Pearson Edexcel International Advanced Level

Tuesday 6 May 2025

Morning (Time: 1 hour 30 minutes)

Paper reference WBI11/01

Biology

International Advanced Subsidiary / Advanced Level
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*.
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to
  structure your answer logically, showing how the points 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 ▶

BLANK PAGE

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: One risk factor for cardiovascular disease is a short blood clotting time.

One test for measuring blood clotting time is the prothrombin time (PT).

(a) Read through the following passage about prothrombin and the blood clotting process.

Complete the passage by writing the most appropriate word or words on the dotted lines.

(3)

Prothrombin is transported in the .... of a human.

It is converted into thrombin by an enzyme called ....

The substrate for thrombin is ....

(b) Which pair of drugs is used to treat patients who have short blood clotting times?

(1)

☒ **A** anticoagulants and antihypertensives

☒ **B** anticoagulants and platelet inhibitors

☒ **C** antihypertensives and statins

☒ **D** platelet inhibitors and statins

(c) The range for a healthy PT is between 10 and 13 seconds.

A person with a PT of 8.5 seconds was treated with a drug to increase the PT time to 10 seconds.

Calculate the percentage increase in PT from 8.5 seconds to 10 seconds.

(1)

Answer .... %

(Total for Question 1 = 5 marks)

2: Haemoglobin transports oxygen and carbon dioxide around the body.

(a) Haemoglobin binds to oxygen in the lungs and releases it in the tissues.

The percentage saturation of haemoglobin plotted against partial pressure of oxygen is called the dissociation curve.

The sketch shows the shape of a dissociation curve.
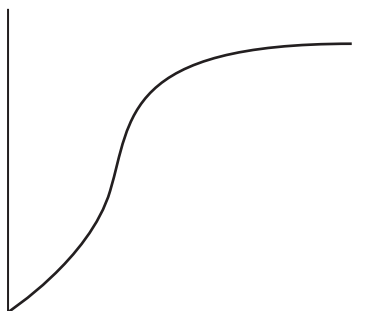
(i) Which describes this dissociation curve?

(1)

⊠ **A** linear curve showing a positive correlation

⊠ **B** linear curve showing a negative correlation

⊠ **C** sigmoid curve showing a negative correlation

⊠ **D** sigmoid curve showing a positive correlation

(ii) Which name is given to the effect of increasing carbon dioxide concentration on this dissociation curve?

(1)

⊠ **A** Benedict

⊠ **B** Bohr

⊠ **C** Fick

⊠ **D** Stahl

(b) Explain how the structure of haemoglobin is related to its function in transporting oxygen and carbon dioxide.

(3)

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(Total for Question 2 = 5 marks)

3: The structures of blood vessels relate to their functions.

(a) The diagram shows part of a cross-section of an artery.

Complete the diagram to show details of the structure of an artery.

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

(3)
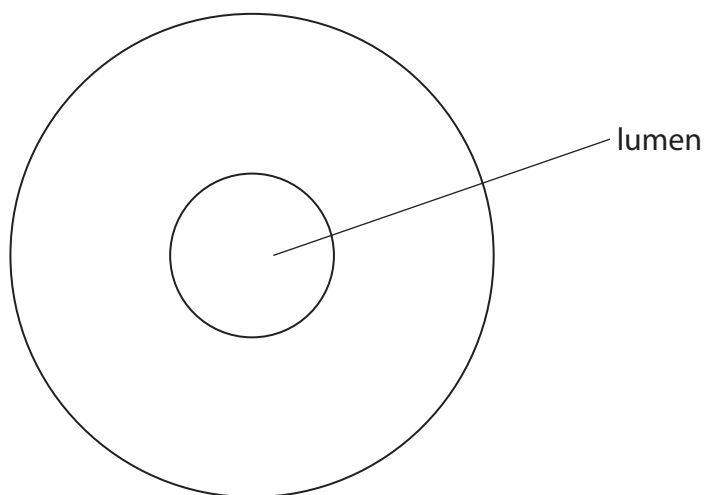
lumen

(b) The table shows some dimensions of two veins.

Vein	Total diameter of the vein	Diameter of the lumen /mm	Thickness of wall /μm
Vena cava	31 mm	30	500
Small vein	46 μm		4

(i) Which is the ratio of the diameter of the lumen to the thickness of wall in the vena cava?

(1)

☒ **A** 0.06 : 1.00

☒ **B** 1.00 : 0.02

☒ **C** 1.00 : 16.67

☒ **D** 60.00 : 1.00

(ii) Calculate the cross-sectional area of the **lumen** of this small vein.

Use the formula:

$$\text{cross-sectional area} = \pi r^2$$

Give your answer as a whole number.

(2)

Answer .... μm^2

(Total for Question 3 = 6 marks)

4: One function of the heart is to transport oxygen from the gas exchange surface to the cells.

(a) The gas exchange surfaces of a frog change as a tadpole develops into an adult frog.

The graph shows some of these changes.
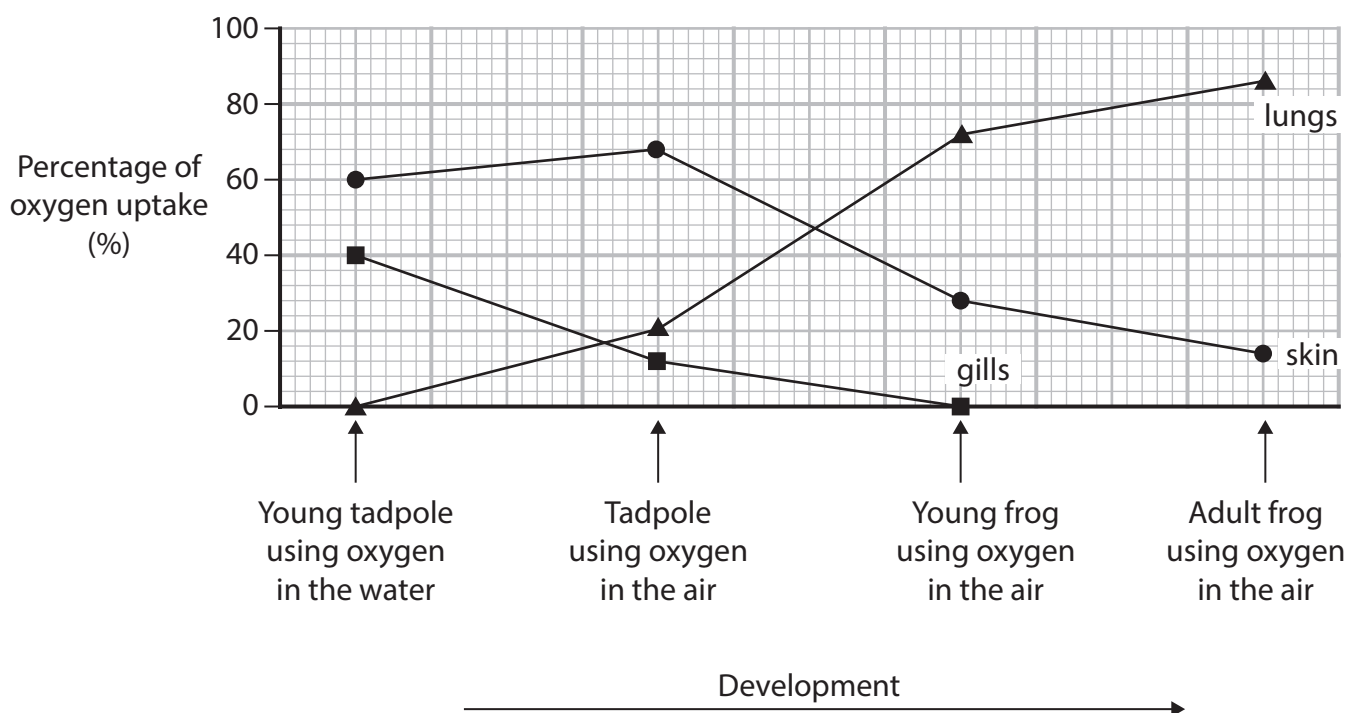
The contribution to gas exchange of the lungs, gills and skin changes as a tadpole develops into a frog.

Explain the importance of these changes.

(3)

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P 7 8 7 3 5 A 0 8 2 8

(b) The diagram shows the structure of the heart of a frog.
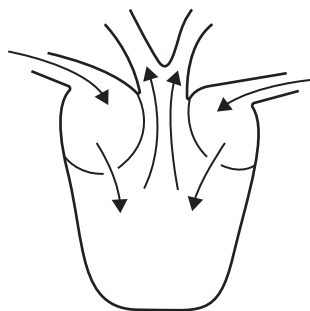
Give **one** similarity and **one** difference between the structure of this heart and a mammalian heart.

(2)

Similarity

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Difference

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*(c) The diagram shows the distribution of blood flowing through the circulatory system of a frog.

The percentages of blood flowing through the parts of the circulatory system are shown on the diagram.
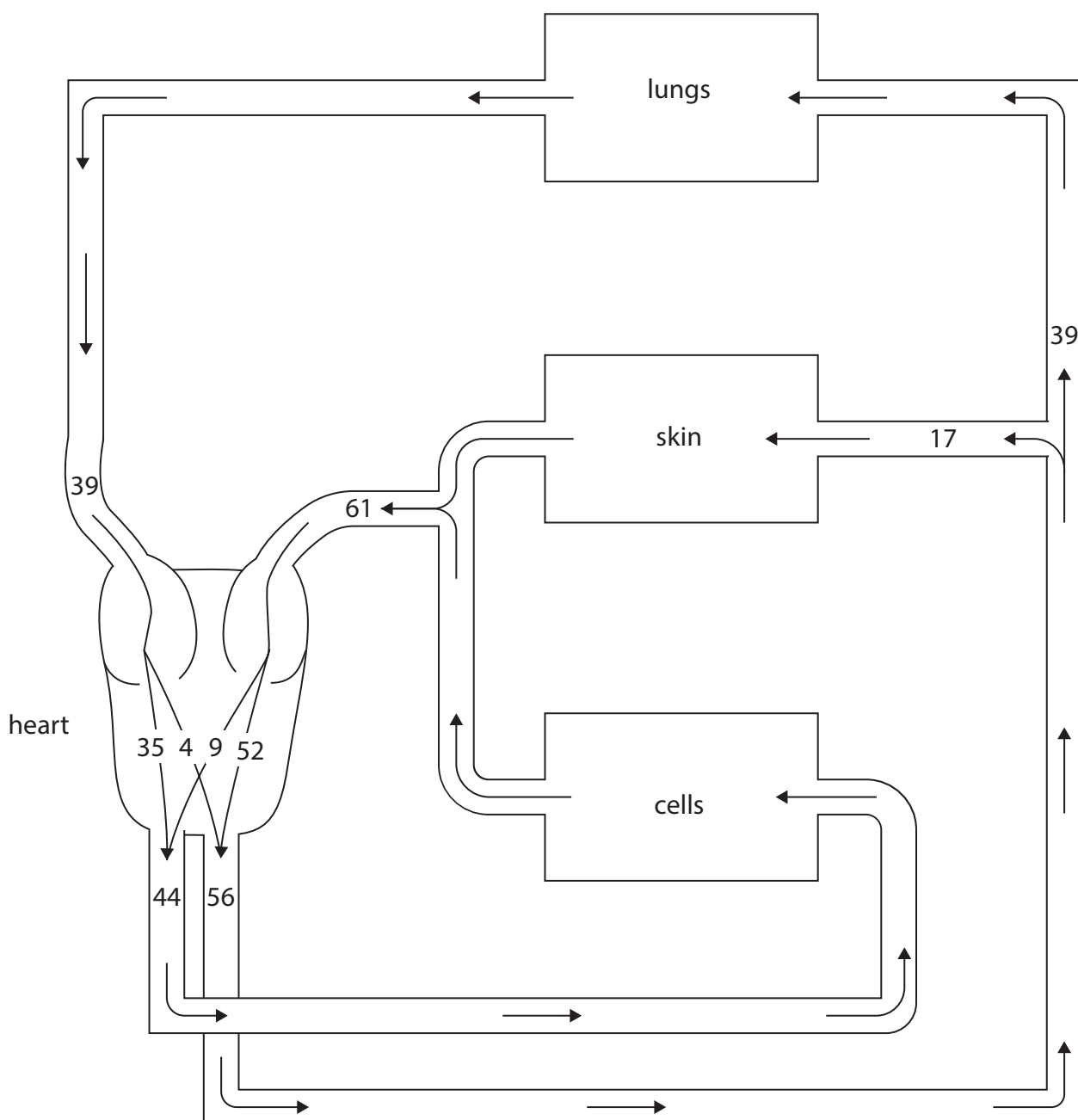
The cells of the frog need oxygen to survive.

Explain how the circulatory system and the gas exchange surfaces of an adult frog are able to meet this need for oxygen.

Use the information in the diagram to support your answer.

(6)

(Total for Question 4 = 11 marks)

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5: When an organism grows or increases in number, cell division takes place.

(a) When a cell is preparing to divide, DNA synthesis takes place.

Explain how two identical molecules of DNA are produced.

(2)

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(b) Protein synthesis increases as a cell grows.

Describe the roles of messenger RNA (mRNA) and transfer RNA (tRNA) in protein synthesis.

(3)

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(c) The Voronoi diagram shows the proportions of molecules in a bacterial cell.

The area of each labelled part of the square is proportional to the percentage of the dry mass of that molecule. The shape of each part has no meaning.

(Source: http://book.bionumbers.org/what-is-the-macromolecular-composition-of-the-cell/)
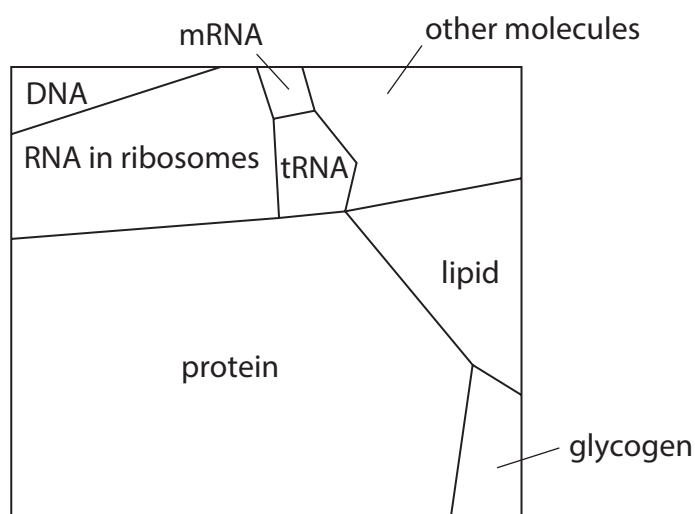
(i) Give **one** advantage and **one** disadvantage of using a Voronoi diagram to present this information.

(2)

Advantage

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Disadvantage

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*(ii)   The proportions of these molecules change as a bacterial cell prepares
to divide, as it divides into two new bacterial cells and as each new
bacterial cell grows.

Discuss how the appearance of this Voronoi diagram might change:

• as a bacterial cell prepares to divide

• in one of the new bacterial cells produced

• as one new bacterial cell increases in size.

Give reasons for these changes to support your answer.

(6)

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(Total for Question 5 = 13 marks)

6: The structure and properties of a cell membrane determine which molecules can pass through the membrane.

(a) The diagram shows some structures in part of a cell membrane.
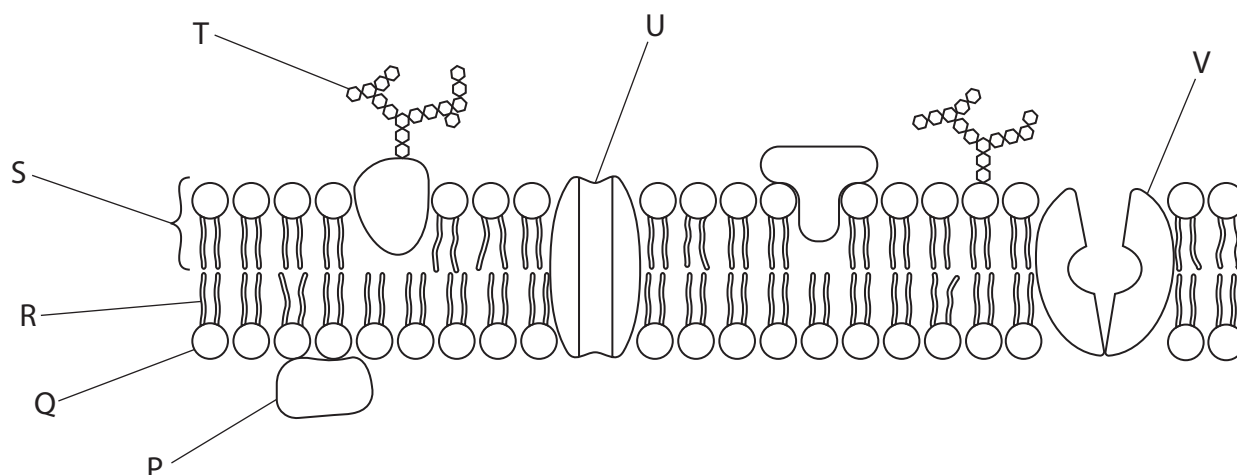
(i) Which structure **prevents** large polar (hydrophilic) molecules from diffusing through the membrane?

(1)

- ☒ **A** Q
- ☒ **B** R
- ☒ **C** T
- ☒ **D** V

(ii) Which structure **allows** ions to diffuse through the membrane?

(1)

- ☒ **A** P
- ☒ **B** S
- ☒ **C** T
- ☒ **D** U

(iii) Which structure **allows** the membrane to be fluid?

(1)

- ☒ **A** P
- ☒ **B** Q
- ☒ **C** S
- ☒ **D** U

(b) The diagram shows a cholesterol molecule.

polar (hydrophilic) region

non-polar (hydrophobic) region
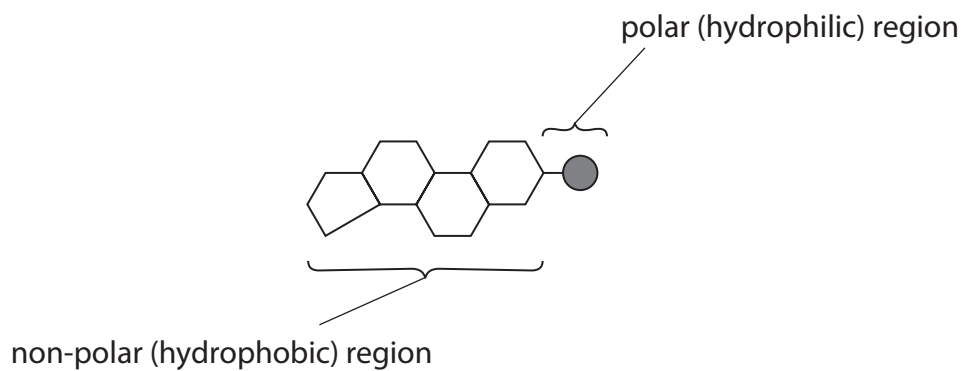
Which diagram shows the correct position of a cholesterol molecule in the membrane?

(1)

◻ **A**

◻ **B**

◻ **C**

◻ **D**
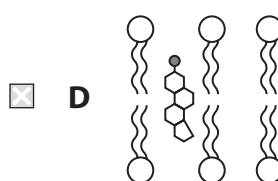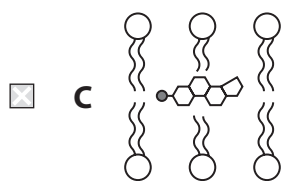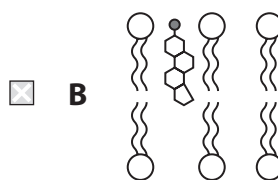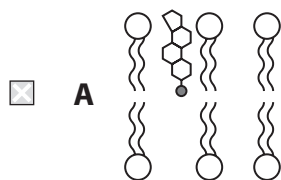
(c) The graph shows the effect of temperature and cholesterol on membrane fluidity.
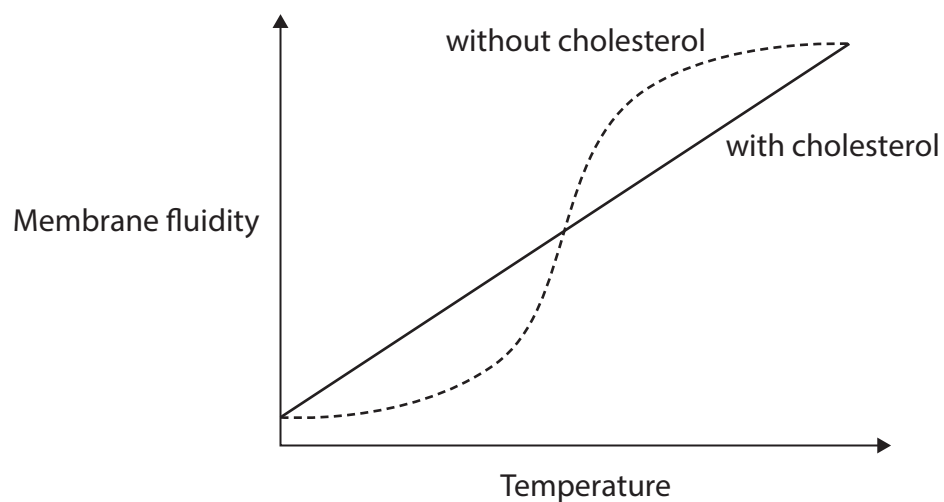
Describe the effect of temperature and cholesterol on membrane fluidity.

(3)

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P 7 8 7 3 5 A 0 1 8 2 8

(d) The table shows the composition of protein, lipid and carbohydrate in three membranes, A, B and C.

Membrane	Percentage of protein (%)	Percentage of lipid (%)	Percentage of carbohydrate (%)
A	49	43	8
B	54	42	4
C	75	25	0

(i) Calculate the ratio of protein : lipid in membrane A.

Give your answer to **2** decimal places.

(1)

Answer .... : 1

(ii) Compare and contrast the composition of these three membranes.

(3)

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(Total for Question 6 = 11 marks)

7: Plastic waste can cause damage to the environment.

Some microorganisms produce enzymes that break down plastic.

Scientists are using protein engineering techniques to modify these enzymes to improve the way in which they break down plastics.

These modifications include:

* changing the properties of the active site

* making enzymes more stable at higher temperatures

* increasing the size of the active site of the enzyme.

(a) The interaction between enzyme and substrate can be improved by changing the properties of the active site.

Explain what determines the properties of an active site.

(2)

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(b) (i) Some types of plastic break down at higher temperatures.
These temperatures are too high for some enzymes to be active.

Explain why some enzymes cannot function at high temperatures.

(3)

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(ii) Changing the bonding in the enzyme can make it more stable at higher temperatures.

Suggest why changing the bonding could enable enzymes to work at higher temperatures.

(2)

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(iii) Suggest why changing the bonding could affect the binding of the plastics to the active site of the enzyme.

(2)

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(c) A larger active site could affect the activity of the enzyme.

(i) Suggest how a larger active site could **increase the rate** of breakdown of plastic.

(2)

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(ii) Suggest why an enzyme with a larger active site may be **less active**.

(1)

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(d) One way of improving the activity of an enzyme is to link it to a different enzyme.

The diagram shows two different enzymes linked together.
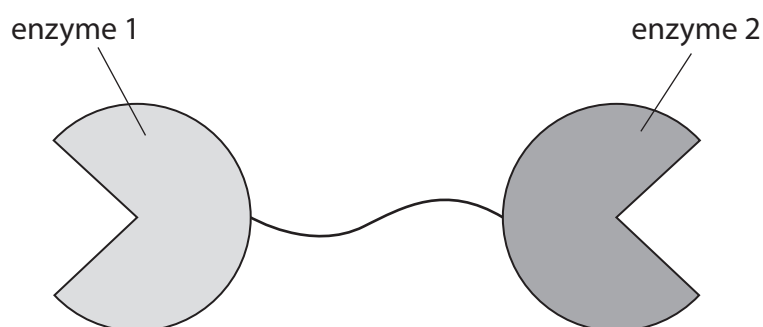
enzyme 1   enzyme 2

Enzyme 1 is the enzyme that is engineered by linking it to a different enzyme, enzyme 2.

Enzyme 1 breaks down plastic into short chains of monomers.

Enzyme 2 can break down these short chains into individual monomers.

Explain why linking these two enzymes together will speed up the breakdown of plastics.

(2)

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(Total for Question 7 = 14 marks)

8: Gum disease affects up to 90% of the world's adult population.

Gum disease has been shown to be associated with the development of cardiovascular disease (CVD).

(a) Towards the end of 2023, the world's population was 8 078 799 080.

Approximately 70% of this population were adults.

Estimate the number of adults in the world.

Give your answer in standard form.

(2)

Answer ....

(b) The development of gum disease can be reduced by good oral hygiene. This is one example of a healthy lifestyle.

Give **two** other examples of a healthy lifestyle that can help reduce the risk of CVD.

(1)

1 ....

2 ....

(c) Gum disease is caused by inflammation.

Chemicals released into the blood as a result of the inflammation are thought to cause damage to the circulatory system.

The number of white blood cells present in the saliva increases in the early stages of gum disease.

In a study, Canadian scientists determined the correlation between the number of neutrophils in saliva and damage to the circulatory system.

Neutrophils are a type of white blood cell.

The scientists took samples of saliva from volunteers in the study, determined the blood pressure in their arteries and assessed the damage to their endothelial cells.

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(i) Give the meaning of the term **correlation**.

(1)

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(ii) It was important that all the people in the study had similar blood pressure that was within a healthy range.

Explain why this was important.

(3)

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(iii) Calculate the blood pressure of a person who has a systolic blood pressure (SBP) of 11.0 kPa and a diastolic blood pressure (DBP) of 6.7 kPa, using the formula:

$$\text{blood pressure} = \frac{SBP + (2 \times DBP)}{3}$$

(1)

Answer ....kPa

(iv) The scientists assessed the damage to endothelial cells.

Explain why damage to endothelial cells might be an indication that a person is at risk of CVD.

(3)

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(v) The graphs show some of the results from this study.

Key:
□ males
◆ females

Proportion of healthy endothelial cells / a.u.

Number of neutrophils in saliva / $\times 10^4$ cells cm^{-3}

Proportion of healthy endothelial cells / a.u.

Low count ($\leqslant$ 2.5)   High count ($>$ 2.5)

Number of neutrophils in saliva / $\times 10^4$ cells cm^{-3}
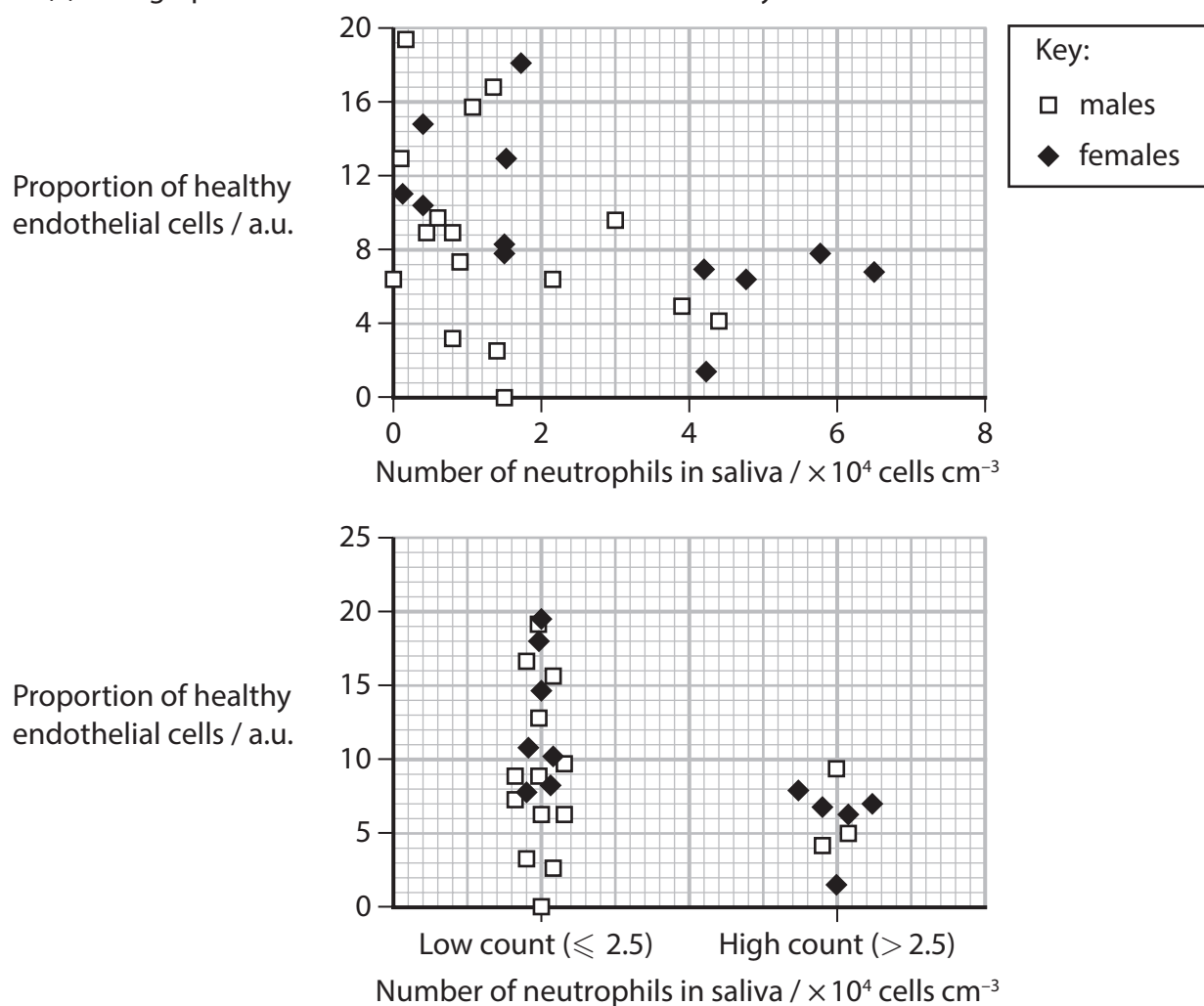
Comment on the relationships between the number of neutrophils and the proportion of healthy endothelial cells of the males and females in this study.

(4)

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(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 80 MARKS

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