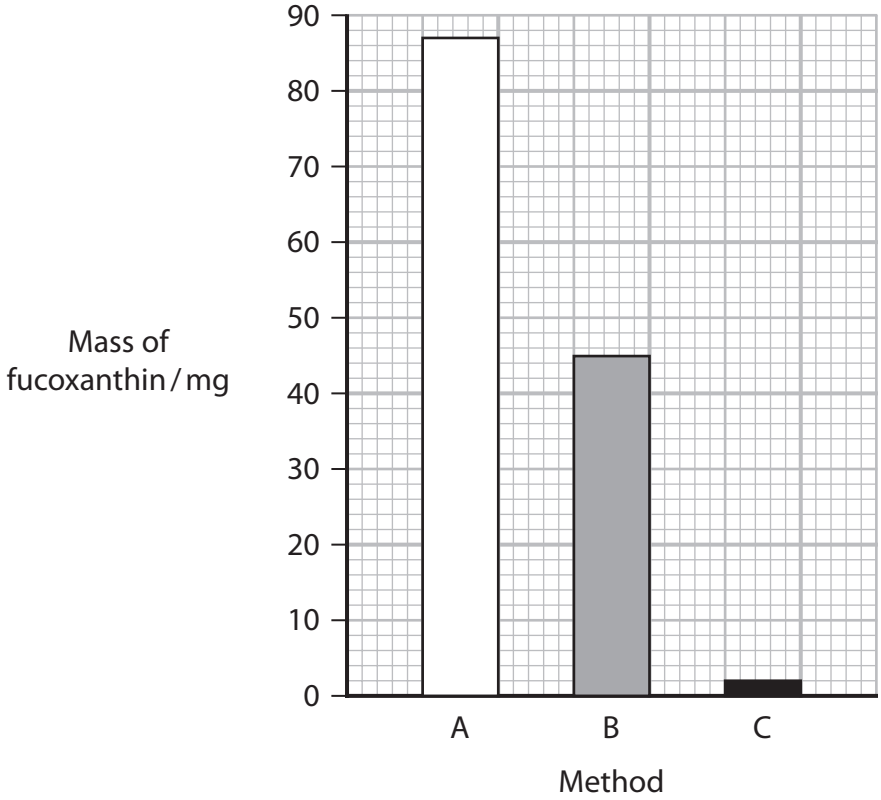
The graph shows the mass of fucoxanthin extracted from 1 dm^3 of cell culture.



(i) Calculate how many times more fucoxanthin was extracted using method A compared with method B.

(1)

Answer .....

(ii) Explain why different masses of fucoxanthin were extracted using these three methods.

(3)

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(Total for Question 6 = 10 marks)

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7 Bacteria are becoming increasingly resistant to antibiotics.

Controlling the spread of antibiotic resistance is necessary.

(a) Many types of bacteria are resistant to penicillin and tetracycline.

(i) Which row of the table shows the part of a bacterial cell affected by these antibiotics?

(1)

	Penicillin	Tetracycline
☒ **A**	cell wall	cell wall
☒ **B**	cell wall	ribosome
☒ **C**	ribosome	cell wall
☒ **D**	ribosome	ribosome

(ii) Which row of the table describes the action of penicillin and tetracycline?

(1)

	Penicillin	Tetracycline
☒ **A**	bactericidal	bactericidal
☒ **B**	bactericidal	bacteriostatic
☒ **C**	bacteriostatic	bactericidal
☒ **D**	bacteriostatic	bacteriostatic

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(b) One method of controlling the spread of antibiotic resistance is to avoid unnecessary prescriptions of antibiotics.

The table shows some illnesses and whether a prescription for antibiotics is recommended.

Illness	Antibiotic prescription
Bronchitis	may be recommended
Ear infection	may be recommended
Influenza	not recommended
Fluid in the ear	not recommended
Strep throat	recommended
Urinary tract infection	recommended

Explain why these recommendations could reduce the spread of antibiotic resistance.

(2)

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(c) In an investigation, *E.coli* bacteria were isolated from animals reared for food and from some wild animals.

The mean percentage of the *E. coli* isolated from each type of animal that were resistant to different types of antibiotics was determined.

The table shows the results of this investigation, where n is the number of each type of animal.

Antibiotic	**Mean percentage of resistant *E.coli* isolated from animals reared for food (%)**			**Mean percentage of resistant *E.coli* isolated from wild animals (%)**	
	Broiler chicken n = 45	**Village chicken n = 45**	**Cattle n = 12**	**Bat n = 13**	**Rodent n = 35**
Ampicillin	50.00	8.89	8.33	0.00	8.57
Cephalothin	14.29	8.89	8.33	20.00	14.58
Chloramphenicol	46.43	0.00	0.00	0.00	0.00
Neomycin	50.00	2.22	25.00	0.00	5.71
Tetracycline	95.86	55.56	25.00	0.00	2.86

(i) Calculate the ratio of tetracycline-resistant *E.coli* in all the chickens to tetracycline-resistant *E.coli* in cattle.

(2)

Answer .....

(ii) There was a total of 2×10^8 *E.coli* isolated from cattle and 6×10^9 *E.coli* isolated from rodents.

Calculate how many more *E.coli* are resistant to cephalothin in rodents than in cattle.

(2)

Answer .....

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(iii) Antibiotics can be added to animal feed.

It is thought this use of antibiotics has contributed to the spread of antibiotic resistance.

Evaluate the extent to which the results of this investigation support this idea.

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8 Infections caused by *Chlamydia* and human papillomavirus (HPV) are sexually transmitted.

The HPV is a non-enveloped DNA virus.

Chlamydia infection is caused by the bacterium, *Chlamydia trachomatis*.

(a) Compare and contrast the structure of a bacterial cell with the structure of HPV.

(3)

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(b) Some people with HPV infections have no symptoms but others develop warts and some types of cancer.

Over 99% of cervical cancers are caused by HPV.

Girls in the UK are offered an HPV vaccine.

(i) Explain how an HPV vaccine protects girls from developing cervical cancer.

(3)

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(ii) Explain why the HPV vaccine will not protect girls from infection with *Chlamydia*.

(3)

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*(iii) The HPV vaccination programme is being extended to boys.

Explain the advantages of offering the HPV vaccine to boys, as well as girls, in schools.

(6)

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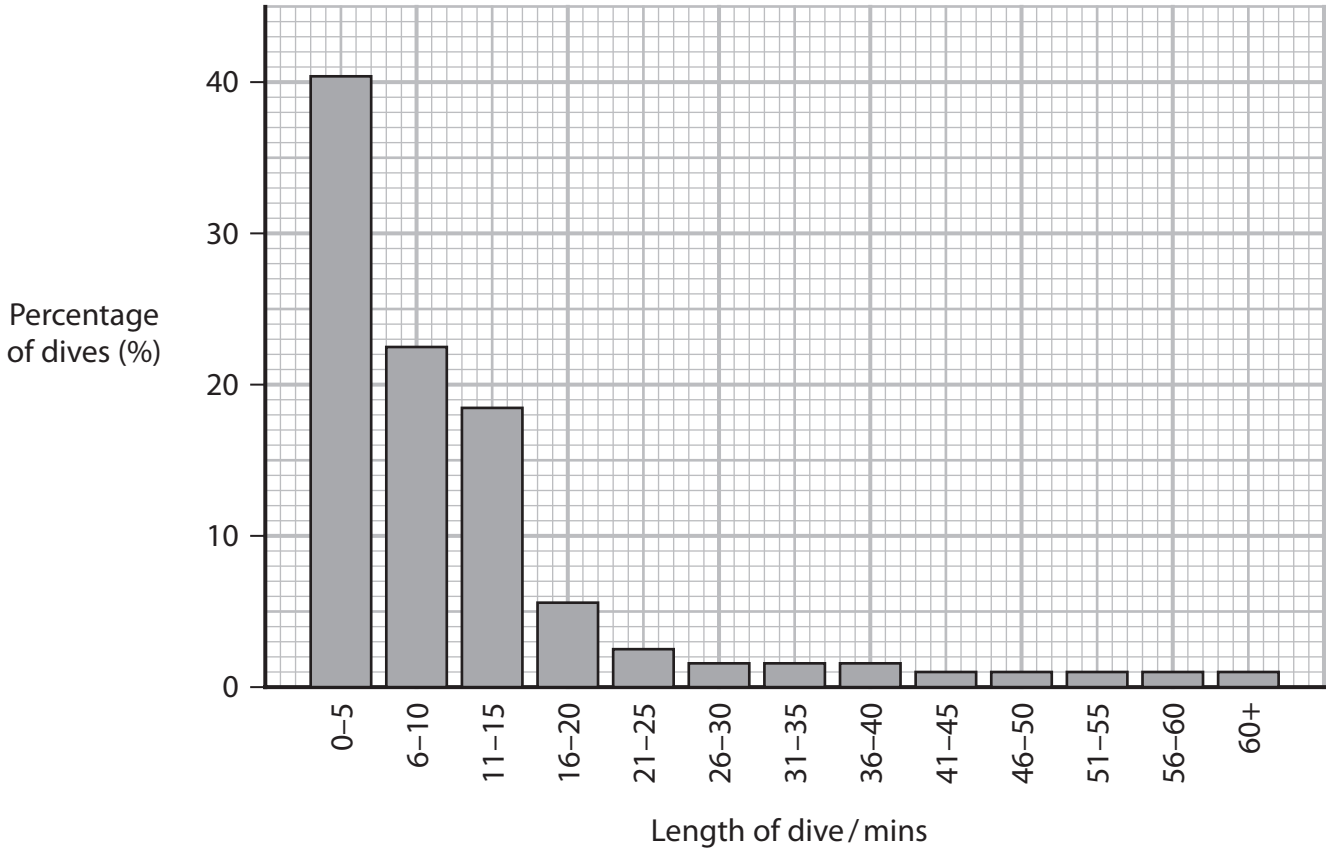
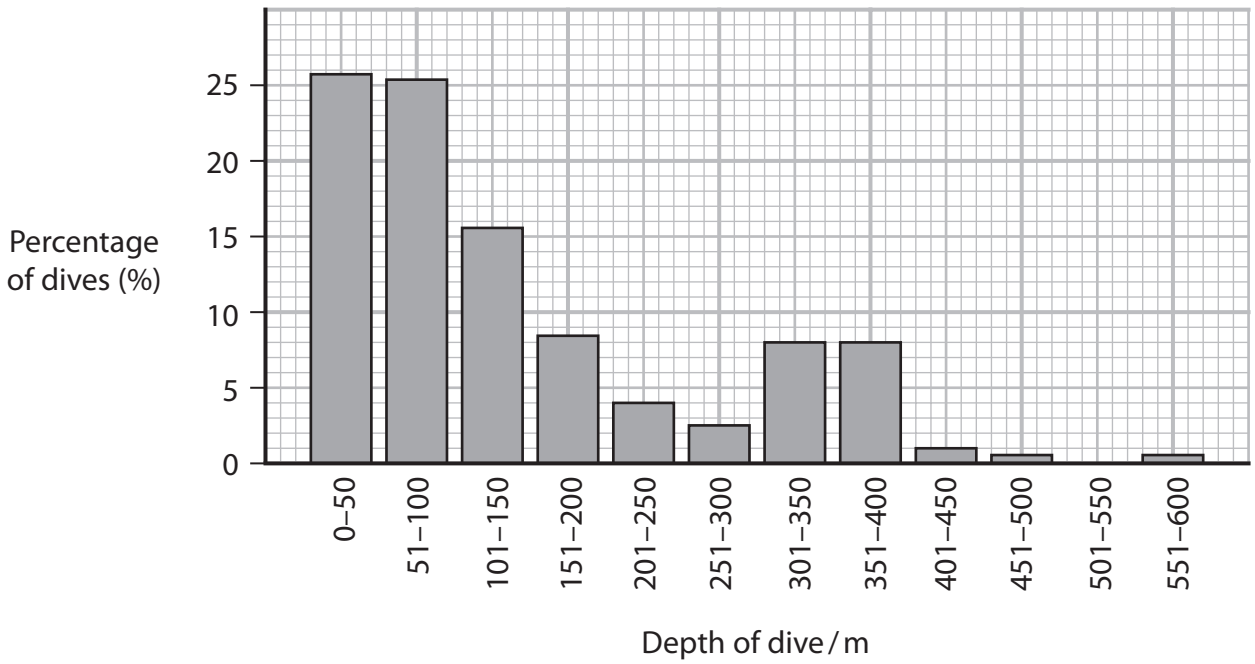
9 Weddell seals spend a lot of their time swimming underwater, diving to find food and diving to avoid predators.

However, they do have to come to the surface to breathe.

(a) The graphs give some information about dives by Weddell seals.





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Comment on the conclusions that can be made about the dives of these seals.

(4)

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(b) Weddell seals carry higher concentrations of oxygen in their bodies than humans.

(i) The haemoglobin of Weddell seals is adapted to carry higher levels of oxygen than the haemoglobin of humans, at each partial pressure of oxygen.

Which row of the table describes the haemoglobin of the Weddell seal?

(1)

	Position of oxygen dissociation curve compared with human haemoglobin	Affinity for oxygen compared with human haemoglobin
☒ **A**	to the left	higher
☒ **B**	to the left	lower
☒ **C**	to the right	higher
☒ **D**	to the right	lower

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*(ii) The table shows how much oxygen is stored in different parts of the body of humans and Weddell seals.

Part of body	Total oxygen stored / a.u. kg^{-1} body tissue	
	humans	Weddell seals
lungs	12	3
blood	10	58
muscle	2	23
body fluids, other than in the blood	2	2

Weddell seals also store erythrocytes in their spleen that are released into the bloodstream during deep dives.

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Analyse the data to explain the differences between these two mammals.

(6)

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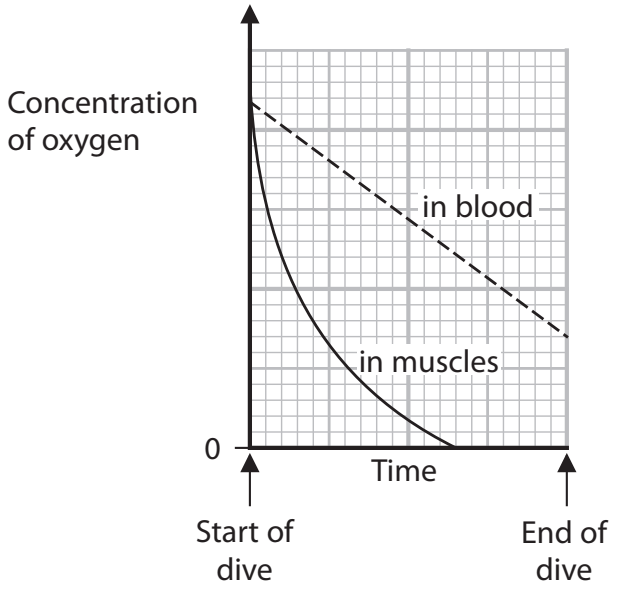
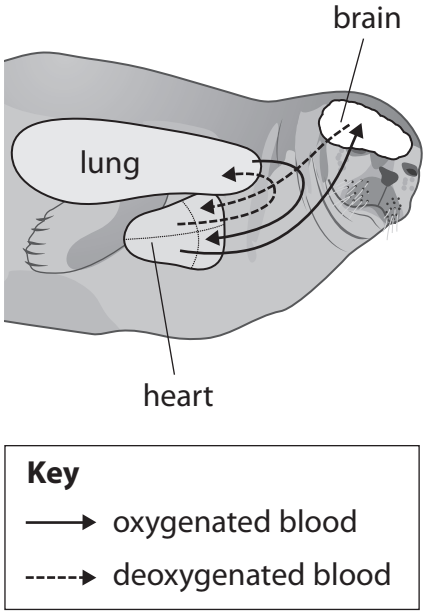
(c) An investigation studied the change in the concentration of oxygen in the blood and muscles of a Weddell seal during a dive.

The graph shows the results of this investigation and the diagram shows part of the circulation of blood in the seal during the dive.





Analyse the data to explain these results.

(3)

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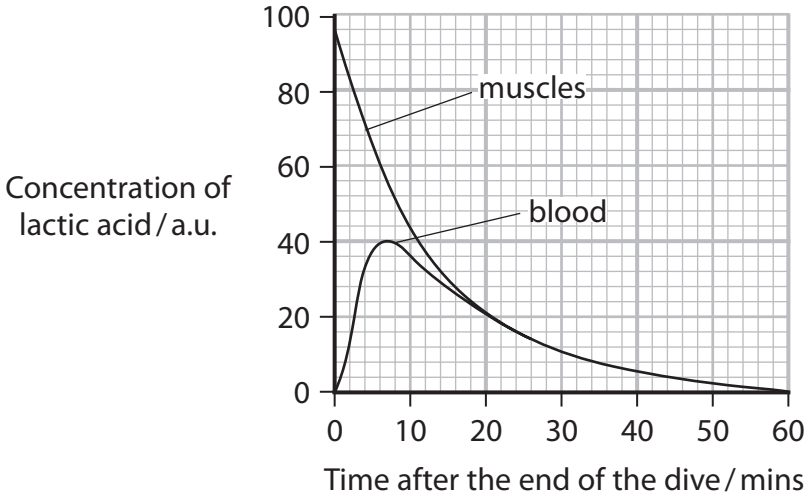
(d) The graph shows the changes in the lactic acid concentration in the muscles and blood of a Weddell seal, after a prolonged dive.



Explain the importance of these changes after the Weddell seal comes to the surface to breathe.

(3)

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(Total for Question 9 = 17 marks)

TOTAL FOR PAPER = 90 MARKS

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