Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Time 1 hour 30 minutes

Paper reference **WBI11/01**

Biology

Advanced Subsidiary

UNIT 1: Molecules, Diet, Transport and Health

You must have:
Scientific calculator, ruler, HB pencil

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.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- 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.

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.

Turn over ▶

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P 7 1 8 4 5 A 0 1 2 8

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

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 cell membrane controls which substances can enter and leave a cell.

The cell membrane is a phospholipid bilayer with proteins embedded in it.

(a) (i) The shapes show the components of a phospholipid.

phosphate group	glycerol	fatty acid	covalent bond
◯	□	▯	———

Draw a diagram to show the structure of a phospholipid, using these shapes.

(2)

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(ii) Which type of bond is found in this molecule?

(1)

- ☒ **A** ester
- ☒ **B** glycosidic
- ☒ **C** hydrogen
- ☒ **D** peptide

(b) (i) How does a nonpolar molecule move through a cell membrane, down a concentration gradient into a cell?

(1)

- ☒ **A** by active transport
- ☒ **B** by diffusion
- ☒ **C** by exocytosis
- ☒ **D** by osmosis

(ii) How many of the following statements are correct for the transport of a substance by endocytosis?

- transports substances out of the cell
- the cell membrane surrounds the substance
- can only transport substances down a concentration gradient

(1)

- ☒ **A** none
- ☒ **B** one
- ☒ **C** two
- ☒ **D** three

(Total for Question 1 = 5 marks)

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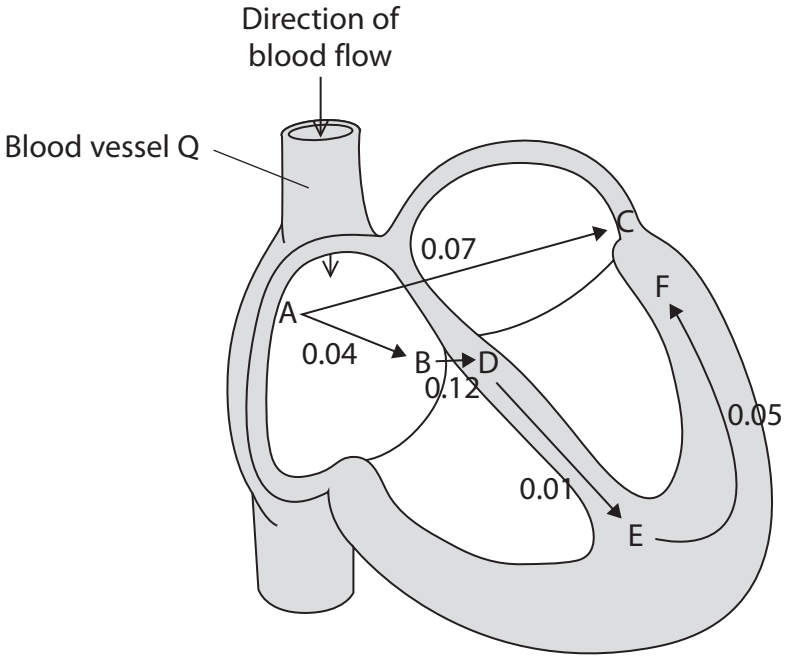
2 The diagram shows the time taken, in seconds, for an impulse to travel through different parts of the heart.



(a) What is the name of blood vessel Q?

(1)

- ☒ **A** aorta
- ☒ **B** pulmonary artery
- ☒ **C** pulmonary vein
- ☒ **D** vena cava

(b) The cardiac cycle is divided into three stages. Two of these stages are atrial systole and ventricular systole.

(i) Name the other stage of the cardiac cycle.

(1)

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(ii) The duration of ventricular systole is the time it takes for the impulse to pass between E and F, shown on the diagram.

Calculate the proportion of time that the ventricles are contracting in one heartbeat if this heart beats 73 times per minute.

(2)

Answer .....

(c) The part labelled B is in the wall of the atrium and the part labelled D is in the wall of the ventricles.

(i) The distance between B and D is 12.5 mm.

Calculate the speed at which the impulse travels between B and D.

(1)

Answer ..... mm s^{-1}

(ii) Explain why this speed needs to be slower than the speeds that the impulse travels between other parts of the heart.

(2)

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(Total for Question 2 = 7 marks)

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3 The structure of blood vessels relates to their function.

(a) Describe how the structure of capillaries relates to their function.

(2)

(b) Draw a cross-section of an artery to show details of its structure.

Label **two** features of the artery on your diagram.

(3)

(c) Explain why veins need valves along their length.

(2)

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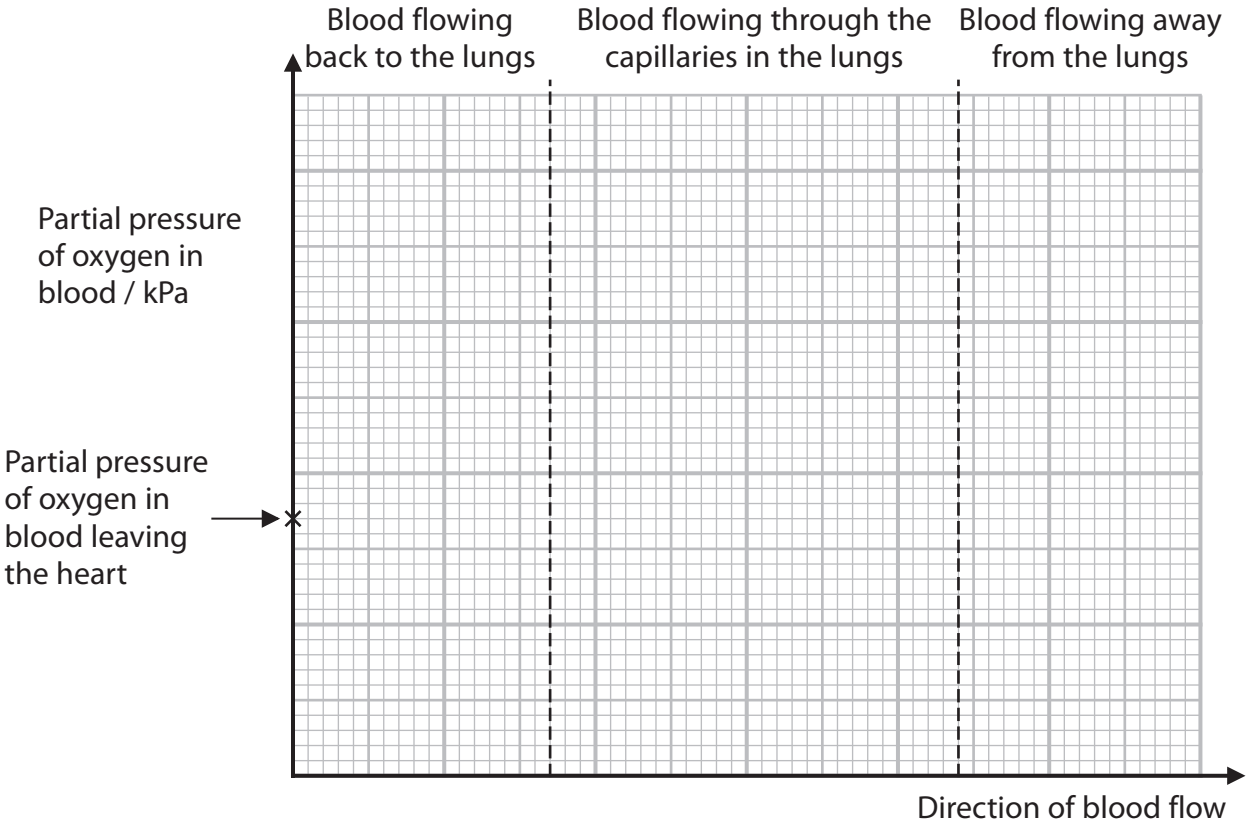
(d) Deoxygenated blood is taken to the lungs and oxygenated blood is taken away from the lungs.

Complete the graph to show the changes in partial pressure of oxygen in the blood as it flows back to the lungs, through the lungs and away from the lungs.

(3)



(Total for Question 3 = 10 marks)

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4 Enzymes are biological catalysts that have an effect on the energy required for a reaction.

(a) State the meaning of the term **biological catalyst**.

(2)

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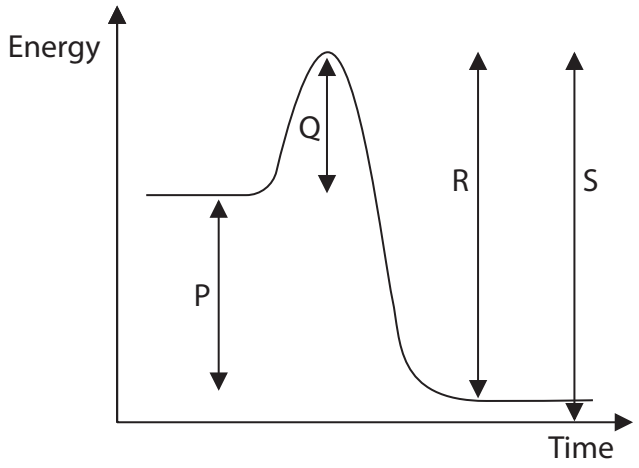
(b) The graph shows the energy changes during an enzyme catalysed reaction.



Which arrow shows the energy required to start the reaction?

(1)

☒ **A** P

☒ **B** Q

☒ **C** R

☒ **D** S

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(c) The diagram shows a series of chemical reactions.

$$A + B \xrightarrow{E_1} AB \xrightarrow{E_2} AC \xrightarrow{E_3} D$$

Three different enzymes, E_1, E_2 and E_3, are involved in these reactions.

Explain why E_1 cannot convert AB into AC or AC into D.

Use the information in the diagram to support your answer.

(3)

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(d) Pectinase is an enzyme that breaks down pectin.

The effect of different combinations of pH and temperature on pectinase activity was investigated.

The volume and concentration of pectinase and pectin were kept the same in all reactions.

The table shows the rate of reaction for each pH and temperature combination tested.

pH	Temperature / °C	Rate of reaction / a.u.
2	5	0
2	30	0
2	60	0
4	5	5
4	30	35
4	60	0
8	5	5
8	30	10
8	60	0

Describe **two** conclusions that can be drawn from these results.

(2)

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2 .....

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(Total for Question 4 = 8 marks)

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5 Gas exchange requires diffusion.

The rate of diffusion is dependent on the surface area, the diffusion distance and the concentration gradient.

The rate of diffusion can be calculated using the formula:

$$\text{rate of diffusion} \propto \frac{\text{surface area} \times \text{concentration gradient}}{\text{diffusion distance}}$$

(a) Name the law on which this formula is based.

(1)

.....

(b) What will happen to the rate of diffusion if all three of the following are changed at the same time?

- the surface area is halved
- the concentration gradient is halved
- the diffusion distance is halved

(1)

☒ **A** it will stay the same

☒ **B** it will be a quarter of its value

☒ **C** it will halve

☒ **D** it will double

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(c) The properties of gas exchange surfaces include:

- a large surface area
- a short diffusion distance
- a high concentration gradient.

Describe how mammalian lungs are adapted to have each of these three properties.

(3)

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*(d) The photograph shows a hellbender salamander.



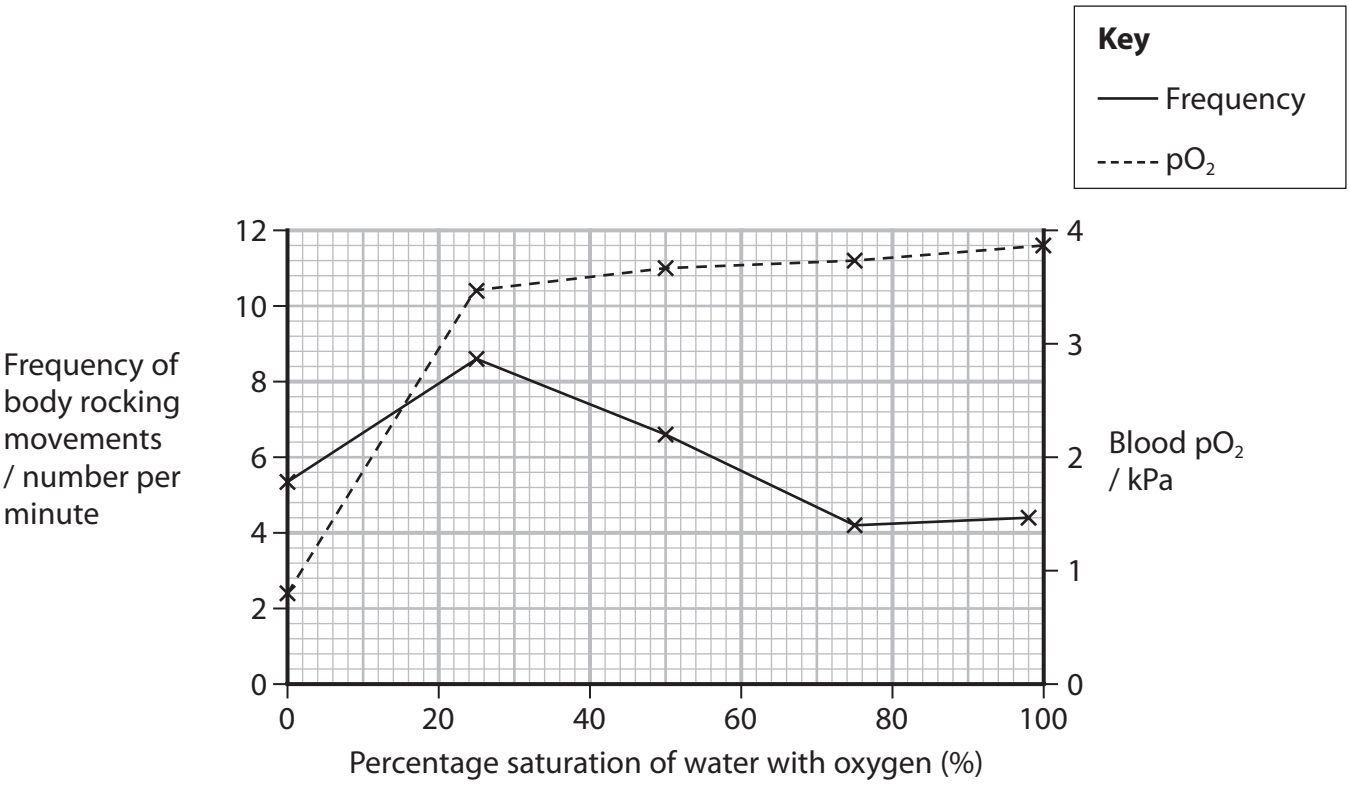
(Source: © Robert Hamilton/Alamy Stock Photo)

These salamanders live in freshwater streams that are shallow and fast-flowing.

They use their lungs and the surface of their skin for gas exchange.

They also use body rocking and swaying movements in the water.

The graph shows the relationship between the frequency of body rocking movements, blood pO_2 and the percentage saturation with oxygen of the water they live in.



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Discuss how the structure and behaviour of these salamanders are adapted for gas exchange.

(6)

(Total for Question 5 = 11 marks)

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6 Warfarin is an anticoagulant.

The dose of warfarin that is given to a patient has to be monitored regularly. This is done by adding thromboplastin to a blood sample and measuring the time it takes for the blood to clot.

The result is compared with a control sample and is reported as an International Normalised Ratio (INR) level.

(a) How many of the following statements are correct for thromboplastin?

- it is stored in platelets
- it is an active enzyme
- it is converted into thrombin

(1)

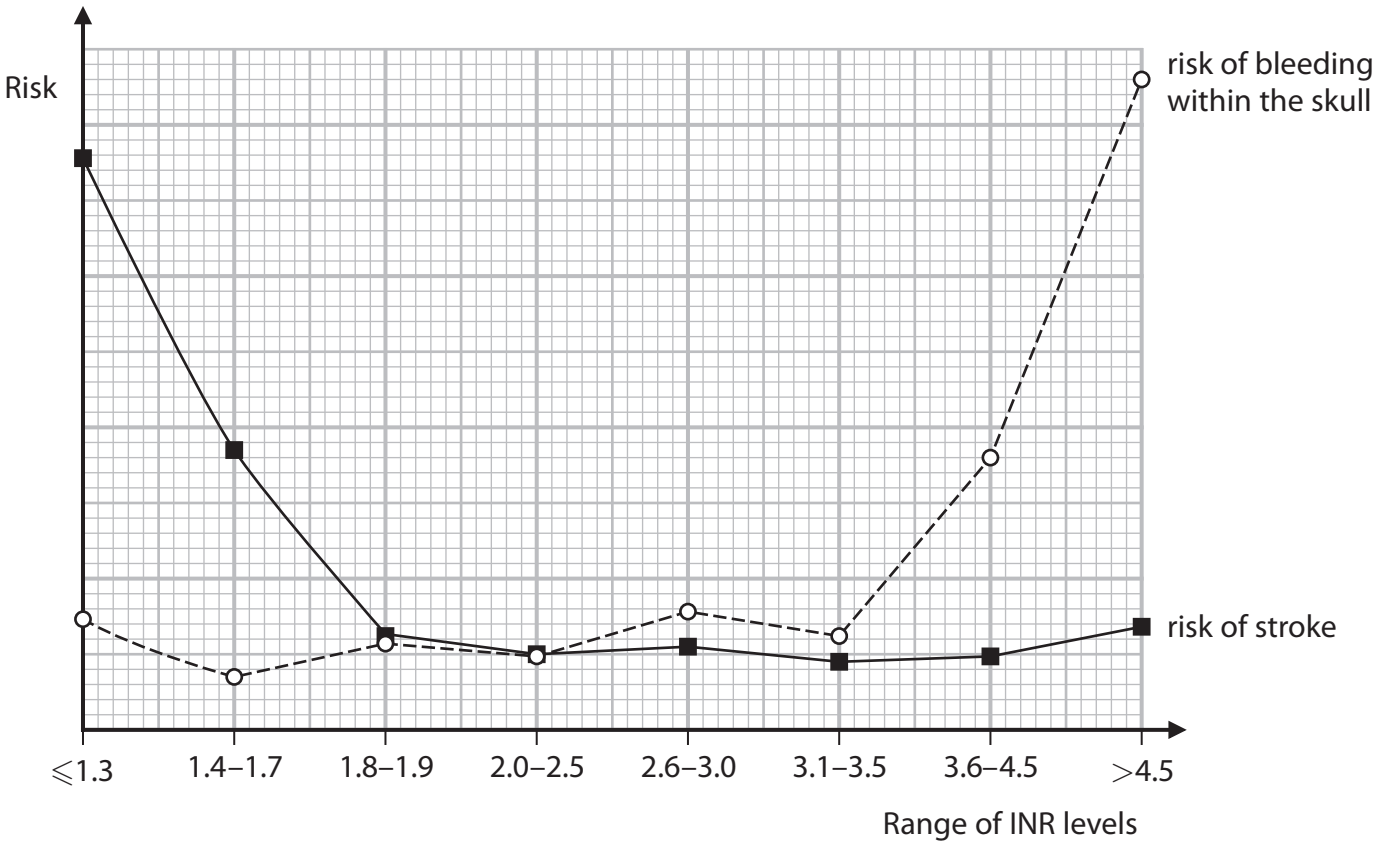
☒ **A** none

☒ **B** one

☒ **C** two

☒ **D** three

(b) The graph shows the relationship between the INR level and the risk of stroke and the risk of bleeding within the skull.



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Deduce a safe range for the INR level.

Use the information in the graph to support your answer.

(3)

(c) Explain how taking this anticoagulant can reduce the risk of cardiovascular disease (CVD).

(3)

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(d) Warfarin is given to patients who have had a heart attack, to prevent further heart attacks and other related health issues.

A study compared warfarin with the use of aspirin, over a four-year period following the first heart attack.

(i) A group of 1216 were given warfarin; 83.3% of these people had no further health issues.

Calculate the number of people given warfarin who had no further health issues following their first heart attack.

(1)

Answer .....

(ii) A second study compared this result with people given a combination of warfarin and aspirin.

Describe how this study should be carried out to produce a valid comparison.

(4)

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(Total for Question 6 = 12 marks)

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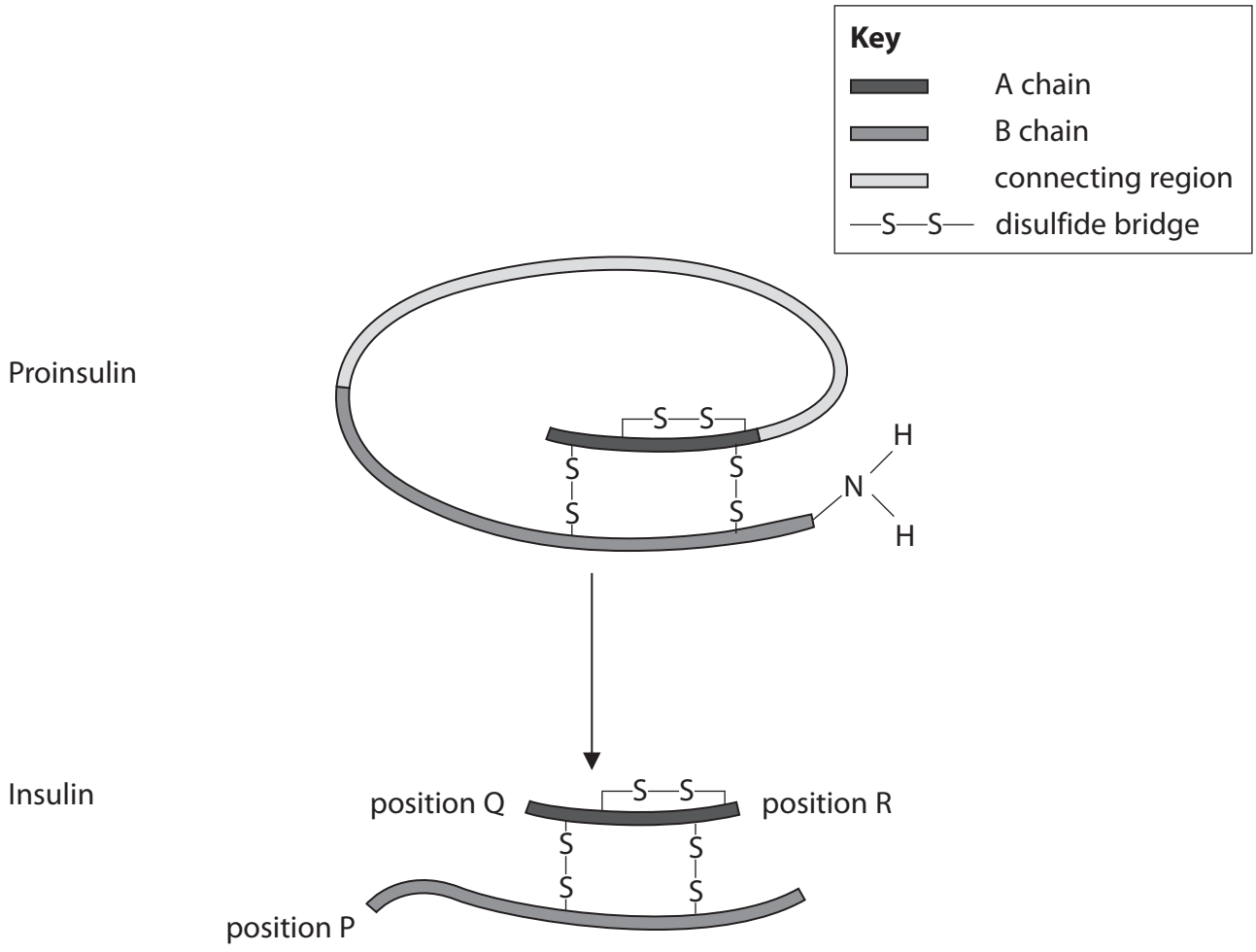
7 Insulin is a small protein composed of two peptide chains, the A chain and the B chain.

Insulin is made from the protein proinsulin.

Proinsulin is composed of the A chain and the B chain joined by a sequence of amino acids called the connecting region.

The diagram shows how insulin is formed from proinsulin.



(a) The connecting region is removed from proinsulin, leaving the A chain connected to the B chain by disulfide bridges (—S—S—).

Which row of the table shows the position of an amino group (NH_2) and a carboxyl group (COOH)?

(1)

	Amino group	Carboxyl group
☒ **A**	position R	position P
☒ **B**	position P	position R
☒ **C**	position Q	position R
☒ **D**	position Q	position P

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(b) Proinsulin is composed of 84 amino acids.

Insulin is composed of 51 amino acids.

(i) What percentage of proinsulin is the connecting region?

(1)

Answer ..... %

(ii) There are three disulfide bridges in insulin. Each disulfide bridge is formed between the R groups of two cysteine amino acids.

Give the ratio of amino acids forming disulfide bridges in insulin to those not forming disulfide bridges in insulin.

(1)

Answer .....

(c) Suggest how insulin is synthesised from proinsulin.

Use the information in the diagram to support your answer.

(2)

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(d) Insulin lowers the levels of glucose in the blood. This glucose is taken up by the liver and stored as glycogen.

Compare and contrast the structure of glucose with the structure of glycogen.

(3)

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*(e) Type 2 diabetes is a disorder that can result from ineffective or insufficient insulin. It is a risk factor for cardiovascular disease (CVD).

Cinnamon is a spice that has been shown to:

- increase the uptake of glucose from the blood into the liver
- increase the synthesis of glycogen.

In a study using rats, the effects of a cinnamon extract on levels of glucose in the blood was determined.

In this study a group of healthy rats and a group of rats with induced diabetes were used. The rats were given either the cinnamon extract or water, each day for 30 days.

The table shows the results of this study.

Time / days	Levels of glucose in the blood in healthy rats / mg dm^{-3}		Levels of glucose in the blood in rats with induced diabetes / mg dm^{-3}	
	Rats given water	Rats given cinnamon extract	Rats given water	Rats given cinnamon extract
0	106	102	395	378
10	101	103	403	346
20	99	96	419	384
30	94	90	493	369

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Explain the results of this study.

(6)

(Total for Question 7 = 14 marks)

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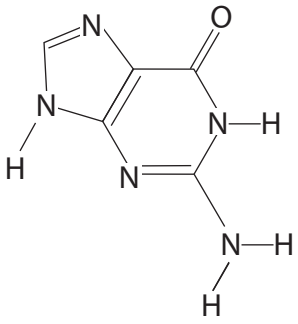
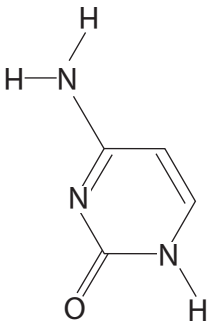
8 Mononucleotides are joined together to form DNA. Each mononucleotide is composed of a deoxyribose linked to a phosphate and one of four bases.

(a) The diagrams show the structure of the four bases.

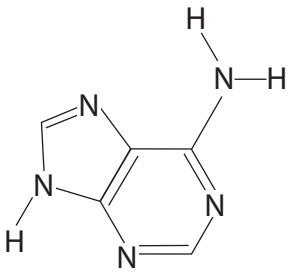
Guanine and adenine have two ring structures, cytosine and thymine have one ring structure.



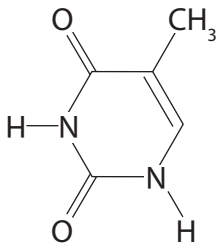
guanine



cytosine



adenine



thymine

Explain the role of these bases in the structure of DNA.

Use the information in the diagram to support your answer.

(3)

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(b) The DNA of the bacterium *E. coli* has a mass of 3.1×10^9 daltons (Da) and consists of 4.7×10^6 base pairs.

(i) Calculate the mean mass of a base pair.

Express your answer in standard form.

(1)

Answer ..... Da

(ii) Calculate the total mass of DNA produced after three cell divisions.

Give your answer in grams, where 1 dalton = 1.67×10^{-24} grams.

(2)

Answer ..... g

(c) Meselson and Stahl provided data that supported the theory that DNA replicates by semi-conservative replication and disproved competing theories.

Heavy nitrogen (N^{15}) and light nitrogen (N^{14}) were used in their experiments.

The flow chart summarises part of one experiment performed by Meselson and Stahl.

Stage 1

Bacteria grown for several generations in culture medium containing heavy nitrogen (N^{15})

↓

Stage 2

Bacteria from stage 1 grown for one generation in culture medium containing light nitrogen (N^{14})

↓

Stage 3

Bacteria from stage 2 grown for one generation in a culture medium containing light nitrogen (N^{14})

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After each stage, a sample of DNA was taken from the bacteria and the DNA molecules separated on a density gradient in a tube.

The heavier DNA molecules form bands lower down the gradient than the lighter DNA molecules.

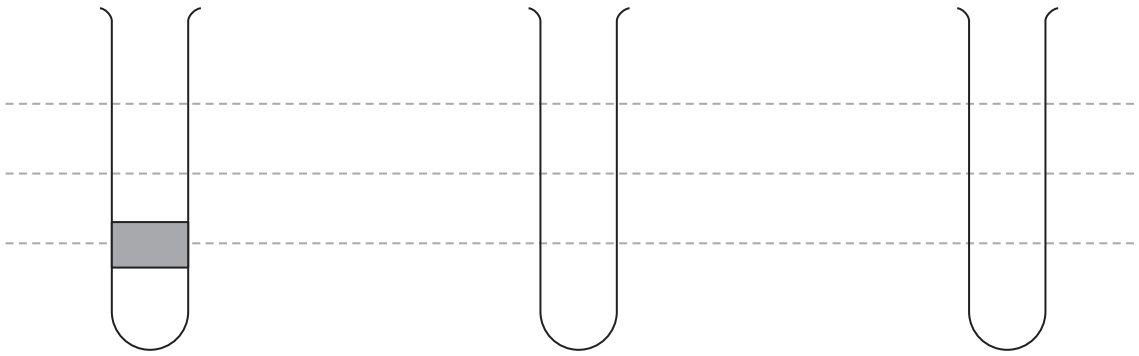
The width of each band is proportional to the percentage of molecules in the sample.

(i) Complete the diagram to show the results of this investigation.

Use the dotted lines to help you position the bands on the diagram.

The first one has been done for you.

(3)



DNA taken after stage 1

DNA taken after stage 2

DNA taken after stage 3

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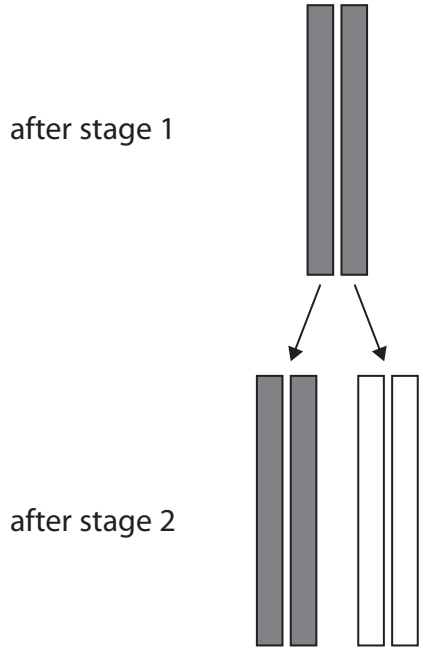
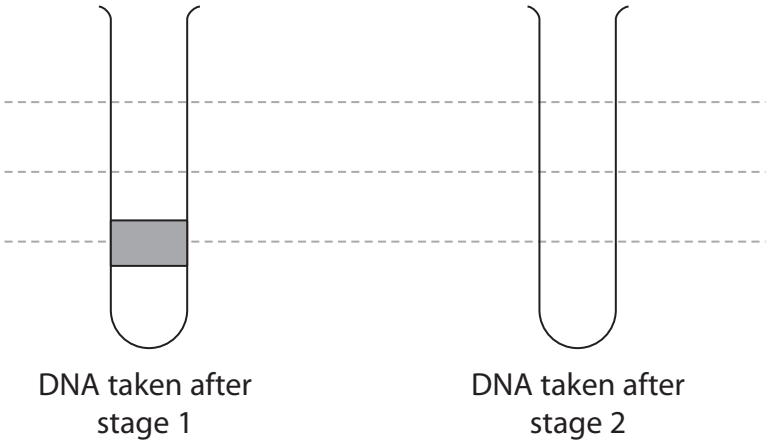
(ii) One competing theory was the conservative theory.

The diagram shows the conservative theory for the replication of DNA.



Complete the diagram to show the position of the bands on the density gradient in a tube if this was the correct theory.

(2)



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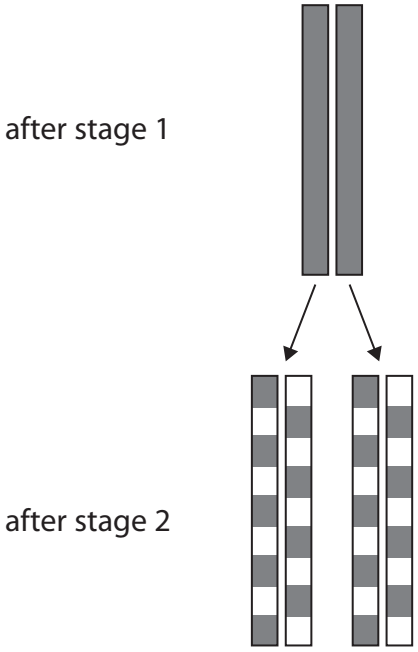
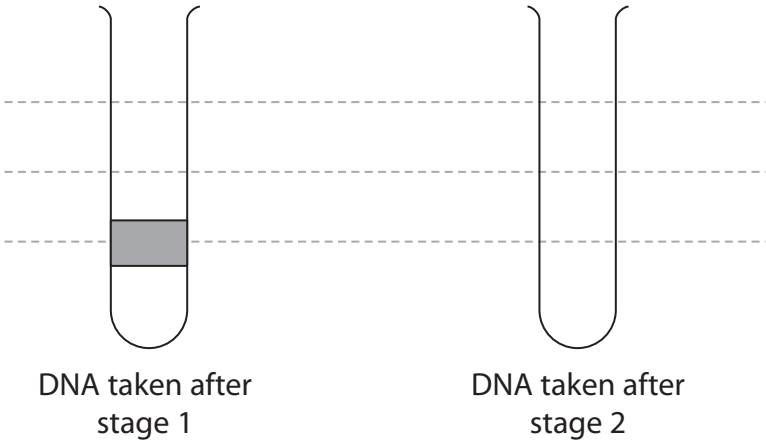
(iii) Another competing theory was the dispersive theory.

The diagram shows the dispersive theory.



Complete the diagram to show the position of the bands on the density gradient in a tube if this was the correct theory.

(2)



(Total for Question 8 = 13 marks)

TOTAL FOR PAPER = 80 MARKS

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