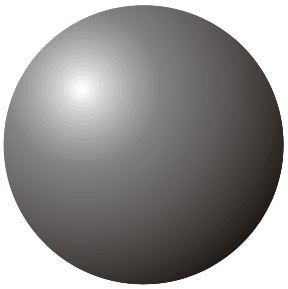
1. A student investigated how the surface area of a single-celled organism is related to its volume. The student used two spheres, **A** and **B**, as models of two organisms. The surface area and volume of each sphere was calculated.

The results are shown in the table below.

	sphere **A**	sphere **B**
		
diameter / cm	1	3
surface area / cm^2	3.14	28.27
volume / cm^3	0.52	14.14

(i) The student calculated the surface area: volume ratio of sphere **B** as 2:1.

Calculate the surface area: volume ratio of sphere **A**. Show your working.

.....

[2]

(ii) How does the surface area: volume ratio of sphere **B** differ from that of sphere **A**?

.....

[1]

(iii) Single-celled organisms generally have a surface-area to volume ratio more like that of sphere **A** than sphere **B**.

Explain why.

.....

.....

.....

.....

.....

[2]

[Total 5 marks]

2. The lungs in the mammalian body are well developed to allow effective exchange of gases.

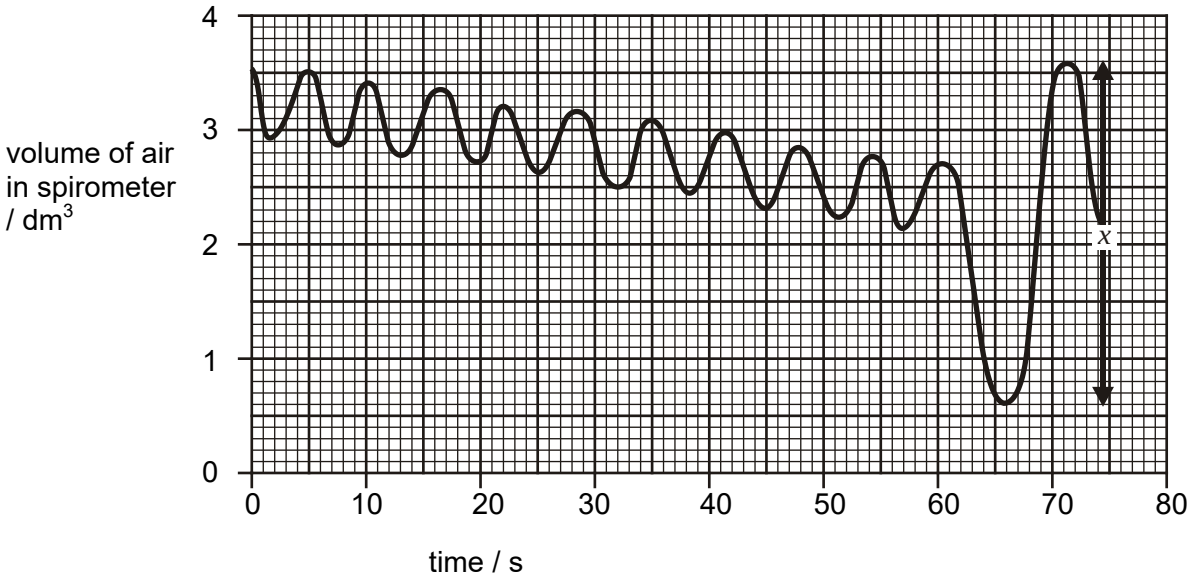
Describe the features of the lungs that make them effective organs for the exchange of gases.

In your answer, you should use appropriate technical terms, spelled correctly.

(Allow one lined page).

[Total 5 marks]

3. The diagram below shows the trace from a spirometer. A spirometer is a device designed to measure the volume of air entering and leaving the lungs. A chamber in the spirometer contains soda lime to absorb the carbon dioxide released by respiration. The measurements shown were recorded from a healthy 17-year-old student at rest.



(i) Explain why the volume of air in the spirometer drops slowly over the first minute.

.....

.....

.....

.....

[2]

(ii) After one minute, the student was asked to breathe in as deeply as possible and then breathe out as much as possible.

The resulting change in the trace is shown in the figure above as **X**.

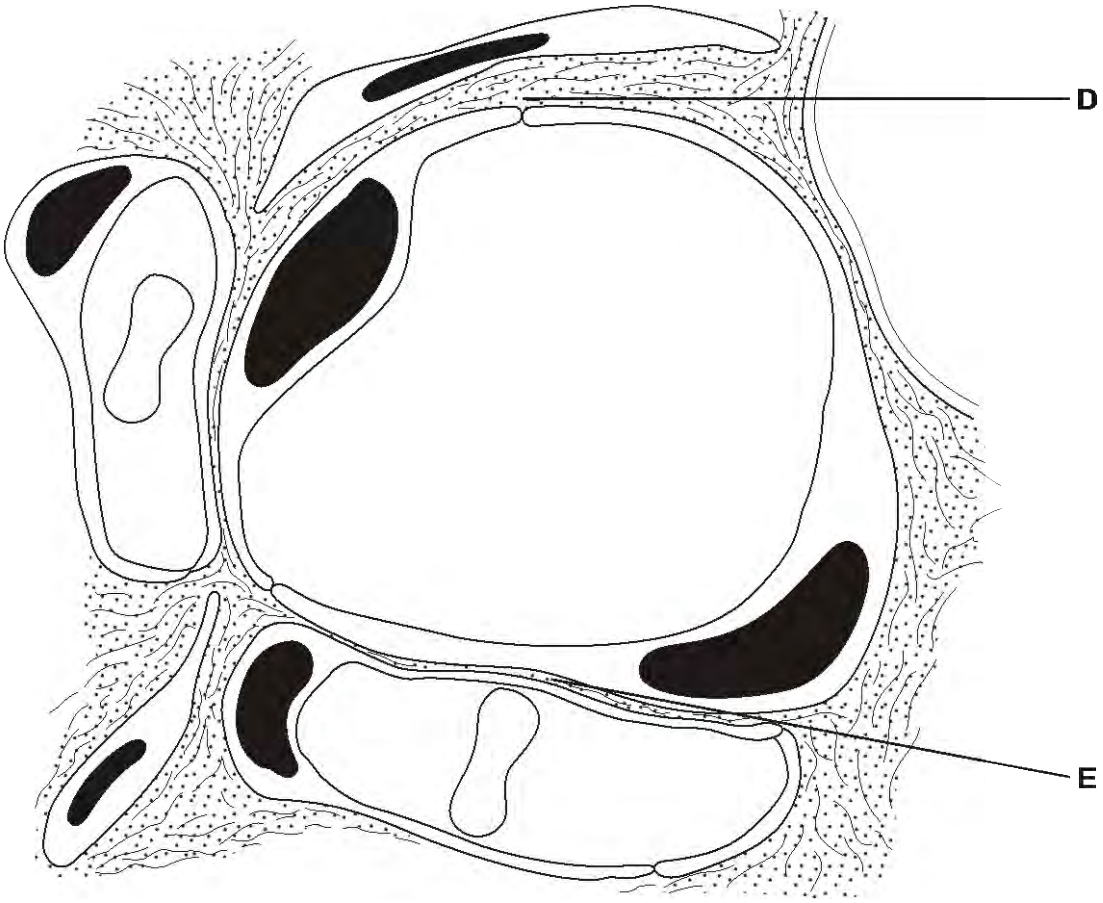
State the term given to measurement **X**.

.....

[1]

[Total 3 marks]

4. The diagram below shows the detailed structure of a small part of the mammalian lung.



(i) State the name of the structure shown between lines **D** and **E**.

.....

[1]

(ii) List **three** features of the structure which you have identified in (i) which make it suitable for gas exchange.

1 .....

.....

2 .....

.....

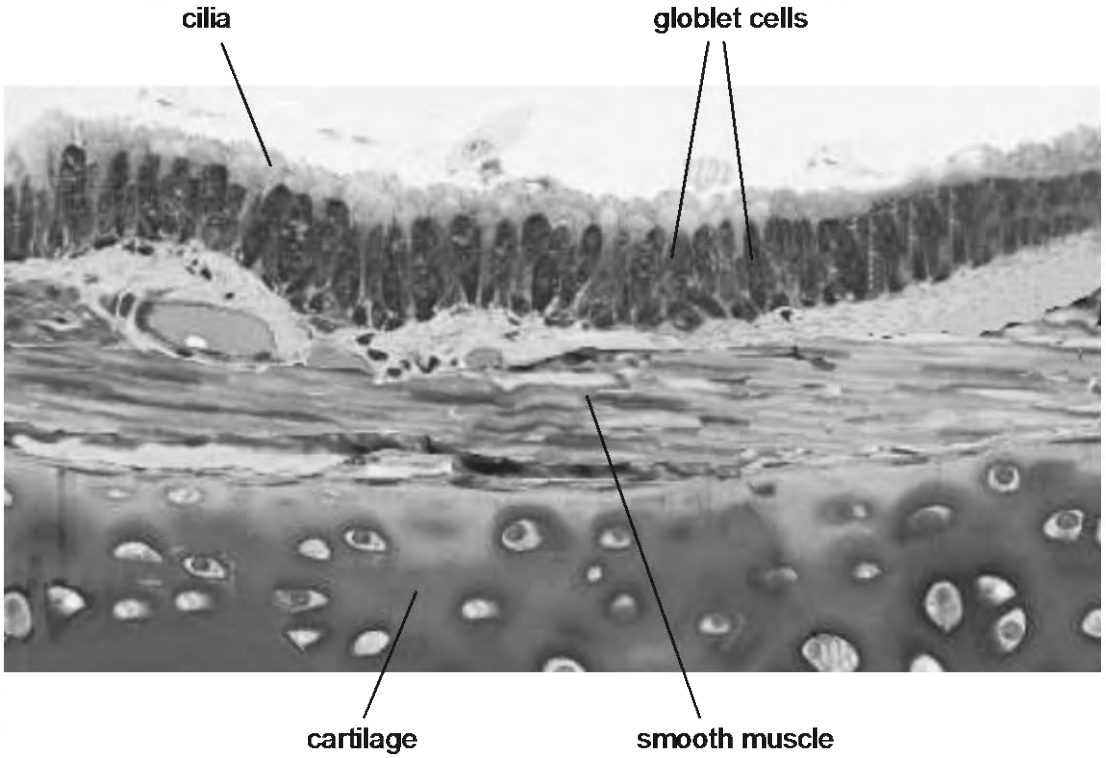
3 .....

.....

[3]

[Total 4 marks]

5. The different parts of the gaseous exchange system, such as the bronchi, show structural adaptations to their functions. The diagram below shows a section through the wall of a bronchus as seen with a light microscope.



(a) (i) State **one** function for each of the following components of the bronchus wall.

goblet cell .....

.....

cartilage .....

.....

[2]

(ii) State **two** ways in which the **structure** of the wall of the bronchus would be different in a long-term smoker.

1 .....

.....

2 .....

.....

[2]

(b) Gaseous exchange occurs across the walls of the alveoli.

Explain why the walls of the alveoli contain elastic fibres.

.....

.....

.....

.....

[2]

(c) One feature of the disease emphysema is that the alveoli lose their elasticity.

Explain the effects of this loss of elasticity on the gaseous exchange system of a person with emphysema.

.....

.....

.....

.....

.....

.....

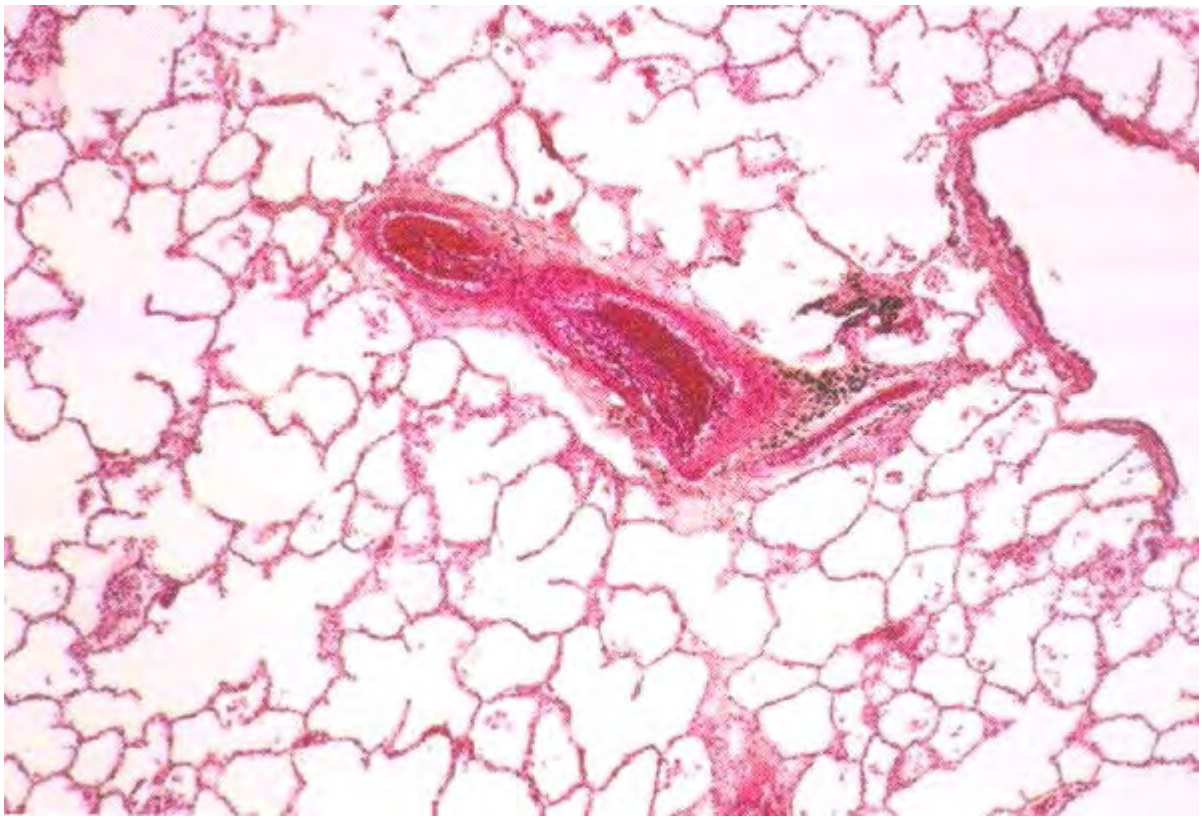
.....

.....

[4]

[Total 10 marks]

6. State **three** features of the lung, **visible in the photograph below**, that permit efficient exchange of gases.



1 .....

.....

2 .....

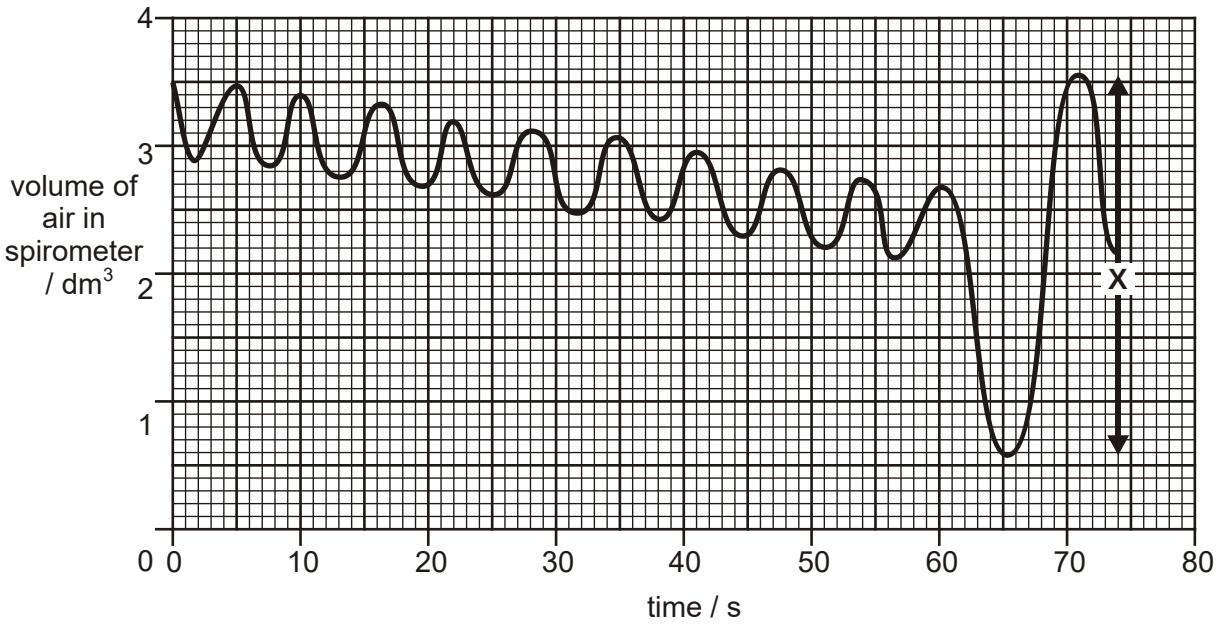
.....

3 .....

.....

[Total 3 marks]

7. The diagram below shows the trace from a spirometer. A spirometer is a device designed to measure the volume of air entering and leaving the lungs. A chamber in the spirometer contains soda lime to absorb the carbon dioxide released from respiration. The measurements shown were recorded from a healthy 16 year old student at rest.



(i) Calculate the mean tidal volume in the first 20 seconds.
Express your answer to two decimal places. Show your working

Answer = ... dm^3

[2]

(ii) At a certain point, the student was asked to breathe in as deeply as possible and then breathe out as much as possible. The resulting change in the trace is shown in the diagram as **X**.

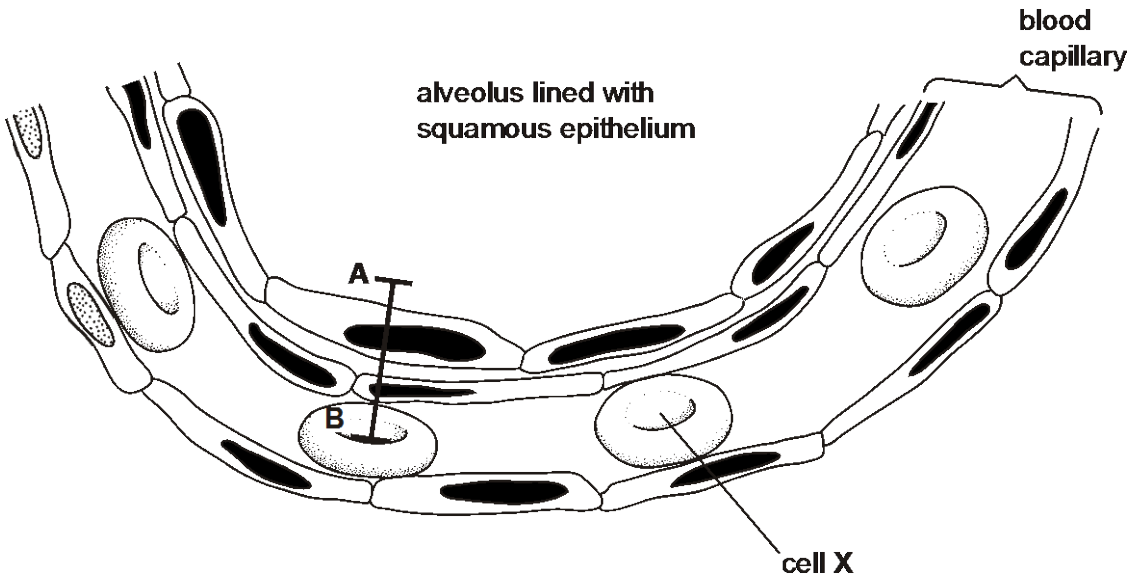
State the term given to measurement **X**.

.....

[1]

[Total 3 marks]

8. The diagram below is a drawing of an alveolus together with an associated blood capillary.



(i) State a feature, **visible in the diagram**, which shows that squamous epithelial cells are eukaryotic.

.....

[1]

(ii) State why squamous epithelium is described as a tissue.

.....

.....

[1]

(iii) State **two** features of a gas exchange surface, such as the lining of the alveolus.

1 .....

2 .....

[2]

[Total 4 marks]

9. A number of definitions are listed in the table below.

In the right hand column, write a term that **best** matches the definition in the left hand column. The first one has been done for you.

The type of B cell which secretes antibodies.	*plasma cell*
The term which refers to any organism that causes infectious disease.	
Diseases which cause a progressive deterioration of part of the body.	
The type of exercise that uses the heart and lungs to provide oxygen for respiration in muscles.	
The volume of air breathed in or out during a single breath.	
A term used to describe a disease that spreads across continents.	

[Total 5 marks]

10. Lugworms are common animals that burrow in the sand of the seashore, just above the low tidemark. They are found where there is mild wave action and where the sand is rich in organic matter. The main external features of a lugworm are shown in Fig. 1.

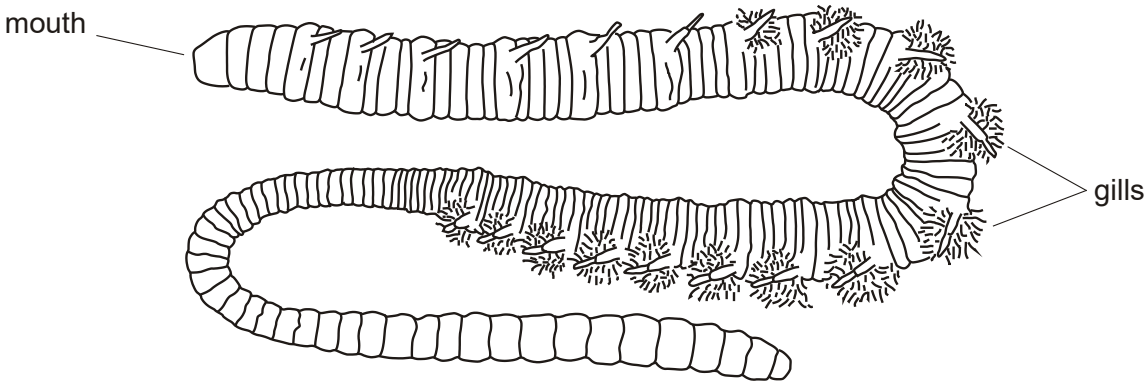


Fig. 1

Each lugworm makes a U-shaped burrow which reaches the surface in two places, as shown in Fig. 2.

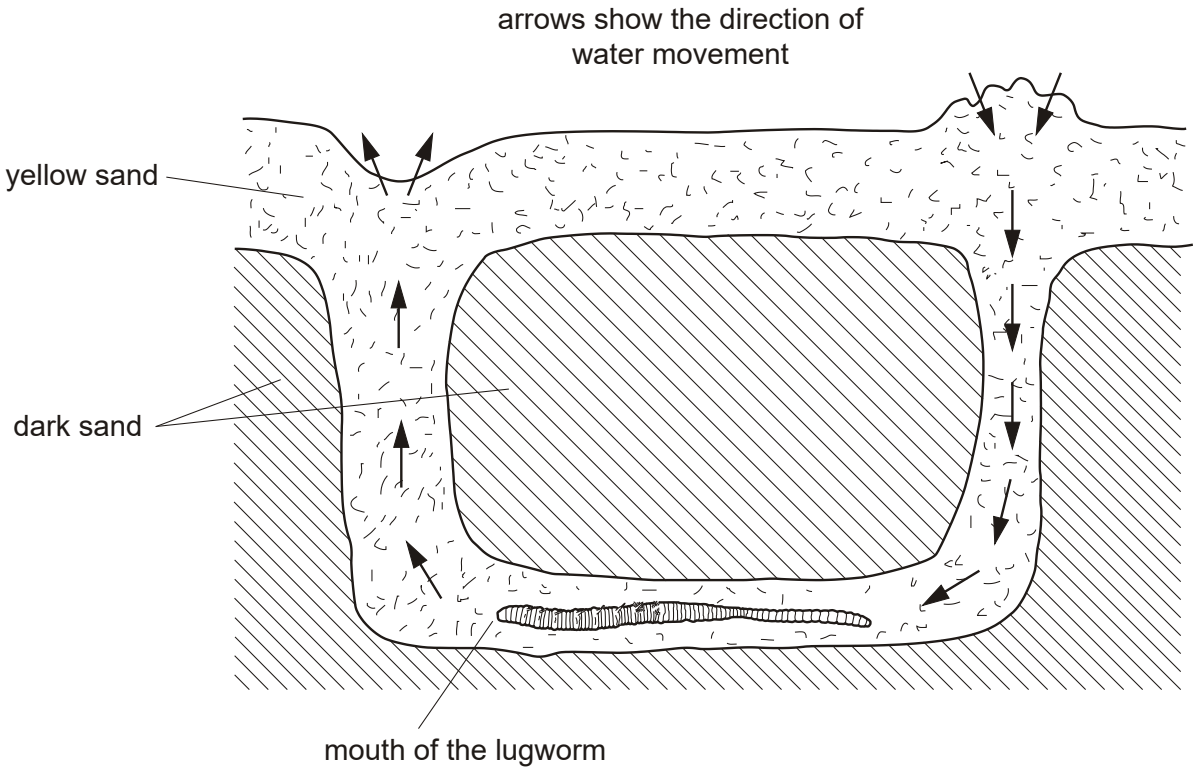


Fig. 2

While the beach is covered by the tide, the lugworm moves its body so that a current of seawater passes down the burrow, over the worm and up through the porous sand, in the direction shown. These ventilation movements allow water to flow slowly past the tufts of gills. The gills are feathery outgrowths of the body wall and appear dark red because they contain many small blood vessels.

A lugworm's blood plasma has a high concentration of haemoglobin dissolved in it. There are no red blood cells. Fig. 3 shows dissociation curves for lugworm haemoglobin and for human haemoglobin.

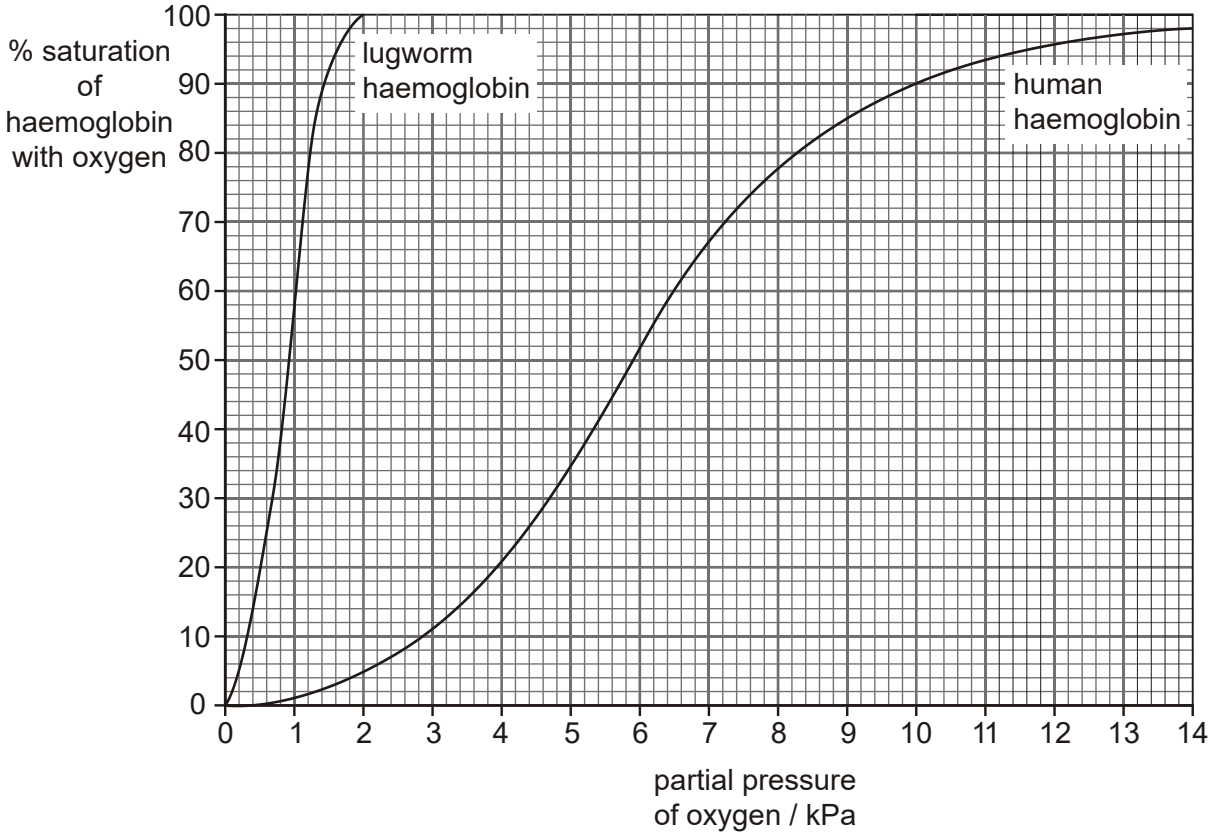


Fig. 3

(a) Describe and explain **one** way in which the dissociation curve for lugworm haemoglobin differs from that for human haemoglobin.

difference .....

.....

explanation .....

.....

[2]

(b) In this question, one mark is available for the quality of spelling, punctuation and grammar.

Describe the similarities and differences between the adaptations for gas exchange and transport of oxygen in mammals and lugworms.

You will gain credit for using information given in question 4.

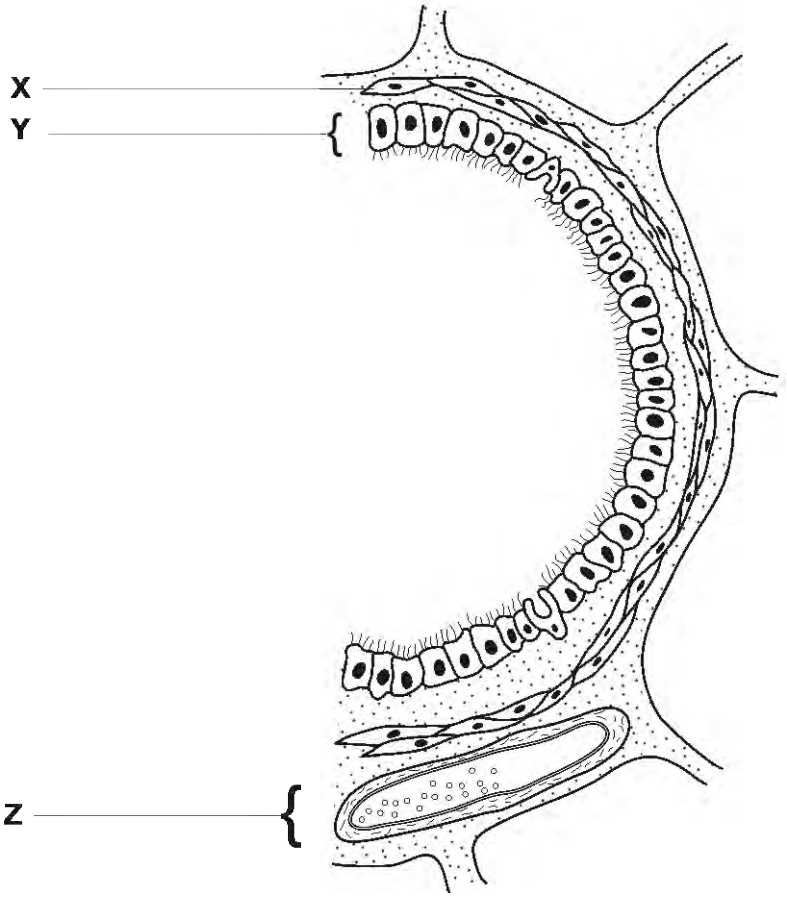
(Allow one lined page)

[7]

Quality of Written Communication [1]

[Total 12 marks]

11. The diagram below is a drawing of a transverse section of part of a bronchiole from a healthy lung.



(i) Name tissues **X** and **Y**.

X .....

Y .....

[2]

(ii) Identify structure **Z**.

Z .....

[1]

[Total 3 marks]

12. In this question, one mark is available for the quality of spelling, punctuation and grammar.

Describe how the tissues in the gaseous exchange system contribute to the functioning of the lungs.

(Allow one lined page).

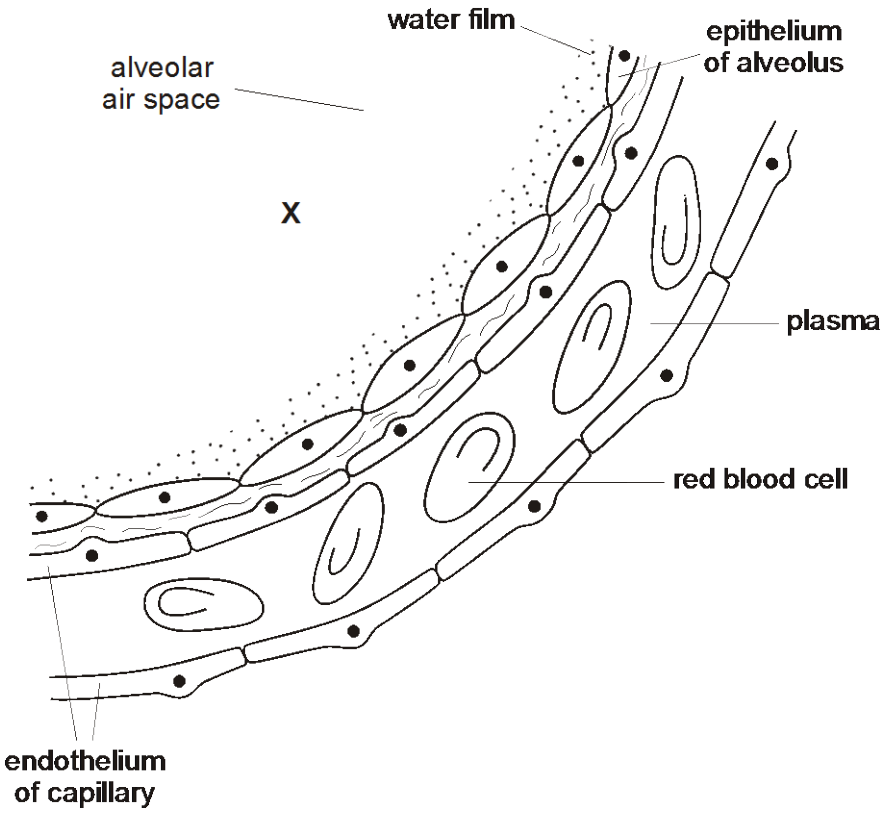
[8]

Quality of Written Communication [1]

[Total 9 marks]

13. Mammals exchange respiratory gases via their lungs, whose surface area is greatly enlarged by the presence of many alveoli.

Below is a diagram showing part of the wall of an alveolus and an associated capillary.



Describe the mechanism by which oxygen gets from point **X** on the diagram to the red blood cells.

.....

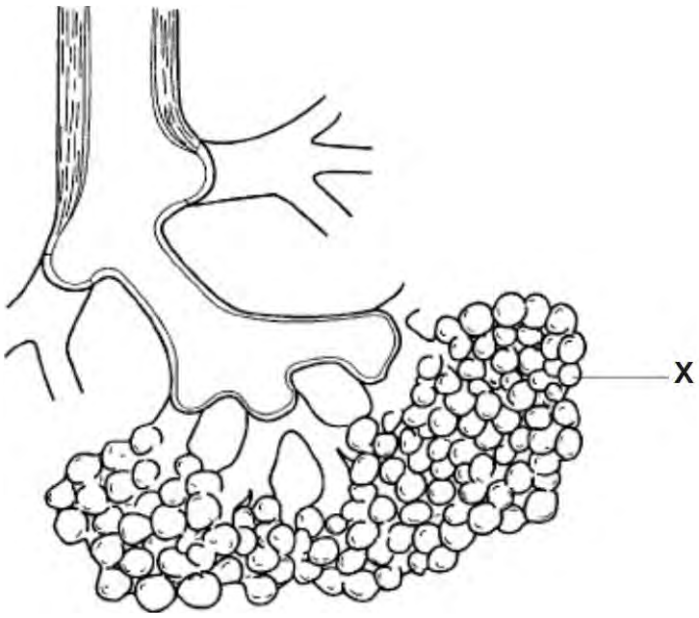
.....

.....

.....

[Total 2 marks]

14. Many small animals rely on diffusion across outer surfaces of their bodies for gas exchange. Mammals have lungs for gas exchange. The diagram below shows the structure of part of a mammalian lung and associated airways.



Taken from 'Advanced Human Biology' by J. Simpkins and J.I. Williams
Fig 12.21, p233 (ISBN 0713527692)

(a) (i) Name structure X.

.....

[1]

(ii) Describe the process by which gases are exchanged at **X**.

.....

.....

.....

.....

.....

[3]

(b) Explain why mammals have large numbers of structure **X** in their lungs.

.....

.....

.....

.....

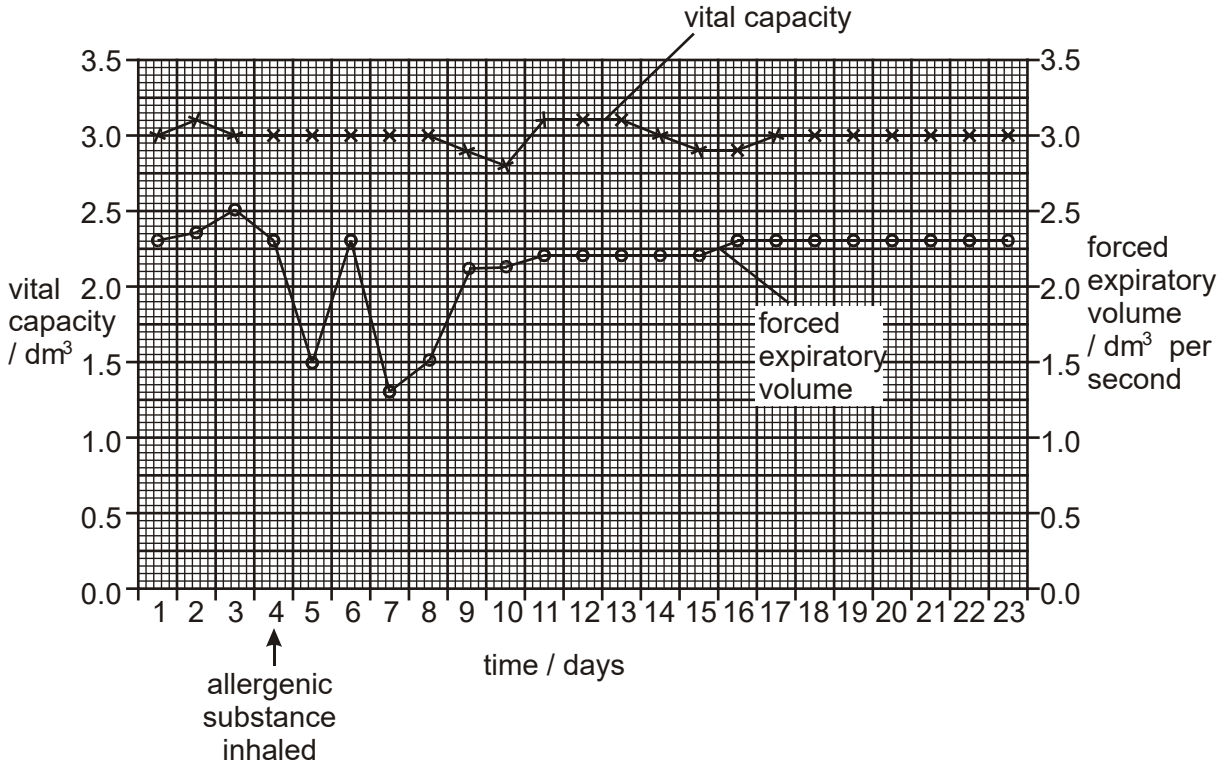
.....

[2]

[Total 6 marks]

15. The vital capacity and the forced expiratory volume of a person with asthma were measured over a period of 23 days. The forced expiratory volume is the volume of air that can be breathed out in one second. On day 4 of the investigation, the person breathed in an allergenic substance.

The results are shown in the graph below.



Graph from ABC of Allergies, p28 top figure, edited by S.R.Durham.
The British Medical Journal, 1998 (ISBN 0727912364)

(i) Calculate for day 1 the percentage of the vital capacity that was breathed out in one second.

Show your working and give your answer to the nearest whole number.

answer ..... %

[2]

(ii) Using the data in the graph, describe the effect of the allergenic substance on the forced expiratory volume and the vital capacity.

forced expiratory volume .....

.....

.....

.....

vital capacity .....

.....

.....

.....

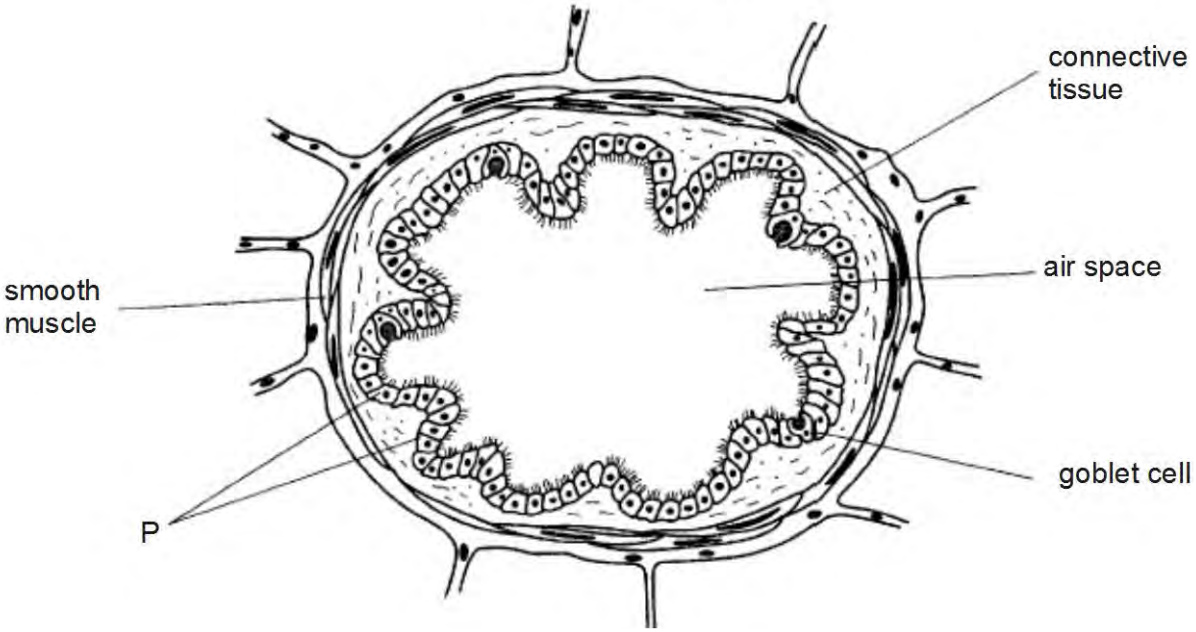
[3]

[Total 5 marks]

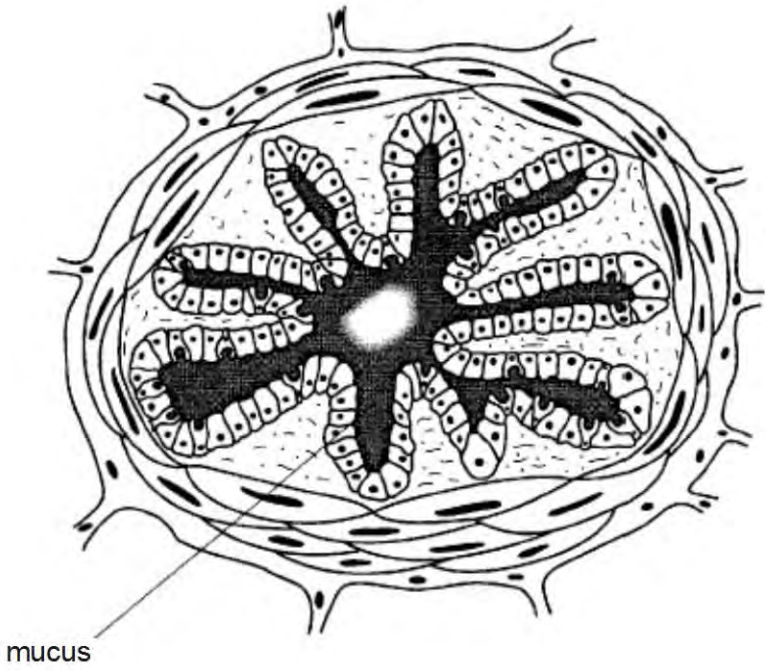
16. The diagram below shows drawings made from cross sections of the upper bronchioles of a non-asthmatic, **X**, and an asthmatic, **Y**. The sections were drawn from observations made with a light microscope.

Upper bronchioles normally have an epithelium with a few, scattered, goblet cells.

X – a non asthmatic



Y – an asthmatic



(a) Describe the function of the cells labelled **P** on the diagram in the gas exchange system.

.....

.....

.....

.....

.....

[3]

(b) Use the information given in the diagram to explain the following observations made on the bronchioles of an asthmatic during an attack of asthma.

(i) The bronchioles fill with mucus.

.....

.....

.....

.....

(ii) The cross sectional area of the air spaces in the bronchioles decreases.

.....

.....

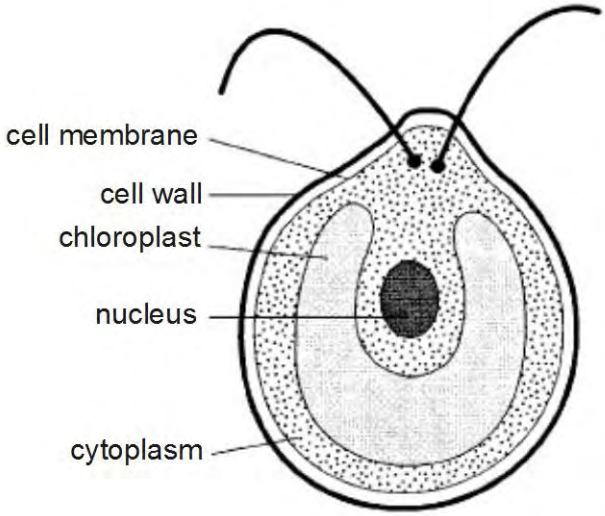
.....

.....

[3]

[Total 6 marks]

17. Fig. 1 shows the structure of a single-celled organism called *Chlamydomonas* which shares many features with plant cells. Fig. 2 shows a cedar tree. The cells of both organisms need water to carry out their metabolic functions.



5μm

Chlamydomonas

Fig. 1

5m

cedar tree

Fig. 2

(a) (i) *Chlamydomonas* lives in fresh water ponds.

Explain how single-celled organisms like *Chlamydomonas* obtain water from their external environment.

.....

.....

.....

.....

[2]

(ii) Sea water contains a much higher percentage of salts than the fresh water in which *Chlamydomonas* lives.

Suggest the changes that would take place in the *Chlamydomonas* cell if it were transferred to sea water.

.....

.....

.....

.....

.....

[2]

(b) *Chlamydomonas* has no water transport system whereas the tree shown in Fig. 2 has a well developed system for water transport.

Explain why a large multicellular organism like a tree needs a water transport system whilst *Chlamydomonas* does not.

.....

.....

.....

.....

[3]

[Total 7 marks]