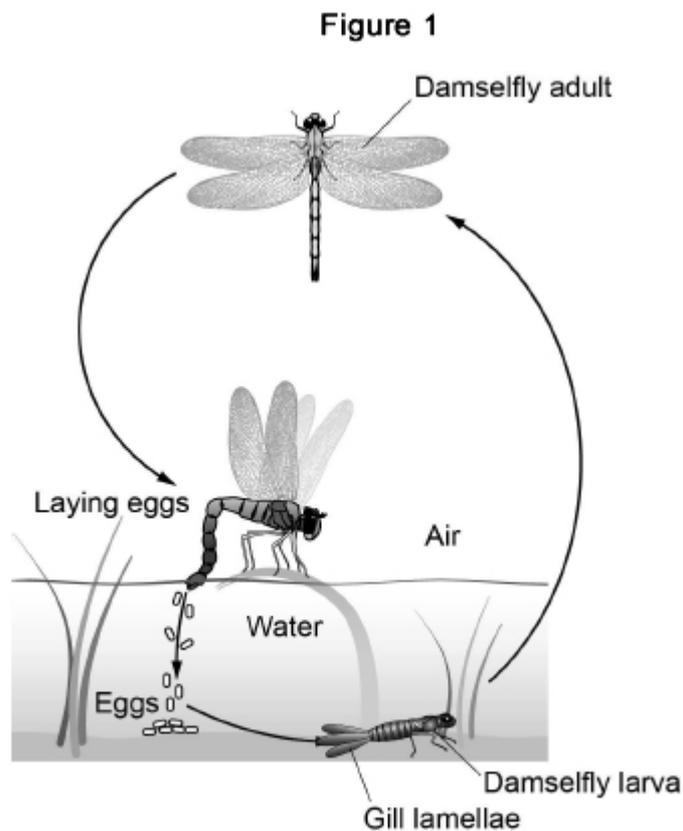


### 3.1 ORGANISMS AND SUBSTANCE EXCHANGE – SURFACE AREA TO VOLUME RATIO – QUESTIONS

Q1. Figure 1 shows the stages of development of an insect called a damselfly.



(a) The adult damselfly uses a tracheal system for gas exchange.

Explain **three** ways in which an insect's tracheal system is adapted for efficient gas exchange.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

3. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(3)

- (b) The damselfly larva is a carnivore that actively hunts prey. It has gills to obtain oxygen from water.

Some other species of insect have larvae that are a similar size and shape to damselfly larvae and also live in water. These larvae do **not** actively hunt prey and do **not** have gills.

Explain how the presence of gills adapts the damselfly to its way of life.

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(2)

- (c) A scientist measured the size of each gill lamella of the gills of 40 damselfly larvae. His results are shown in the table.

Mean width / mm ( $\pm$ uncertainty / mm)	1.61 ( $\pm$ 0.19)
Mean width / mm ( $\pm$ uncertainty / mm)	6.12 ( $\pm$ 0.41)

Calculate the mean surface area of **one side** of one gill lamella. Assume that a gill lamella is rectangular and give your answer to an **appropriate number of significant figures**.

Include the percentage error (uncertainty) of surface area in your answer.  
Show your working.

Mean surface area = \_\_\_\_\_

Percentage error (uncertainty) of surface area = \_\_\_\_\_

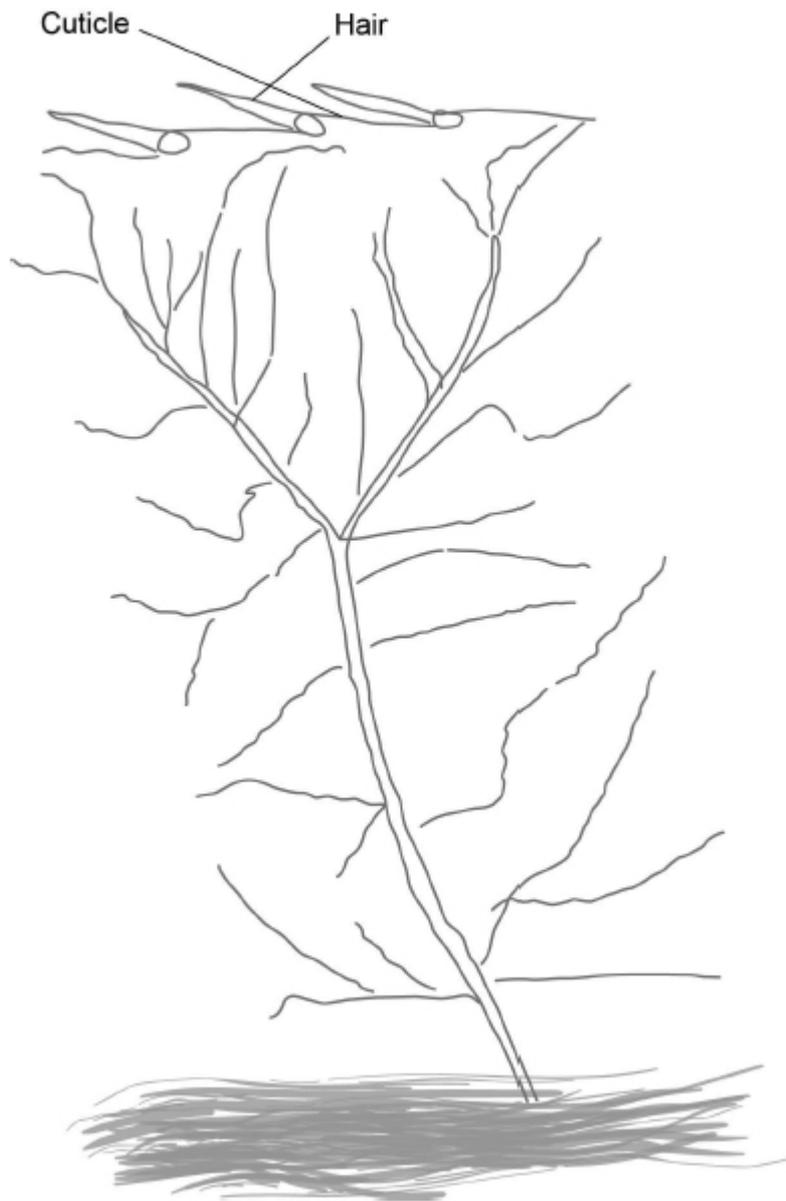
(3)

- (d) A student used an optical microscope to observe part of a damselfly larva gill.

**Figure 2** shows the drawing the student produced.

**Figure 2**

Part of a damselfly larva's gill



Suggest **two** ways the student could improve the quality of her scientific drawing of this gill.

1. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2)  
(Total 10 marks)



2. \_\_\_\_\_

(2)

(b)



© iStock/Thinkstock

The photograph shows a fire-breather creating a ball of fire. Fire-breathers do this by blowing a fine mist of paraffin oil onto a flame. Some of this mist can be inhaled and may eventually lead to fibrosis.

People who have been fire-breathers for many years often find they cannot breathe out properly. Explain why.

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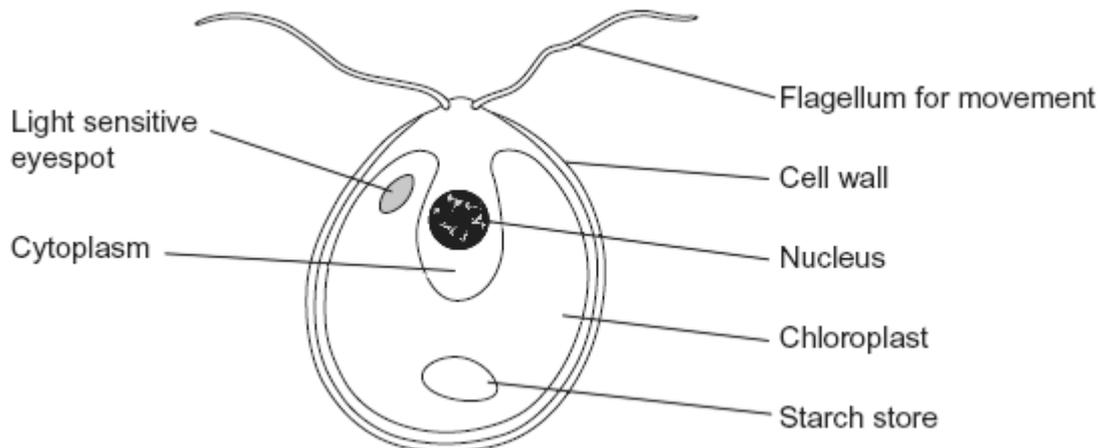
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(2)

(Total 5 marks)

**Q4.** The diagram shows an organism called *Chlamydomonas*.



(a) Name **two** structures shown in the diagram that are present in plant cells but are **not** present in animal cells.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_ (2)

(b) *Chlamydomonas* lives in fresh water ponds. Use your knowledge of osmosis to suggest an advantage of using starch as a carbohydrate store.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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\_\_\_\_\_ (2)

(c) *Chlamydomonas* has adaptations that help it to maintain a high rate of photosynthesis.

Use information in the diagram to explain what these adaptations are.

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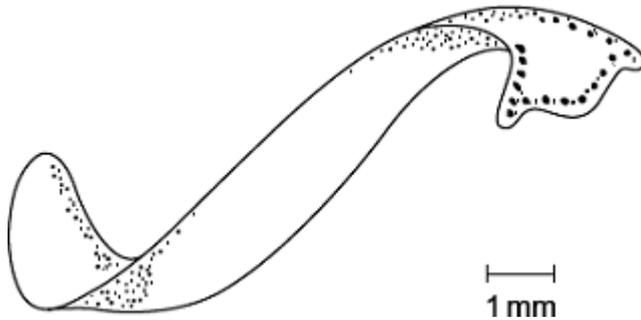
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\_\_\_\_\_ (3)

(Total 7 marks)

**Q5.** (a) Flatworms are small animals that live in water. They have no specialised gas exchange or circulatory systems.

The drawing shows one type of flatworm.



(i) Name the process by which oxygen reaches the cells inside the body of this flatworm.

\_\_\_\_\_ (1)

- (ii) The body of a flatworm is adapted for efficient gas exchange between the water and the cells inside the body.

Using the diagram, explain how **two** features of the flatworm's body allow efficient gas exchange.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_ (2)

- (b) (i) A leaf is an organ. What is an organ?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (1)

- (ii) Describe how carbon dioxide in the air outside a leaf reaches mesophyll cells inside the leaf.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(Extra space) \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (3)

(Total 7 marks)

- Q6.** (a) The oxygen dissociation curve for haemoglobin shifts to the right during vigorous exercise. Explain the advantage of this shift.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

- (b) Weddell seals are diving mammals that live in cold environments. A Weddell seal is shown in **Figure 1**.

**Figure 1**



By Jerzysrzelecki (own work)  
[CC BY 3.0] via Wikimedia Commons

- (i) Explain how the body shape of a Weddell seal is an adaptation to living in a cold environment.

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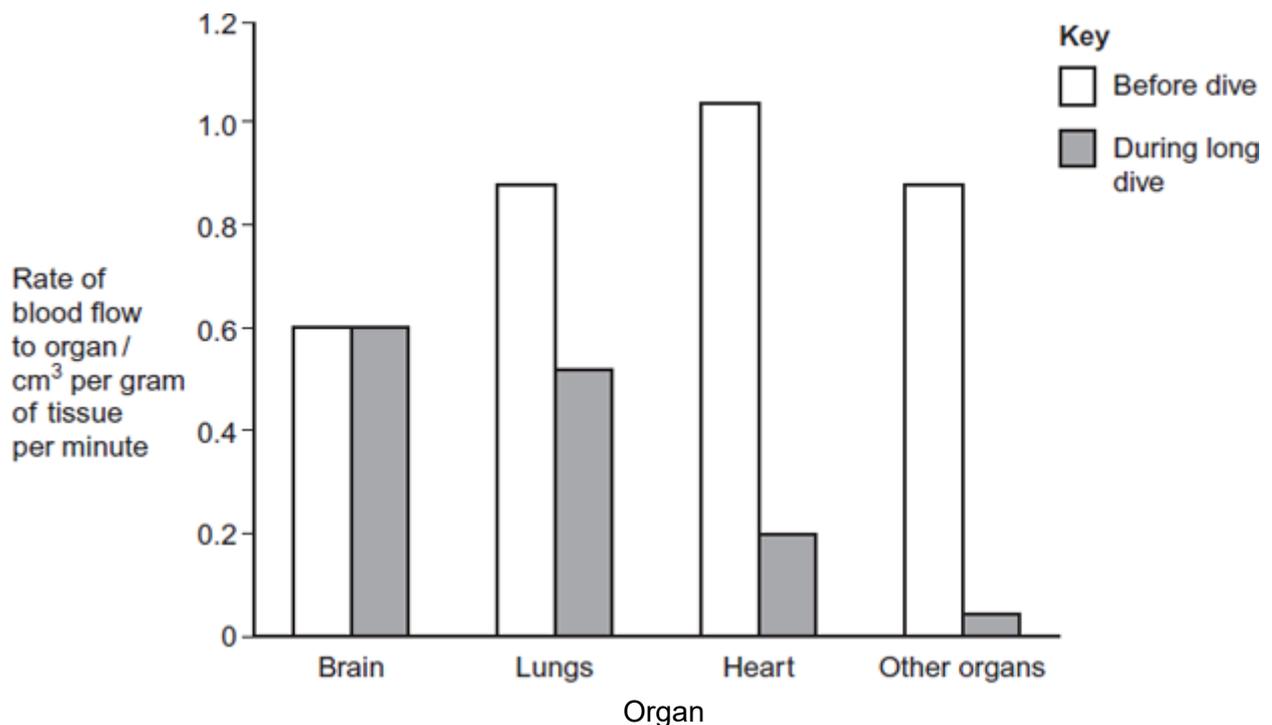
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(2)

- (ii) Weddell seals can remain underwater for long periods of time. **Figure 2** shows the rate of blood flow to different organs of a Weddell seal before a dive and during a long dive.

**Figure 2**



Describe and explain the changes in the rate of blood flow to the different organs during a long dive.

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(Extra space) \_\_\_\_\_

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(3)

(Total 8 marks)

**Q7.** Doctors investigated the effect of the smoking habits of men on their non-smoking wives.

The doctors recruited 540 non-smoking women aged 40 or older. They divided these women into groups according to the smoking habits of their husbands. After 14 years, the doctors recorded how many of the wives had died and their cause of death.

They used these data to determine the relative risk of a wife dying from a particular disease according to her husband's smoking habit.

In this comparison, they gave the relative risk to the wife of a non-smoker as 1.00. A value greater than 1.00 shows an increased risk compared to the wife of a non-smoker.

The results are shown in the table below.

Cause of death	Relative risk of wife dying		
	Husband non-smoker	Husband smokes 1 to 19 cigarettes /day	Husband smokes more than 19 cigarettes / day
Lung cancer	1.00	1.61	2.08
Emphysema	1.00	1.29	1.49
Cervical cancer	1.00	1.15	1.14
Stomach cancer	1.00	1.02	0.99

Heart disease	1.00	0.97	1.03
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A journalist concluded from these data that if a husband smoked, it greatly increased the risk of his wife dying of certain diseases. Evaluate this statement.

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(Total 4 marks)

**Q8.** (a) Describe and explain how the countercurrent system leads to efficient gas exchange across the gills of a fish.

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(Extra space) \_\_\_\_\_

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(3)

(b) Amoebic gill disease (AGD) is caused by a parasite that lives on the gills of some species of fish. The disease causes the lamellae to become thicker and to fuse together.

AGD reduces the efficiency of gas exchange in fish. Give **two** reasons why.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_ (2)

(c) The table below shows some features of gas exchange of a fish at rest.

Volume of oxygen absorbed by the gills from each dm <sup>3</sup> of water / cm <sup>3</sup>	7
Mass of fish / kg	0.4
Oxygen required by fish / cm <sup>3</sup> kg <sup>-1</sup> hour <sup>-1</sup>	90

(i) Calculate the volume of water that would have to pass over the gills each hour to supply the oxygen required by the fish. Show your working.

\_\_\_\_\_ dm<sup>3</sup> (2)

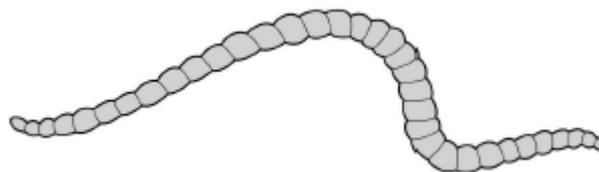
(ii) The volume of water passing over the gills increases if the temperature of the water increases. Suggest why.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (1)

(Total 8 marks)

**Q9.** Tubifex worms are small, thin animals that live in water. They have no specialised gas exchange or circulatory system.

The figure below shows a tubifex worm.



(a) Name the process by which oxygen reaches the cells inside the body of a tubifex worm.

\_\_\_\_\_ (1)

(b) Using the information provided, explain how **two** features of the body of the tubifex worm allow efficient gas exchange.

1. \_\_\_\_\_

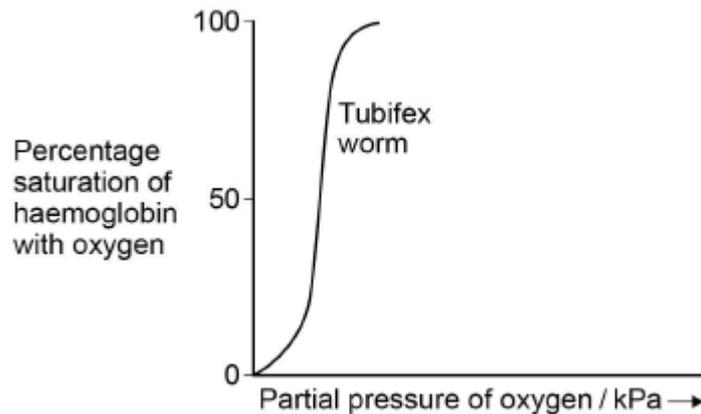
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2. \_\_\_\_\_

\_\_\_\_\_ (2)

(c) Most species of tubifex worms live at the bottom of ponds, lakes and rivers where the partial pressure of oxygen is low. Pollution of water by sewage can cause the partial pressure of oxygen to fall below 0.2 kPa.

The graph shows the oxyhaemoglobin dissociation curve for a species of tubifex worm found in a river polluted with sewage.



The species of tubifex worm in the graph has 50% saturation of their haemoglobin with oxygen at 0.08 kPa.

Explain how this enables this species to survive in water polluted with sewage.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (2)

(d) Species of tubifex worm that live in ponds, lakes and rivers **cannot** survive in seawater.

Use your knowledge of water potential to explain why they cannot survive in seawater.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (2)

(Total 7 marks)

**Q10.** (a) Describe how oxygen in the air reaches capillaries surrounding alveoli in the lungs. Details of breathing are **not** required.

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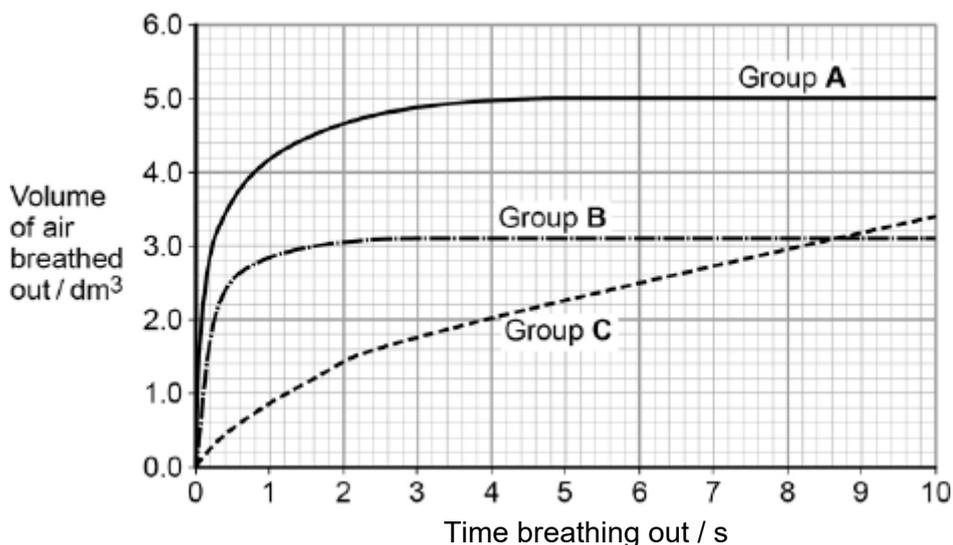
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(4)

Forced expiratory volume (FEV) is the greatest volume of air a person can breathe out in 1 second.

Forced vital capacity (FVC) is the greatest volume of air a person can breathe out in a single breath.

The figure below shows results for the volume of air breathed out by three groups of people, **A**, **B** and **C**. Group **A** had healthy lungs. Groups **B** and **C** had different lung conditions that affect breathing.



(b) Calculate the percentage drop in FEV for group **C** compared with the healthy people.

Answer = \_\_\_\_\_ (1)

- (c) Asthma affects bronchioles and reduces flow of air in and out of the lungs.  
Fibrosis does not affect bronchioles; it reduces the volume of the lungs.

Which group, **B** or **C**, was the one containing people with fibrosis of their lungs? Use the information provided and evidence from the figure above to explain your answer.

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(Extra space) \_\_\_\_\_

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(3)

(Total 8 marks)

**Q11.** Breathing out as hard as you can is called forced expiration.

- (a) Describe and explain the mechanism that causes forced expiration.

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(4)

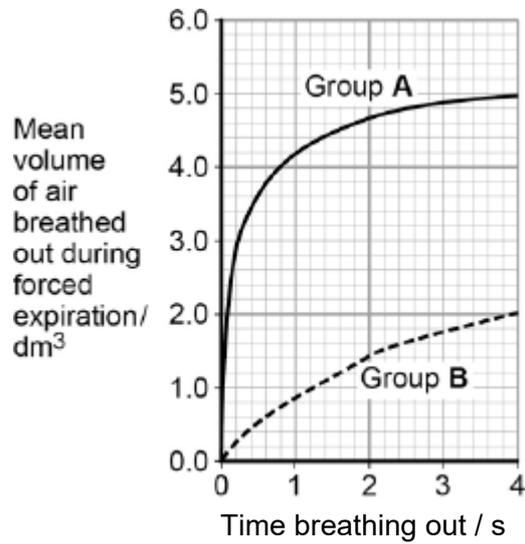
Two groups of people volunteered to take part in an experiment.

- People in group **A** were healthy.
- People in group **B** were recovering from an asthma attack.

Each person breathed in as deeply as they could. They then breathed out by forced expiration.

A scientist measured the volume of air breathed out during forced expiration by each person.

The graph below shows the results.



(b) Forced expiration volume (FEV) is the volume of air a person can breathe out in 1 second.

Using data from the first second of forced expiration, calculate the percentage decrease in the FEV for group B compared with group A.

Answer = \_\_\_\_\_ %

(1)

(c) The people in group B were recovering from an asthma attack. Explain how an asthma attack caused the drop in the mean FEV shown in the figure above.

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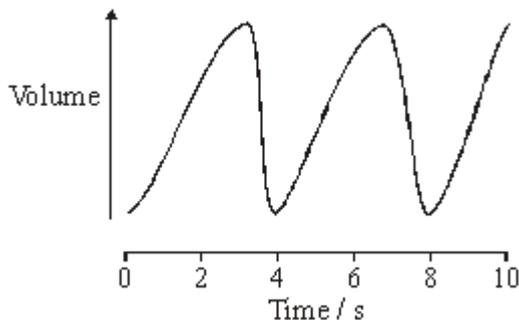
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(4)

(Total 9 marks)

**Q12.** A person was sitting at rest and breathing normally. A recording was made of the changes in the volume of air in his lungs over a ten-second period. The diagram shows this recording.



- (a) Describe the part played by muscles in bringing about the change between 3 and 4 seconds.

\_\_\_\_\_ (1)

- (b) Describe how an increase in lung volume leads to air entering the lungs.

\_\_\_\_\_ (1)

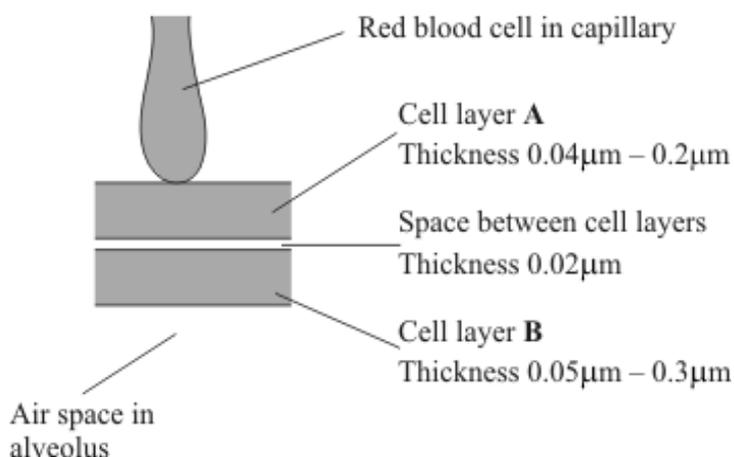
(Total 2 marks)

**Q13.** In the lungs, the alveoli are the site of gas exchange.

- (a) A large number of small alveoli is more efficient in gas exchange than a smaller number of larger alveoli. Explain why.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (2)

- (b) The diagram shows part of an alveolus and a capillary.



(i) Name the type of cells in layer **B**.

\_\_\_\_\_ (1)

(ii) What is the minimum distance a molecule of carbon dioxide diffuses from the blood plasma to the air space in the alveolus?

\_\_\_\_\_ (1)

(c) Just before a person starts to exhale, the composition of the air in an alveolus differs from the composition of the air in the trachea.

(i) Give **two** ways in which the composition would differ.

1. \_\_\_\_\_

2. \_\_\_\_\_ (1)

(ii) Explain what causes this difference in composition between the air in the alveolus and the air in the trachea.

\_\_\_\_\_  
\_\_\_\_\_ (1)

(d) The partial pressure of a gas is a measure of the amount of gas that is present. The partial pressure of carbon dioxide in blood going to the lungs is 6.3 kPa. The partial pressure of carbon dioxide in an alveolus is 5.3 kPa.

(i) Through which vessel does blood leave the heart to go to the lungs?

\_\_\_\_\_ (1)

(ii) Suggest why blood returning to the heart from the lungs contains some carbon dioxide.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2)

**(Total 9 marks)**

**Q14.** Miner's lung is a disease caused by breathing in dust in coal mines. The dust causes the alveolar epithelium to become thicker. People with miner's lung have a lower concentration of oxygen in their blood than healthy people.

(a) (i) Describe the path by which oxygen goes from an alveolus to the blood.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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(2)

(ii) Explain why people with miner's lung have a lower concentration of oxygen in their blood.

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(1)

(b) In healthy lungs, a gradient is maintained between the concentration of oxygen in the alveoli and the concentration of oxygen in the lung capillaries.

(i) Describe how ventilation helps to maintain this difference in oxygen concentration.

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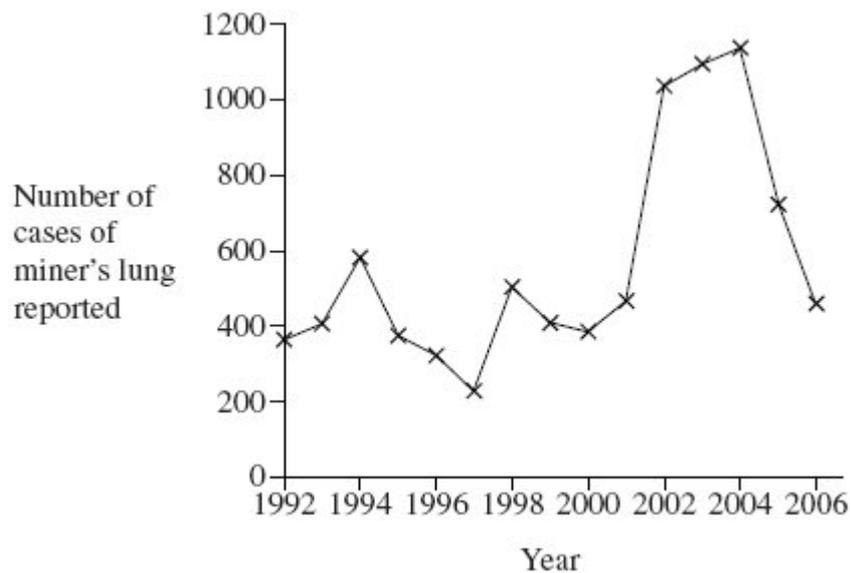
(2)

(ii) Give **one** other way that helps to maintain the difference in oxygen concentration.

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(1)

(c) Scientists investigated the number of cases of miner's lung reported in Britain between 1992 and 2006.



Coal mining in Britain had been dramatically reduced by 1990.

Some scientists concluded that the rise in reported cases of miner's lung after 1992 shows that the disease takes a long time to develop.

Evaluate this conclusion.

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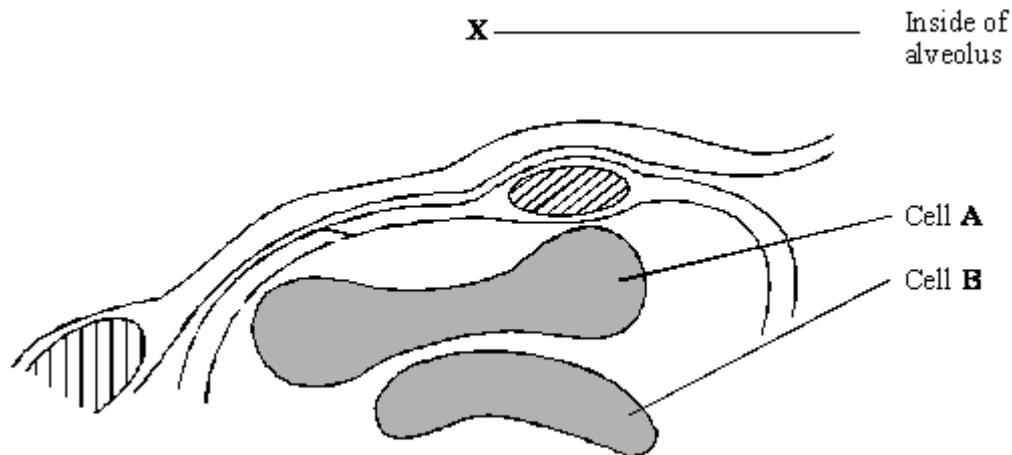
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(2)  
(Total 8 marks)

**Q15.** The drawing shows an electron micrograph of a section through part of an alveolus from a lung.



(a) Describe the path of a molecule of oxygen from the air in the alveolus at **X** to the plasma membrane of cell **A**.

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(1)

(b) Cell **A** is a eukaryotic cell. Give **two** features that may be found in a prokaryotic cell which are not found in cell **A**.

1. \_\_\_\_\_

2. \_\_\_\_\_

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(2)

(c) Cells **A** and **B** are biconcave discs. Explain **one** advantage of a biconcave disc over a spherical cell of the same volume in transporting oxygen.

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(2)

(d) The diameter of a human red blood cell is 7  $\mu\text{m}$ .

- (i) Calculate the magnification of the drawing. Show your working.

Magnification = \_\_\_\_\_ (2)

- (ii) In calculating the magnification, what assumption did you have to make about how the section was cut?

\_\_\_\_\_

\_\_\_\_\_ (1)

(Total 8 marks)

**Q16.** (a) The photograph shows part of the gill of a fish as seen through a light microscope. It is magnified  $\times 400$ .



- (i) Explain how the structure of the gill makes oxygen uptake efficient.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (2)

- (ii) Water containing dissolved oxygen flows over the gill in the opposite direction to the blood flow inside. Explain why this arrangement is important for efficient oxygen uptake.

\_\_\_\_\_

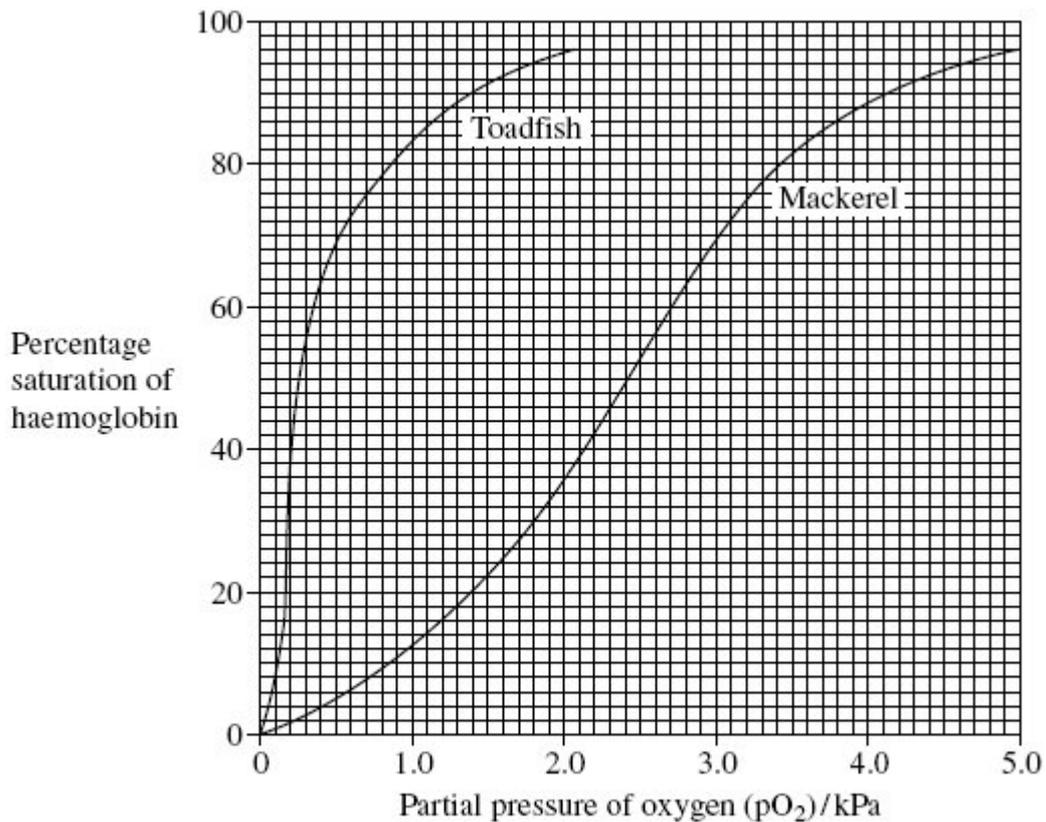
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\_\_\_\_\_ (2)

- (b) There is a one-way flow of water over the gills of a fish whereas there is a two-way flow of air in the lungs of a mammal. Suggest **one** advantage to a fish of this one-way flow of water over its gills.





Explain how the shape of the curve for toadfish haemoglobin is related to where the toadfish is normally found.

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(2)

- (d) Scientists analysed the sequence of amino acids in one polypeptide chain in the haemoglobin of four different species of ape. The only difference they found affected the amino acids at three positions in the polypeptide chain. Their results are shown in the table. The letters are abbreviations for particular amino acids.

Species	Position 87	Position 104	Position 125
Chimpanzee	T	R	P
Bonobo	T	R	P
Gorilla	T	K	P
Orang utan	K	R	Q

What information do the data in the table suggest about the relationships between the chimpanzee, the bonobo and the gorilla? Explain your answer.

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(2)  
(Total 12 marks)

**Q18.** (a) Explain how the shape of a red blood cell allows it to take up a large amount of oxygen in a short time.

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(2)

Samples of blood were mixed with equal volumes of different liquids. A drop of each mixture was put on a slide and examined with an optical microscope. The table shows the appearance of each slide.

Slide	Liquid added	Appearance of slide
<b>A</b>	Distilled water	No cells seen. Slide appears a uniform pale red colour
<b>B</b>	Sucrose solution	Cells are smaller in diameter than in an untreated sample of blood
<b>C</b>	Detergent (dissolves lipids)	No cells seen. Slide appears a uniform pale red colour

(b) (i) What does the appearance of slide **B** tell you about the plasma membrane surrounding a red blood cell?

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(1)

(ii) Explain the appearance of slide **C**.

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(2)

(Total 5 marks)

**Q19.** (a) When first hatched, the young of some species of fish are less than 2 mm long. Explain how these young fish get enough oxygen to their cells without having gills.

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(2)

- (b) Mackerel are fast swimming fish whereas toadfish only swim slowly. The table shows some features of the gills of these fish.

	Thickness of lamellae / $\mu\text{m}$	Number of lamellae per mm of gill length
Mackerel	5	32
Toadfish	35	8

Use evidence from the table to explain how mackerel are able to swim faster than toadfish.

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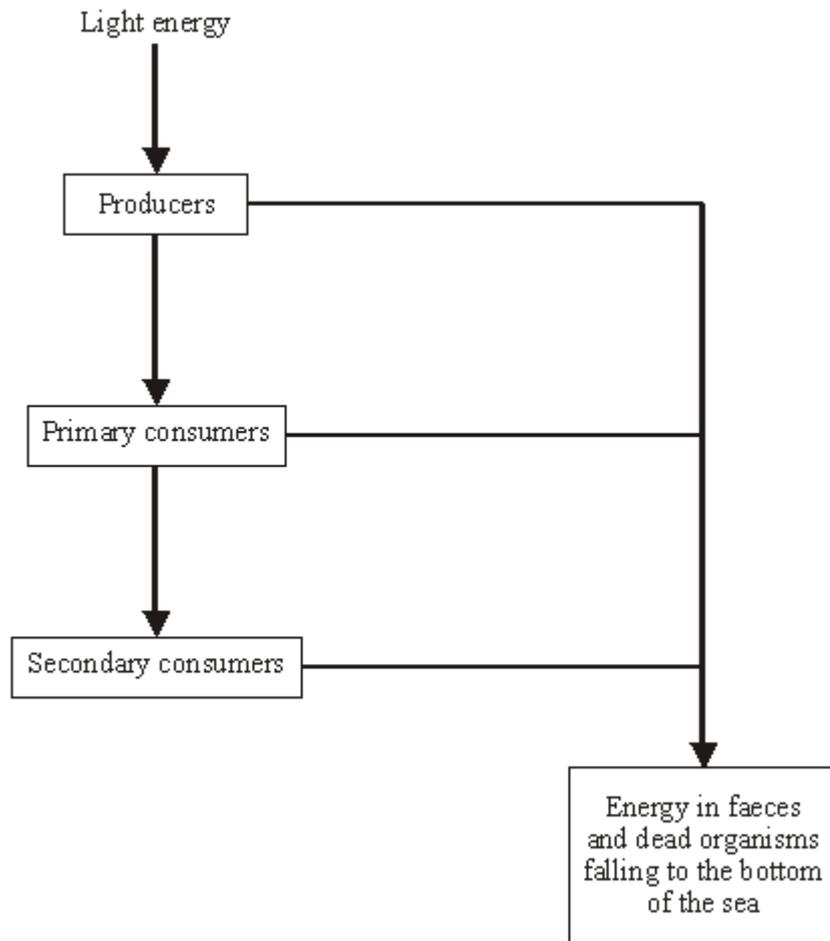
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(3)

(Total 5 marks)

**Q20.** The diagram shows the flow of energy through a marine ecosystem.



(a) Give **one** reason why not all the light energy falling on the producers is used in photosynthesis.

\_\_\_\_\_ (1)

(b) The producers in this ecosystem are seaweeds, which have a large surface area to volume ratio. Give **two** advantages to seaweeds of having a large surface area to volume ratio.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_ (2)

(c) Some species of seaweed are submerged in water for most of the time. Explain how being under water might affect the rate of photosynthesis.

\_\_\_\_\_

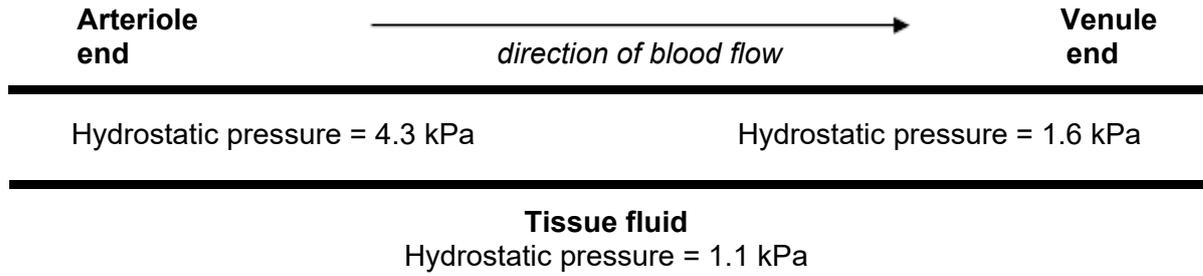
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The values of the hydrostatic pressure are shown.



(a) Use the information in the figure above to explain how tissue fluid is formed.

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(2)

(b) The hydrostatic pressure falls from the arteriole end of the capillary to the venule end of the capillary. Explain why.

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(1)

(c) High blood pressure leads to an accumulation of tissue fluid. Explain how.

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(3)

**(Extra space)** \_\_\_\_\_

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(3)

(d) The water potential of the blood plasma is more negative at the venule end of the capillary than at the arteriole end of the capillary. Explain why.

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(3)

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(Extra space) \_\_\_\_\_

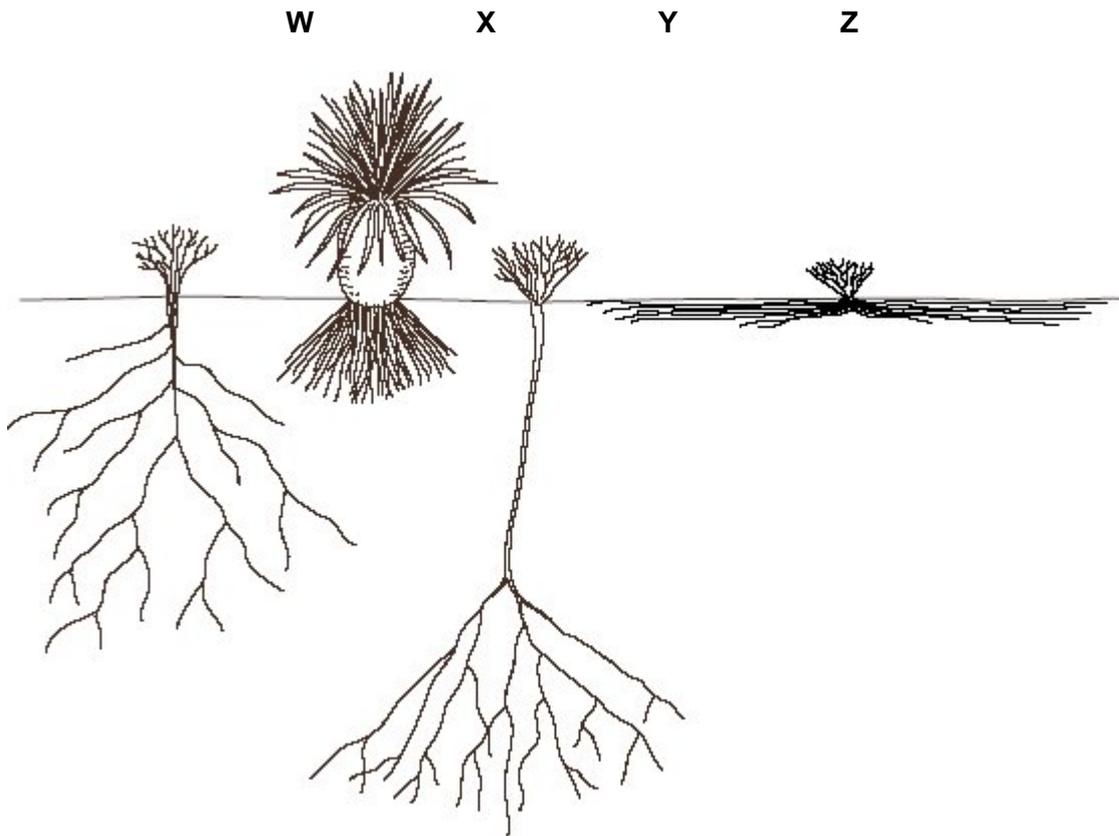
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(3)  
(Total 9 marks)

**Q23.** The drawing shows four common plants found in the Mojave Desert.



(a) Explain how **three** features of the plants shown in the drawing are adaptations to desert conditions.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

3. \_\_\_\_\_

\_\_\_\_\_

(3)

(b) Resurrection plants can lose up to 95% of their water content without dying. They can survive for many years in this desiccated state and will revive within hours of rainfall. Suggest which of the plants **W** to **Z** is most likely to be a resurrection plant. Give a reason

for your choice.

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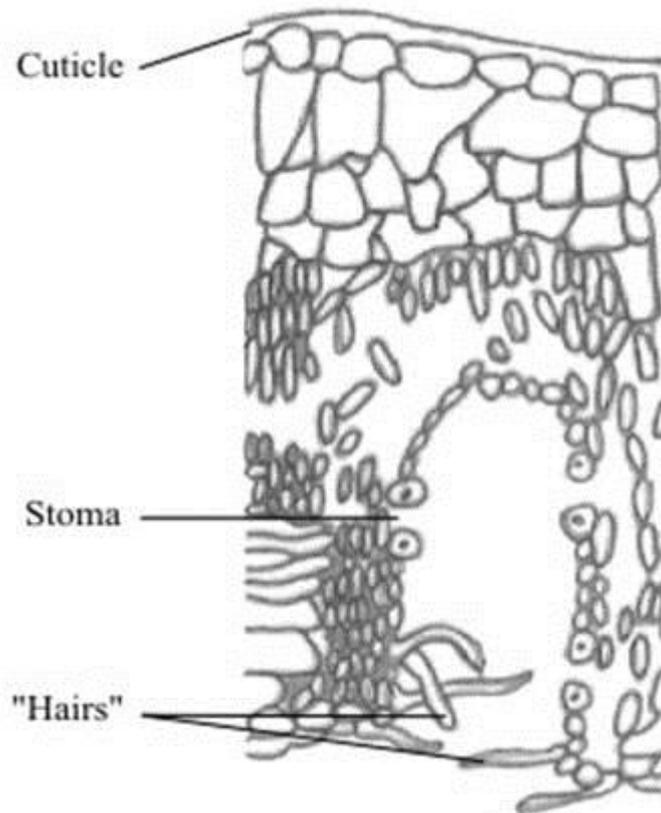
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(2)  
(Total 5 marks)

**Q24.** Figure 1 shows a single stoma and surrounding cells from the leaf of a xerophytic plant.

**Figure 1**



(i) Explain how the cuticle reduces water loss.

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(1)

(ii) Explain how **one** of the other labelled parts reduces water loss.

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(2)  
(Total 3 marks)

**Q25. (a)** Describe the features of fish gills that give them a large surface area.

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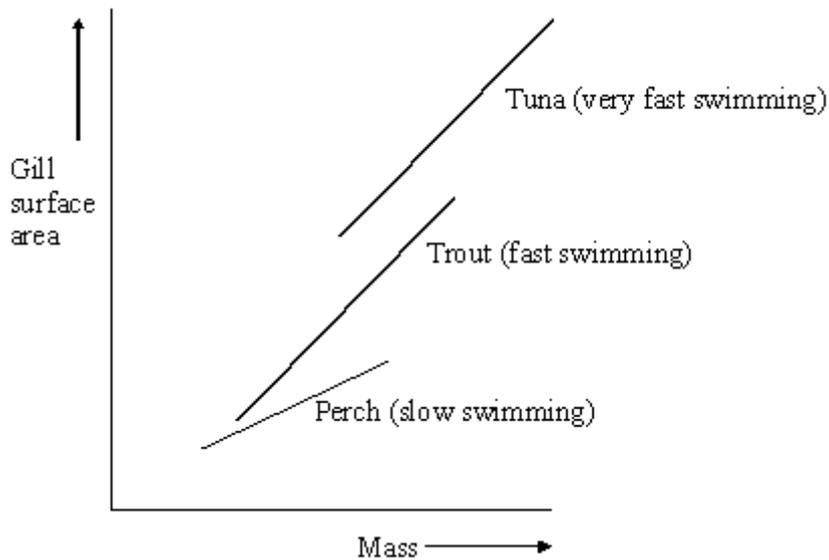
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(2)

The graph shows the relationship between gill surface area and body mass for three species of fish.



(b) (i) Describe the relationships between gill surface area, mass and swimming speed shown in the diagram.

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(1)

(ii) Explain the relationship between gill surface area and swimming speed.

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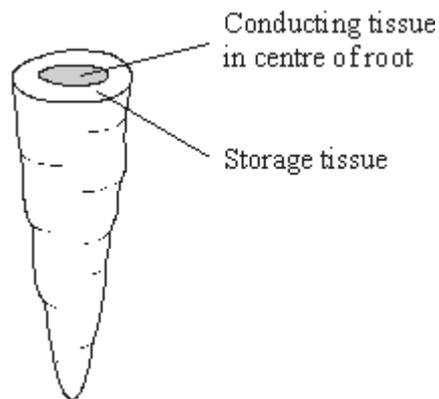
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(2)

(Total 5 marks)

**Q26.** The diagram shows a carrot.



A group of students investigated the effect of sucrose concentration on the length of cylinders cut from a carrot.

- (a) The students used a cork borer to cut cylinders from the carrot. Describe how the students should cut these cylinders to make sure that this was a fair test and would produce reliable results.

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(2)

- (b) They measured the initial length of each cylinder then placed the cylinders into test tubes containing different concentrations of sucrose solution. Bungs were placed in the tubes and the tubes were left overnight. Explain why the bungs were placed in the tubes.

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(2)

- (c) The students then measured the final lengths of the carrot cylinders. Their results are shown in the table.

Concentration of sucrose / mol dm <sup>-3</sup>	$\frac{\text{Final length}}{\text{Initial length}}$
0.0	1.4
0.2	1.4
0.4	1.2
0.6	1.1
0.8	0.9

- (i) The students used these results to find the concentration of sucrose that has the same water potential as the carrot cylinders. Describe how they could have done this.

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(2)

- (ii) Was it important in this investigation that the carrot cylinders had the same initial length? Explain your answer.

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(1)

**(Total 7 marks)**

**Q27.** Read the following passage.

The plasma membrane plays a vital role in microorganisms. It forms a barrier between the cell and its environment, controlling the entry and exit of solutes.

This makes bacteria vulnerable to a range of antiseptics and antibiotics.

When bacteria are treated with antiseptics, the antiseptics bind to the proteins in the membrane and create tiny holes. Bacteria contain potassium ions at a concentration many times that outside the cell. Because of the small size of these ions and their concentration in the cell, the first observable sign of antiseptic damage to the plasma membrane is the leaking of potassium ions from the cell. Some antibiotics damage the plasma membrane in a similar way. One of these is tyrocidin. This is a cyclic polypeptide consisting of a ring of ten amino acids. Tyrocidin and other polypeptide antibiotics are of little use in medicine.

Other antibiotics also increase the rate of potassium movement from cells. It is thought that potassium ions are very important in energy release and protein synthesis, and a loss of potassium ions would lead to cell death. Gramicidin A coils to form a permanent pore passing through the plasma membrane. This pore enables potassium ions to be conducted from the inside of the cell into the surrounding medium. Vanilomycin also facilitates the passage of potassium ions from the cell.

A molecule of vanilomycin forms a complex with a potassium ion and transports it across the membrane. The potassium ion is released on the outside and the vanilomycin is free to return and pick up another potassium ion. Vanilomycin depends on the fluid nature of the plasma membrane in order to function.

Polyene antibiotics have flattened ring-shaped molecules. The two sides of the ring differ from each other. One side consists of an unsaturated carbon chain. This part is strongly hydrophobic and rigid. The opposite side is a flexible, strongly hydrophilic region. It has been shown that

polyene antibiotics bind only to sterols. Sterols are lipids found in the membranes of eukaryotes but not in the membranes of prokaryotic organisms. It is thought that several sterol-polyene complexes come together.

The plasma membranes of eukaryotic cells treated with these polyene antibiotics lose the ability to act as selective barriers and small ions and molecules rapidly leak out.

Use information in the passage and your own knowledge to answer the questions.

- (a) By what process do potassium ions normally enter a bacterial cell? Explain the evidence for your answer.

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(2)

- (b) (i) Draw a peptide bond showing how the COOH group of one amino acid joins to the NH<sub>2</sub> group of another.

(1)

- (ii) How many peptide bonds are there in a molecule of tyrocidin (lines 9 - 10)?

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(1)

- (c) Experiments have shown that vanilomycin is unable to transport potassium ions across a membrane when it is cooled. Gramicidin A continues to facilitate the movement of potassium ions at these low temperatures. Explain these results.

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(3)

- (d) Draw a simple diagram of one of the phospholipid layers to show how polyene antibiotics allow small ions and molecules to leak rapidly through a plasma membrane. Use the following symbols to represent the different molecules.

Note that the zigzag line on the symbol for the polyene antibiotic represents its

hydrophobic region.

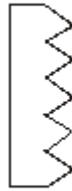
Phospholipid



Sterol



Polyene antibiotic



These symbols have been drawn to the same scale

(2)

(Total 9 marks)

**Q28.** Read the following passage.

Several diseases are caused by inhaling asbestos fibres. Most of these diseases result from the build up of these tiny asbestos fibres in the lungs.

5 One of these diseases is asbestosis. The asbestos fibres are very small and enter the bronchioles and alveoli. They cause the destruction of phagocytes and the surrounding lung tissue becomes scarred and fibrous. The fibrous tissue reduces the elasticity of the lungs and causes the alveolar walls to thicken. One of the main symptoms of asbestosis is shortness of breath caused by reduced gas exchange.

10 People with asbestosis are at a greater risk of developing lung cancer. The time between exposure to asbestos and the occurrence of lung cancer is 20–30 years.

Use information in the passage and your own knowledge to answer the following questions.

(a) Destruction of phagocytes (lines 4–5) causes the lungs to be more susceptible to infections. Explain why.

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(2)

(b) (i) The reduced elasticity of the lungs (lines 6–7) causes breathing difficulty. Explain

how.

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(2)

- (ii) Apart from reduced elasticity, explain how changes to the lung tissue reduce the efficiency of gas exchange.

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(4)

- (c) (i) Doctors did not make the link between exposure to asbestos and an increased risk of developing lung cancer for many years. Use information in the passage to explain why.

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(1)

- (ii) Give **one** factor, other than asbestos, which increases the risk of developing lung cancer.

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(1)

**(Total 10 marks)**

**Q29.** (a) Gas exchange in fish takes place in gills. Explain how **two** features of gills allow efficient gas exchange.

1. \_\_\_\_\_

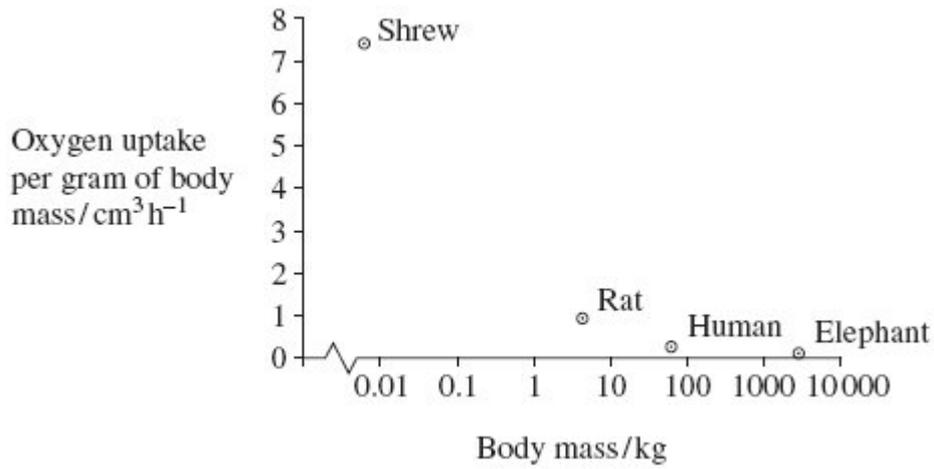
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2. \_\_\_\_\_

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(2)

- (b) A zoologist investigated the relationship between body mass and rate of oxygen uptake in four species of mammal. The results are shown in the graph.



(i) The scale for plotting body mass is a logarithmic scale. Explain why a logarithmic scale was used to plot body mass.

\_\_\_\_\_  
 \_\_\_\_\_ (1)

(ii) Describe the relationship between body mass and oxygen uptake.

\_\_\_\_\_  
 \_\_\_\_\_ (1)

(iii) The zoologist measured oxygen uptake per gram of body mass. Explain why he measured oxygen uptake per gram of body mass.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ (2)

(Total 6 marks)

**Q30.** Organic compounds synthesised in the leaves of a plant can be transported to the plant's roots. This transport is called translocation and occurs in the phloem tissue of the plant.

(a) One theory of translocation states that organic substances are pushed from a high pressure in the leaves to a lower pressure in the roots.

Describe how a high pressure is produced in the leaves.

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 \_\_\_\_\_  
 \_\_\_\_\_

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(Extra space) \_\_\_\_\_

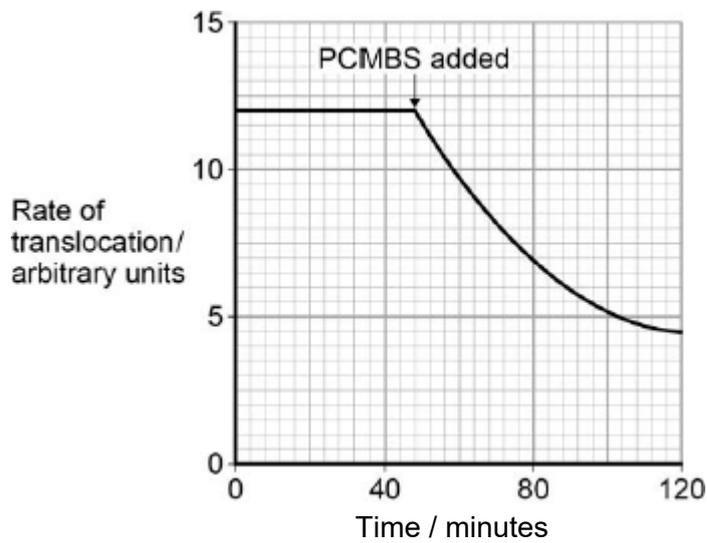
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(3)

PCMBS is a substance that inhibits the uptake of sucrose by plant cells.

Scientists investigated the effect of PCMBS on the rate of translocation in sugar beet. The figure below shows their results.



- (b) During their experiment, the scientists ensured that the rate of photosynthesis of their plants remained constant. Explain why this was important.

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(2)

- (c) The scientists concluded that some translocation must occur in the spaces in the cell walls. Explain how the information in the figure above supports this conclusion.

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(2)

(Total 7 marks)

### Q31. Essay

You should write your essay in continuous prose.

Your essay will be marked for its scientific accuracy.

It will also be marked for your selection of relevant material from different parts of the specification and for the quality of your written communication.

The maximum number of marks that can be awarded is

Scientific	16
Breadth of knowledge	3
Relevance	3
Quality of written communication	3

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Write an essay on the following topic:

Heat and many different substances are transferred within the body and between the body and the environment. Explain how surface area is linked to this transfer.

**(Total 25 marks)**

