1. State the maximum magnification that can be achieved by a light microscope and a transmission electron microscope.

Select your answers from the list below.

10x 40x 100x 400x 1500x 25 000x 50 000x 500 000x

light microscope x

transmission electron microscope x

[Total 2 marks]

2. Describe what is meant by the term *resolution*.

.....

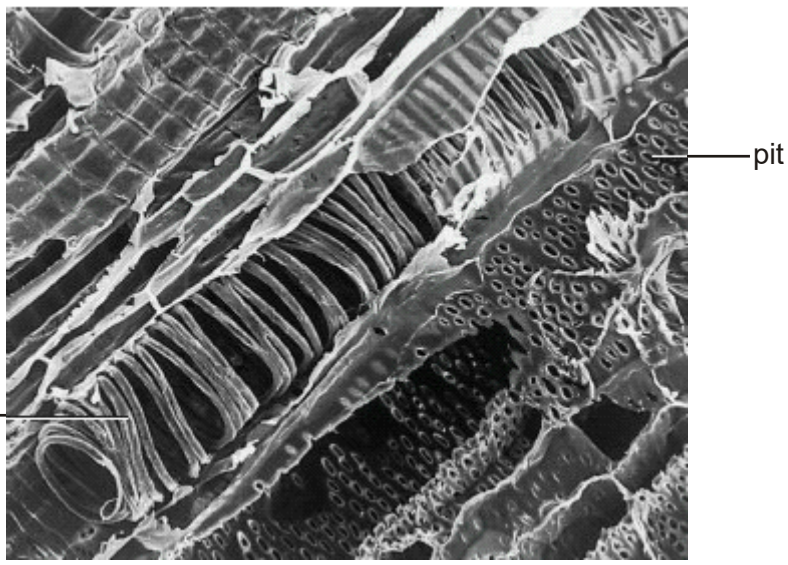
.....

.....

.....

[Total 2 marks]

3. The figure below is an electron micrograph of xylem tissue in the stem of a plant.



(i) State **one** function of xylem tissue.

.....

.....

[1]

(ii) The spiral band in the xylem vessel shown in the figure above contains a substance called lignin.

State the function of this spiral band of lignin **and** explain why it is important that the xylem vessel becomes lignified in this way.

.....

.....

.....

.....

.....

.....

.....

[3]

(iii) Explain the function of the pits seen in the figure above.

.....

.....

.....

.....

.....

[2]

[Total 6 marks]

4. (i) Explain what is meant by the term *tissue*.

.....

.....

.....

.....

[2]

(ii) Name **one** type of epithelial tissue found in the lungs.

.....

.....

[1]

[Total 3 marks]

5. Explain why the lungs can be considered to be an organ.

.....

.....

.....

.....

[Total 2 marks]

6. In the lungs, goblet cells secrete mucus. The mucus is then moved by cilia.

Name **one** cellular structure from the list below that is associated with each of the following functions. You must select a structure once only.

mitochondria ribosome Golgi vesicle centriole nucleus cytoskeleton

(i) release of energy .....

(ii) movement of cilia .....

(iii) secrete mucus .....

[Total 3 marks]

7. Complete the passage below.

Membranes have a variety of functions in cells. All membranes are ..... permeable. This means that they allow the passage of certain substances by processes such as active transport or ..... through the membrane.

The cell surface membrane, also known as the ..... membrane, surrounds the cytoplasm.

The cell surface membrane consists of a bilayer of ..... . To stabilise the structure of the membrane and keep it fluid, molecules of ..... are also found in this bilayer.

[Total 5 marks]

8. Membranes contain a variety of proteins. Some of these proteins are combined with carbohydrates to form glycoproteins.

Describe the functions of glycoproteins in the cell surface membrane.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

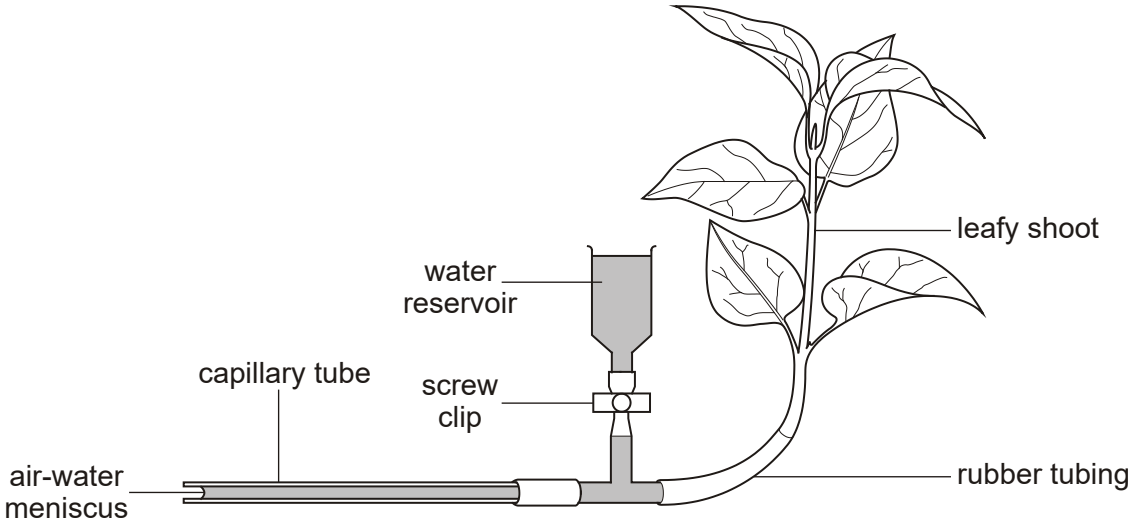
.....

.....

.....

[Total 5 marks]

9. The figure below shows a potometer, a piece of apparatus used for estimating the rate of transpiration.



(a) State **one** essential component of the apparatus, not shown in the figure above, that must be added before any results can be recorded.

.....

[1]

(b) Describe **three** steps a student should take when **setting up** the potometer to ensure that the apparatus works correctly.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

(c) A student used the apparatus shown in the figure above to investigate how transpiration rates vary during the day. The student placed the potometer on a window ledge in the laboratory and estimated the rate of transpiration four times during the day.

The results are shown in the table below.

time of day	rate of transpiration (arbitrary units)			
	replicate 1	replicate 2	replicate 3	mean
10.00	32	29	31	30.7
12.00	37	35	38	36.7
14.00	23	26	25	24.7
16.00	25	27	24	

(i) Calculate the mean value for the rate of transpiration at 16.00 hours.

Give your answer to **one decimal place**.

Answer = ...

[1]

(ii) Explain why, for each time of the day, the student carried out three replicates to calculate a mean.

.....

.....

.....

.....

[2]

(iii) Suggest **two** possible reasons, other than light and temperature, why the rate of transpiration was **lower** in the afternoon than in the morning.

1 .....

.....

2 .....

.....

[2]

(iv) Explain why the potometer only gives an **estimate** of the rate of transpiration.

.....

.....

.....

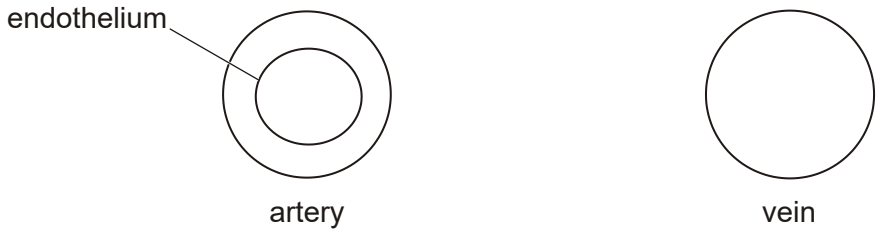
.....

[2]

[Total 11 marks]

10. (i) The figure below represents a transverse section of an artery and a vein.

Draw a line to show the relative position of the endothelium of the **vein**.



[1]

(ii) State **two other** ways in which the wall of an artery is different from the wall of a vein.

1 .....

.....

2 .....

.....

[2]

[Total 3 marks]

11. (i) Blood in the arteries has a high hydrostatic pressure.

State how this hydrostatic pressure is generated in the heart.

.....

.....

[1]

(ii) Explain why the hydrostatic pressure of the blood drops as blood moves away from the heart.

.....

.....

.....

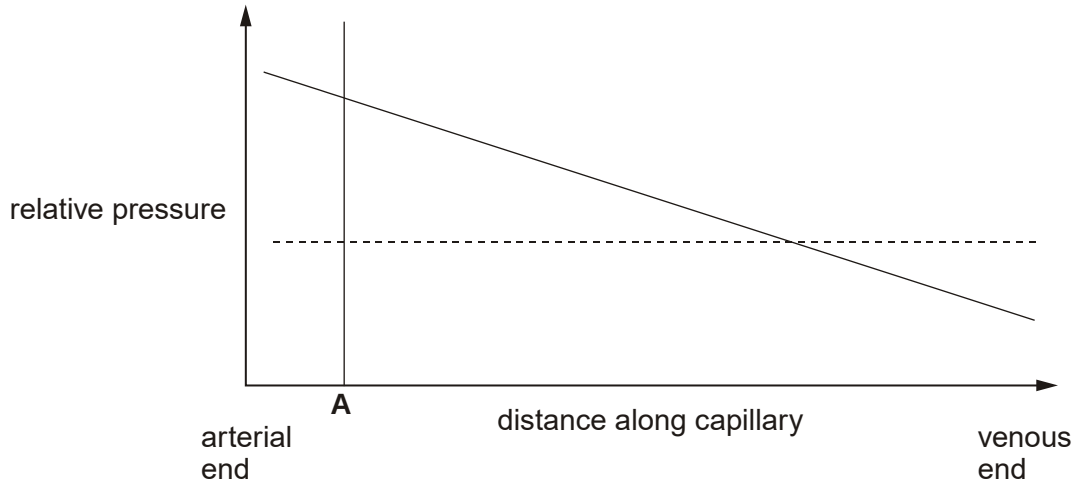
.....

[2]

(iii) Capillaries have walls that are one cell thick.

The figure below shows how the hydrostatic pressure of the blood changes as it moves through a capillary.

The figure below also shows the water potential of the blood, due largely to the plasma proteins, which tends to move water into the blood.



Describe **and** explain what happens to the blood plasma at point **A** along the capillary in the figure above.

.....

.....

.....

.....

.....

.....

.....

.....

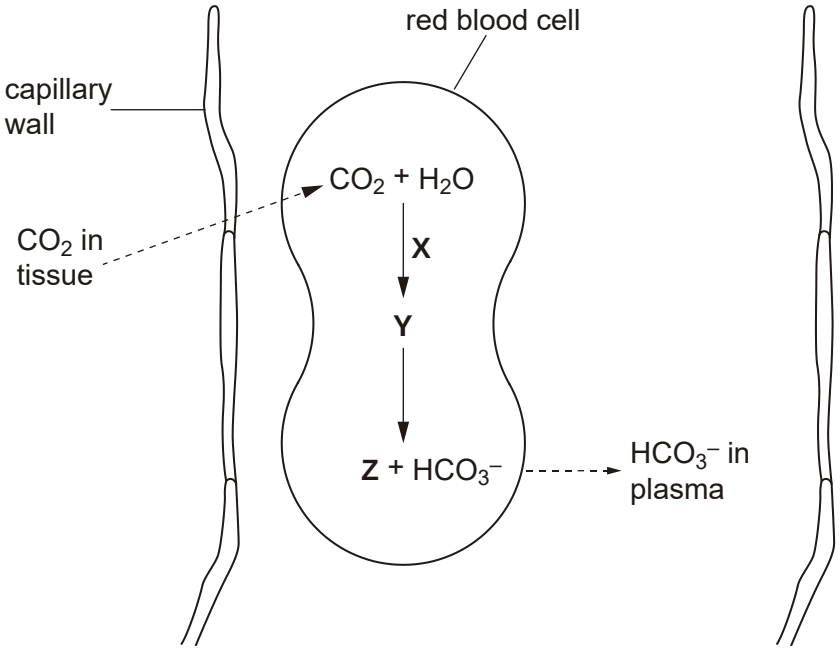
[3]

[Total 6 marks]

12. Carbon dioxide is produced in tissues as a waste product of respiration.

The majority of carbon dioxide is carried as hydrogencarbonate ions (HCO_3^-) in the plasma.

The figure below shows the chemical pathway in which carbon dioxide is converted into HCO_3^- in a red blood cell.



Identify the following:

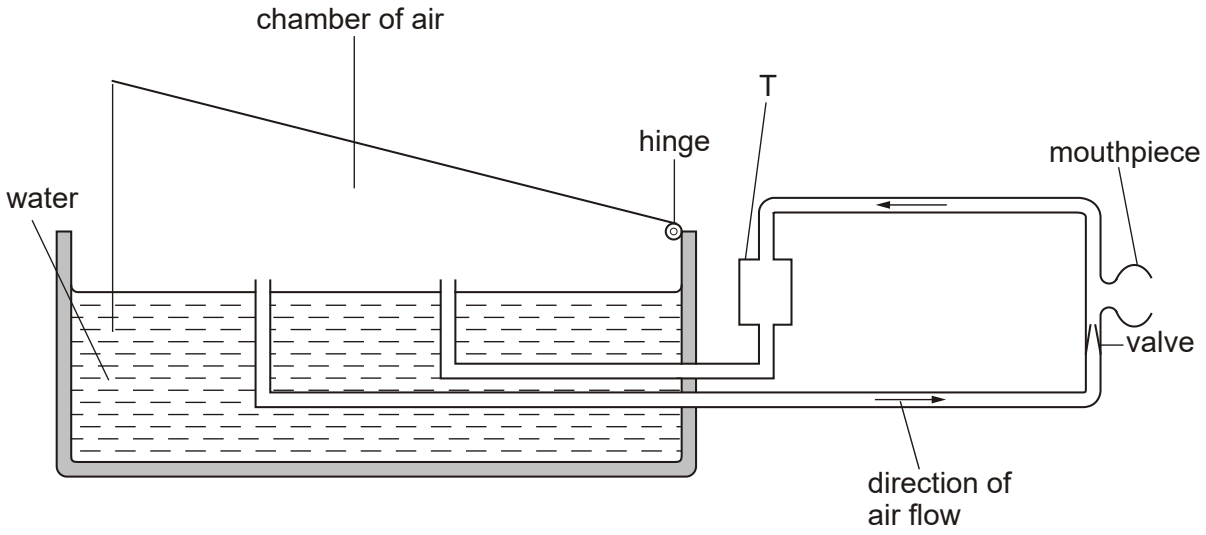
enzyme **X** .....

substance **Y** .....

ion **Z** .....

[Total 3 marks]

13. The figure below is a diagram of a spirometer, a piece of apparatus used to measure some aspects of breathing, such as breathing rate and vital capacity.



(a) (i) Outline the mechanism of **inspiration**.

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

.....

.....

.....

.....

.....

.....

[3]

(ii) A person breathes through the mouthpiece of a spirometer.

State what happens to the air chamber in the figure above during **inspiration**.

.....

[1]

(iii) Chamber **T** contains a chemical that absorbs carbon dioxide.

Suggest a chemical that could be used in chamber **T** to absorb carbon dioxide.

.....

.....

[1]

(b) Explain why a person using the spirometer to measure their vital capacity should wear a nose clip.

.....

.....

.....

.....

[2]

(c) State **two** other precautions that should be taken when using a spirometer to measure vital capacity.

1 .....

.....

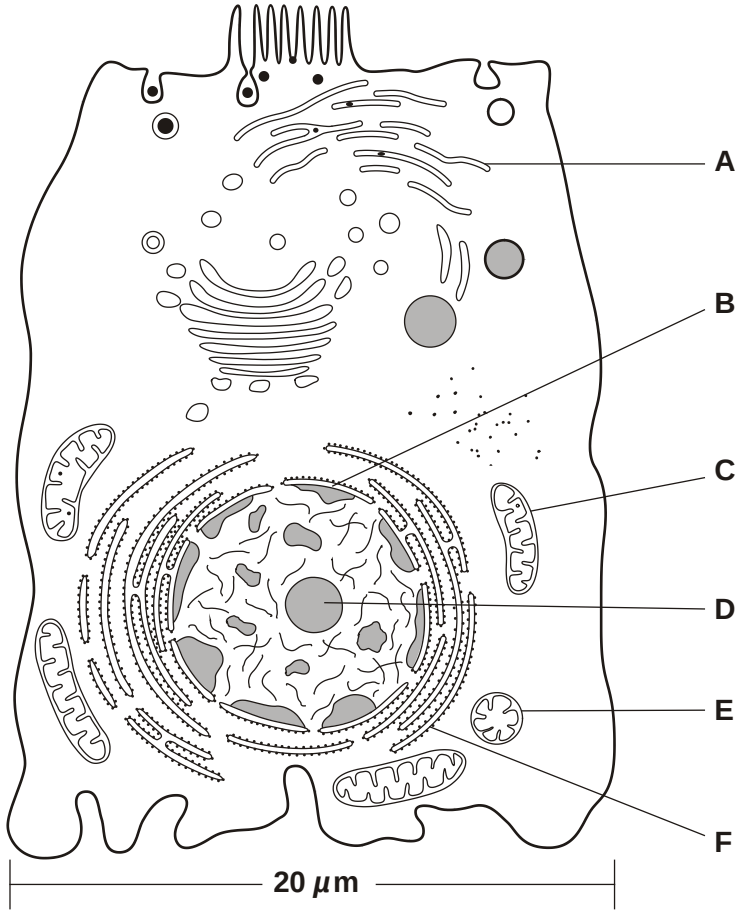
2 .....

.....

[2]

[Total 9 marks]

14. The figure below is a diagram of an animal cell as seen using a transmission electron microscope.



(i) Name the structures of the cell labelled **A**, **B**, **C** and **D**.

A .....

B .....

C .....

D .....

[4]

(ii) Structures **C** and **E** are examples of the same organelle.

Suggest why **E** looks so different to **C**.

.....

.....

.....

.....

[2]

(iii) Calculate the actual length of structure **C**.

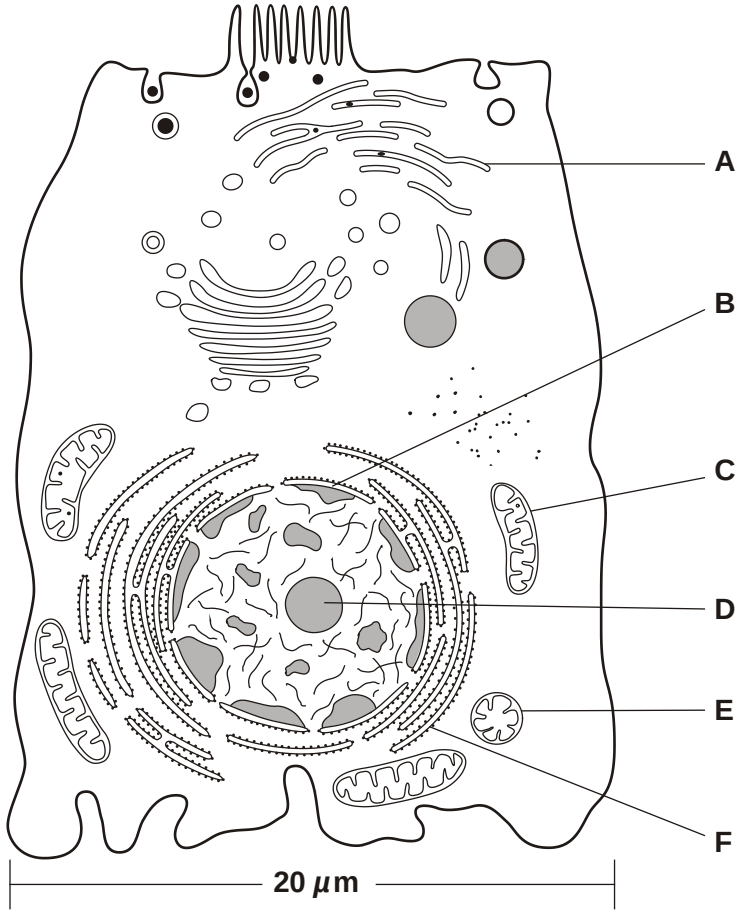
Show your working and give your answer in micrometres (μm).

Answer = ... μm

[2]

[Total 8 marks]

15. The figure below is a diagram of an animal cell as seen using a transmission electron microscope.



Proteins are produced by the structure labelled **F**. Some of these proteins may be extracellular proteins that are released from the cell.

Outline the sequence of events following the production of extracellular proteins that leads to their release from the cell.

.....

.....

.....

.....

.....

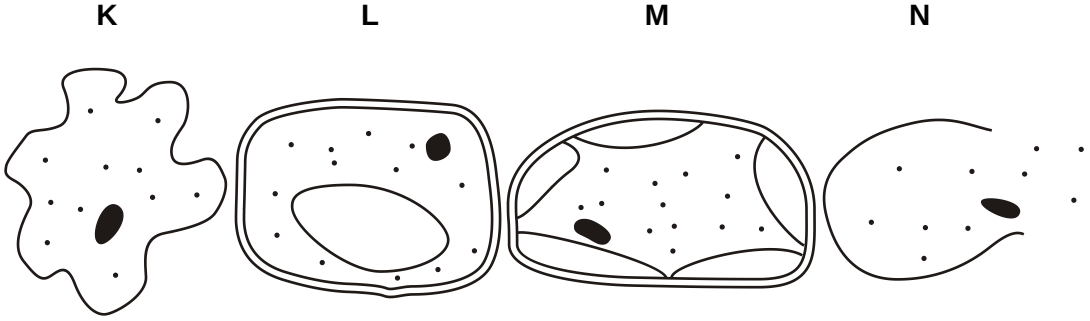
.....

.....

.....

[Total 3 marks]

16. The figure below shows diagrams of four cells that have been placed in different solutions.



(a) In the table below, write the letter **K**, **L**, **M** or **N** next to the description that best matches the diagram. One has been done for you.

description	letter
an animal cell that has been placed in distilled water	
an animal cell that has been placed in a concentrated sugar solution	
a plant cell that has been placed in distilled water	
a plant cell that has been placed in a concentrated sugar solution	**M**

[3]

(b) Explain, using the term **water potential**, what has happened to cell **M**.

.....

.....

.....

.....

.....

.....

.....

.....

[3]

[Total 6 marks]

17. Small non-polar substances enter cells in different ways to large or polar substances.

Outline the ways in which substances, **other than water**, can enter a cell through the plasma (cell surface) membrane.

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

small, non-polar substances .....

.....

.....

.....

.....

.....

large substances .....

.....

.....

.....

.....

.....

polar substances .....

.....

.....

.....

.....

.....

[Total 5 marks]

18. The division of stem cells by mitosis produces cells that are genetically identical.

(i) State what is meant by the term *stem cell*.

.....

.....

.....

.....

[2]

(ii) Name **one** tissue in **plants** that contains stem cells.

.....

[1]

[Total 3 marks]

19. State **three** reasons why mitosis is important to organisms.

1 .....

2 .....

3 .....

[Total 3 marks]

20. Explain, using the term **surface area to volume ratio**, why large, active organisms need a specialised surface for gaseous exchange.

.....

.....

.....

.....

.....

.....

[Total 2 marks]

21. The table below describes some of the features of the mammalian gas exchange system.

Complete the table by explaining how each feature improves the efficiency of gaseous exchange. The first one has been completed for you.

feature of gas exchange system	how feature improves efficiency of gaseous exchange
many alveoli	this increases the surface across which oxygen and carbon dioxide can diffuse
the epithelium of the alveoli is very thin	
there are capillaries running over the surface of the alveoli	
the lungs are surrounded by the diaphragm and intercostal muscles	

[Total 3 marks]

22. Outline how the diaphragm **and** intercostal muscles cause **inspiration**.

.....

.....

.....

.....

.....

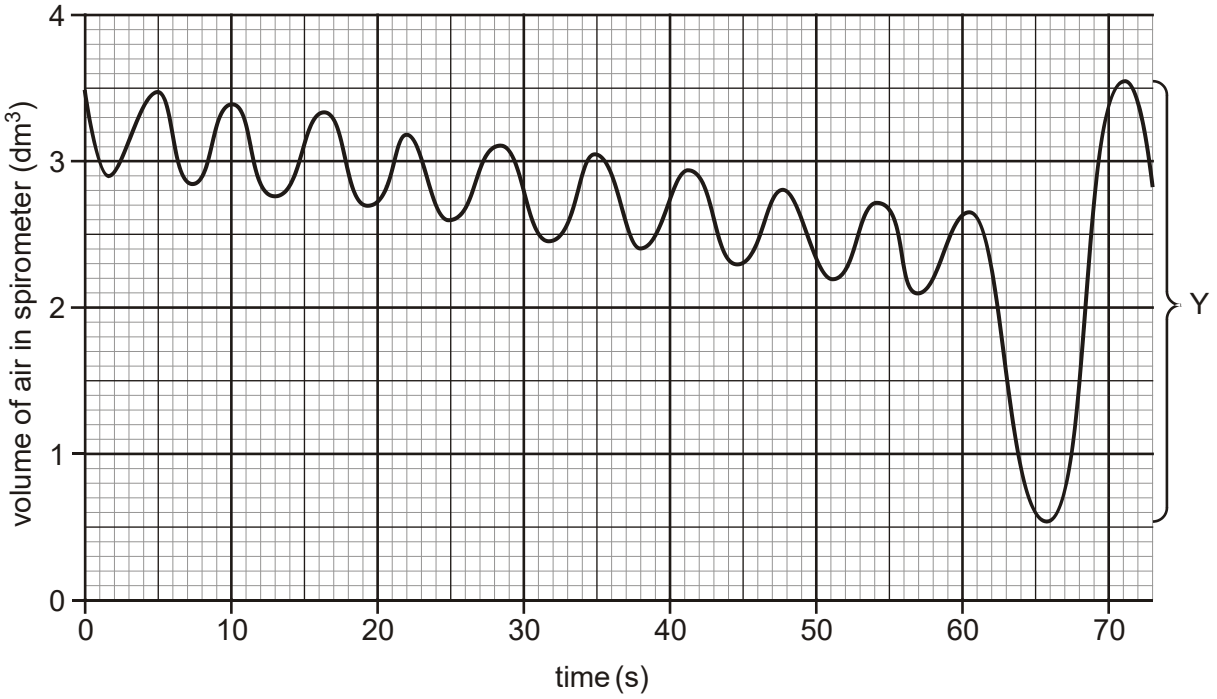
.....

.....

.....

[Total 4 marks]

23. The figure below shows the trace from a spirometer recorded from a 16-year-old student.



(i) **Label on the trace**, using the letter **X**, a point that indicates when the student was inhaling.

[1]

(ii) At the end of the trace the student measured his vital capacity. This is indicated by the letter **Y**.

State the vital capacity of the student.

.....

[1]

[Total 2 marks]

24. Fish have a single, closed circulatory system.

State the meaning of the terms single circulatory system and closed circulatory system.

single circulatory system .....

.....

.....

closed circulatory system .....

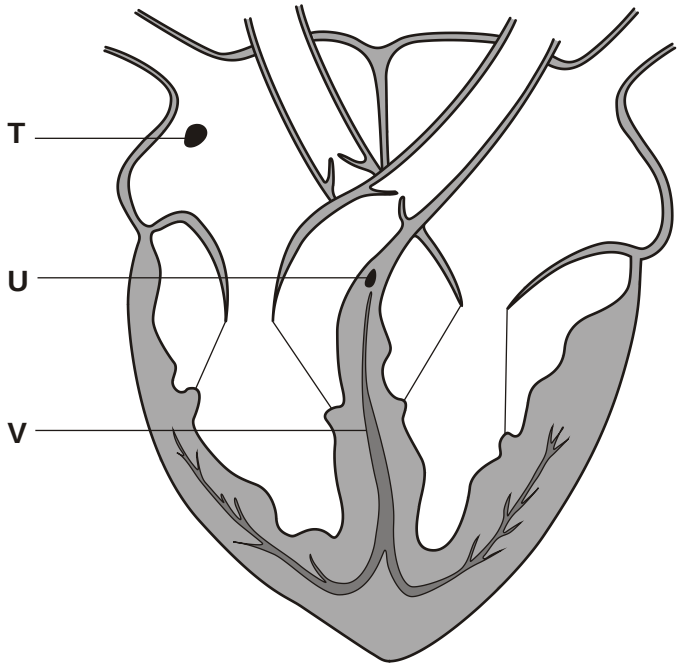
.....

.....

[Total 2 marks]

25. The heart of a mammal contains four main chambers. The action of these chambers is coordinated by electrical activity in specialised tissues.

The figure below shows where these tissues are found in the heart.



(i) Name the tissues labelled **T**, **U** and **V**.

T .....

U .....

V .....

[3]

(ii) Describe how the action of the heart is initiated **and** coordinated.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[5]

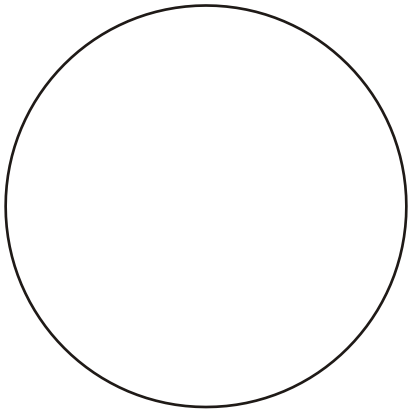
[Total 8 marks]

26. Translocation is the movement of the products of photosynthesis within a plant.

Translocation occurs in the phloem and involves sources and sinks.

Using the outline below, draw in the position of the phloem in the root of a dicotyledonous plant.

root



[Total 1 mark]

27. Research using carbon dioxide containing a radioactive label, C^{14}, has revealed the following evidence about the mechanism of translocation:

A labelled carbon can be observed in the phloem soon after being supplied to a well-lit plant;

B the rate of movement of sugars in the phloem is many times faster than could be achieved by diffusion alone.

Different research has revealed that:

C an insect such as an aphid feeds by inserting its proboscis (mouth parts) into the phloem;

D the pH of the phloem companion cells is lower than surrounding cells;

E the phloem companion cells contain many mitochondria.

Using the letters **A**, **B**, **C**, **D** and **E**, select **two** pieces of evidence from the list above which support the theory that translocation occurs in the phloem.

.....

.....

[Total 2 marks]

28. State what is meant by the terms *source* and *sink*.

.....

.....

.....

.....

.....

[Total 2 marks]

29. When the bark is removed from a tree, the phloem is also removed. If a complete ring of bark is removed, the tree trunk can be seen to swell above the cut.

Suggest **two** reasons why the trunk swells above the cut.

.....

.....

.....

.....

.....

.....

[Total 2 marks]

30. Fig. 1 (a) is a diagram of a part of a mammalian lung.

Fig. 1 (b) is an enlargement of part of the lining of the bronchus.

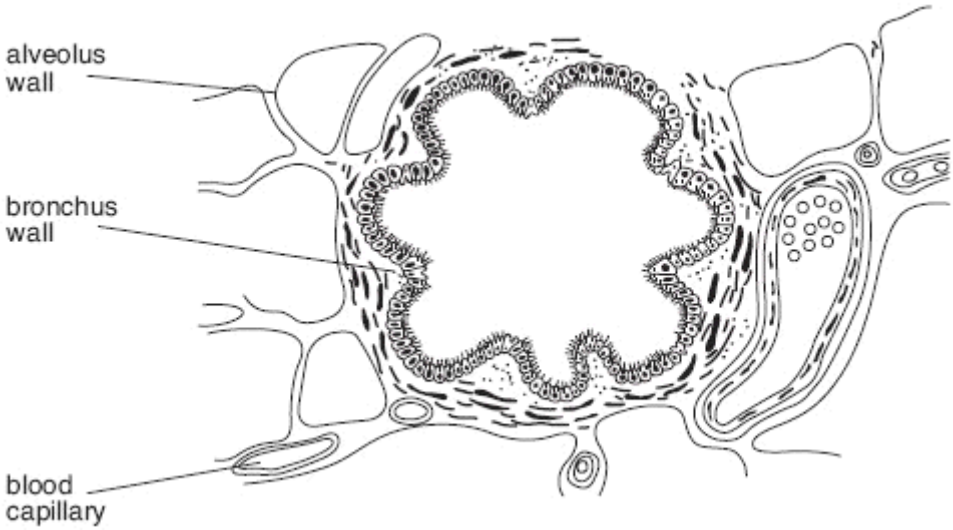


Fig.1 (a)

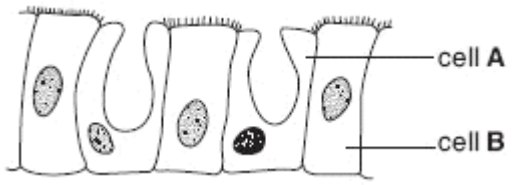


Fig.1 (b)

(i) Name the two types of cell, **A** and **B**, shown lining the **bronchus**.

A .....

B .....

[2]

(ii) Describe how cell types **A** and **B** work together to keep the lung surface clear of dust and other particles.

.....

.....

.....

.....

.....

.....

[3]

(iii) The bronchus wall also contains smooth muscle fibres.

State the function of the smooth muscle fibres.

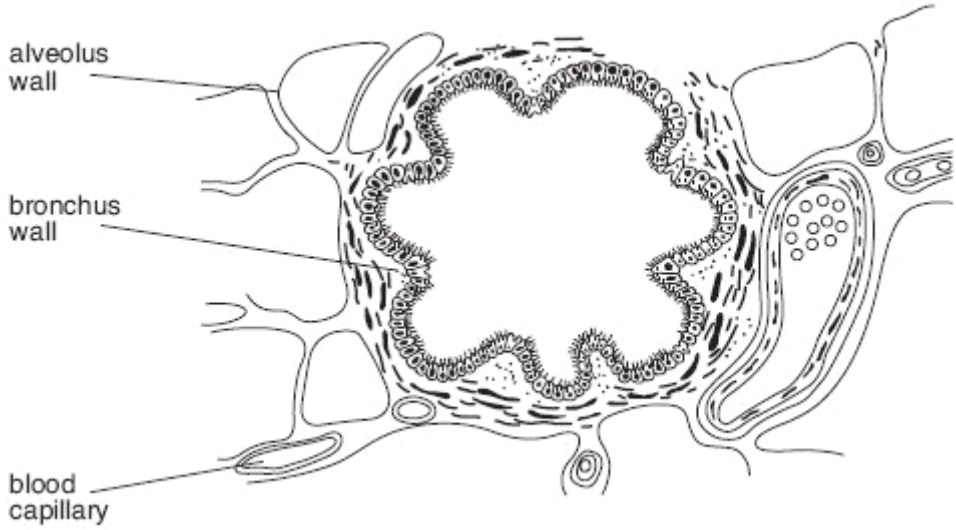
.....

.....

[1]

[Total 6 marks]

31. The picture below is a diagram of a part of a mammalian lung.



(i) Explain why blood capillaries and alveoli are very close together.

.....

.....

.....

.....

.....

[2]

(ii) The walls of the alveoli contain elastic fibres.

State the function of these elastic fibres.

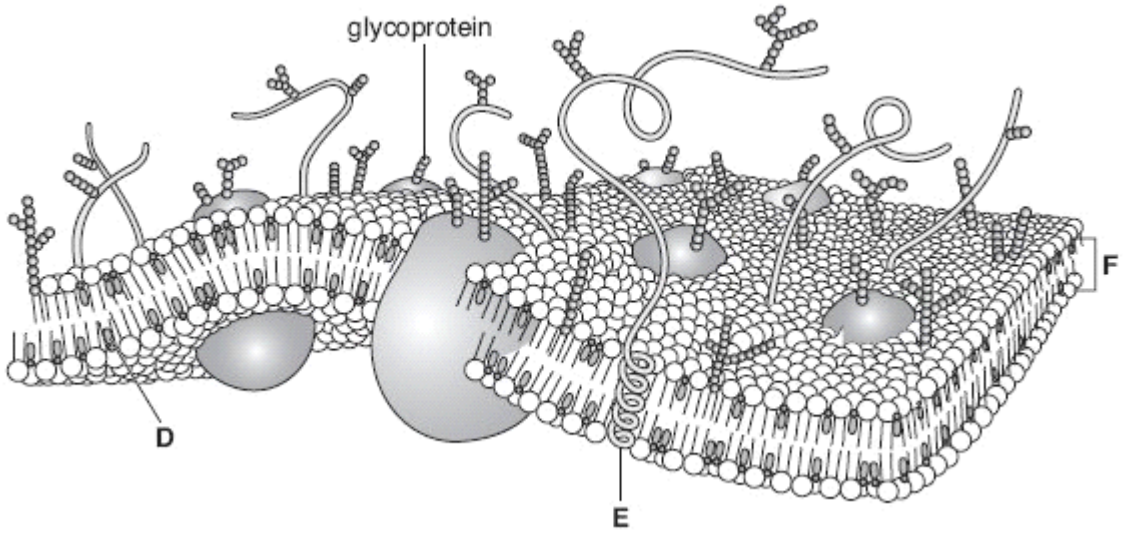
.....

.....

[1]

[Total 3 marks]

32. The figure below shows the structure of a plasma (cell surface) membrane.



(a) (i) Name the components of the plasma (cell surface) membrane labelled **D**, **E** and **F**.

D .....

E .....

F .....

[3]

(ii) State **one** function for each of the components **D**, **E** and **F**.

D .....

.....

E .....

.....

F .....

.....

[3]

(b) Glycoprotein molecules are positioned in the plasma (cell surface) membrane with the carbohydrate chain outside the cell.

This is to allow the glycoproteins to act as receptors in the process of cell signalling.

(i) Explain what is meant by the term *cell signalling*.

.....

.....

.....

.....

[2]

(ii) Explain **how** a glycoprotein can act as a receptor.

.....

.....

.....

.....

[2]

[Total 10 marks]

33. A student investigated the effect of temperature on the release of pigment from pieces of beetroot.

She cut a fresh beetroot into four pieces and placed each piece into water at a different temperature.

After 10 minutes she removed the beetroot and used a colorimeter to test how much pigment had entered the water.

She placed the coloured water into the colorimeter and measured the percentage transmission of light through the water. Her results are shown in the table below.

temperature of water (°C)	percentage transmission of light
10	85
30	87
50	78
100	0

(i) The results show that below 50 °C little pigment had entered the water.

Explain why there was no transmission of light after the beetroot had been placed in water at 100 °C.

.....

.....

.....

.....

.....

[2]

(ii) Suggest **three** ways in which the student could have improved her investigation.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

[Total 5 marks]

34. (a) Complete the following paragraph about the loss of water from plants.

The loss of water from the aerial parts of a plant is known as

..... .

The majority of water is lost from the leaves. Water is transported up the stem in the ..... and passes into the mesophyll cells of the leaf by ..... . Water evaporates from the surface of these cells.

From the air spaces in the leaf, the water vapour diffuses out of the leaf through the .....

[4]

(b) (i) Explain why water loss from the leaves of a plant is unavoidable.

.....

.....

.....

.....

[2]

(ii) Name the **type** of plant adapted to reduce water loss from its leaves.

.....

[1]

(iii) State **and** explain **two** adaptations of leaves that reduce evaporation.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[5]

[Total 12 marks]

35. The table below compares the structures of prokaryotic and eukaryotic cells.

Complete the table.

prokaryotic	eukaryotic
no true nucleus	genetic material held in a nucleus
genetic material consists of 'naked' DNA	
average diameter of cell 0.5 – 5 μm	
	ribosomes about 22 nm in diameter
	cell wall sometimes present

[Total 4 marks]

36. The cytoskeleton is an important component in the cytoplasm of all eukaryotic cells.

(i) Name **one** structure, **associated with the cytoskeleton**, which can bring about cell movement.

.....

[1]

(ii) Suggest **two** processes **inside cells** that rely on the cytoskeleton for movement.

.....

.....

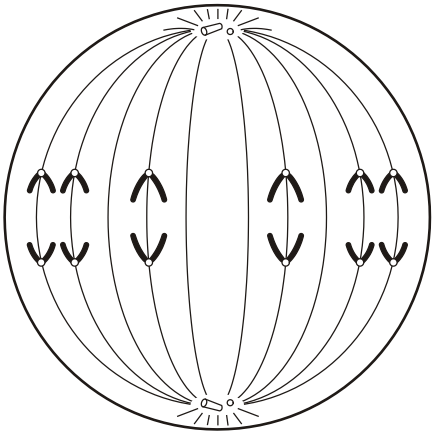
.....

.....

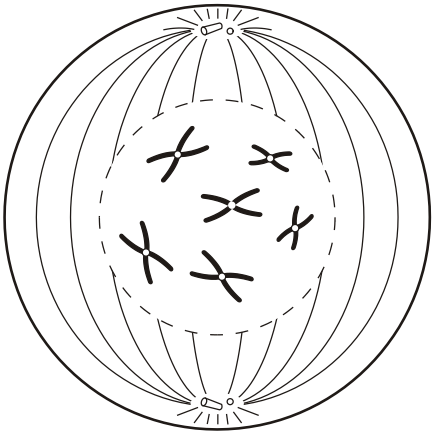
[2]

[Total 3 marks]

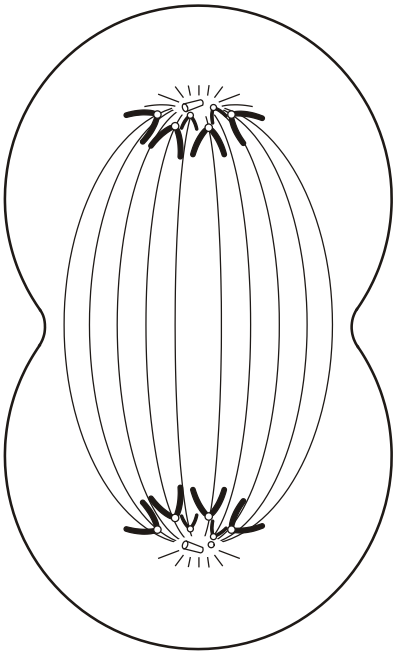
37. The figure below shows some drawings of a cell during different stages of mitosis.



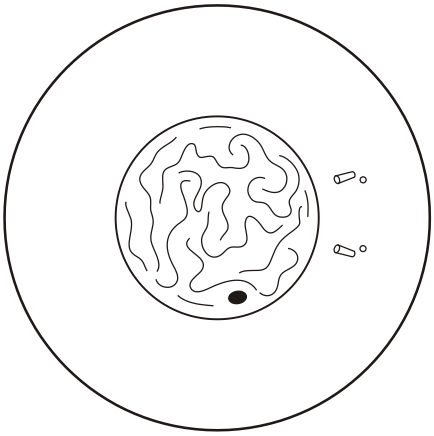
P



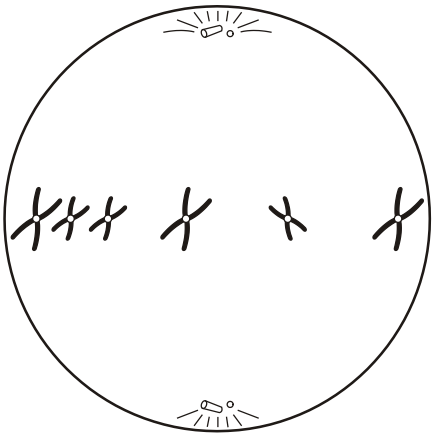
Q



R



S



T

Place stages **P**, **Q**, **R**, **S** and **T** in the correct sequence.

The first stage has been identified for you.

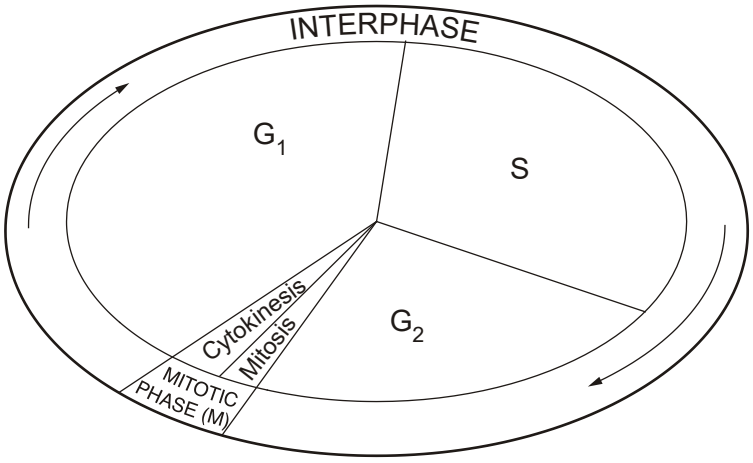
S

.....

[Total 4 marks]

38. Mitosis is part of the cell cycle.

The figure below shows a diagram of the cell cycle.



(i) Name **one** process that occurs during stages G_1 and G_2.

.....

[1]

(ii) During stage **S**, the genetic information is copied and checked.

Suggest what might happen if the genetic information is not checked.

.....

.....

.....

.....

[2]

[Total 3 marks]

39. During **meiosis** a cell undergoes two divisions.

Suggest how cells produced by meiosis may differ from those produced by mitosis.

.....

.....

.....

.....

.....

.....

[Total 2 marks]

40. (i) Name the type of muscle found in the walls of the heart chambers.

.....

[1]

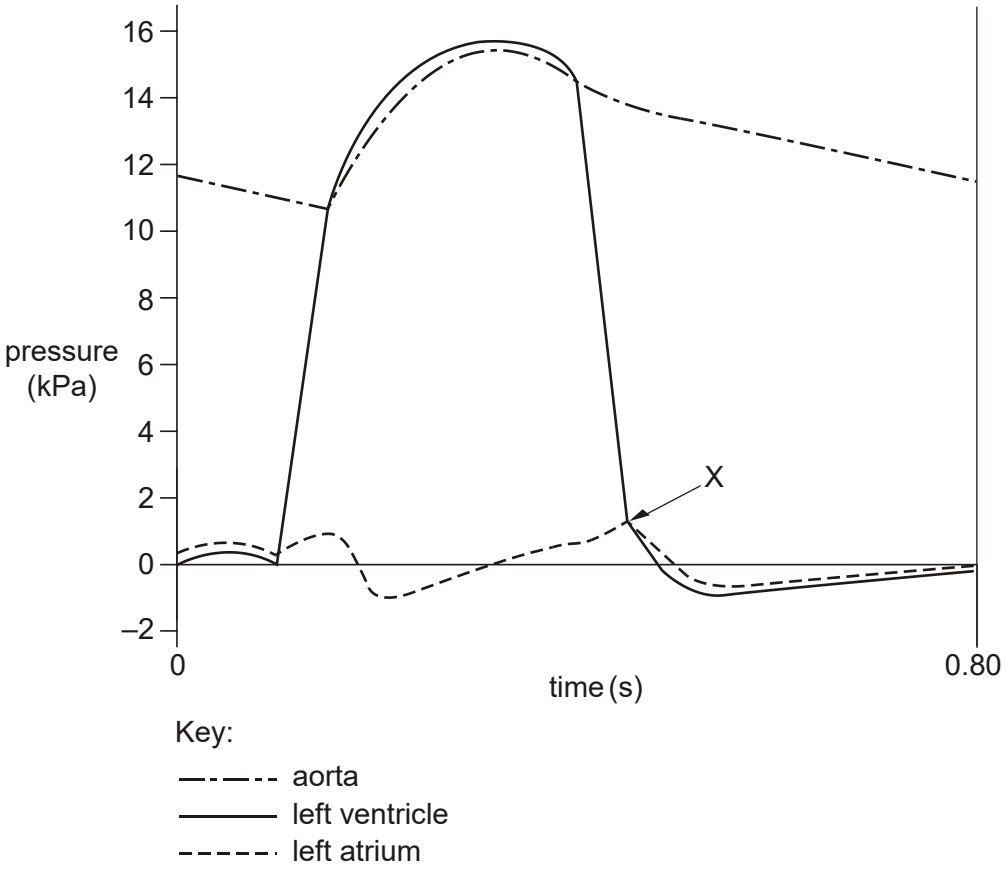
(ii) Name the process that creates pressure inside the heart chambers.

.....

[1]

[Total 2 marks]

41. The figure below shows the changes in pressure inside the heart chambers during one heart beat.



(i) Calculate the heart rate from the information in the figure above.

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

Answer = ... beats min^{-1}

[2]

(ii) Describe and explain what happens **immediately after X** on the figure above.

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

.....

.....

.....

.....

.....

.....

.....

.....

[4]

[Total 6 marks]

42. The table below compares features of typical eukaryotic and prokaryotic cells.

(i) Complete the table by placing one of the following, as appropriate, in each empty box of the table.

- a tick (✓)
- a cross (✗)
- the words 'sometimes present'

Some of the boxes have been completed for you.

	eukaryotic cell	prokaryotic cell
cell wall	sometimes present	✓
nuclear envelope	✓	
Golgi apparatus		✗
ribosomes		✓
flagellum	sometimes present	

(ii) Outline the roles of the Golgi apparatus and the ribosomes.

Golgi apparatus .....

.....

.....

[4]

Ribosomes .....

.....

[2]

[Total 6 marks]

43. The figure below is a diagram of a mammalian sperm cell.

Explain how the structure of the sperm cell is specialised for carrying out its role.

.....

.....

.....

.....

.....

.....

[Total 3 marks]

44. (i) Explain the meaning of the term *tissue*.

.....

.....

.....

[2]

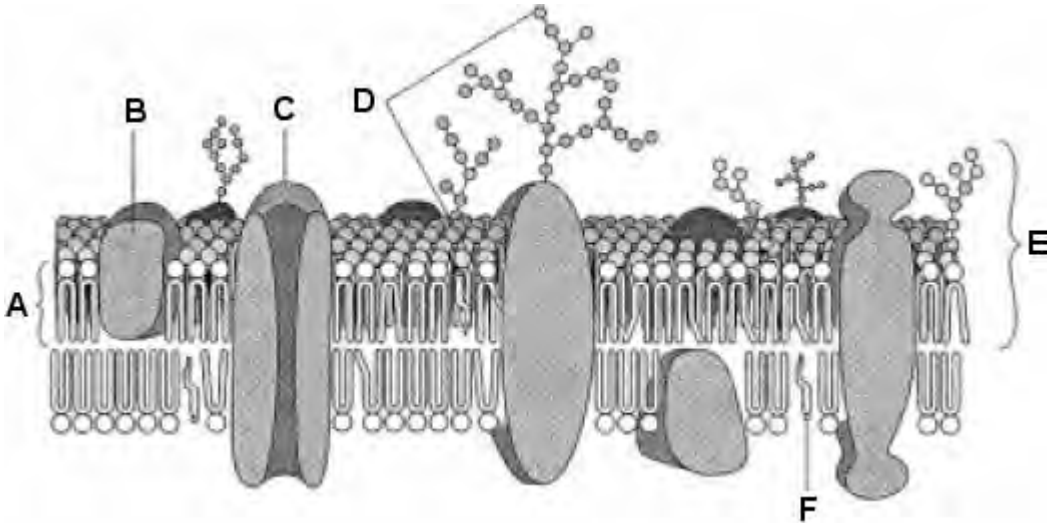
(ii) Name **one** example of a plant tissue.

.....

[1]

[Total 3 marks]

45. The diagram below represents the structure of a plasma (cell surface) membrane.



(a) (i) Name molecules **A, B** and **F**.

In your answer you should spell the names of the molecules correctly.

A .....

B .....

F .....

[3]

(ii) **E** represents the width of the plasma (cell surface) membrane in a typical animal cell.

State the approximate width of the membrane.

.....

[1]

(b) (i) Describe the structure of molecule **A**.

.....

.....

.....

[2]

(ii) State **one** function of molecule **C**.

.....

.....

[1]

(iii) Molecule **D** is a glycoprotein. This molecule consists of a protein embedded in the membrane with a branched carbohydrate chain projecting out from the surface of the cell.

Outline **three** roles of glycoproteins in membranes.

1 .....

.....

2 .....

.....

3 .....

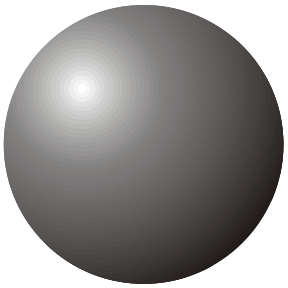
.....

[3]

[Total 10 marks]

46. 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]

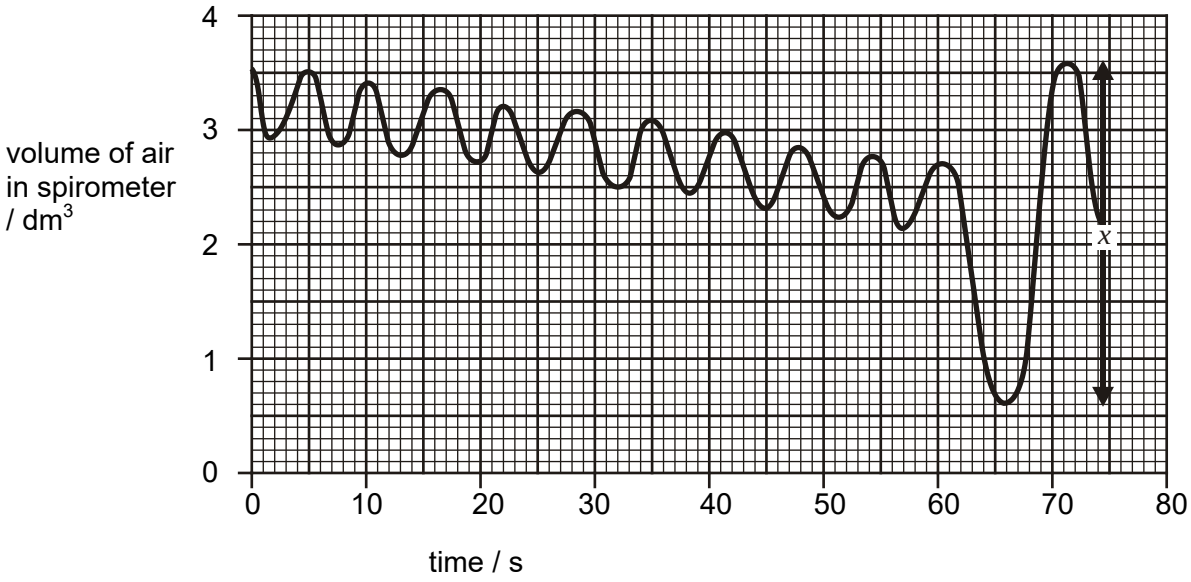
47. The lungs in the mammalian body are well developed to allow effective exchange of gases.

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.

[Total 5 marks]

48. 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]

49. The transport system in mammals is a double circulatory system driven by a pump (the heart).

Explain what is meant by a *double circulatory system*.

.....

.....

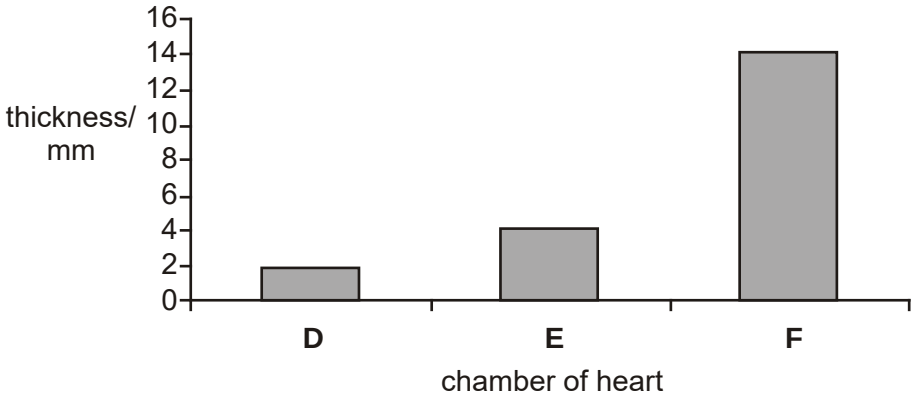
.....

.....

[Total 2 marks]

50. The diagram below gives information about the relative thickness of the walls of three chambers of the heart:

- left ventricle
- right ventricle
- right atrium



(i) State which of these chambers are identified by the letters **D**, **E** and **F**.

D .....

E .....

F .....

[3]

(ii) Explain, with reference to its function, why the wall of chamber **F** is much thicker than the walls of chambers **D** and **E**.

.....

.....

.....

.....

.....

.....

[3]

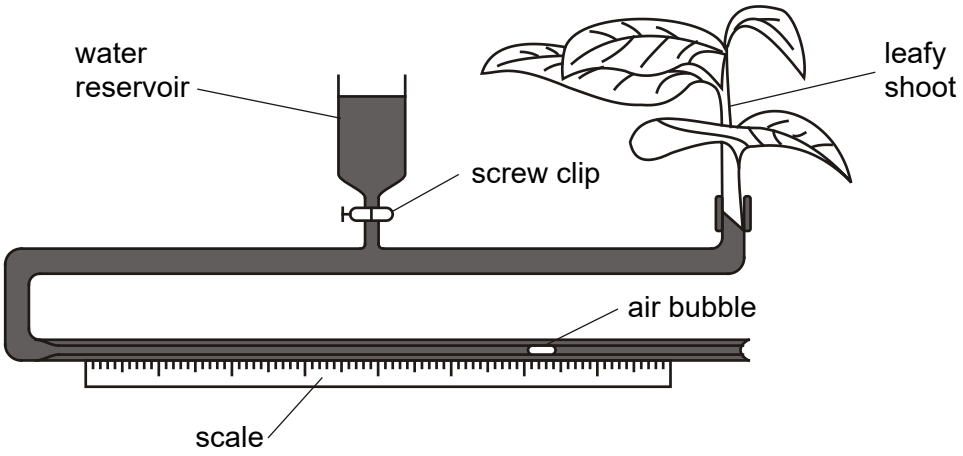
[Total 6 marks]

51. Use the most appropriate terms to complete the paragraph below about the role of haemoglobin in the mammalian blood.

Haemoglobin, a pigment found in the blood of mammals, has an important role in the transport of respiratory gases. Each haemoglobin molecule contains haem groups. In the lungs, oxygen binds with the atom of …… in each haem group. The maximum number of molecules of oxygen that can be carried by one molecule of haemoglobin is …… . In areas like muscle tissue where the partial pressure of oxygen is low, oxygen dissociates from the haem group. This dissociation is increased by the presence of carbon dioxide; this is called the …… …… . Most of the carbon dioxide produced in respiring tissues diffuses into the red blood cells where the enzyme …… …… catalyses a reaction leading to the production of hydrogen ions and hydrogen carbonate ions. The hydrogen ions combine very readily with haemoglobin to form a compound known as …… …… . The effect of this is to increase the release of oxygen from haemoglobin.

[Total 5 marks]

52. Transpiration is the loss of water from plants by evaporation. The diagram below shows a potometer, an apparatus used to **estimate** transpiration rates.



(a) Transpiration itself is not measured directly by a potometer.

State what is measured by this apparatus.

.....

[1]

(b) Describe how the apparatus should be set up to ensure that valid measurements can be made.

In your answer, you should make clear how the steps in the process are sequenced.

[7]

[Total 8 marks]

53. A student investigated the transpiration rates of two different plants **A** and **B**.

The results of the investigation are shown in the table below.

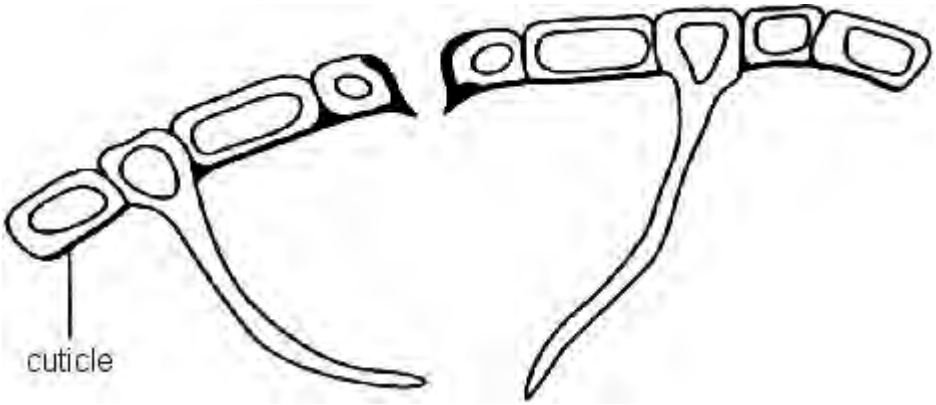
reading	estimate of transpiration rate / arbitrary units	
	plant **A**	plant **B**
1	45	107
2	39	99
3	41	106
4	46	101
5	38	103
mean	42	

(i) Calculate the mean estimated transpiration rate for plant **B**.

Express your answer to the nearest whole number and write it in the shaded box in the table.

[1]

(ii) The student prepared a temporary slide of a transverse section through one of the leaves. The figure below shows a diagram the student drew of the **lower epidermis** from one of the leaves.



State from which plant, **A** or **B**, the leaf was taken. Explain your answer.

Plant .....

Explanation .....

.....

.....

.....

[3]

[Total 4 marks]

54. In coastal regions, unusually high tides can cause flooding of land that is not normally covered by sea water.

Explain how plants living in these regions would be affected by the change in water potential (Ψ) of the soil caused by such flooding.

.....

.....

.....

.....

.....

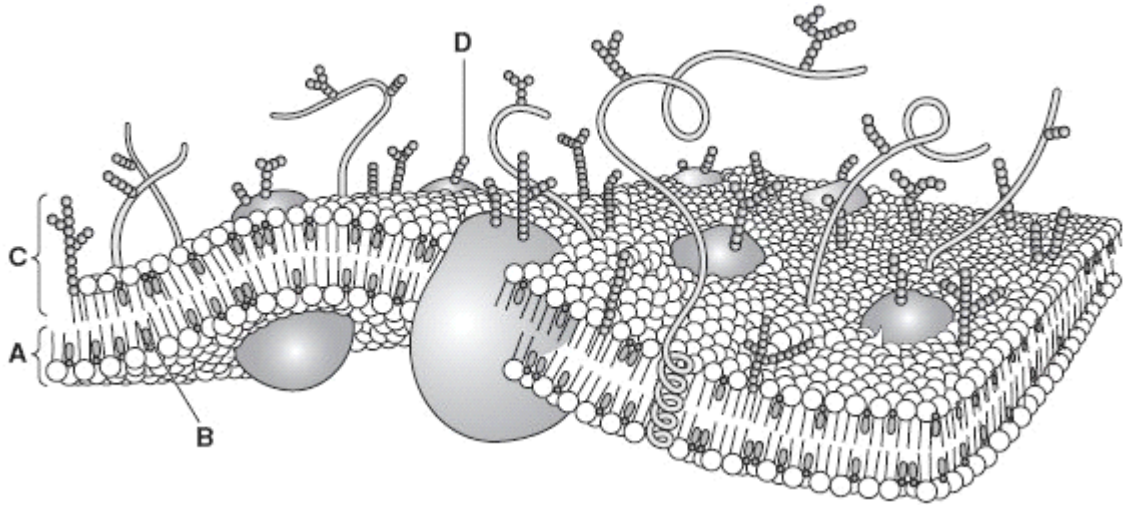
.....

.....

.....

[Total 4 marks]

55. The diagram below represents the structure of the plasma (cell surface) membrane.



(i) State the name given to the model of membrane structure shown in the diagram.

.....

[1]

(ii) Name the parts labelled **A** to **D**.

A .....

B .....

C .....

D .....

[4]

[Total 5 marks]

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

Outline the roles of membranes at the **surface** of cells and **within** cells.

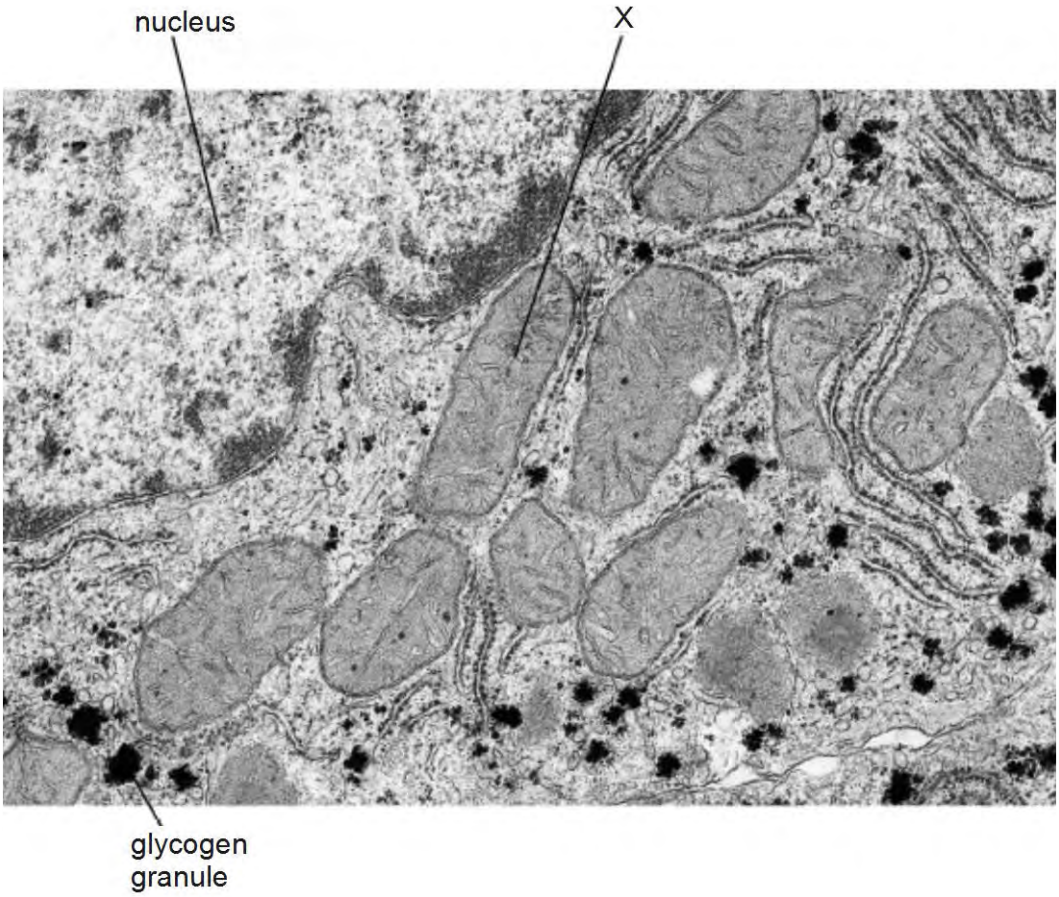
[9]

Quality of Written Communication [1]

[Total 10 marks]

57. The diagram below is an electron micrograph of part of a cell from a human liver.

This cell is responsible for converting glucose in the body into glycogen for storage. The glycogen can be seen as granules in the cytoplasm.



(i) Identify the organelle labelled **X** in the diagram above.

.....

[1]

(ii) Suggest why liver cells of the type shown in the diagram contain many of these organelles.

.....

[1]

[Total 2 marks]

58. The haploid number of chromosomes for a human is 23.

(i) State the number of chromosomes present in the nucleus of the liver cell.

.....

[1]

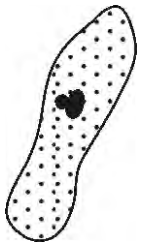
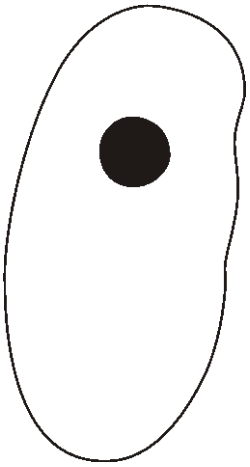
(ii) Name the type of nuclear division that produced this liver cell.

.....

[1]

[Total 2 marks]

59. A student was studying the surface area to volume ratio of three unicellular organisms, **A**, **B** and **C**, from the same habitat. The diagram below shows the three organisms and some of the calculations the student made.

scale: 0.075 mm	**A** 	**B** 	**C** 
surface area / mm^2	0.28	3.1	23
volume / mm^3	0.02	0.59	11.3
surface area to volume ratio	14:1		2:1

Adapted data © M Jones and G Jones, *Advanced Biology*, 1997, Cambridge University Press

(a) (i) Calculate the surface area to volume ratio for organism **B to the nearest whole number**.

Write your answer in the shaded box in the table.

[1]

(ii) By how many times does the surface area to volume ratio for organism **C** differ from that for organism **A**?

.....

[1]

(b) The student determined the rate of oxygen uptake for the three organisms in cm^3 of oxygen g^{-1} h^{-1}. The student found that the results were:

1.0 cm^3 g^{-1} h^{-1}

0.5 cm^3 g^{-1} h^{-1}

7.0 cm^3 g^{-1} h^{-1}

State which of the three figures is most likely to be the value for the rate of oxygen uptake for **organism C**.

.....

[1]

(c) None of the organisms **A**, **B** or **C** has a transport system.

Explain why organisms larger than organism **C** need to have transport systems.

.....

.....

.....

.....

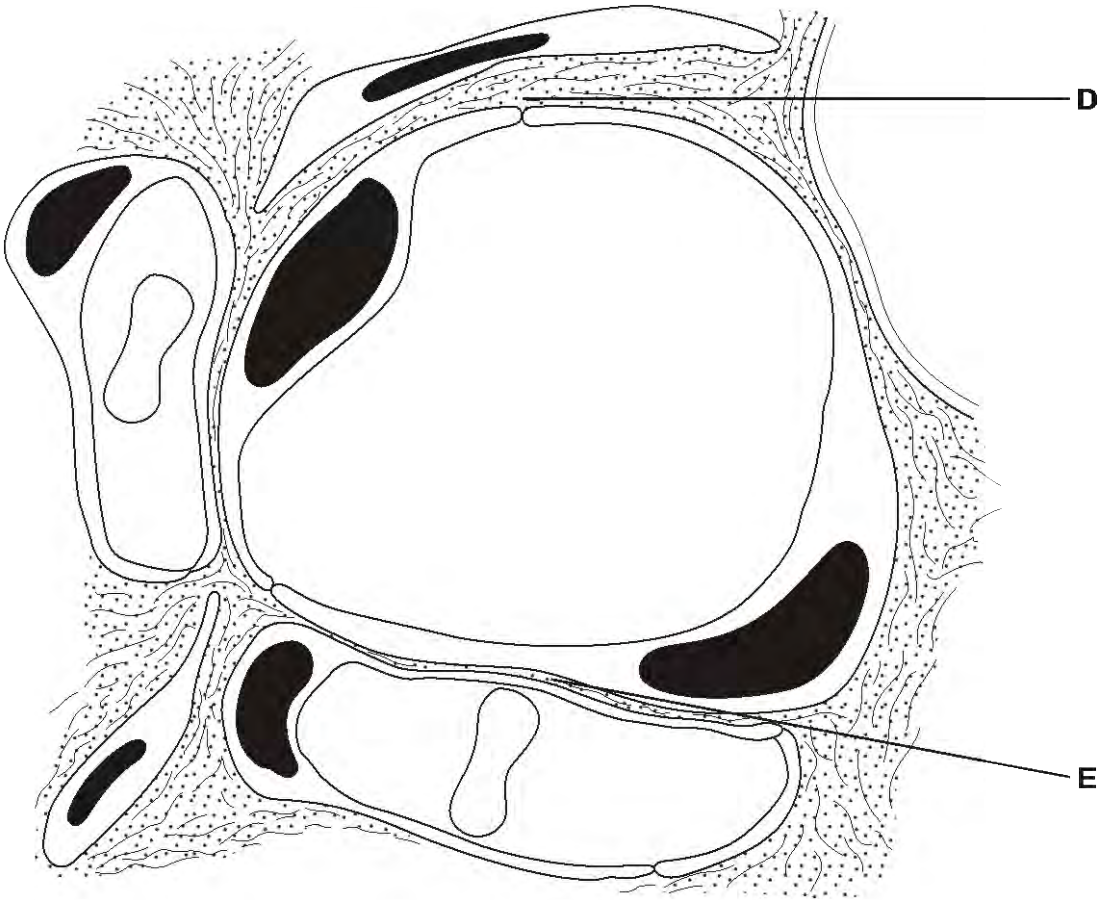
.....

.....

[3]

[Total 6 marks]

60. 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]

61. The table below contains some terms or names of structures related to the mammalian heart and circulatory system.

Complete the table by selecting the statement from the list **A** to **I** below that best matches the term or structure in the table.

The first one has been done for you.

You may use each letter once, more than once or not at all.

term or structure	statement
a closed system	**A**
a double circulation	
Purkyne tissue	
fibrous tissue between the atria and the ventricles	
atrioventricular node (AVN)	
sinoatrial node (SAN)	
coronary artery	

A the blood flows in vessels

B the left and right side of the heart contract at different times

C transmits waves of excitation to the base of the heart

D initiates the cardiac cycle

E is unable to conduct waves of excitation

F carries oxygen to the heart muscle

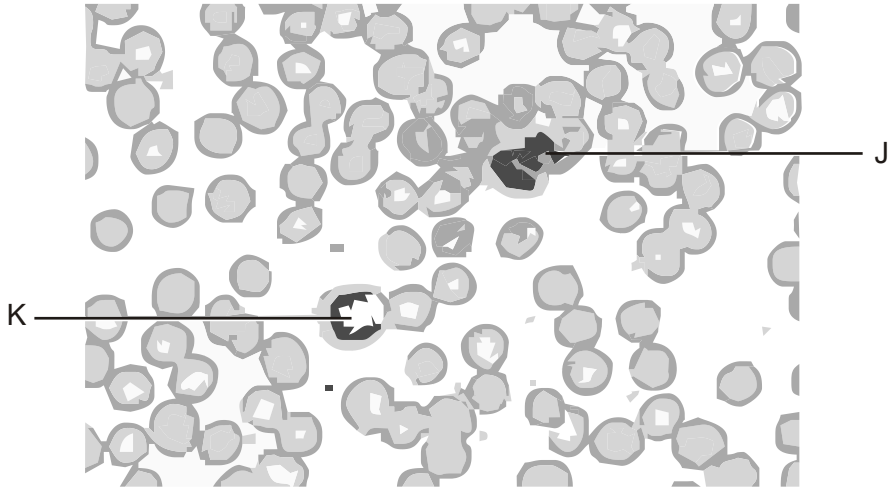
G conducts waves of excitation over the walls of the ventricles

H blood passes twice through the heart for one complete circuit of the body

I delays transmission of the waves of excitation by about 0.1 s

[Total 6 marks]

62. Below is a diagram of blood showing both red and white blood cells.



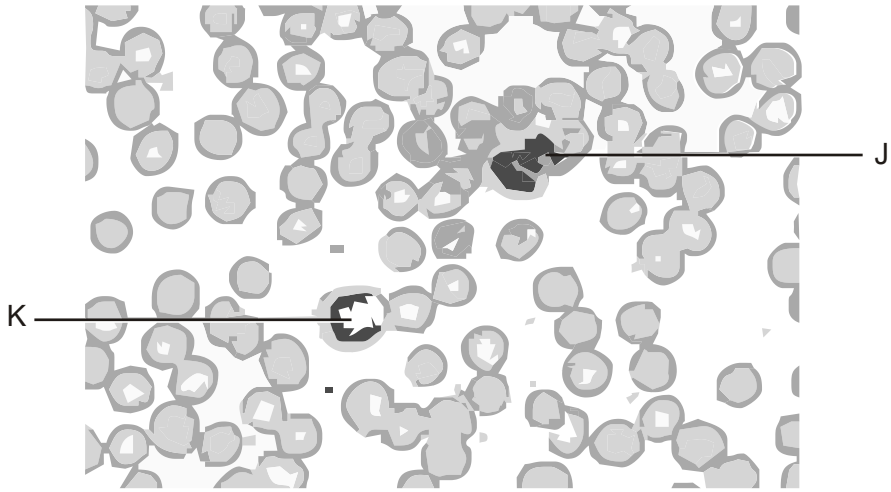
Complete the table below to give the name and function of the white blood cells labelled **J** and **K**.

cell	name	function
J		
K		

[Total 4 marks]

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

Below is a diagram of blood showing both red and white blood cells.



Describe how red blood cells, such as those shown in the photograph, are adapted for their function.

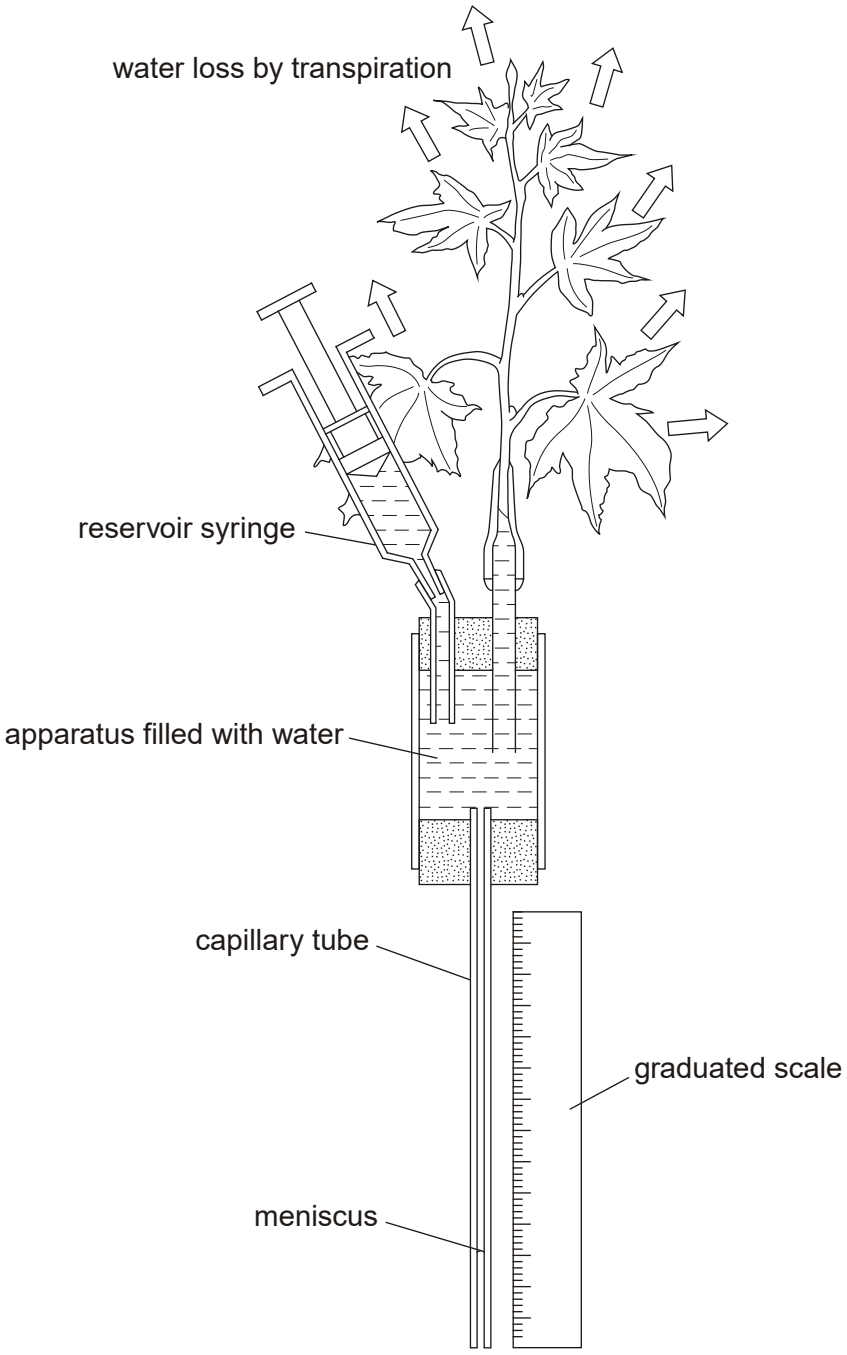
[6]

Quality of Written Communication [1]

[Total 7 marks]

64. Transpiration may be defined as the loss of water vapour by diffusion from a plant to its environment.

The diagram below shows apparatus that can be used to estimate transpiration rates of a leafy shoot.



(i) State the name of the apparatus shown in the diagram.

.....

[1]

(ii) A student was told that any results gained by using the apparatus shown in the diagram above are not measures of the actual transpiration rate, but only give values from which transpiration can be **estimated**.

With reference to the definition of transpiration **and** the apparatus in the diagram above, explain why the results gained by using the apparatus are **not** measures of the actual transpiration rate.

.....

.....

.....

.....

.....

.....

.....

[3]

(iii) Describe the precautions you would take when setting up and using the apparatus shown in the diagram above in order to get valid readings from which the transpiration rate can be estimated.

.....

.....

.....

.....

.....

.....

.....

.....

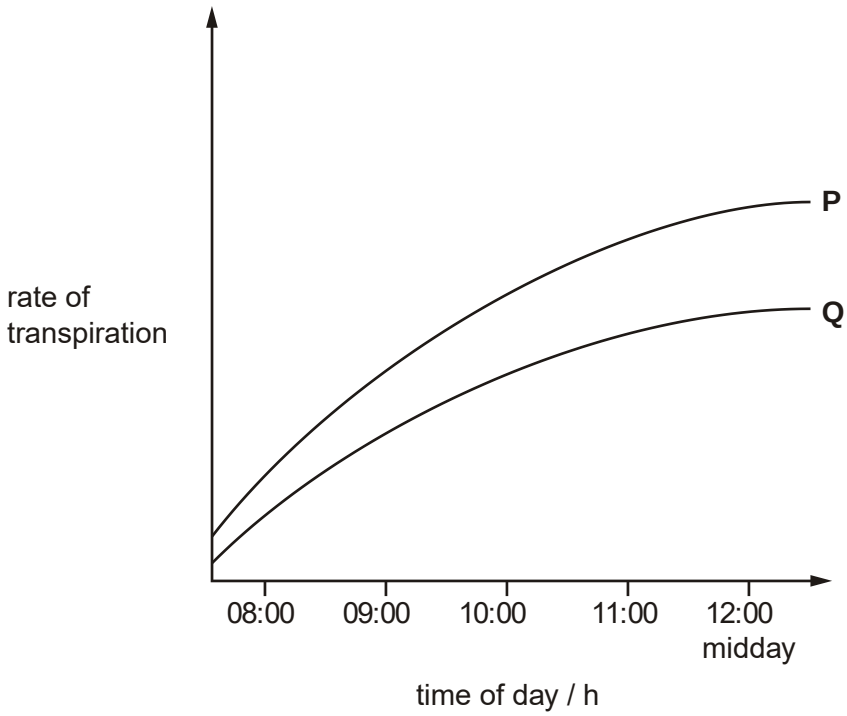
.....

.....

[4]

[Total 8 marks]

65. The diagram below shows the results gained from an experiment to compare the rates of transpiration in two species, **P** and **Q**. Both species were kept under the same conditions during the course of the experiment.



(i) Give **two** possible explanations for the increase in the rate of transpiration in **both** species **P** and **Q** over the course of the experiment.

1 .....

.....

.....

.....

2 .....

.....

.....

.....

[4]

(ii) Species **P** has smaller leaves than species **Q**. The student had predicted that the rate of transpiration would be **lower** in **P** than in **Q** due to its smaller leaves.

Suggest and explain one possible reason why the results are **not** as the student predicted.

.....

.....

.....

.....

[2]

[Total 6 marks]

66. Explain why it is important that red blood cells are stored in a solution with a suitable water potential.

.....

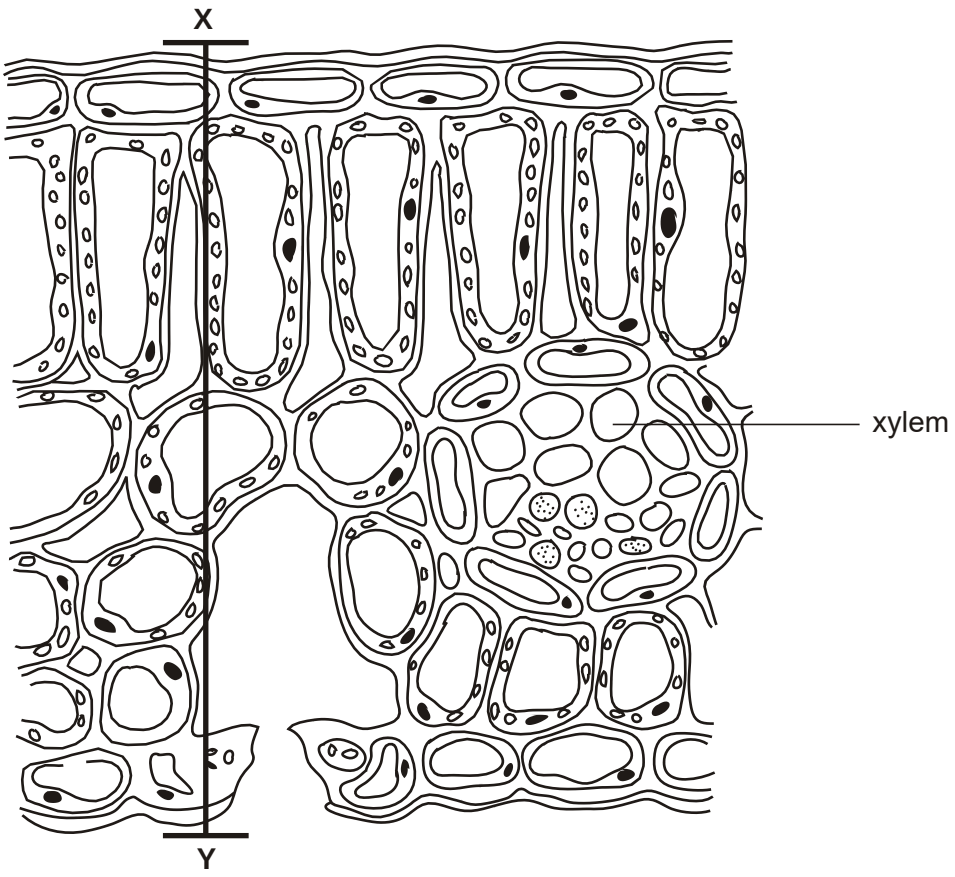
.....

.....

.....

[Total 2 marks]

67. (a) The diagram below is a drawing of a vertical section of part of a dicotyledonous leaf.



(i) Use label lines and the letters **P**, **E** and **C** to indicate the following on the diagram.

P a palisade mesophyll cell

E a lower epidermal cell

C cuticle

[3]

(ii) The distance **XY** represents an actual distance of 0.7 mm.

Calculate the magnification of the drawing. Show your working.

Answer = ...

[2]

(b) Explain why xylem is described as a *tissue*.

.....

.....

.....

.....

[2]

[Total 7 marks]

68. Complete the table to show **three** ways in which prokaryotic and eukaryotic organisms differ in the **structure** of their cells.

prokaryotic	eukaryotic
1	....
2	....
3	....

[Total 3 marks]

69. (a) Name the stage of the mitotic cell cycle in which each of the following takes place:

(i) chromosomes become visible as two chromatids

.....

[1]

(ii) DNA replicates

.....

[1]

(iii) nuclear envelope reforms.

.....

[1]

(b) During mitosis, chromosomes line up at the equator of the cell.

Describe what happens to chromosomes after this, until the nuclear envelope reforms.

.....

.....

.....

.....

.....

.....

.....

.....

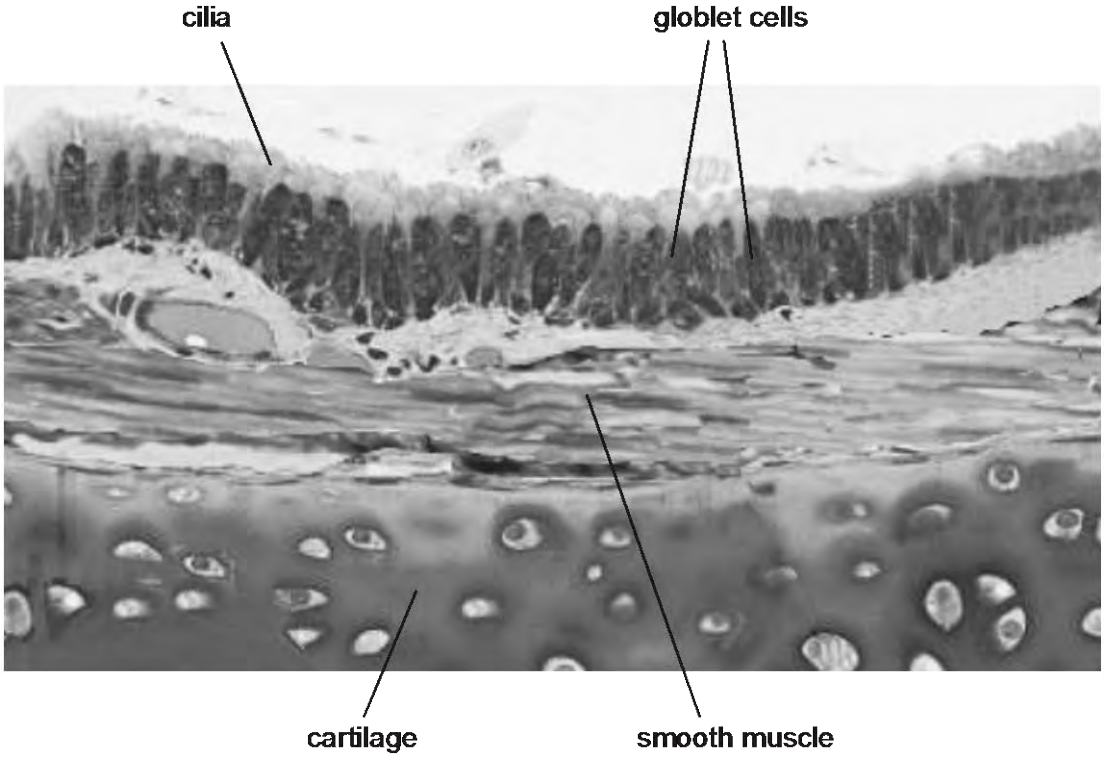
.....

.....

[4]

[Total 7 marks]

70. 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.

.....

.....

.....

.....

.....

.....

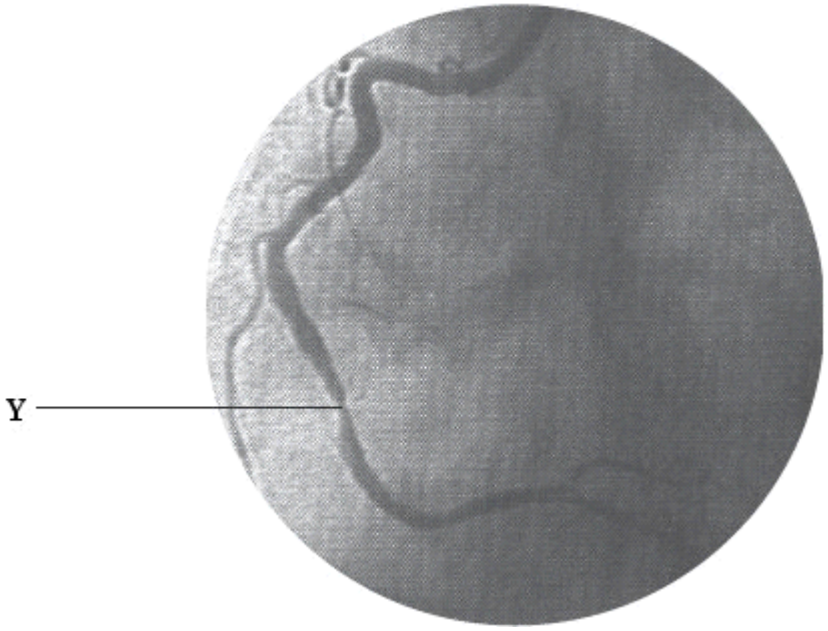
.....

.....

[4]

[Total 10 marks]

71. The diagram below shows an artery lying on the surface of living heart muscle as seen by an instrument called an endoscope. The lumen of the artery has become narrowed at the point labelled **Y**.



The Forum on Ischaemic Heart Disease.
Reproduced by kind permission of Dr Graham Jackson,
Cardiology Unit, Guy's and St Thomas' Hospital.

(i) Name the artery shown in the diagram.

.....

[1]

(ii) Explain how the lumen of the artery has become narrowed at point **Y**.

.....

.....

.....

.....

[2]

[Total 3 marks]

72. (i) Suggest how doctors might treat a patient with narrowing of the arteries that supply the heart muscle.

.....

.....

.....

.....

[2]

(ii) Suggest **two** pieces of advice that a doctor might give to such a patient to try to reduce the likelihood of further narrowing of the arteries.

1 .....

.....

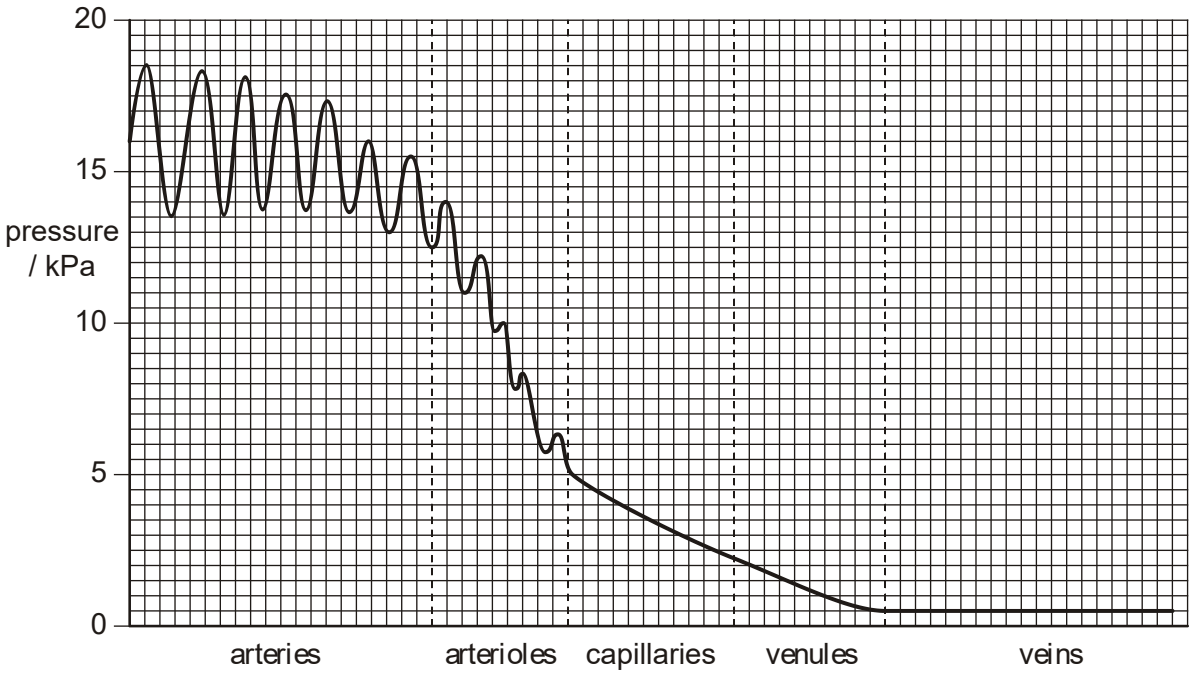
2 .....

.....

[2]

[Total 4 marks]

73. The diagram below shows the changes in the pressure of blood as it flows through various parts of the mammalian blood system.



(a) The diagram shows that the pressure rises and falls in the arteries.

Explain what causes this rise and fall in pressure.

.....

.....

.....

.....

[2]

(b) The diagram shows that:

- the rise and fall in pressure seen in the arteries is not evident by the time the blood enters the capillaries
- the pressure is much lower by the time the blood enters the capillaries.

Explain what causes the changes described above.

.....

.....

.....

.....

.....

.....

[3]

(c) Explain why it is important that the pressure is lower by the time blood reaches the capillaries.

.....

.....

.....

.....

.....

[2]

(d) The pressure in veins is very low. Explain how the blood in veins is returned to the heart.

.....

.....

.....

.....

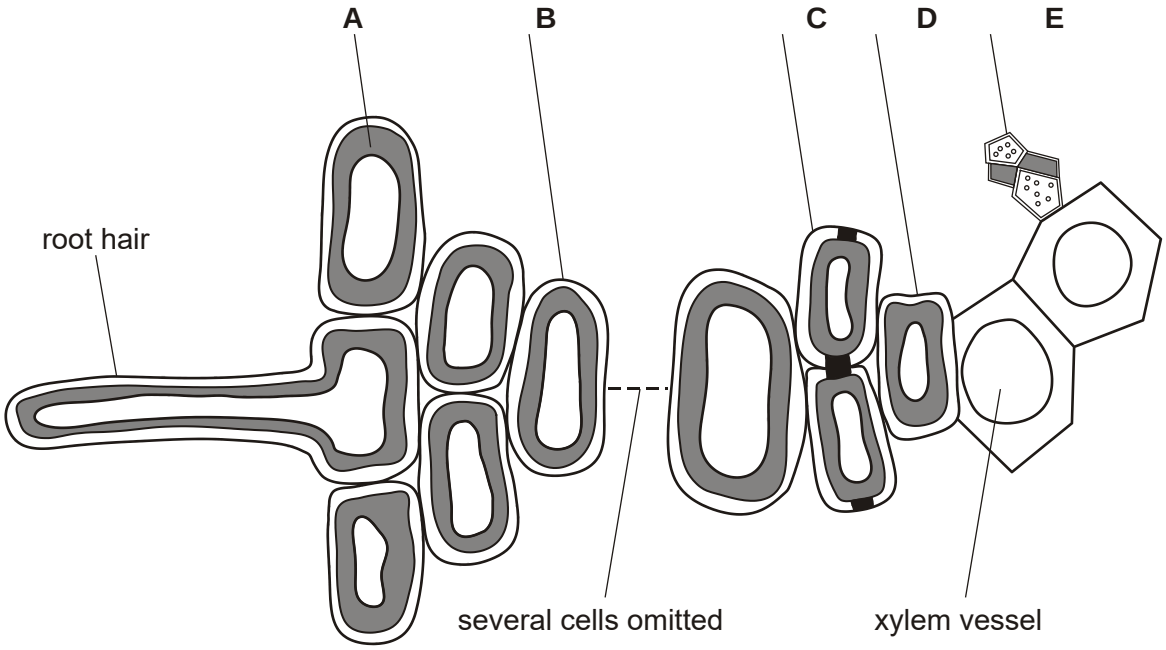
.....

.....

[2]

[Total 9 marks]

74. The figure below is a diagram showing some of the cells in the root of a dicotyledonous plant.



(a) Complete the table below by indicating which of the letters **A** to **E** indicates:

- a cell from the endodermis
- a cell from the phloem.

	letter
endodermis	
phloem	

[2]

(b) State **two** features of root hair cells which adapt them for water uptake.

1 .....

2 .....

[2]

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

Plants absorb water from the soil via their roots.

Describe the pathways **and** mechanisms by which water passes from the soil to the xylem vessels in the root.

[6]

Quality of Written Communication [1]

(d) After water has entered the xylem vessels in the root, it passes through them to the rest of the plant.

Describe how **two** features of xylem vessels adapt them for water transport.

1 .....

.....

.....

.....

2 .....

.....

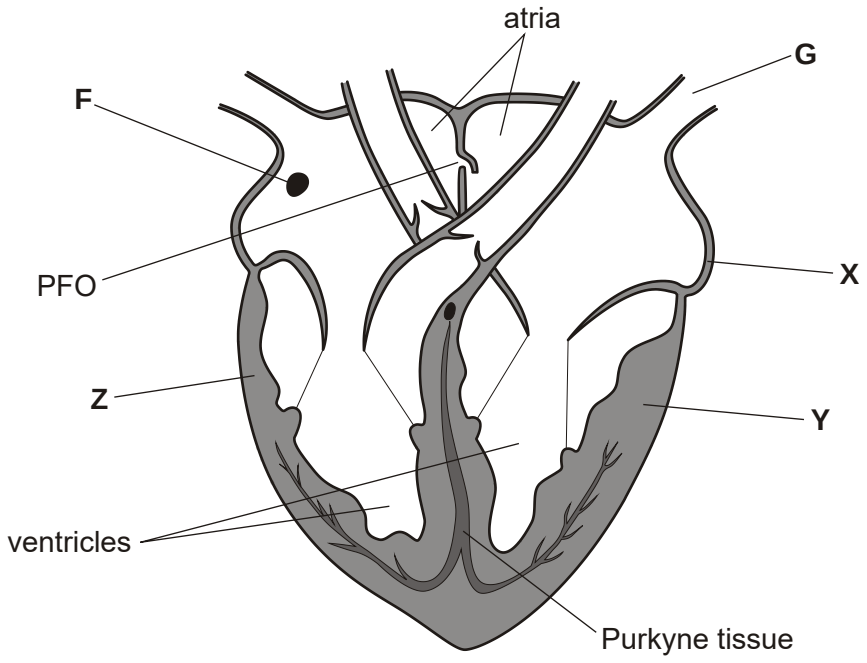
.....

.....

[4]

[Total 15 marks]

75. The diagram below is a vertical section of the heart to show the position of certain structures. The diagram also shows a minor heart defect called patent foramen ovale (PFO).



(a) State the names of structures **F** and **G**.

F ......

G .....

[2]

(b) The statements below were made to a group of students.

Explain why each statement is true.

(i) The difference in thickness of the walls of the chambers, as shown by the letters **X**, **Y** and **Z**, is related to the functions of the different chambers.

.....

.....

.....

.....

.....

.....

[3]

(ii) Without the Purkyne tissue, blood would not be pumped out of the heart efficiently.

.....

.....

.....

.....

[2]

(c) Recent research has shown that there may be a link between migraines (severe headaches) and the minor heart defect PFO. In PFO the small flap shown in the diagram fails to close completely at birth.

Suggest how PFO might lead to a migraine.

.....

.....

.....

.....

.....

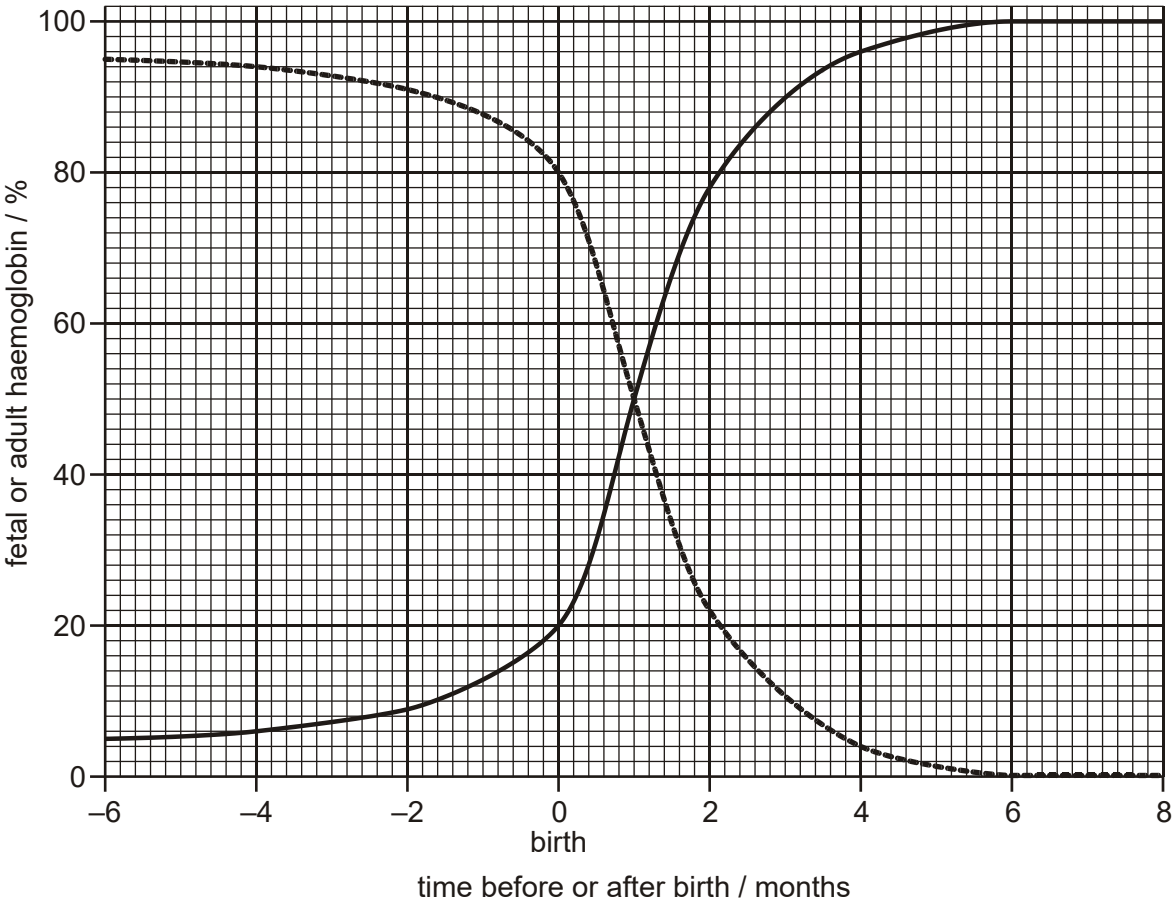
.....

[3]

[Total 10 marks]

76. (a) Two slightly different types of haemoglobin are found in mammals. Fetal haemoglobin is found in the developing fetus, but is replaced by adult haemoglobin. In humans, this replacement is completed by the time a baby is six months old.

The diagram below shows the change in the percentage of each type of haemoglobin for six months before birth and for eight months after birth.



State the percentage of adult haemoglobin present when the baby is two months old.

Answer = ...%

[1]

(b) (i) Explain why it is essential that the fetus has a different type of haemoglobin from the adult.

.....

.....

.....

.....

.....

.....

.....

(ii) Explain why the change from fetal to adult haemoglobin seen in the diagram above is essential after birth.

.....

.....

.....

.....

[5]

[Total 6 marks]

77. Use the most appropriate terms to complete the paragraph below about the transport of gases in the blood.

Respiring tissues in the body produce carbon dioxide which diffuses into the blood.

Most of it then enters red blood cells where an enzyme named .....

..... catalyses a reaction to produce ..... .

This dissociates rapidly into hydrogen ions and ..... ions.

The hydrogen ions combine very readily with haemoglobin to form a compound known

as ..... . There are two effects of this reaction.

1 Hydrogen ions are removed from the blood making it less acidic.

2 As haemoglobin picks up the hydrogen ions it releases ..... .

[Total 5 marks]

78. The table below shows the approximate size and number of stomata in the leaves of three plant species.

The data were collected by taking photographs of pieces of leaf placed under a microscope. The length and width of a large number of stomata visible on the photographs were measured.

species	mean number of stomata per mm^2 on lower epidermis	mean length of fully open stomata / μm	mean width of fully open stomata / μm	mean area available for water loss through fully open stomata / μm^2 per mm^2
Phaseolus vulgaris (bean)	281	7	3	5 901
Hedera helix (ivy)	158	11	4	6 952
Triticum sp. (wheat)	14	18	7	1 764

(a) (i) Explain why a large number of stomata are measured in order to calculate a mean.

.....

.....

.....

.....

[2]

(ii) Suggest **two** ways in which photographing the leaf surfaces makes measuring the stomata easier.

1 .....

.....

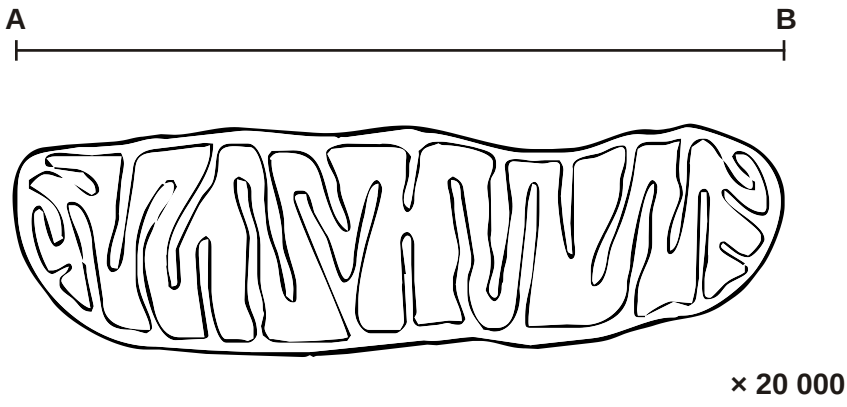
2 .....

.....

[2]

[Total 4 marks]

79. The diagram below is a drawing of an organelle from a ciliated cell as seen with an electron microscope.



× 20 000

(i) Name the organelle shown in the diagram.

.....

[1]

(ii) State the function of this organelle.

.....

.....

[2]

(iii) State why ciliated cells contain relatively large numbers of these organelles.

.....

.....

[1]

(iv) Calculate the actual length of the organelle as shown by the line AB in the diagram. Express your answer to the nearest micrometer (μm).

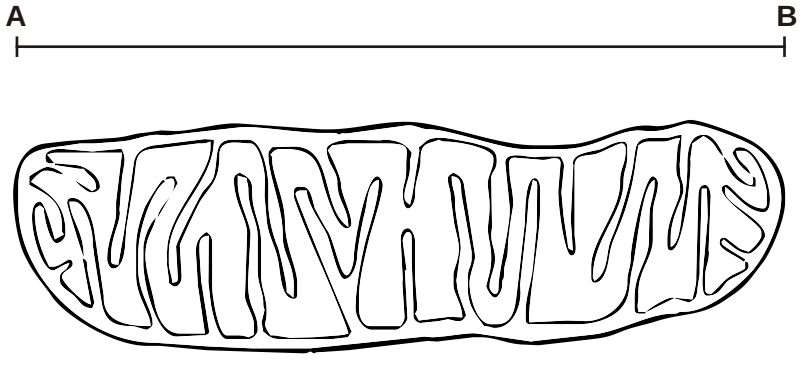
Show your working.

Answer = ... μm

[2]

[Total 6 marks]

80. The diagram below is a drawing of an organelle from a ciliated cell as seen with an electron microscope.



× 20 000

An image drawn to the same magnification as in the diagram could be produced using a light microscope.

Explain why such an image would be of little use when studying cells.

.....

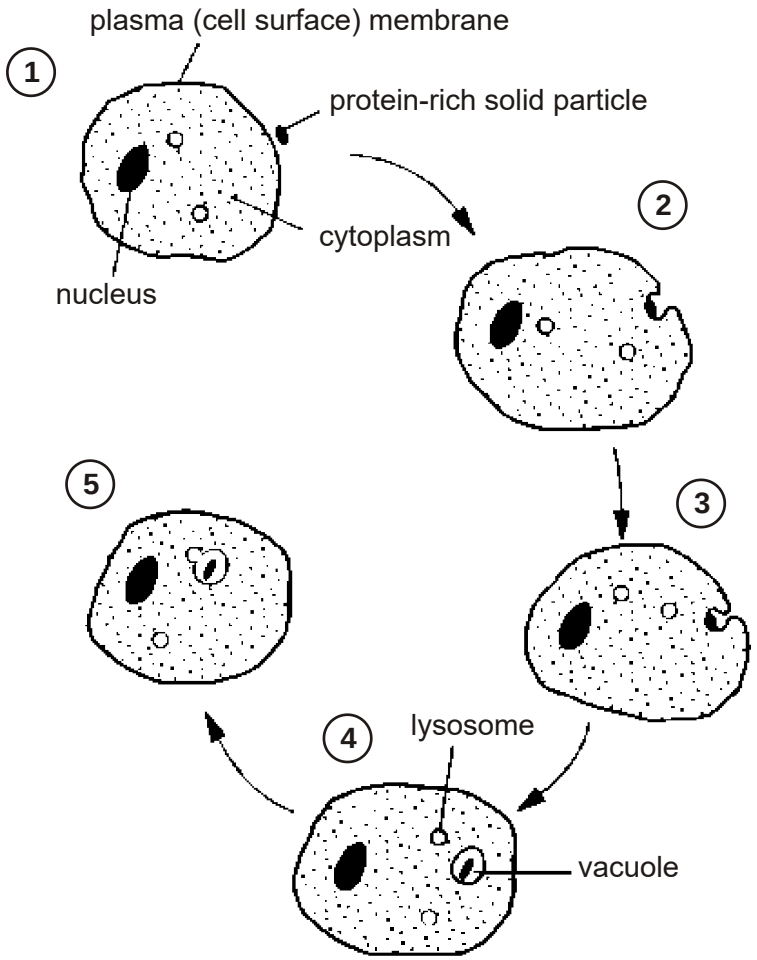
.....

.....

.....

[Total 2 marks]

81. The figure below is a diagram showing the transport of a protein-rich solid particle into an animal cell.



(i) Name the method of transport shown in stages 1 to 4 in the figure.

.....

[1]

(ii) Describe what happens within the vacuole after it fuses with the lysosome.

.....

.....

.....

.....

.....

.....

[3]

[Total 4 marks]

82. Ovary cells contain large amounts of endoplasmic reticulum (ER).

Suggest the importance of this in using these cells for the production of Factor VIII.

.....

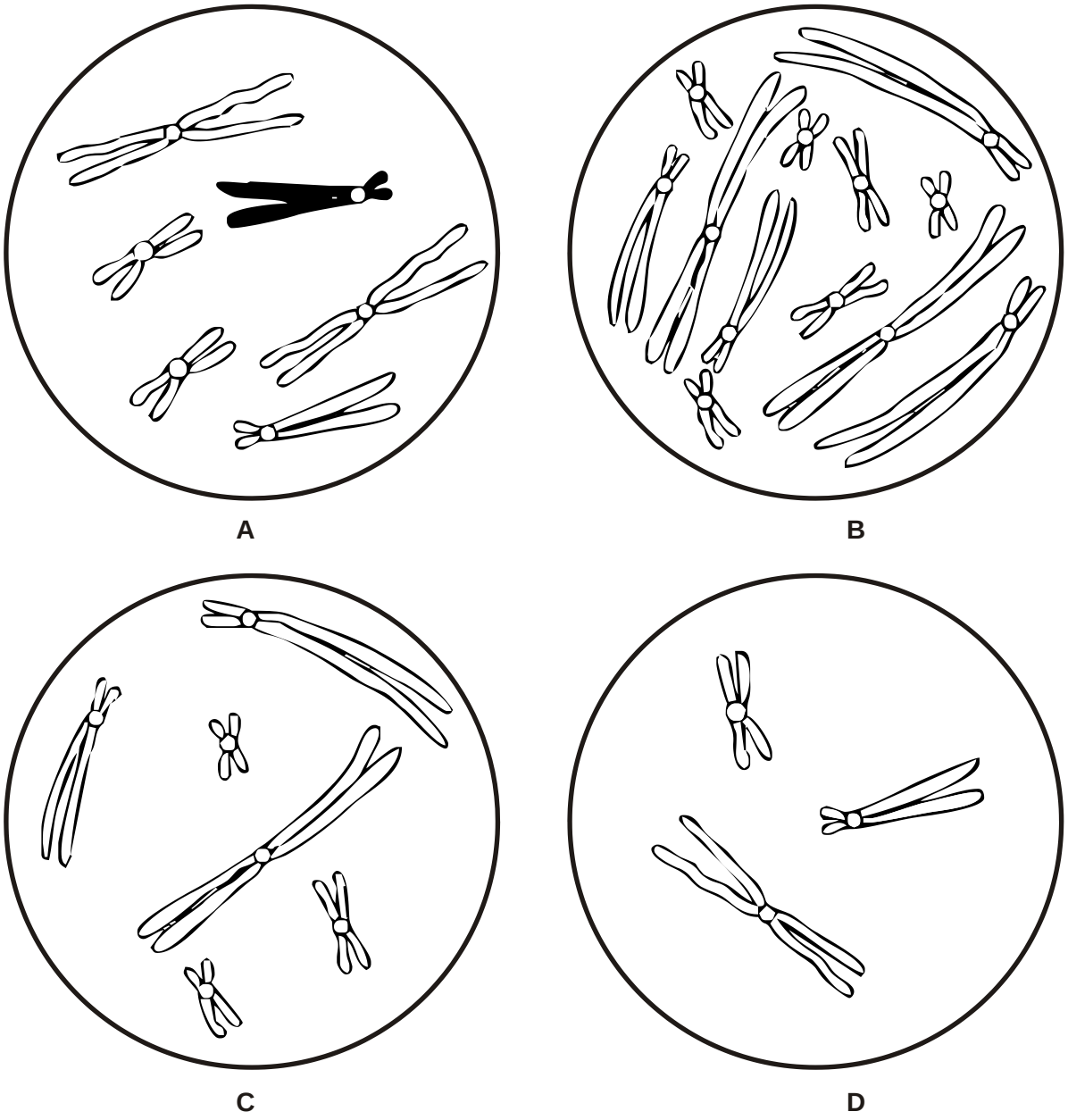
.....

.....

.....

[Total 2 marks]

83. The diagram below shows drawings of nuclei, **A** to **D**, from two different plant species seen in the prophase stage of mitosis.



(a) On drawing **A**, one of a pair of homologous chromosomes has been shaded. Shade in the other member of the pair.

[1]

(b) (i) Name the stage in mitosis that **immediately** follows prophase.

.....

[1]

(ii) Describe the behaviour of the chromosomes in this stage.

.....

.....

.....

.....

[2]

(c) The diploid number for crocus, *Crocus balansae*, is **6** and the diploid number for broad bean, *Vicia faba*, is **12**.

State which of the drawings, **A**, **B**, **C** or **D**, shown in the diagram, represents the following:

haploid cell of broad bean .....

root tip cell of crocus .....

[2]

[Total 6 marks]

84. (a) Fig. 1 represents the appearance of a plant cell in salt solutions of three different concentrations.

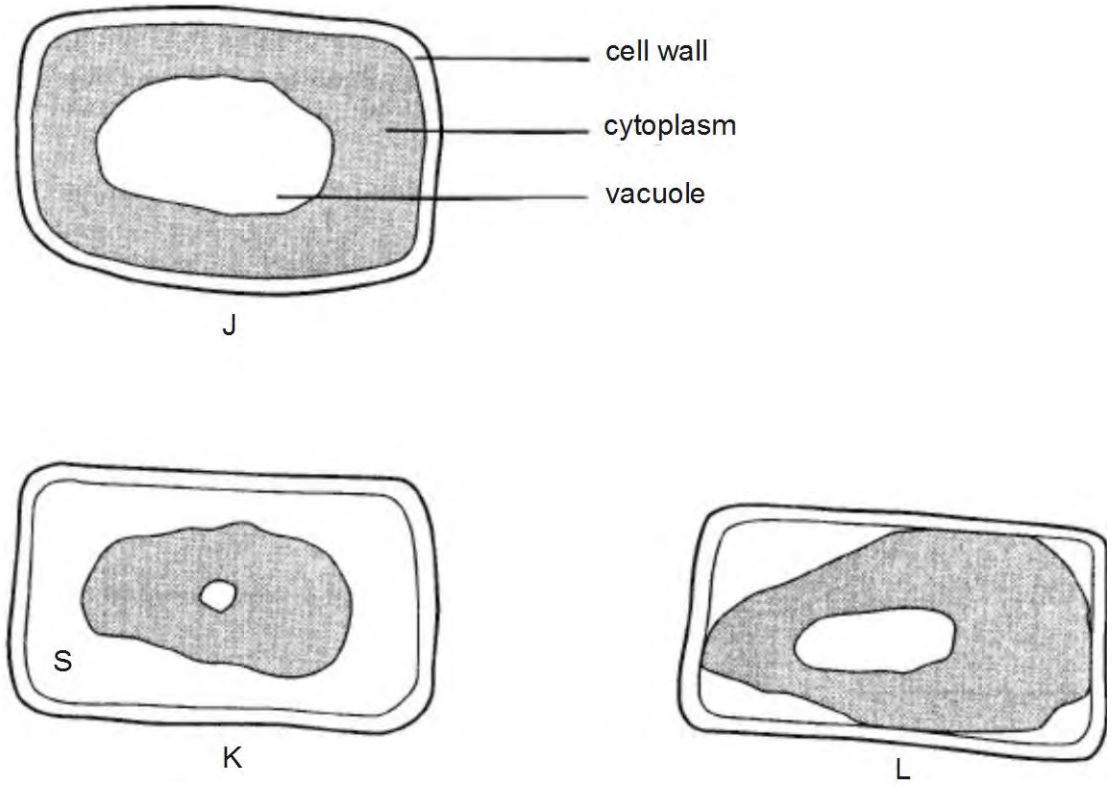


Fig. 1

(i) State which of the diagrams, **J** to **L**, represents a fully plasmolysed cell.

.....

[1]

(ii) Suggest why the vacuole in **K** is smaller than that in **L**.

.....

.....

[1]

(iii) Region **S** contains salt solution. State what this indicates about the permeability of the cell wall.

.....

.....

[1]

(b) (i) The list below shows three different values for water potential (ψ) in plant cells. Underline the water potential (ψ) which has the lowest value.

$\psi = 0$ $\psi = -1300$ kPa $\psi = -1150$ kPa

[1]

(ii) Fig. 2 is a diagram that shows four neighbouring spongy mesophyll cells from the leaf of a dicotyledonous plant. The water potential of the cytoplasm of the cells is shown in each case.

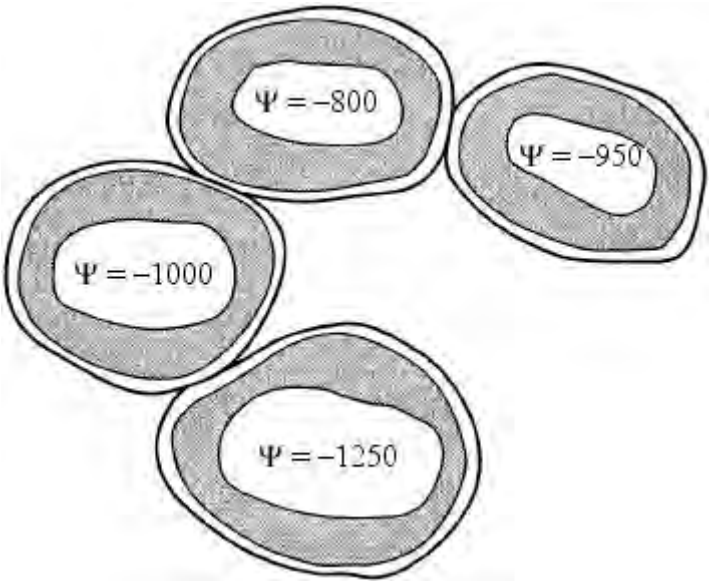


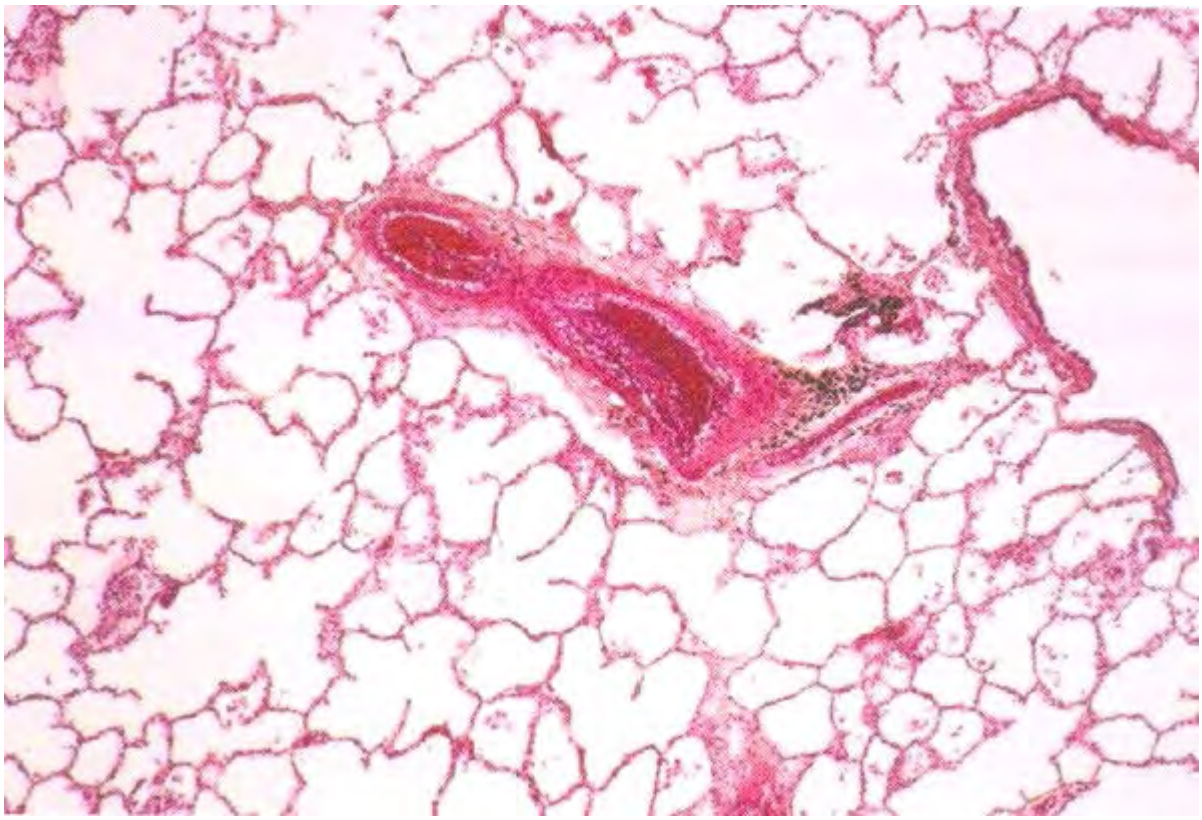
Fig. 2

Draw arrows on Fig. 2 to show the net flow of water between the cells.

[3]

[Total 7 marks]

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



1 .....

.....

2 .....

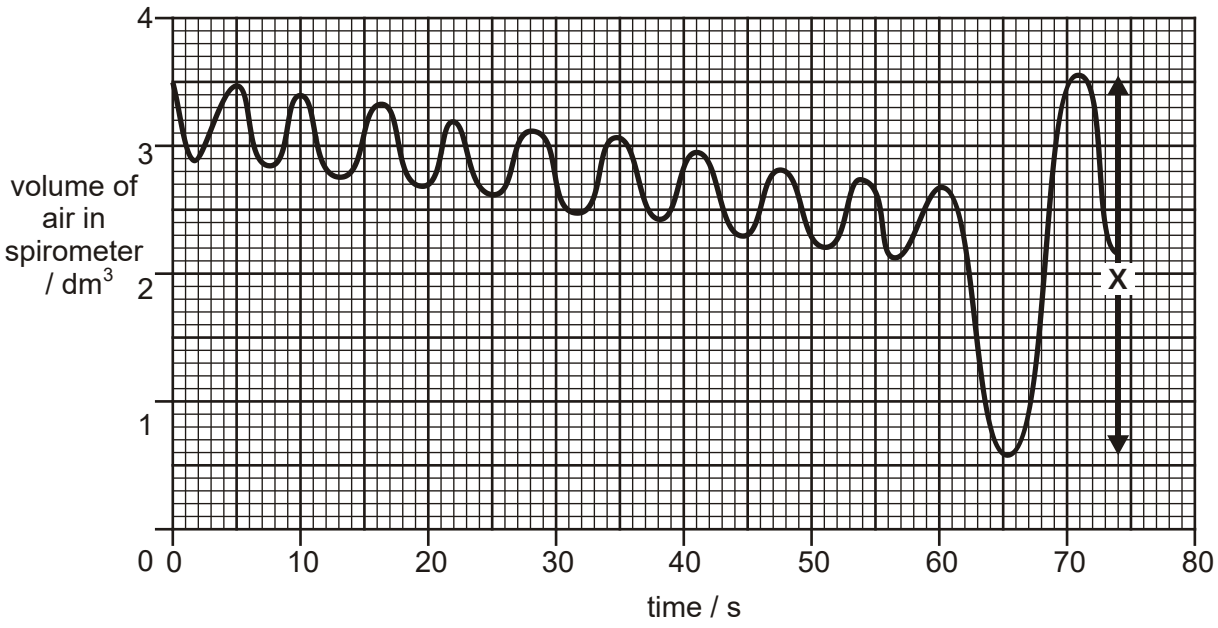
.....

3 .....

.....

[Total 3 marks]

86. 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**.

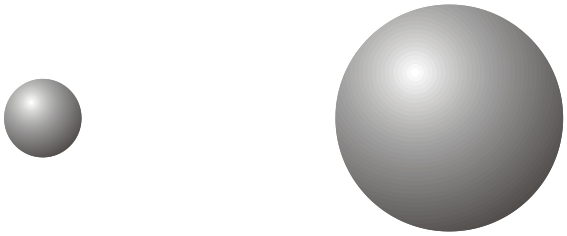
State the term given to measurement **X**.

.....

[1]

[Total 3 marks]

87. A student was told by a teacher that the surface area to volume ratio (SA:V ratio) of an organism varies according to its size. The student decided to investigate this using two spheres, **A** and **B**, as models of organisms of different sizes. These are shown in the table below. The surface area and volume of each sphere were calculated.



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

(a) (i) The student calculated the SA:V ratio of sphere **B** as 2:1. Calculate the SA:V ratio of sphere **A**. Show your working.

Answer = ...

[2]

(ii) Describe how the SA:V ratio changes as the size of the sphere increases.

.....

.....

.....

.....

[2]

(b) The teacher also told the student that differences in the SA:V ratio, such as those seen between sphere **A** and sphere **B**, have influenced the need for transport systems.

Explain how such differences have influenced the need for transport systems in mammals.

.....

.....

.....

.....

.....

.....

[3]

(c) There are several parts of the mammalian body where the surface area is relatively large to allow effective functioning.

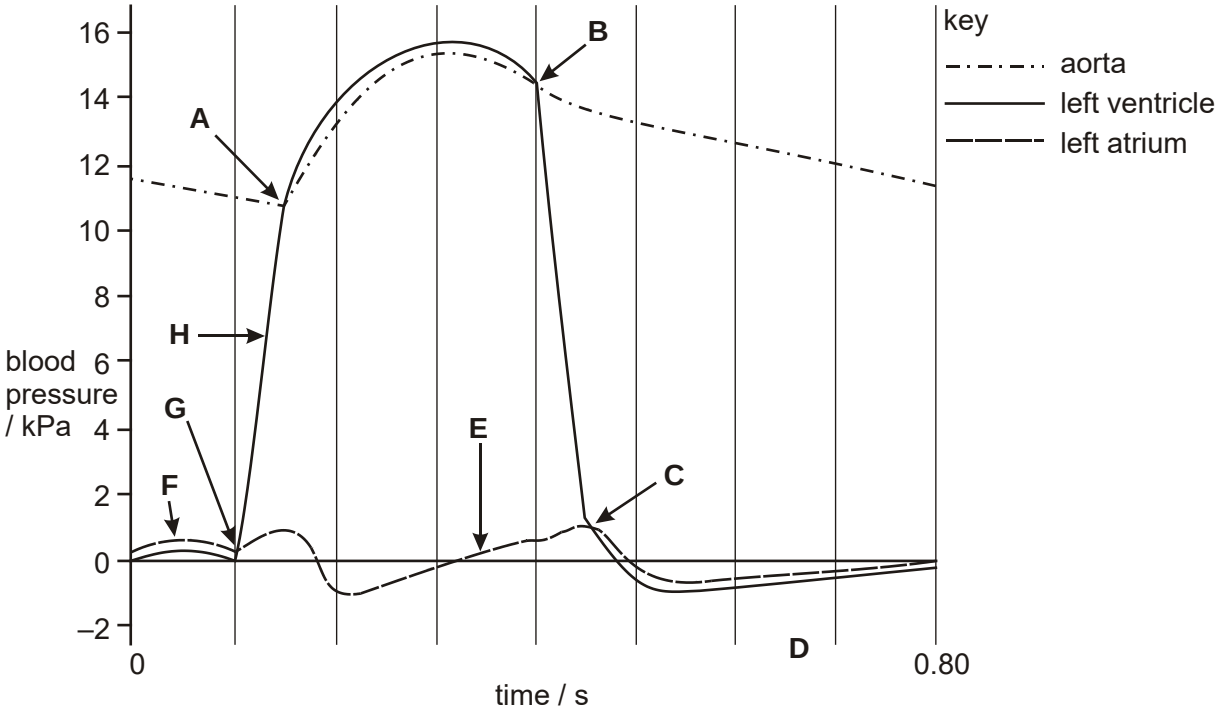
State **one** example of such a part of the mammalian body.

.....

[1]

[Total 8 marks]

88. The diagram below shows the pressure changes in the aorta, left ventricle and left atrium during one cardiac cycle.



In the table below, match up each statement with an appropriate letter from **A** to **H** on the diagram. One has been done for you.

You may use each letter once, more than once or not at all.

statement	letter
semilunar (aortic) valve starting to open	**A**
atrio-ventricular (bicuspid) valve about to open	
semilunar (aortic) valve about to close	
atrio-ventricular (bicuspid) valve about to close	
left ventricle starting to contract	
both left atrium and left ventricle relaxing	
minimum blood volume in left ventricle	

[Total 6 marks]

89. Complete the following paragraph on the control of the cardiac cycle using the most appropriate word or words.

Heart wall muscle is a special type of muscle called ..... muscle. This muscle can contract or relax without nervous stimulation and is thus described as ..... . To ensure that the cardiac cycle stays in sequence there is an in-built control mechanism. The wall of the right atrium contains a special region of muscle called the ..... which sets up a wave of electrical activity causing the atrial walls to contract almost simultaneously. There is a band of fibres between the atria and ventricles which ..... the wave of activity passing to the ventricle walls. The wave of activity is picked up by the ..... situated in the septum at the junction of the atria and ventricles. The wave of activity then passes down the septum in the ..... causing the ventricles to contract.

[Total 6 marks]

90. The changes in electrical activity that occur in the muscle of the heart wall during the cardiac cycle can be recorded as an electrocardiogram (ECG).

Fig. 1 shows a normal ECG.

- **P** represents activity in the atrial walls.
- **R** represents the contraction of the ventricles.
- **T** represents the recovery of the ventricle walls.

Fig. 2 shows an ECG from a person who has entered a condition known as fibrillation.

Fibrillation should be treated rapidly to increase the chances of survival.

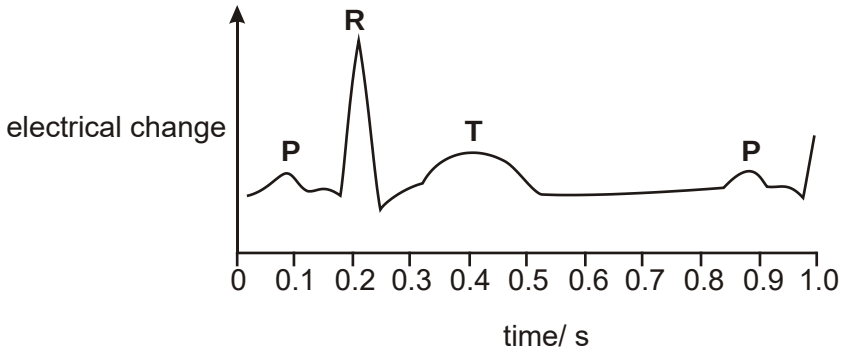


Fig. 1

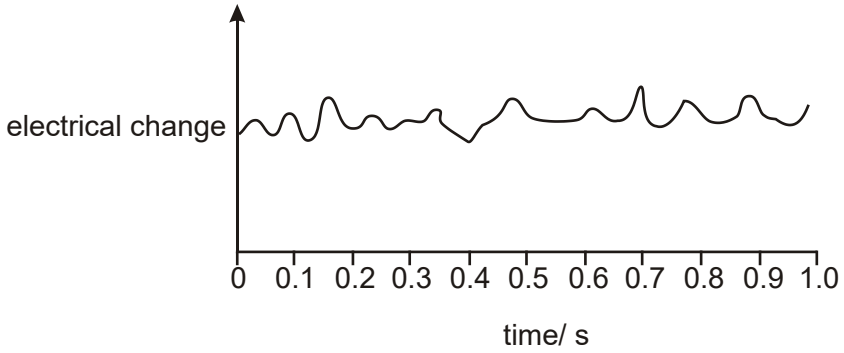


Fig. 2

Using the information in Figs. 1 and 2, suggest why a person with a fibrillating heart is unlikely to survive for long if not treated.

.....

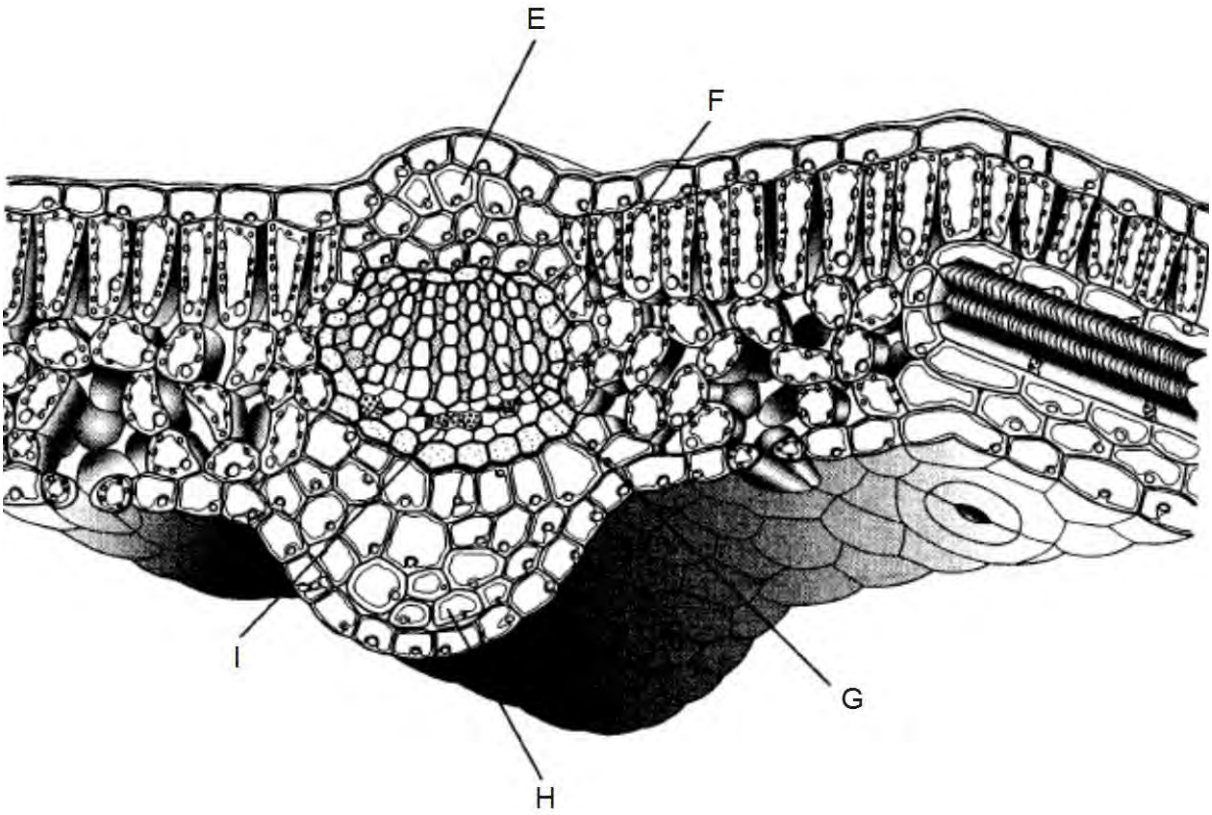
.....

.....

.....

[Total 2 marks]

91. The diagram below is a vertical section through part of a leaf of a dicotyledonous plant.



Reproduced by kind permission of D.G. Mackean

Complete the table below to identify xylem and phloem from the tissues labelled **E** to **I**.

tissue	letter
xylem	
phloem	

[Total 2 marks]

92. (i) Define the term *transpiration*.

.....

.....

.....

.....

[2]

(ii) Explain why transpiration in plants cannot be avoided.

.....

.....

.....

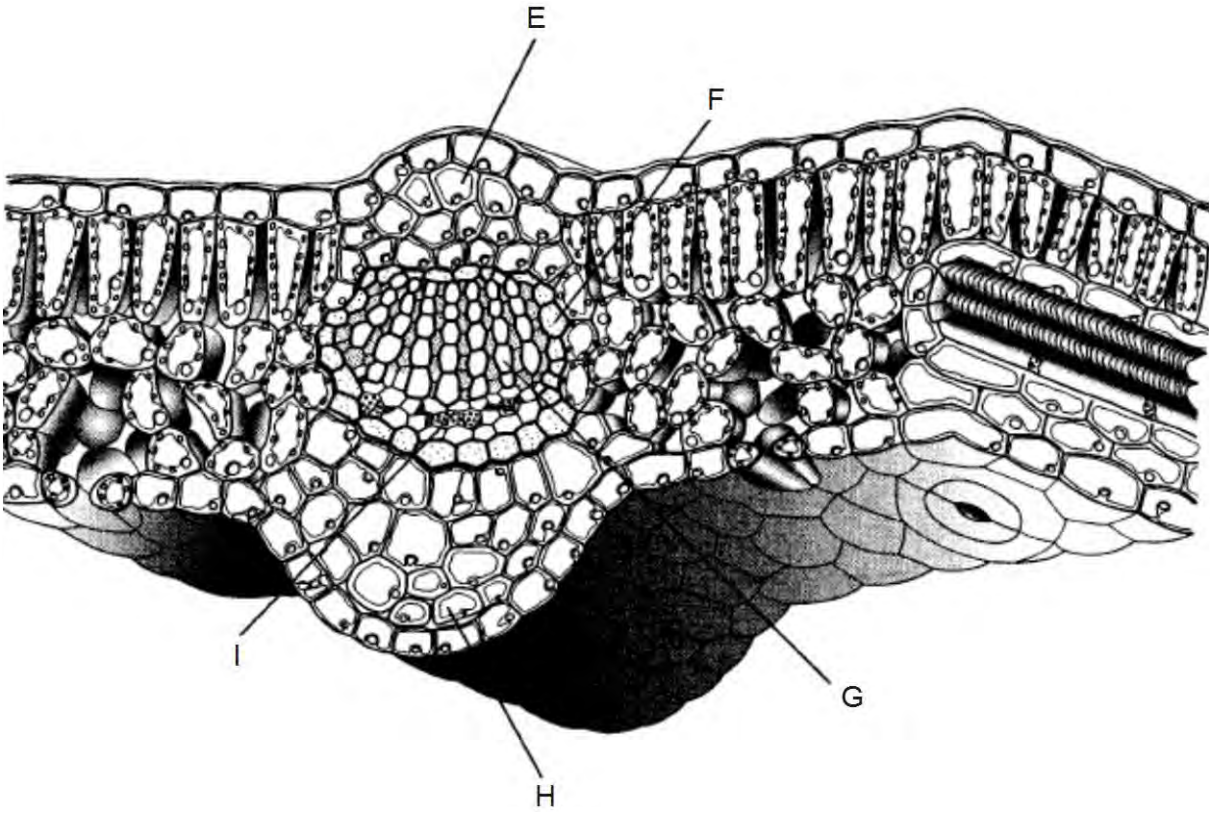
.....

.....

.....

[3]

(iii) The leaves of xerophytes show a variety of modifications that are not shown in the diagram below.
For instance, they may be covered in epidermal hairs.



Reproduced by kind permission of D.G. Mackean

Explain how a covering of leaf epidermal hairs helps xerophytes survive in their habitat.

.....

.....

.....

.....

[2]

[Total 7 marks]

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

Explain how water travels up the stem and into the leaf of a dicotyledonous plant.

[6]

Quality of Written Communication [1]

[Total 7 marks]

94. Fig. 1 shows the effect of two different partial pressures of carbon dioxide on the dissociation curve for haemoglobin.

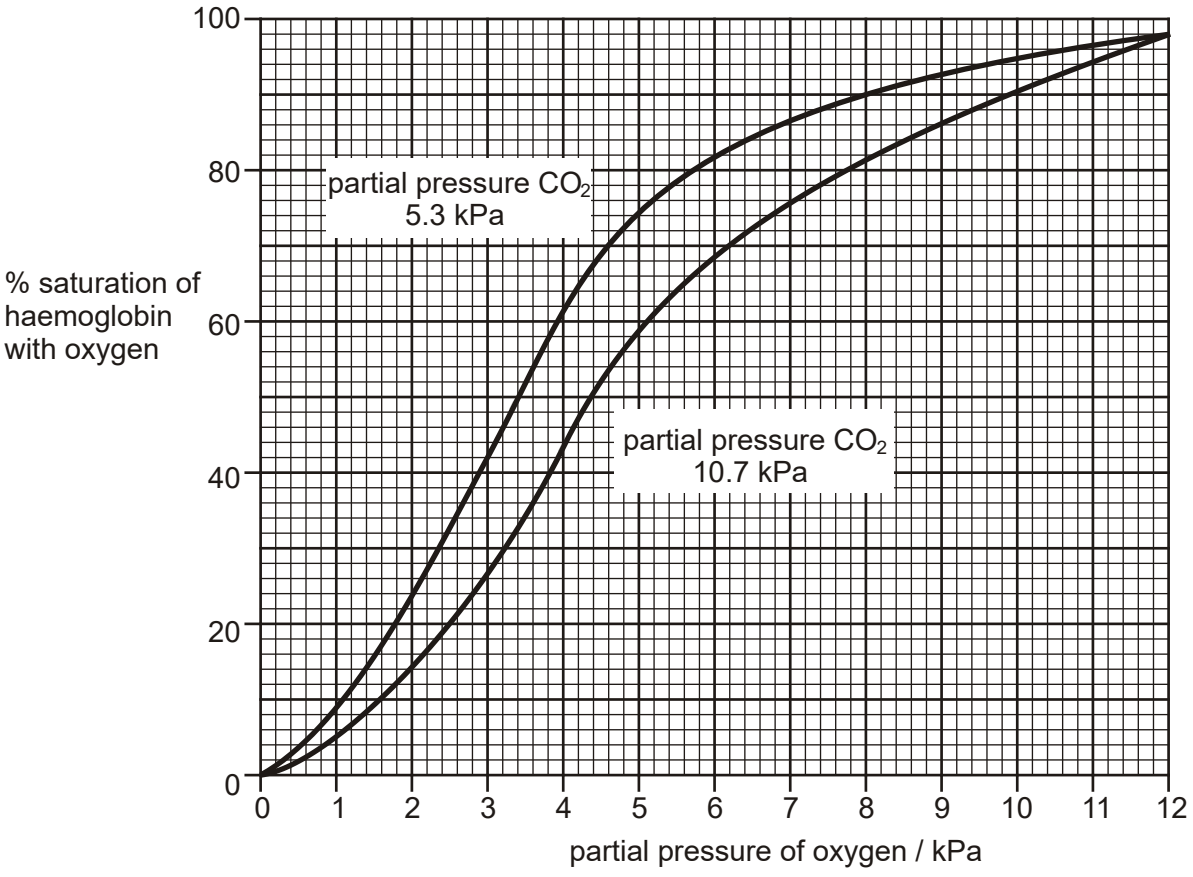


Fig. 1

(a) (i) Name the effect illustrated by the two curves.

.....

[1]

(ii) The steepest part of each curve in Fig. 1 is between the oxygen partial pressures of 2 and 5 kPa.

Explain why it is important that this is so.

.....

.....

.....

.....

[2]

(iii) Explain how the effect of increasing the partial pressure of carbon dioxide from 5.3 to 10.7 kPa ensures a greater delivery of oxygen to exercising muscle tissue.

.....

.....

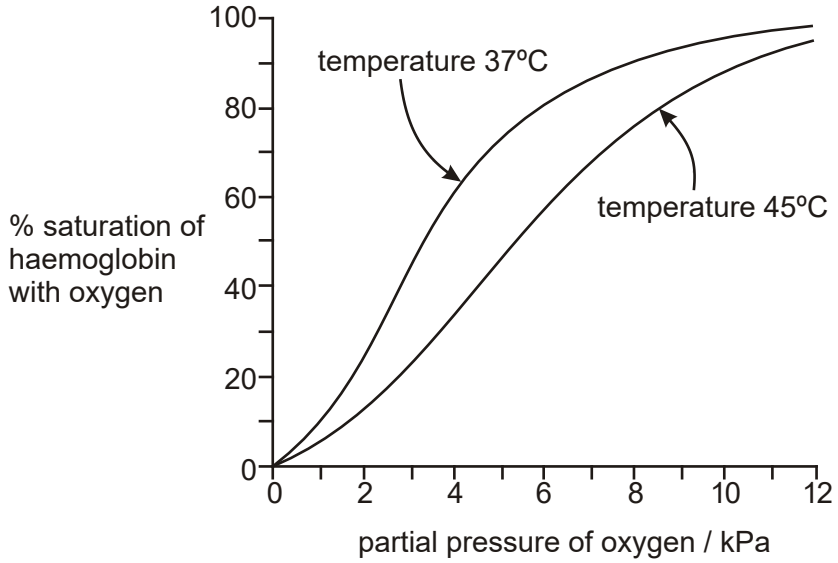
.....

.....

.....

[2]

(b) The effect shown in Fig. 2 also increases the delivery of oxygen to exercising muscle tissue.



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

Fig. 2

Suggest how exercising muscle tissue can bring about the changes seen in Fig. 2.

.....

.....

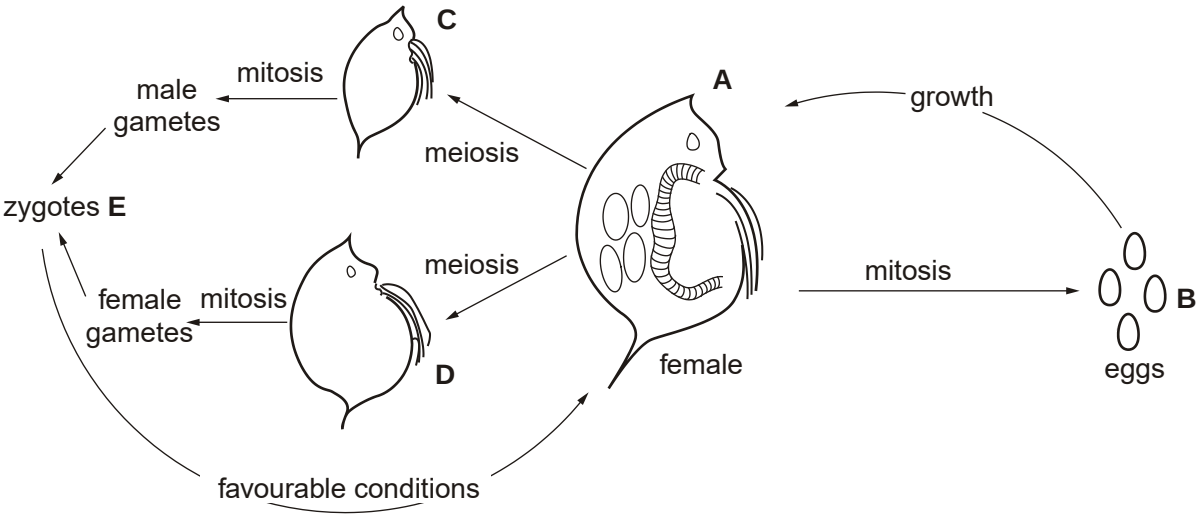
.....

.....

[2]

[Total 7 marks]

95. The figure below shows several stages in the life cycle of the water flea, *Daphnia*.



- In favourable conditions, all the individuals in a population are females, **A**.
- These females produce eggs, **B**, by **mitosis** which develop into further females.
- In unfavourable conditions, eggs are produced by **meiosis** and develop without fertilisation into either males, **C**, or females, **D**.
- Gametes are produced by **mitosis** from **C** and **D**.
- The resultant zygotes, **E**, develop a protective case which enables them to survive unfavourable conditions.
- When favourable conditions return, these zygotes develop into young females.

(i) State which of the stages, **A** to **E**, contain individuals with the diploid number of chromosomes.

.....

[1]

(ii) Explain why the females in stage **A** show greater variation than the females in stage **D**.

.....

.....

.....

.....

[2]

(iii) Explain why gametes are produced by mitosis from males **C** and females **D**.

.....

.....

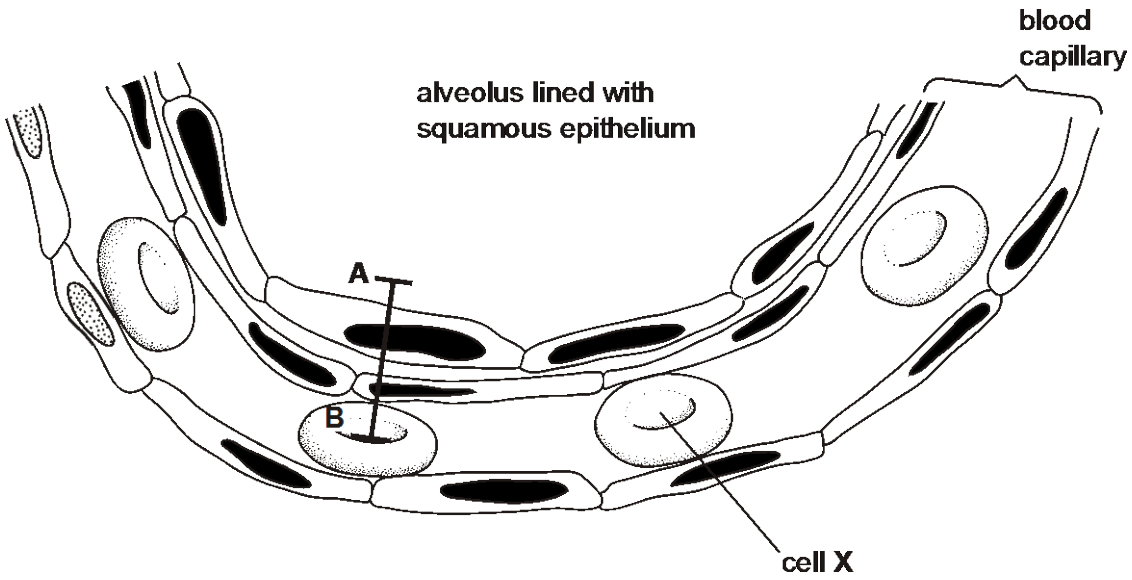
.....

.....

[2]

[Total 5 marks]

96. 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.

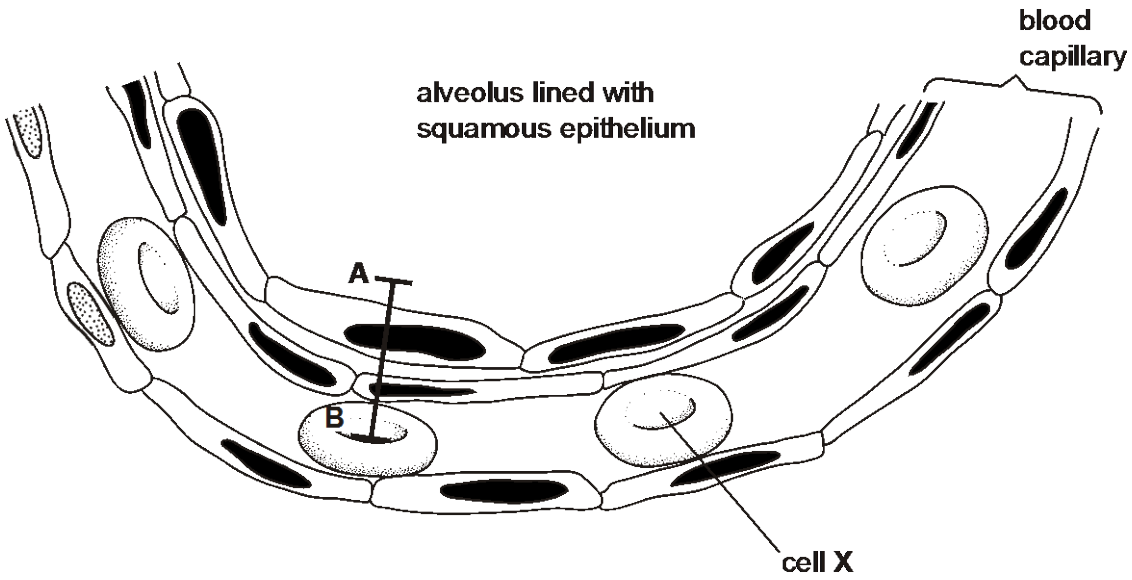
1 .....

2 .....

[2]

[Total 4 marks]

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



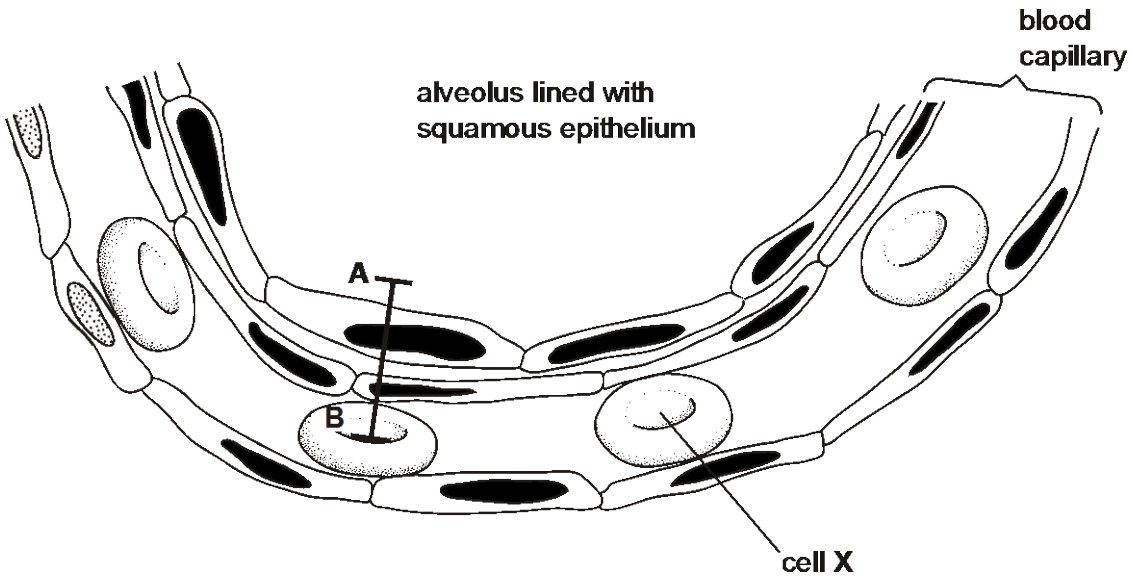
The line **AB** in the diagram represents an actual distance of 1.5 µm.

Calculate the magnification of the drawing. Show your working.

Answer = × .....

[Total 2 marks]

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



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

When passing from the alveolus to cell **X**, oxygen diffuses through cell membranes.

Describe how other molecules or ions cross a plasma (cell surface) membrane by **active transport** and **facilitated diffusion**.

You should refer to the structure of the plasma (cell surface) membrane in your answer.

[7]

Quality of Written Communication [1]

[Total 8 marks]

99. Complete the following passage by inserting the most suitable terms in the blank spaces.

Mitosis is a type of nuclear division and can be observed using a light microscope. In the first stage, known as ..... , the chromosomes become visible. Each chromosome is seen as two chromatids joined at the ..... .

The nuclear ..... breaks down, a spindle is formed and the ..... line up at the equator.

During the stage known as ..... the chromatids separate, one of each pair moving to opposite ..... of the spindle.

Separate nuclei are formed. The cytoplasm is then shared between the daughter cells in a process known as ..... .

These two cells are ..... identical.

[Total 8 marks]

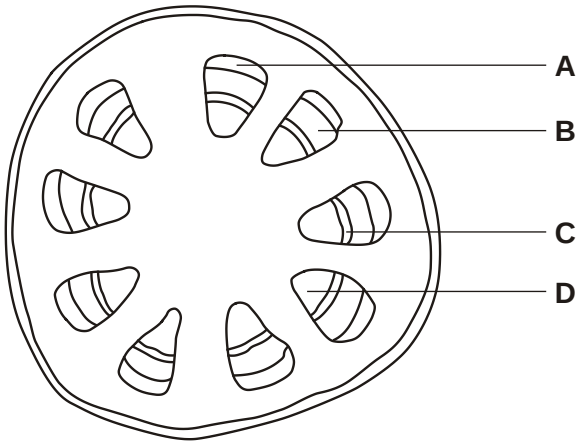
100. A number of definitions are listed in the table below.

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]

101. Below is a diagram of a cross section of an organ from a dicotyledonous plant showing some of the tissues.



(i) Name the plant organ shown in the diagram above.

.....

[1]

(ii) State which of the regions **A** to **D** is phloem tissue.

.....

[1]

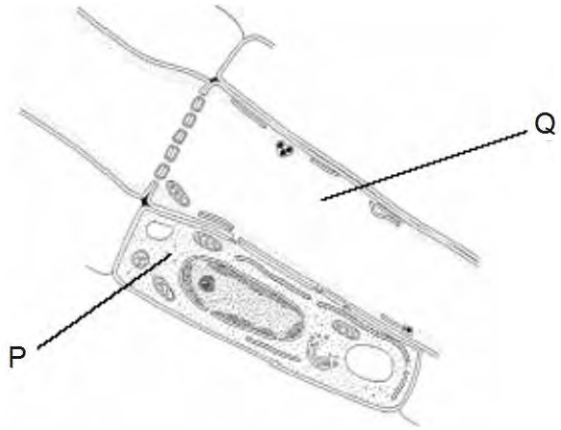
[Total 2 marks]

102. (a) From the list below, circle the carbohydrate that is transported in phloem.

auxin fructose glucose glycine glycogen starch sucrose

[1]

(b) Phloem is responsible for the transport of carbohydrate in plants. The diagram below shows the structure of the cells in phloem.



A-level Biology, page 362 Fig. 31.10A,
by W D Phillips and T J Chilton,
published by Oxford University Press,
1989. (ISBN 0 19 914089 8)

(i) Name the cells **P** and **Q** in the diagram.

P .....

Q .....

[2]

(ii) Outline how **P** and **Q** are involved in the transport of carbohydrate in phloem.

.....

.....

.....

.....

.....

.....

[3]

[Total 6 marks]

103. Carbohydrate moves from regions of plants called sources to regions called sinks.

Explain how, at different times, the same plant root may be a source or a sink.

.....

.....

.....

.....

.....

.....

[Total 2 marks]

104. (a) The diagram below shows some mammalian blood vessels in cross section.

Vessel **X** is an artery. Its magnification is given on the diagram.

Calculate the actual width of the vessel in mm between points **E** and **F**. Show your working and express your answer **to the nearest whole number**.

Answer = …… mm

[2]

(b) In this question, one mark is available for the quality of use and organisation of scientific terms.

Describe how the structure of an artery is related to its function.

You may refer to features visible in the diagram above to help in your answer.

[6]

Quality of Written Communication [1]

[Total 9 marks]

105. Complete the following passage on water uptake by the root using the most appropriate word or words.

Water moves from the soil to the xylem in the root down a ..... gradient.

The root hairs provide a large surface area for water uptake and once water has been taken up it crosses to the xylem by two pathways. The ..... pathway goes via the cell walls but is blocked at the ..... by the ..... . The other route involves the water crossing cell membranes by the process of osmosis and entering the cytoplasm. This is called the ..... pathway.

[Total 5 marks]

106. The table below contains information about various components of the mammalian circulatory system.

	blood in aorta	tissue fluid	lymph	blood in vena cava
red blood cells	many		none	many
white blood cells		some	some	many
glucose concentration	high	high		high
pressure	high	low	low	

(a) (i) Complete each of the shaded boxes in the table with the most appropriate word.

[4]

(ii) Explain the differences recorded in the table for glucose and pressure.

glucose .....

.....

.....

.....

pressure .....

.....

.....

.....

[4]

(b) The blood also contains hydrogen carbonate ions (HCO_3^-). Describe how these ions are formed in the blood.

.....

.....

.....

.....

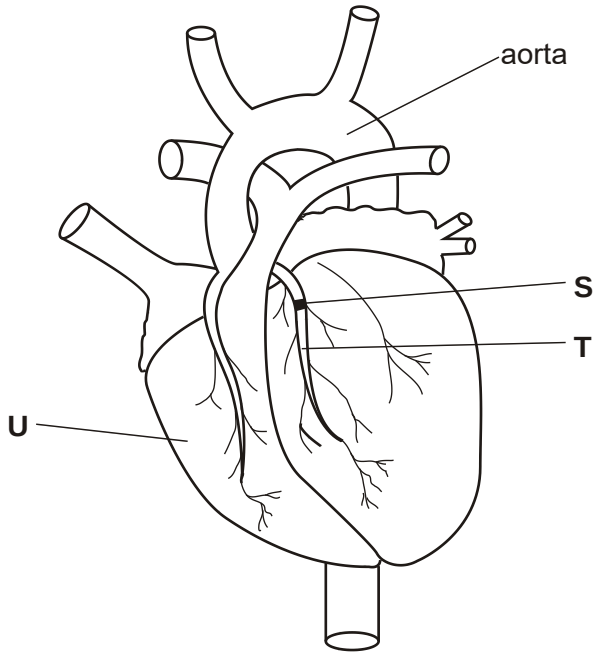
.....

.....

[3]

[Total 11 marks]

107. The diagram below shows an external view of a human heart as seen from the front.



(i) Name the structures **T** and **U**.

T .....

U .....

[2]

(ii) Suggest the consequences of a blockage at point **S** as shown on the diagram.

.....

.....

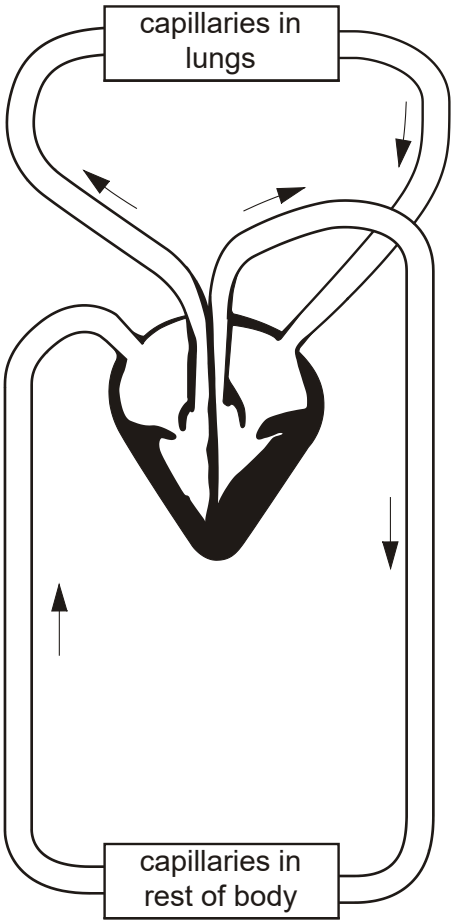
.....

.....

[2]

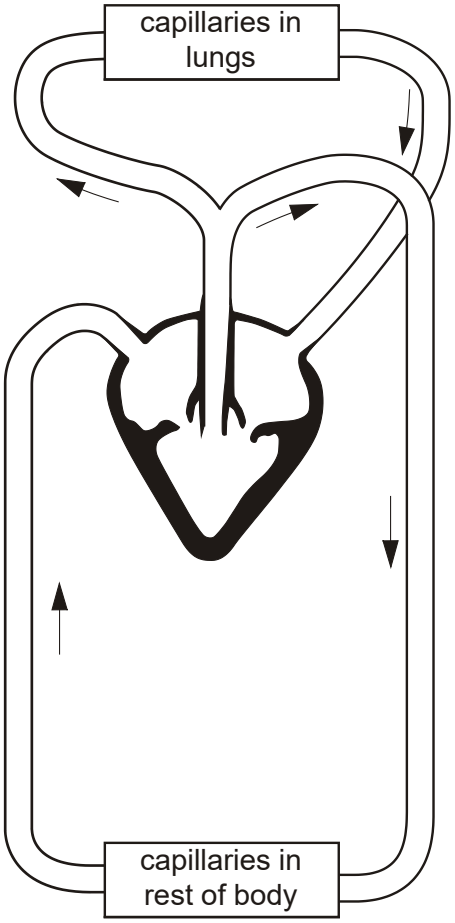
[Total 4 marks]

108. Figs. 1 and 2 are diagrams to show the internal structure of the heart and its associated circulatory system in a simplified form. Fig. 1 represents the system for a mammal and Fig. 2 that for a frog (an amphibian).



mammal

Fig. 1



frog

Fig. 2

Both systems are described as closed systems. The mammalian system is also described as a complete double circulation but the frog as a partial double circulation.

(i) State what is meant by a closed system.

.....

.....

[1]

(ii) Use the information in Fig. 1 and Fig. 2 to suggest why the mammalian system is called a **complete** double circulation whilst that of the frog is called a **partial** double circulation.

.....

.....

.....

.....

.....

.....

.....

.....

[3]

(iii) Suggest why the system shown for the frog may be less effective at supplying the body tissues with oxygen.

.....

.....

.....

.....

.....

[2]

[Total 6 marks]

109. 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.

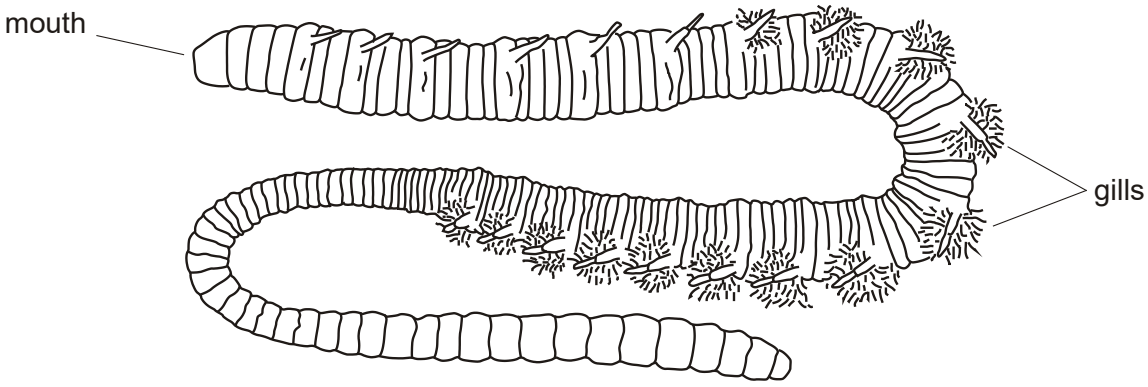


Fig. 1

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

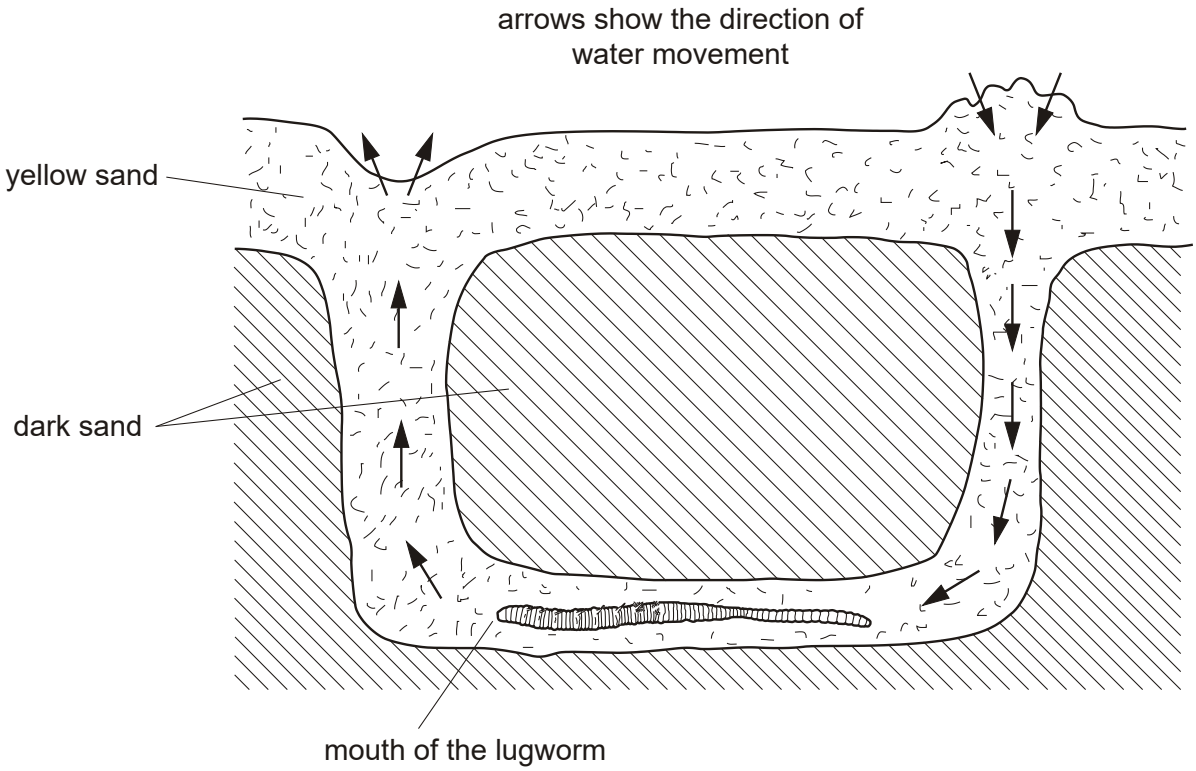


Fig. 2

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.

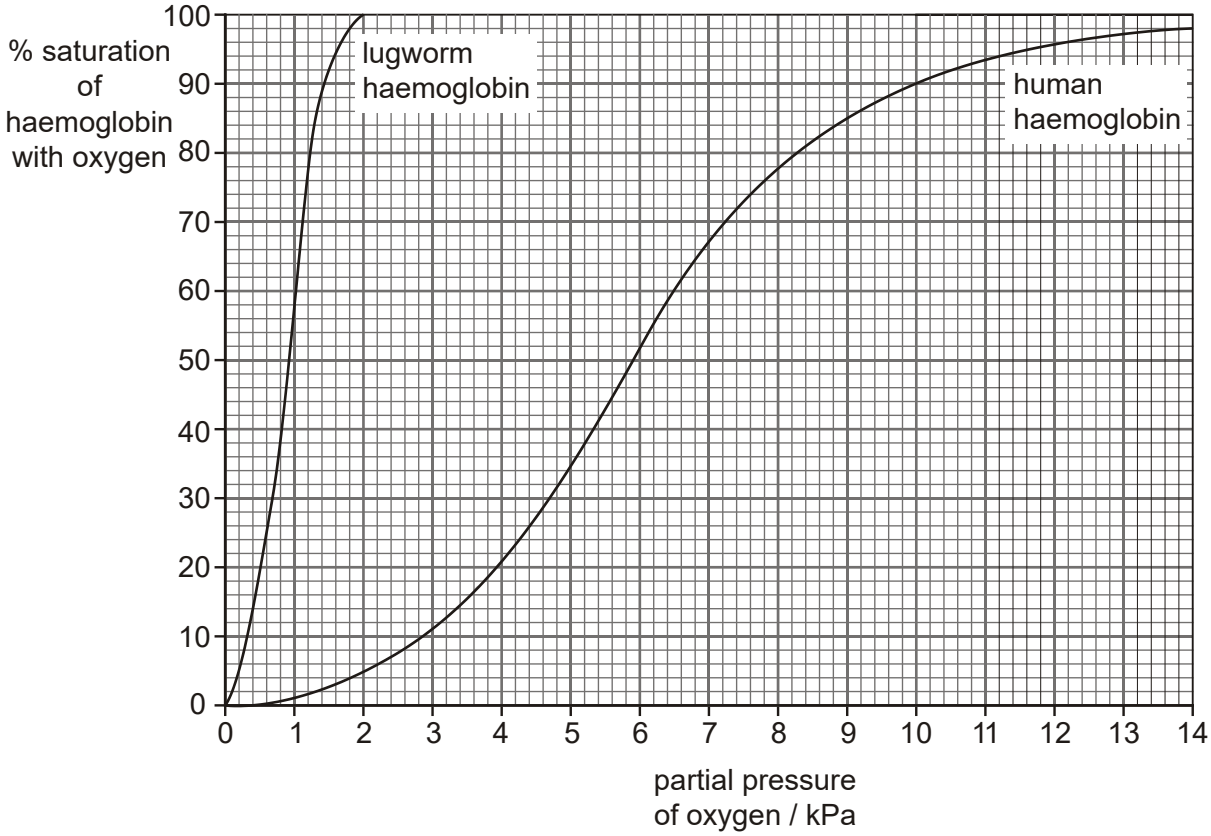


Fig. 3

(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.

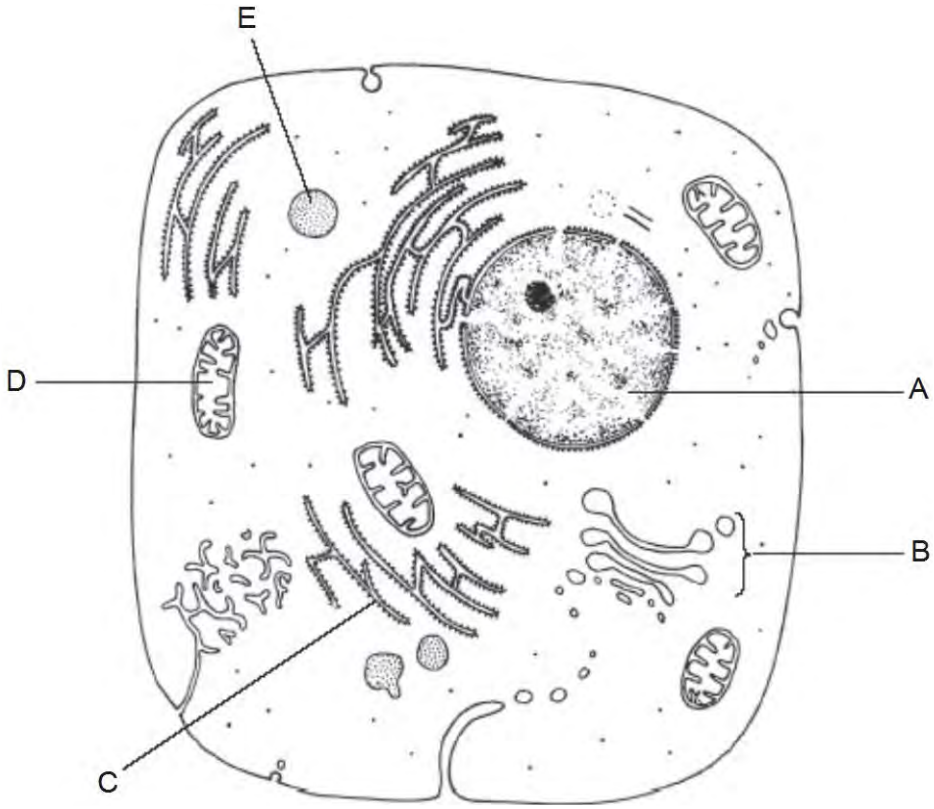
You will gain credit for using information given in question 4.

[7]

Quality of Written Communication [1]

[Total 12 marks]

110. Below is a drawing of an animal cell as seen under an electron microscope.



Complete the following table by:

- identifying the parts of the cell **A** to **E**
- naming the part of the cell responsible for the function stated.

The first one has been done for you.

function	part of cell	label
controls activities of the cell	*nucleus*	***A***
carries out aerobic respiration		
attaches to mRNA in protein synthesis		
produces secretory vesicles		
contains digestive enzymes		

[Total 8 marks]

111. Plants take up nitrate ions and water from the soil into the roots.

(i) State **one** way in which root hairs are adapted to increase uptake.

.....

[1]

(ii) State **one** method used by root hairs to take up nitrate ions.

.....

[1]

(iii) Outline the process by which water enters the cells of the root from the soil.

.....

.....

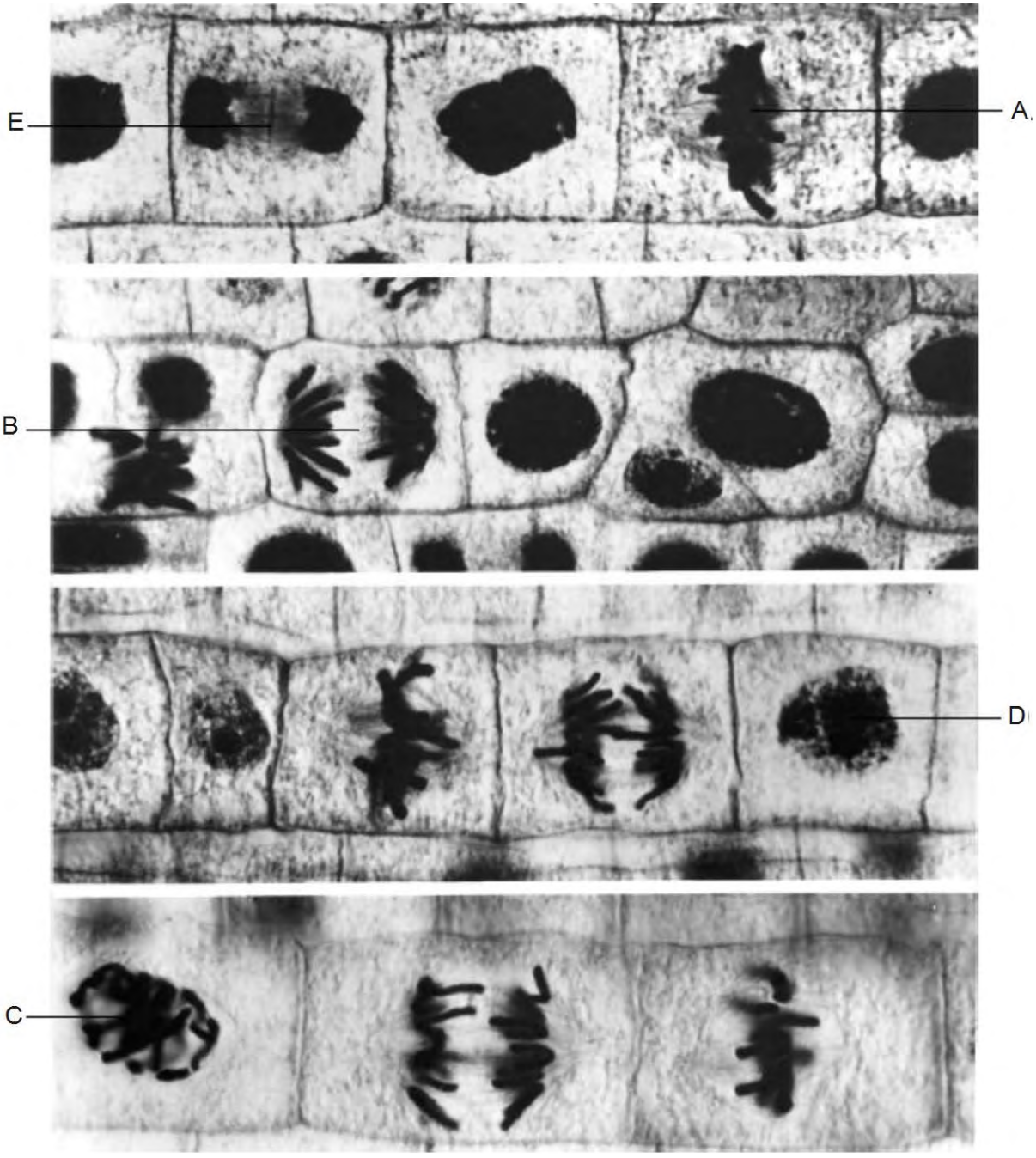
.....

.....

[2]

[Total 4 marks]

112. Four light micrographs of onion cells undergoing mitosis are shown below.



Biophoto Associates

In this question, one mark is available for the quality of the use and organisation of scientific terms.

Outline what happens to chromosomes during the mitotic cell cycle.

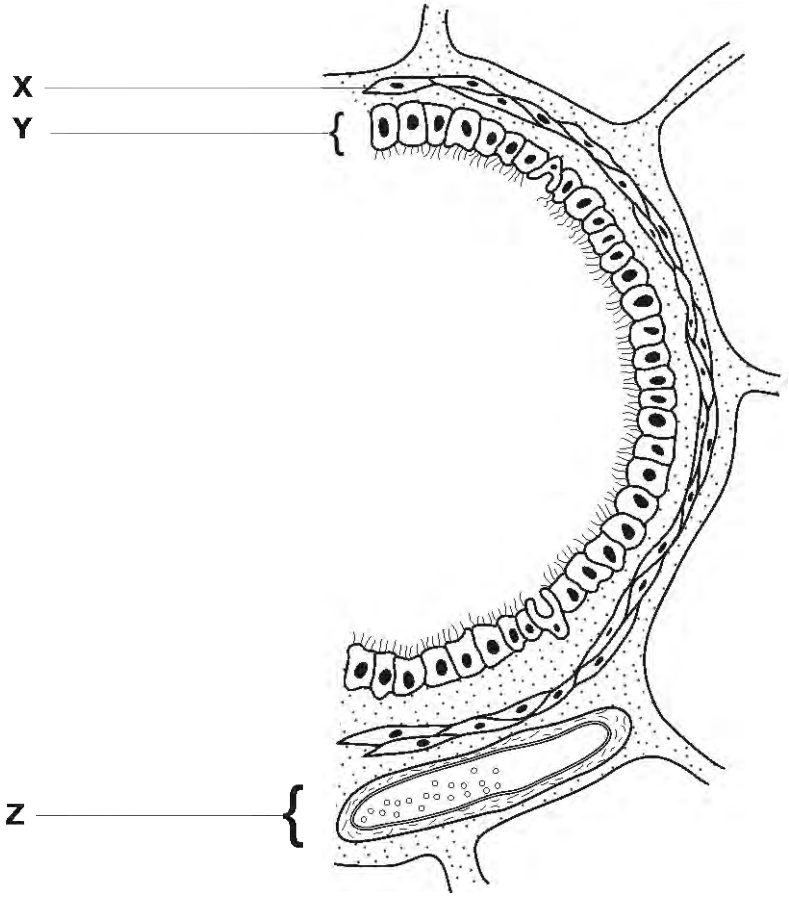
You will gain credit if you refer to the labelled cells in the micrographs.

[9]

Quality of Written Communication [1]

[Total 10 marks]

113. 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]

114. 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.

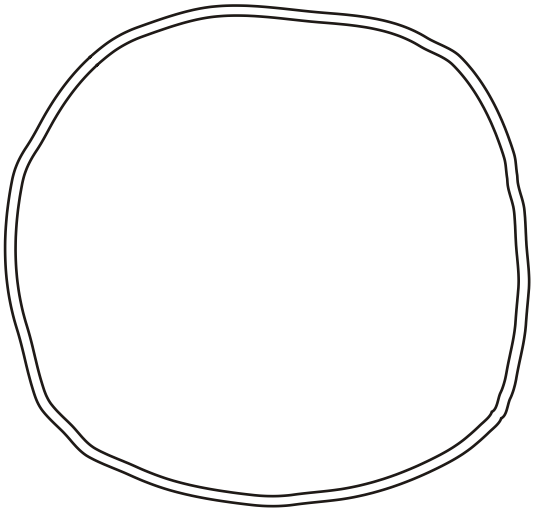
[8]

Quality of Written Communication [1]

[Total 9 marks]

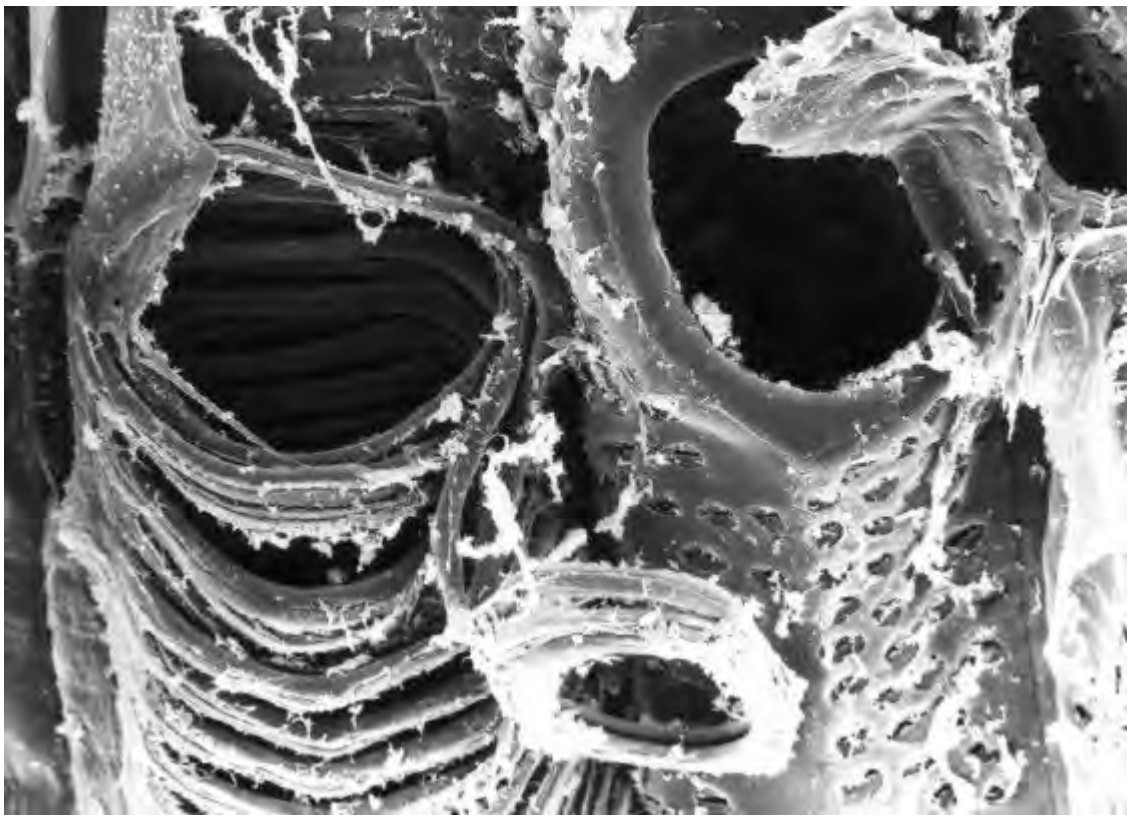
115. Flowering plants have two tissues to transport materials, xylem and phloem. The diagram below shows the outline of a transverse section of the **root** of a dicotyledonous flowering plant.

Sketch in and label the areas occupied by the xylem and phloem.



[Total 2 marks]

116. The diagram below is a scanning electron micrograph of some xylem vessels.



Biophoto Associates

Select **two** features **that are visible in the electron micrograph** and explain how these features help with the functioning of xylem vessels.

feature 1 .....

.....

.....

.....

feature 2 .....

.....

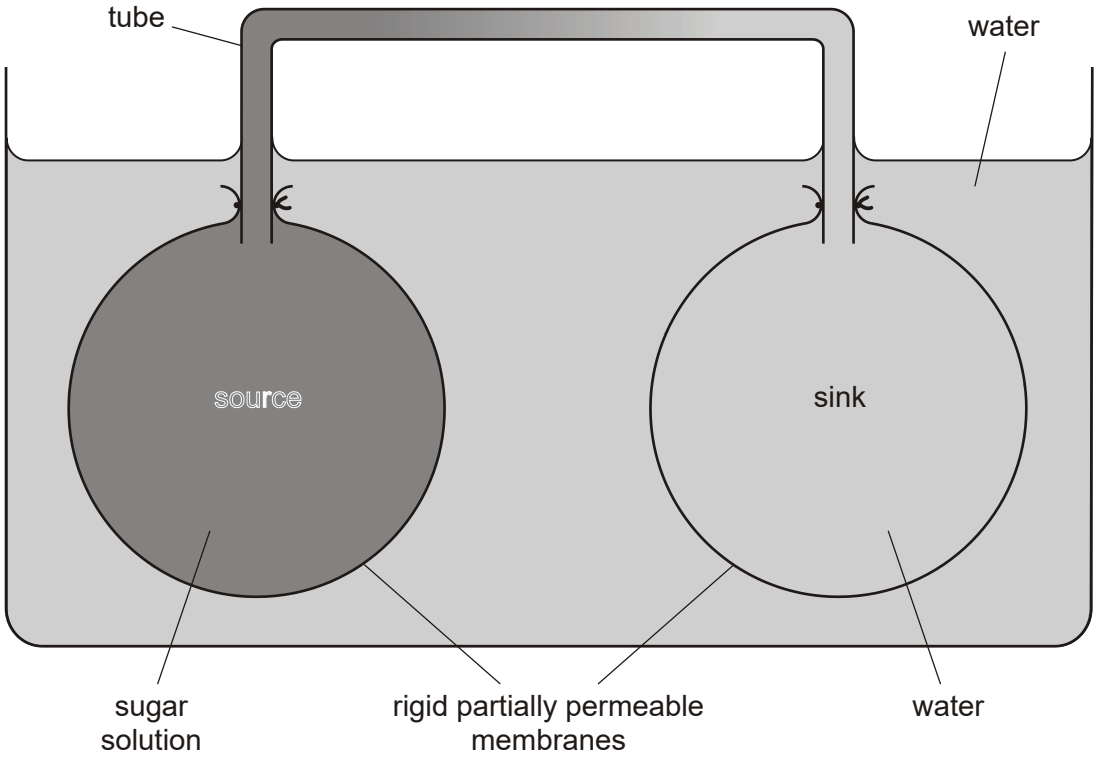
.....

.....

[Total 4 marks]

117. Various hypotheses for the mechanism of transport in phloem have been suggested. One hypothesis proposes that movement between sources and sinks occurs entirely passively by the process of mass flow.

The diagram below shows a physical model to illustrate the principle of mass flow.



(i) Give an example in plants of:

a source .....

a sink .....

[2]

(ii) Use the information in the diagram to explain how mass flow of materials between the source and the sink would be brought about.

.....

.....

.....

.....

.....

.....

.....

[4]

[Total 6 marks]

118. There is evidence that sugar transport from sources to sinks in plants does not only involve passive movement by mass flow. There is also an active part to the mechanism.

(i) State **one** piece of evidence for the involvement of an active process.

.....

.....

[1]

(ii) Describe an active mechanism which could possibly be involved in the transport of sugars from sources to sinks.

.....

.....

.....

.....

.....

.....

[3]

[Total 4 marks]

119. Use the most appropriate terms to complete the paragraph below about the role of haemoglobin.

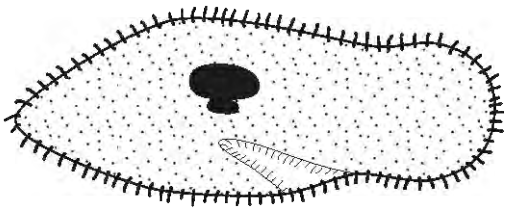
Haemoglobin is a pigment found in the blood of mammals which has an important role in the transport of respiratory gases. Each haemoglobin molecule contains haem groups. In the lungs, oxygen binds with the atom of …… in each haem group. The maximum number of molecules of oxygen that can be carried by one molecule of haemoglobin is …… . In areas like muscle tissue where the partial pressure of oxygen is low, oxygen dissociates from the haem group. This dissociation is increased by the presence of carbon dioxide; this is called the …… …… . Most of the carbon dioxide produced in respiring tissues diffuses into the red blood cells where the enzyme …… …… catalyses a reaction leading to the production of hydrogen ions and hydrogen carbonate ions. The hydrogen ions combine very readily with haemoglobin to form a compound known as …… …… The effect of this is to increase the release of oxygen from haemoglobin.

[Total 5 marks]

120. The diagram below shows a mammal and a unicellular organism. The transport system in mammals is a double circulatory system driven by a pump (the heart), whilst unicellular organisms have no need for special transport systems.

mammal (cat)

X 0.075



unicellular organism
(Paramecium)
X 300

(i) Explain what is meant by a *double circulatory system*.

.....

.....

.....

.....

[2]

(ii) Explain **two** reasons why mammals need a circulatory system whilst unicellular organisms, such as that shown in the diagram, do not.

first reason .....

.....

.....

.....

second reason .....

.....

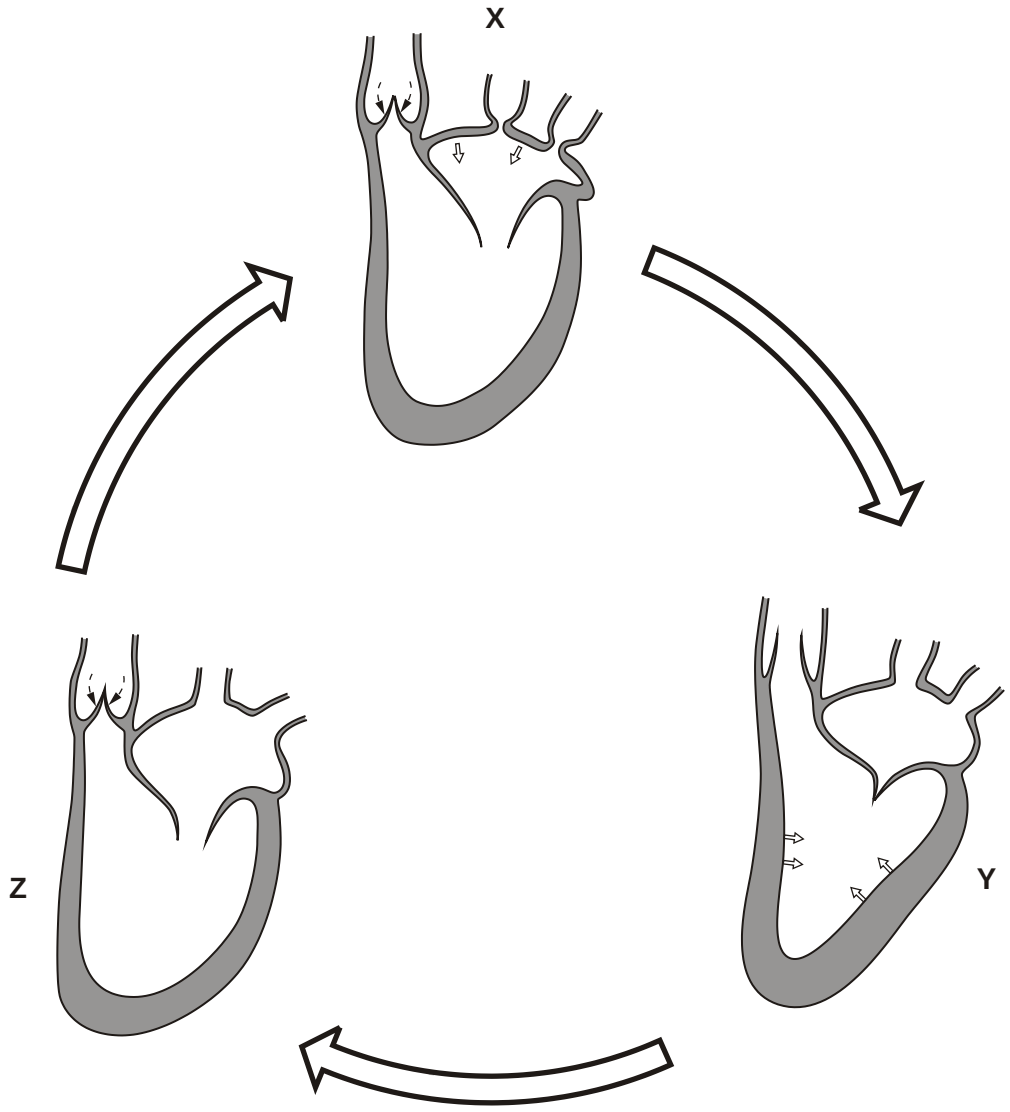
.....

.....

[4]

[Total 6 marks]

121. The cardiac cycle is the sequence of events which makes up one heart beat. The diagram below shows the events in the heart during one heart beat. The heart is viewed from the side.



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

Using the information in the diagram, describe the sequence of events involved in one heart beat.

You may annotate **X**, **Y** and **Z** in the diagram to help your answer. (Do **not** describe how the beat is initiated and controlled.)

[6]

Quality of Written Communication [1]

[Total 7 marks]

122. (a) Fig. 1 shows the changes in blood pressure as blood flows through various parts of the mammalian blood system.

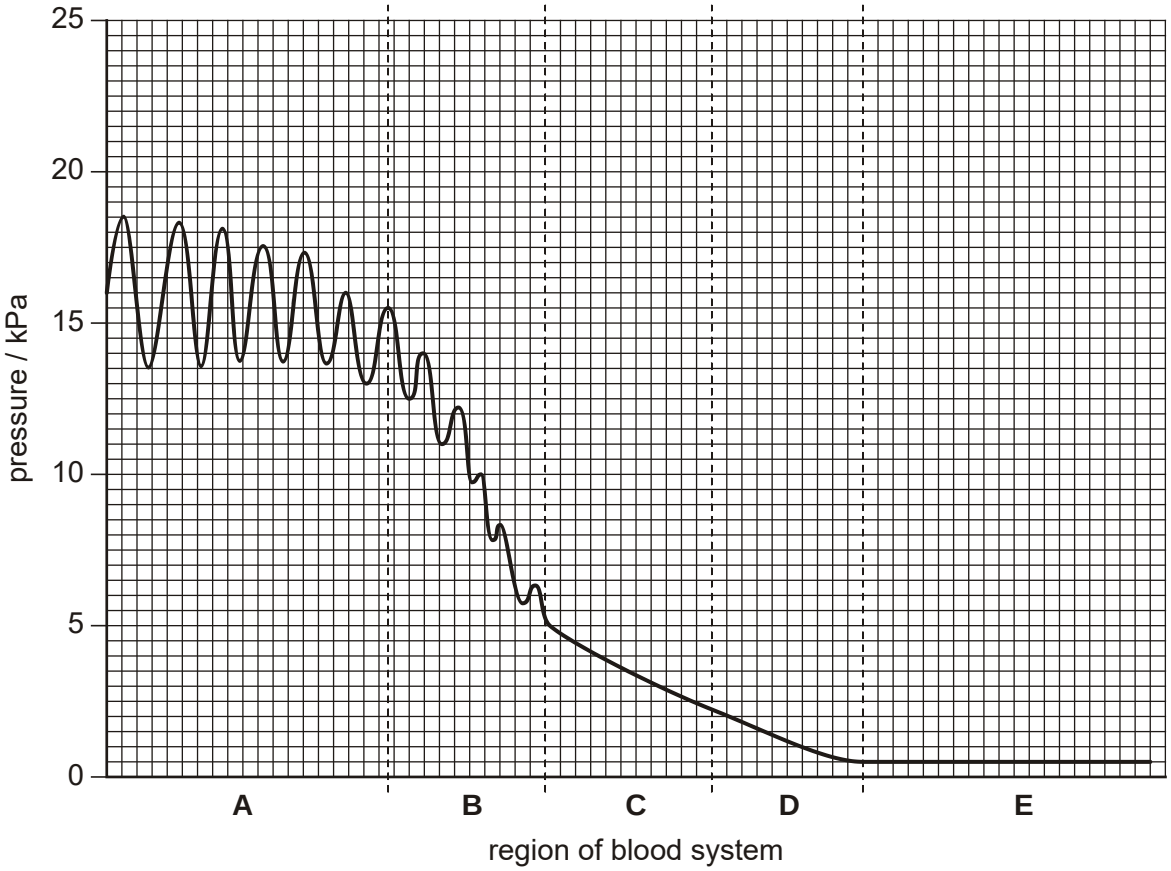


Fig. 1

(i) Calculate the drop in blood pressure from the **start** of region **B** to the **end** of region **D**. Show your working.

Answer =…… kPa

[2]

(ii) Explain what brings about the drop in pressure between **B** and **D**.

.....

.....

.....

.....

.....

[2]

(iii) Suggest why it is important that the pressure in region **C** is not as great as the pressure in region **A**.

.....

.....

.....

.....

[2]

(b) Fig. 2 shows the structure of part of a capillary.

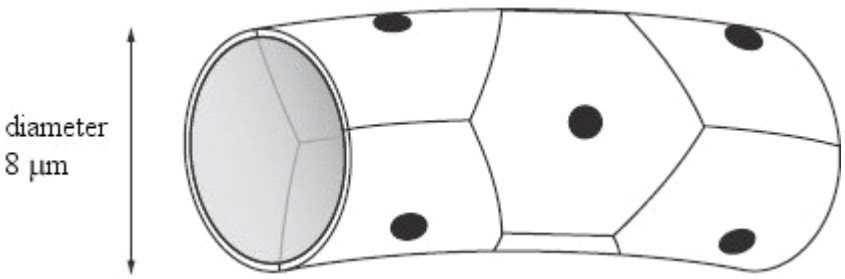


Fig. 2

(i) State which of the regions **A** to **E** shown on Fig. 1 represents the capillaries.

.....

[1]

(ii) Select **two** structural features of capillaries and explain how each feature helps with the exchange of materials between the blood and the tissue fluid.

feature .....

role in exchange .....

.....

.....

feature .....

role in exchange .....

.....

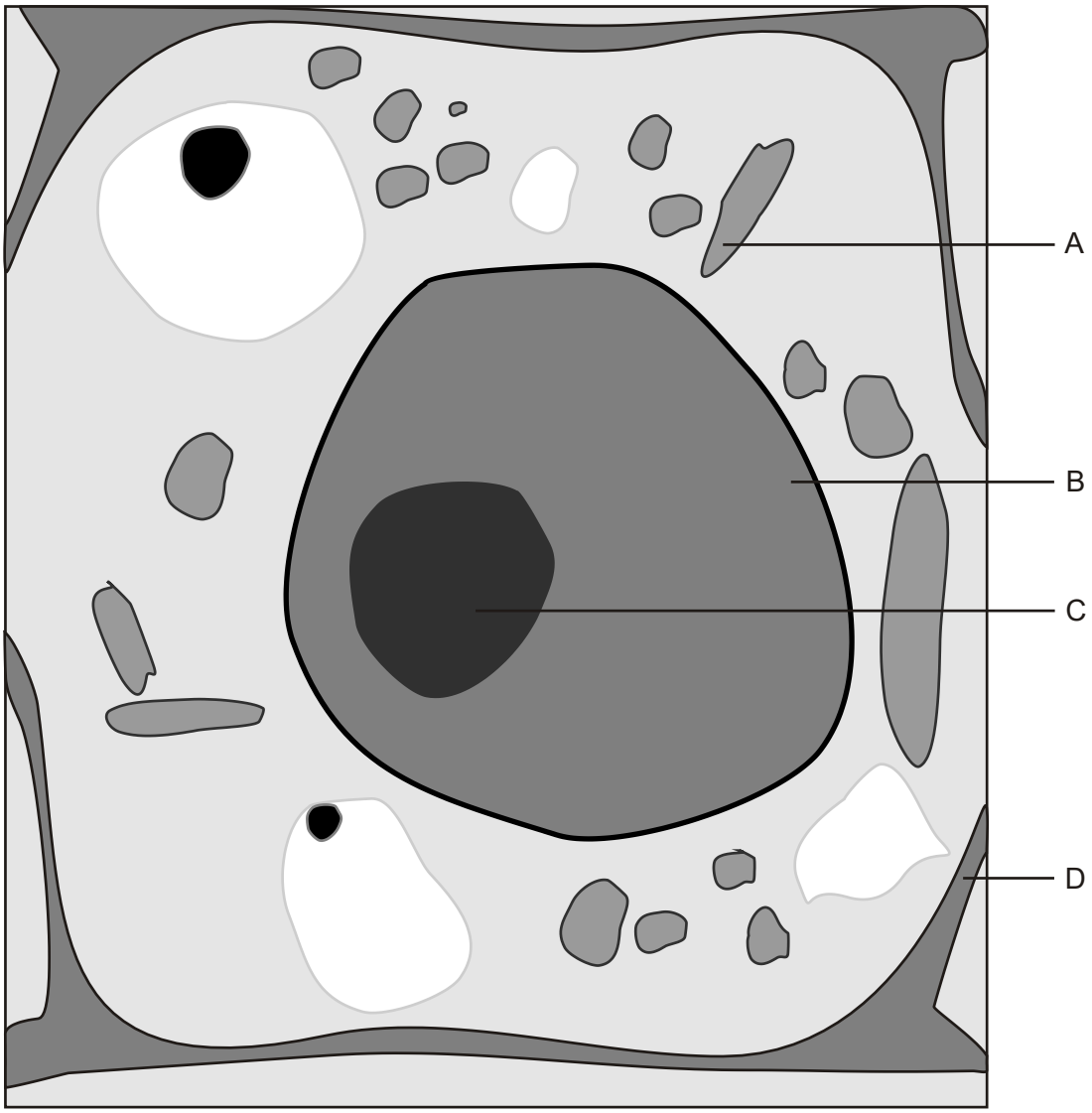
.....

.....

[4]

[Total 11 marks]

123. The diagram below is of a plant cell.



Name the parts of the cell labelled **A** to **D**.

A .....

B .....

C .....

D .....

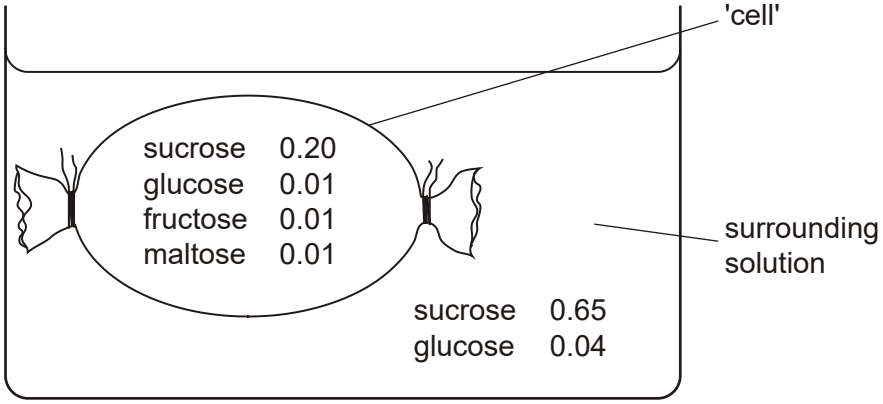
[Total 4 marks]

124. An experiment was carried out in which an artificial membrane was used to form the boundary of a model of a cell. A solution of different sugars was placed inside this 'cell', which was then placed in a beaker containing a solution of sucrose and glucose.

The artificial membrane is:

- permeable to monosaccharides (e.g. glucose and fructose) and water;
- not permeable to disaccharides (e.g. maltose and sucrose);
- flexible.

The diagram below shows the 'cell', together with the concentrations of the sugars inside the 'cell' and in the surrounding solution. The figures represent the concentration in mol dm^{-3}.



(a) (i) State which sugar or sugars will show a net movement **out of** the 'cell'.

.....

[1]

(ii) State which sugar or sugars will show a net movement **into** the 'cell'.

.....

[1]

(iii) Name the method by which these sugars cross the membrane.

.....

[1]

(iv) Explain why the volume of the 'cell' would change during the experiment.

.....

.....

.....

.....

.....

.....

.....

.....

[4]

(b) The artificial membrane used in this experiment does not resemble a plasma (cell surface) membrane in all respects.

State **one** method by which substances would be **unable** to cross the artificial membrane.

.....

[1]

[Total 8 marks]

125. State **two** functions of mitosis.

.....

.....

.....

[Total 2 marks]

126. Name the stage of mitotic cell division during which each of the following takes place.

(i) Nuclear envelope reforms.

.....

[1]

(ii) Chromosomes align at equator.

.....

[1]

(iii) Chromosomes become visible.

.....

[1]

(iv) Chromatids move towards the poles.

.....

[1]

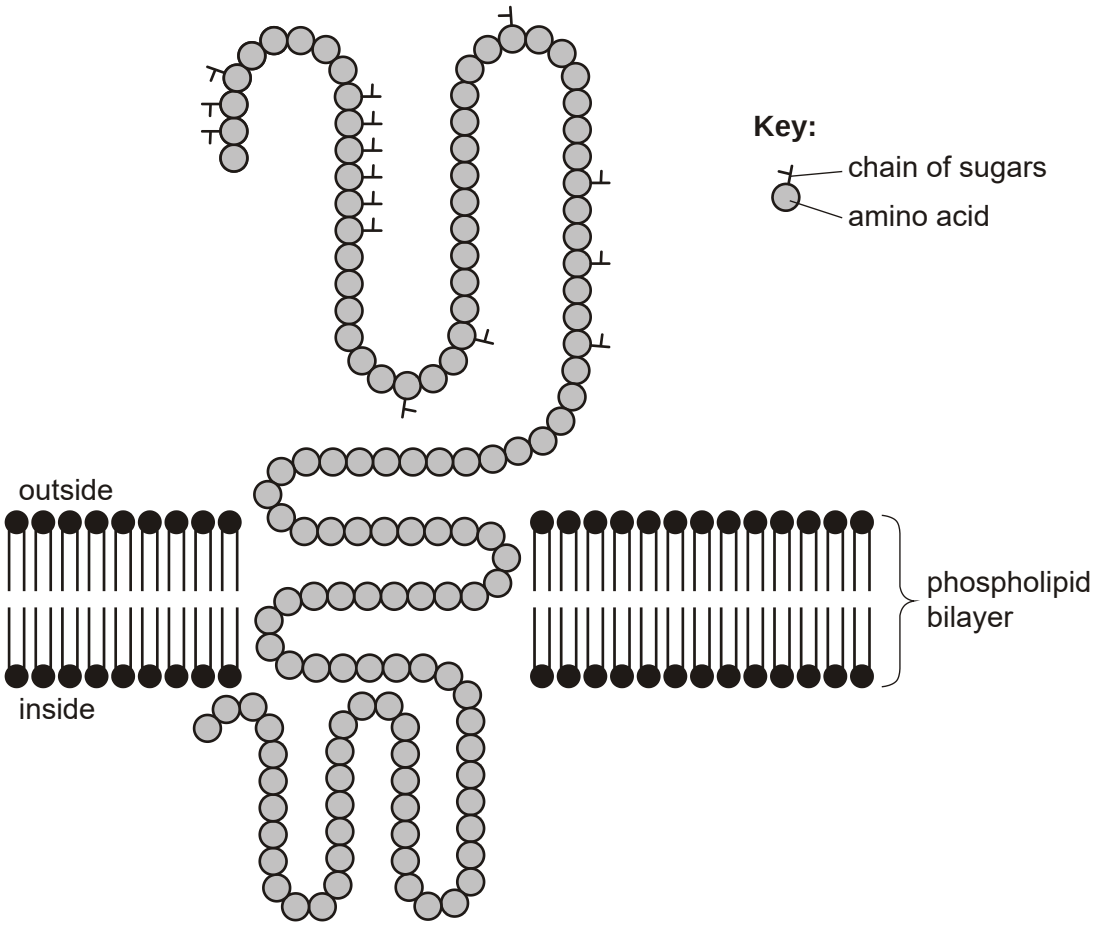
(v) Spindle microtubules shorten.

.....

[1]

[Total 5 marks]

127. Many human proteins are attached to specific sugars that are important in the functioning of the protein. Some of these proteins are found in the plasma (cell surface) membrane. The diagram below represents a protein of this type.



(i) What name is given to proteins with sugars attached?

.....

[1]

(ii) State **one** function of this type of protein in plasma (cell surface) membranes.

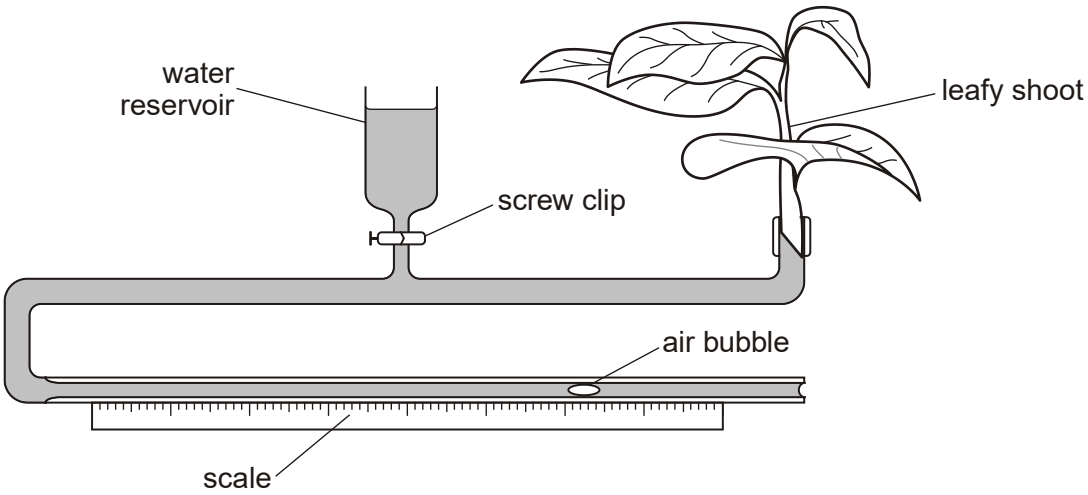
.....

.....

[1]

[Total 2 marks]

128. Transpiration is the loss of water from plants by evaporation. The diagram below shows a potometer, an apparatus used to **estimate** transpiration rates.



(i) Describe how the apparatus should be set up to ensure that valid measurements can be obtained.

.....

.....

.....

.....

.....

.....

.....

.....

[4]

(ii) Transpiration itself is not measured by the potometer. State **precisely** what is measured by using the apparatus.

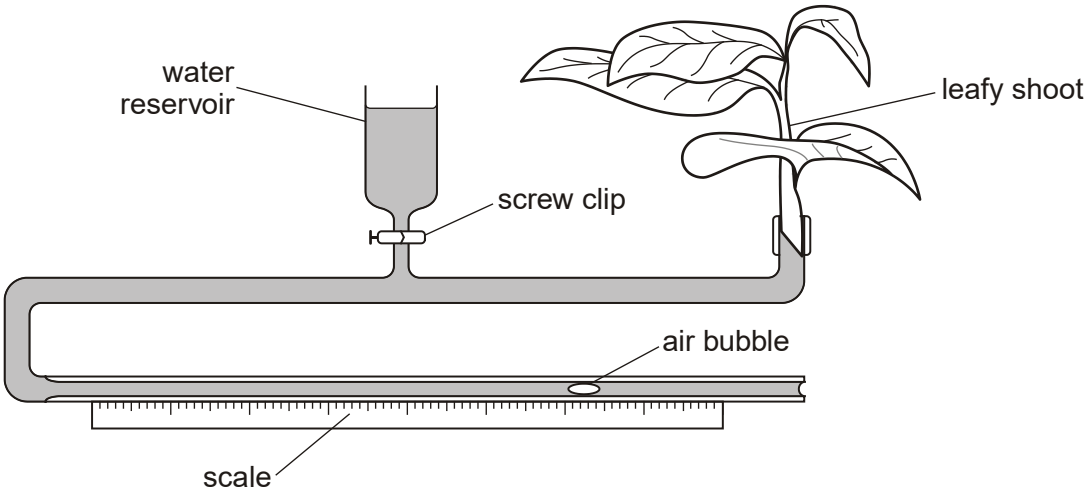
.....

.....

[1]

[Total 5 marks]

129. Transpiration is the loss of water from plants by evaporation. The diagram below shows a potometer, an apparatus used to **estimate** transpiration rates.



(a) A student investigated transpiration rates of a plant under two conditions, **A** and **B**, in the laboratory using a potometer. In both cases the temperature, the humidity, and the duration were the same. A fan was placed next to the potometer and was turned on for condition **B**, but not for condition **A**.

The results are shown in the table below.

reading	estimate of transpiration rate / arbitrary units	
	condition **A**	condition **B**
1	45	107
2	39	99
3	41	106
4	46	101
5	38	103
mean	42	

(i) Calculate the mean estimated transpiration rate for condition **B**. Express your answer **to the nearest whole number** and write it in the table above.

[1]

(ii) Explain why the mean estimated transpiration rate for condition **B** is greater than that for condition **A**.

.....

.....

.....

.....

.....

.....

[3]

(b) The student wanted to compare the rates of transpiration of two species of plant using the potometer shown in the diagram.

Suggest what the student would need to do in order to get a valid comparison of the rates of transpiration of the two species.

.....

.....

.....

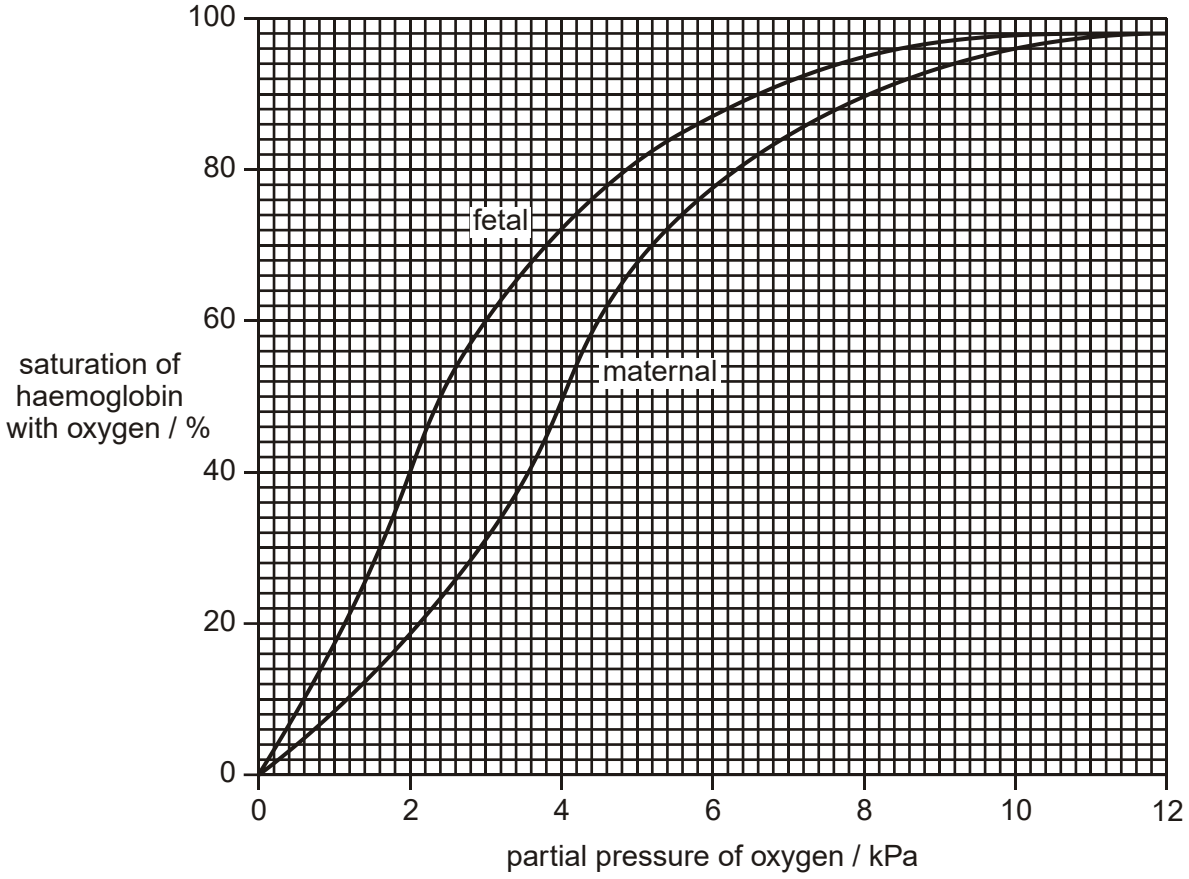
.....

[2]

[Total 6 marks]

130. (a) Oxygen is carried around the bodies of mammals, bound reversibly to the pigment haemoglobin. The pigment is found in both adult and fetal red blood cells.

The graph below shows the dissociation curves for maternal and fetal oxyhaemoglobin.



(i) State the difference in the percentage saturation of haemoglobin with oxygen between the fetal and the maternal blood at an oxygen partial pressure of 3 kPa.

.....

[1]

(ii) Explain why the difference between the two curves is essential for the survival of the fetus.

.....

.....

.....

.....

.....

.....

.....

[4]

(b) After birth, the adult form of haemoglobin gradually replaces the fetal form of haemoglobin.

Suggest why this is necessary.

.....

.....

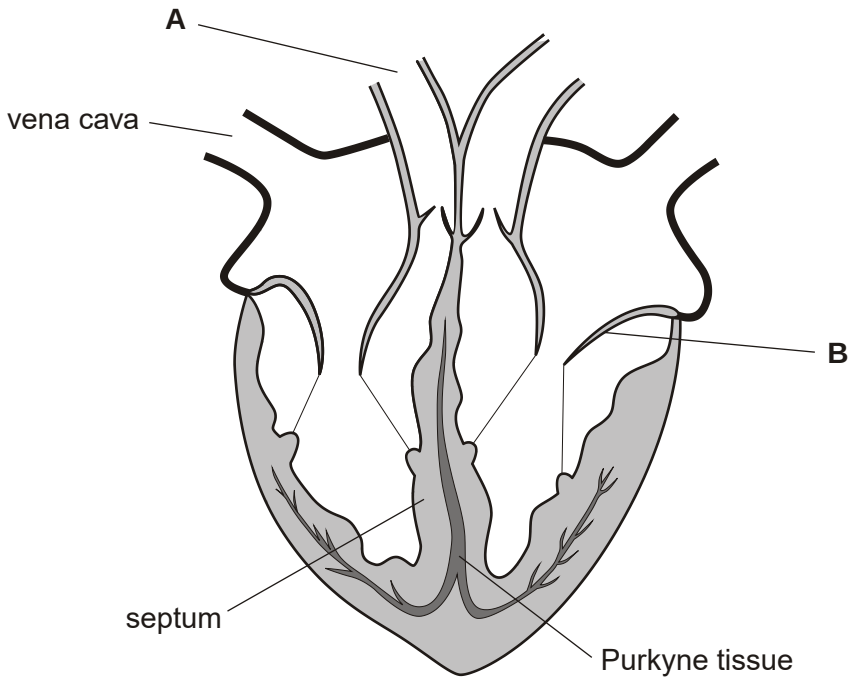
.....

.....

[2]

[Total 7 marks]

131. The diagram below shows the internal structure of the mammalian heart and associated blood vessels.



(i) State the name of structures **A** and **B**.

A .....

B .....

[2]

(ii) Use arrows on the diagram to show the direction of blood flow through the **left** side of the heart.

[1]

(iii) Suggest how the heart would be affected if the Purkyne tissue ceased to function.

.....

.....

.....

.....

.....

.....

[2]

(iv) The septum shown on the diagram completely separates the left and right sides of the heart.

Explain why it is important that the two sides of the heart are completely separated.

.....

.....

.....

.....

.....

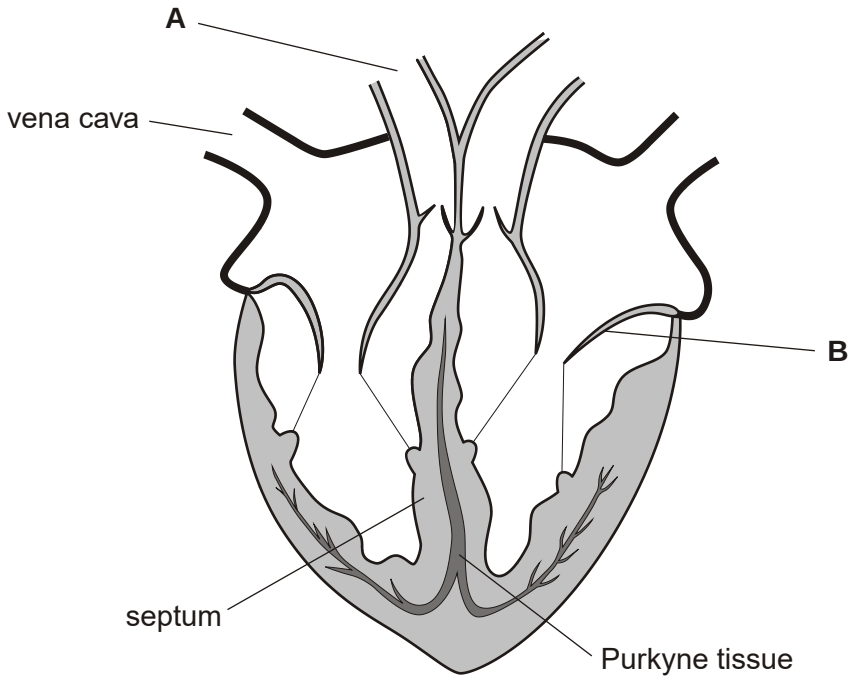
.....

[2]

[Total 7 marks]

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

The diagram below shows the internal structure of the mammalian heart and associated blood vessels.



Veins, such as the vena cava shown on the figure above, all have a similar structure. Describe the structure of veins **and** explain how their structure is related to their function.

[6]

Quality of Written Communication [1]

[Total 7 marks]

133. Xerophytes are plants that are adapted for survival in areas where there is not much water available in the soil.

Xerophytes are usually found in habitats where the soil water potential is about –50 kPa.
Explain why the cell contents of the roots of xerophytes must have a water potential lower (more negative) than –50 kPa if the plants are to survive in these habitats.

.....

.....

.....

.....

[Total 2 marks]

134. Xerophytes are plants that are adapted for survival in areas where there is not much water available in the soil.

Xerophytes have various modifications that reduce water loss from their leaves.

State **two** such adaptations that reduce water loss **and** explain how the reduction in loss is achieved.

adaptation 1 .....

.....

.....

.....

adaptation 2 .....

.....

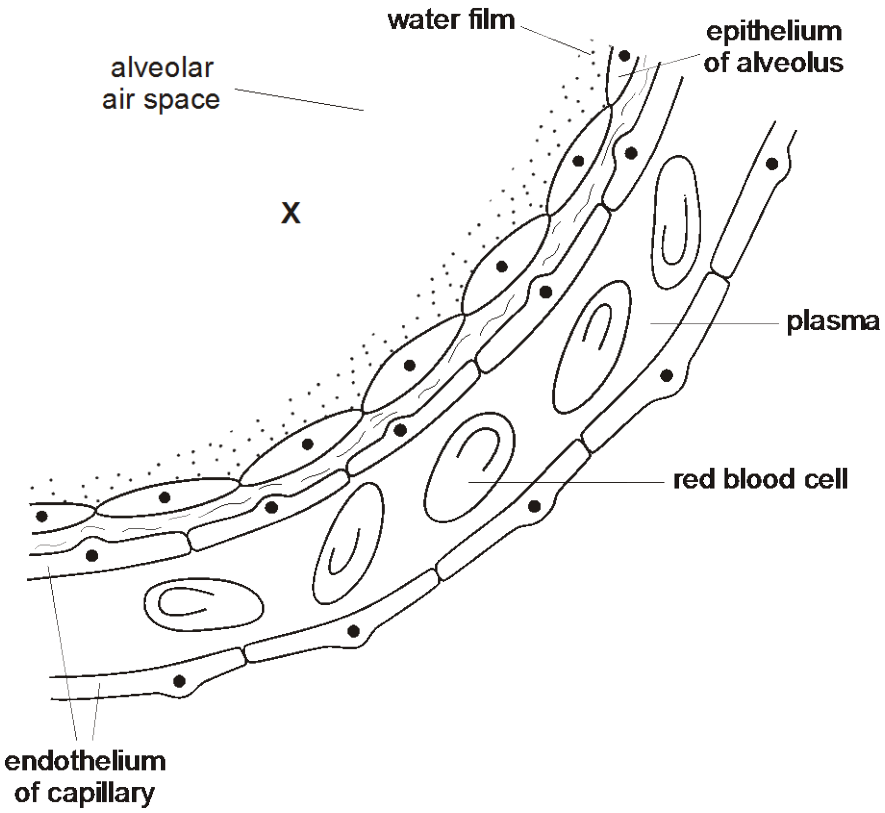
.....

.....

[Total 4 marks]

135. 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.

.....

.....

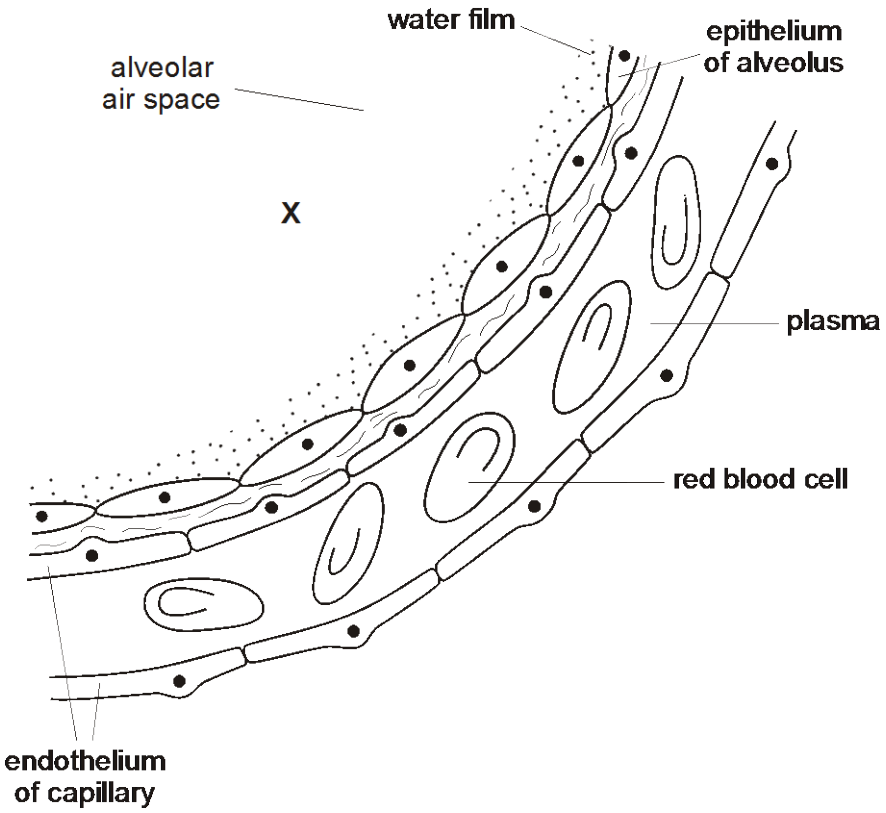
.....

.....

[Total 2 marks]

136. 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.



(a) Once in the red blood cells, the oxygen is picked up by haemoglobin. Explain how **two** features of red blood cells, **other than the presence of haemoglobin**, make them efficient in the collection of oxygen and its transport to the tissues.

feature 1 .....

.....

.....

.....

feature 2 .....

.....

.....

.....

[4]

(b) In addition to the red blood cells shown in the diagram, various types of white blood cell can be found in the blood system. Some of these white blood cells are lymphocytes.

Describe **one** feature that would allow you to identify a white blood cell as a lymphocyte when viewed with a light microscope.

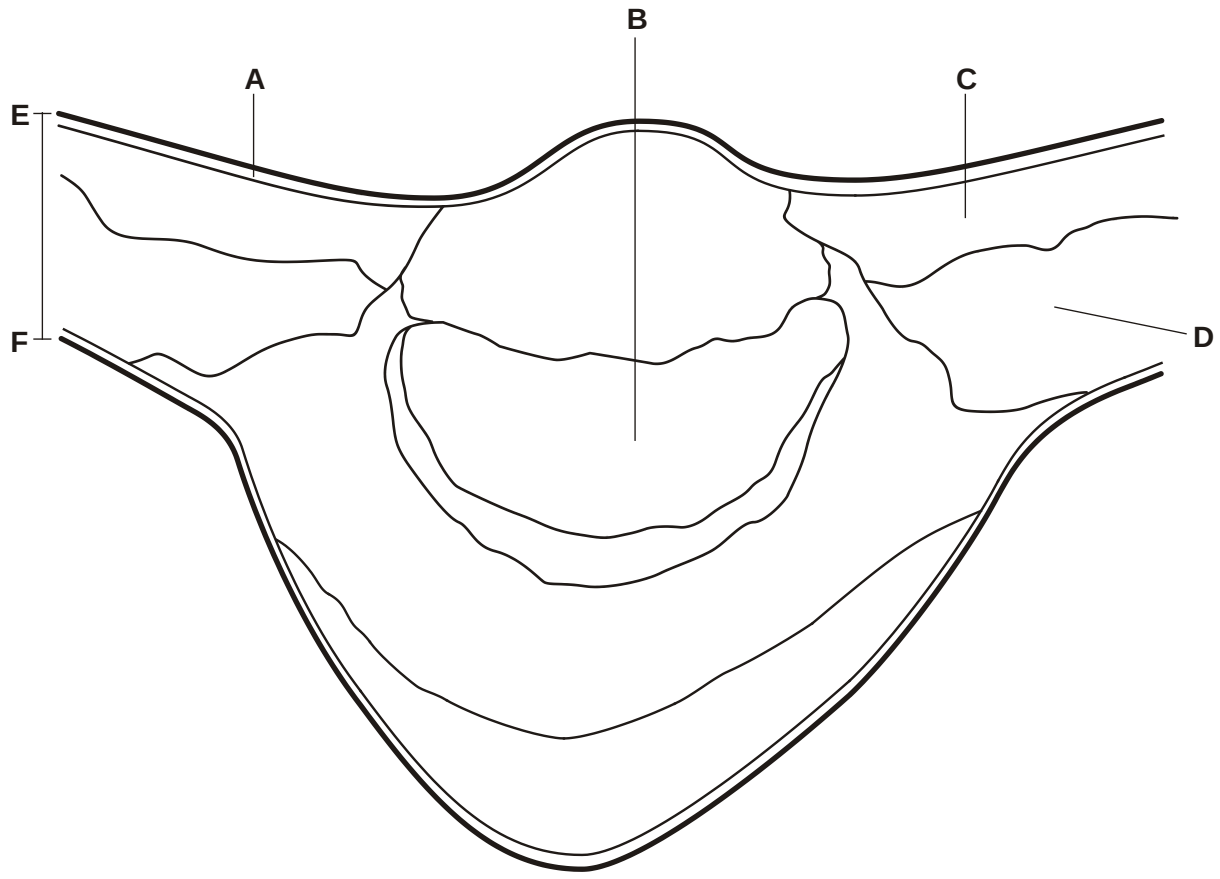
.....

.....

[1]

[Total 5 marks]

137. Below is a plan diagram of tissues in a transverse section of a dicotyledonous leaf.



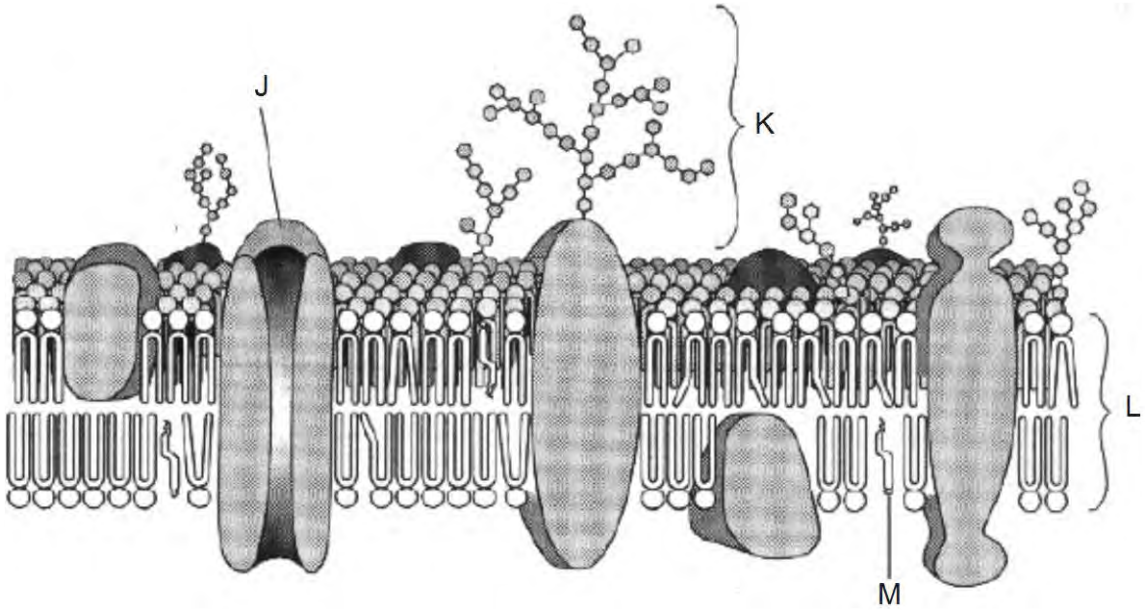
The actual thickness of the leaf along the line **EF** is 0.6 mm.

Calculate the magnification of the diagram. Show your working.

Magnification = × .....

[Total 2 marks]

138. The diagram below represents the structure of the plasma (cell surface) membrane.



(i) State one function of the parts labelled J to M.

J .....

.....

K .....

.....

L .....

.....

M .....

.....

[4]

(ii) Circle the most appropriate measurement for the actual width of this membrane.

0.07 μm 7 nm 0.0007 mm 7 μm

[1]

[Total 5 marks]

139. Endocytosis is one method by which substances enter cells.

Describe the process of endocytosis.

.....

.....

.....

.....

.....

.....

.....

.....

[Total 3 marks]

140. Some single-celled organisms live in estuaries where the concentration of salt changes regularly.

Explain, **in terms of water potential**, the problem faced by these organisms.

.....

.....

.....

.....

[Total 2 marks]

141. Read the following passage carefully, then answer the questions below.

Rhizobium is a bacterium that is closely associated with the roots of certain plants known as legumes. These plants produce chemicals to attract the bacteria and extra root hairs are produced. The bacteria attach to the surface of the root hairs. Chemical links are formed between a complex polysaccharide on the bacterial surface and lectin, a protein, formed by the plants. The bacteria penetrate the cell walls of the root hairs and enter the cells. The presence of the bacteria stimulates the cells of the root to divide, forming swellings known as nodules.

The bacteria produce an enzyme, nitrogenase, that is the catalyst for the conversion of nitrogen gas to ammonia. The bacteria use carbon compounds manufactured by the plant to respire, making energy available for this conversion. The ammonia is then used to form amino acids. Nitrogenase only functions in low oxygen concentrations. The root cells produce a pigment, leghaemoglobin, that is very similar to haemoglobin. Leghaemoglobin absorbs oxygen, leaving low concentrations in the nodules.

(i) *Rhizobium* is a prokaryotic organism.

State **one** characteristic that is typical of prokaryotes, but not of eukaryotes.

.....

.....

[1]

(ii) Lectin (line 5) and polysaccharides are compounds that are formed from small molecules joined together by chemical bonds.

Explain how the small molecules are joined together to form these compounds.

.....

.....

.....

.....

[3]

(iii) Leghaemoglobin contains the same metal element as haemoglobin.

Name this metal element.

.....

[1]

(iv) State the names of **two** proteins, **other than lectin**, mentioned in the passage.

1 .....

2 .....

[2]

(v) Name the process that occurs in *Rhizobium* to convert nitrogen gas into ammonia.

.....

[1]

(vi) It has been suggested that oxygen is an inhibitor of nitrogenase.

Explain **one** way in which oxygen could act as an inhibitor.

.....

.....

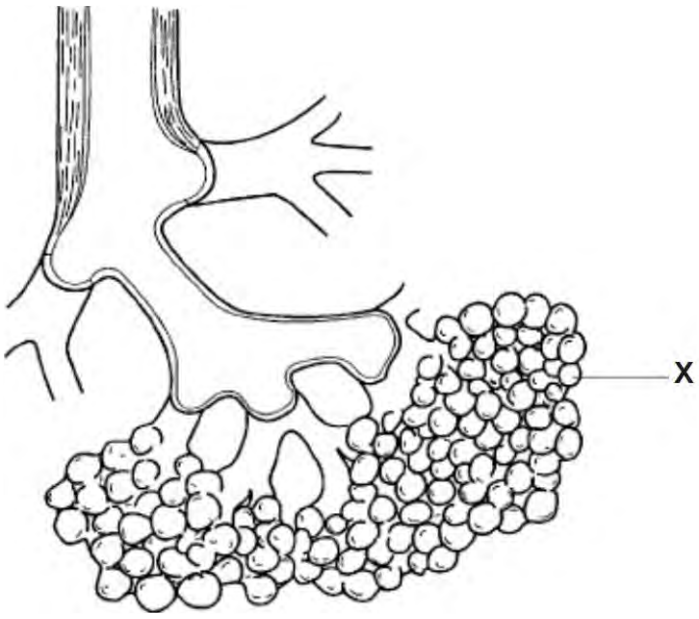
.....

.....

[2]

[Total 10 marks]

142. 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.

.....

.....

.....

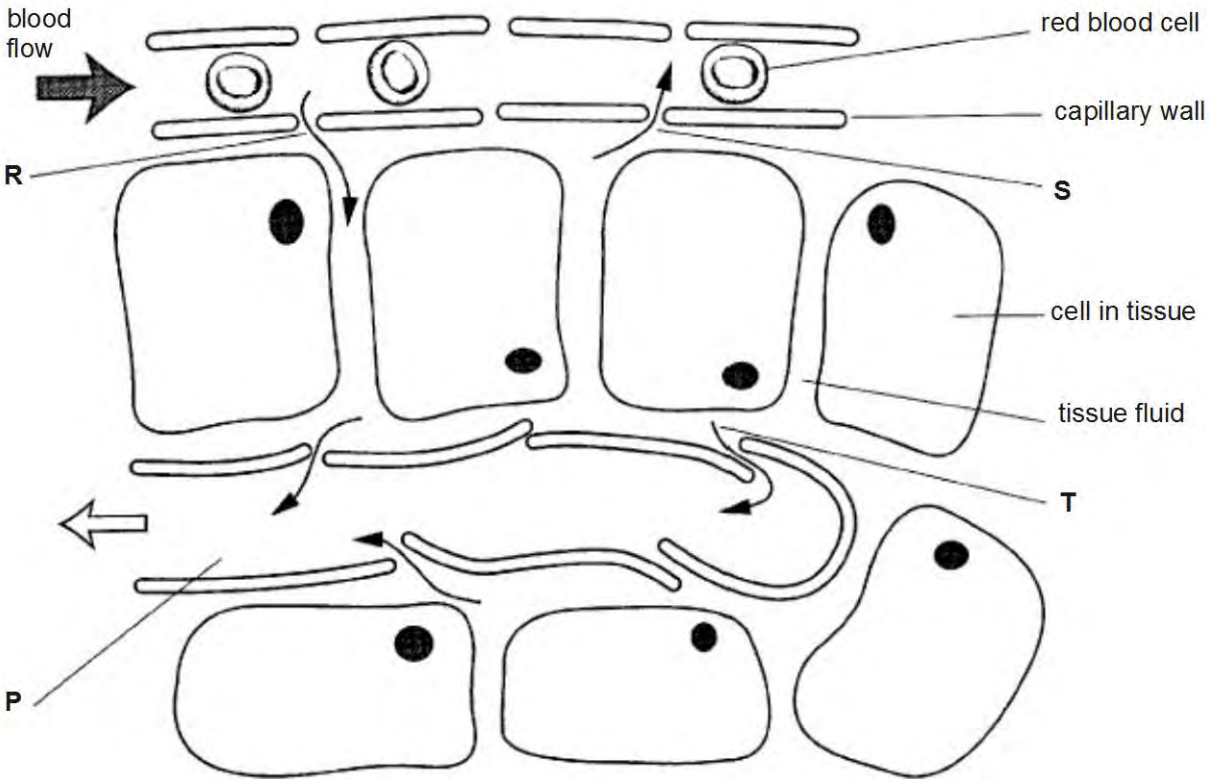
.....

.....

[2]

[Total 6 marks]

143. The diagram below shows the formation and drainage of tissue fluid in a mammal.



(a) (i) Complete the table to give **three** differences between tissue fluid and blood.

tissue fluid	blood

[3]

(ii) Name the type of vessel labelled **P** in the diagram.

.....

[1]

(b) In this question, one mark is available for the quality of written communication.

Describe how tissue fluid is **formed** at **R** and **drained** at **S** and **T**.

Credit will be given if you use information from the diagram.

[6]

Quality of Written Communication [1]

(c) Suggest what could happen in the tissues of a person if the drainage at S and T was inefficient.

.....

.....

.....

.....

[2]

[Total 13 marks]

144. Fig. 1 shows the distribution of some of the tissues in a transverse section of a plant organ. Fig. 2 is a photograph showing details of two cells, **D** and **E**, from one of the tissues.

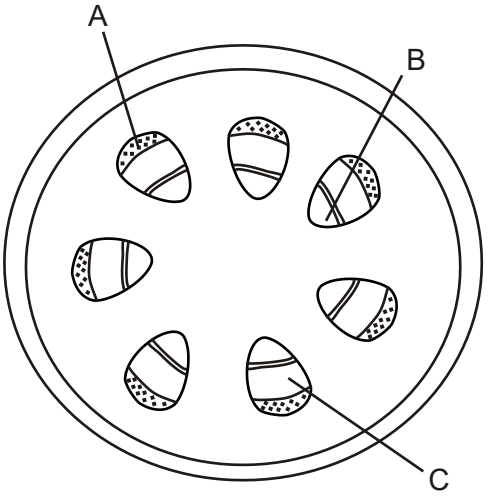


Fig. 1

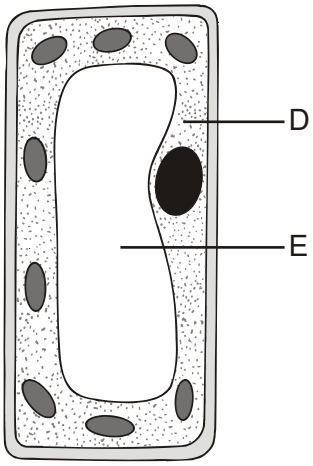


Fig. 2

(a) Name the plant organ shown in Fig. 1

.....

[1]

(b) Name the tissue shown in Fig. 2.

.....

[1]

(c) State in which region, **A** to **C** of Fig. 1, you would expect to find the tissue shown in Fig. 2.

.....

[1]

(d) Complete the table below by:

- **stating three** features or properties of cells **D** or **E** in Fig. 2 which adapt them to their function;
- **explaining** how the features or properties you have given help the tissue to carry out its function.

Make it clear in your answer which cell, **D** or **E**, you are describing for each feature you give.

feature or property	how the feature or property helps the tissue to carry out its function

[6]

[Total 9 marks]

145. The photograph below shows some plants growing in desert conditions. Such plants are known as xerophytes.

Suggest how each of the following features of xerophytic plants helps them to survive in their habitat.

(a) The stomata are shut during the day and open at night.

.....

.....

.....

(b) The leaves of some plants are reduced to spines or needles.

.....

.....

.....

(c) The epidermis may be covered by hairs.

.....

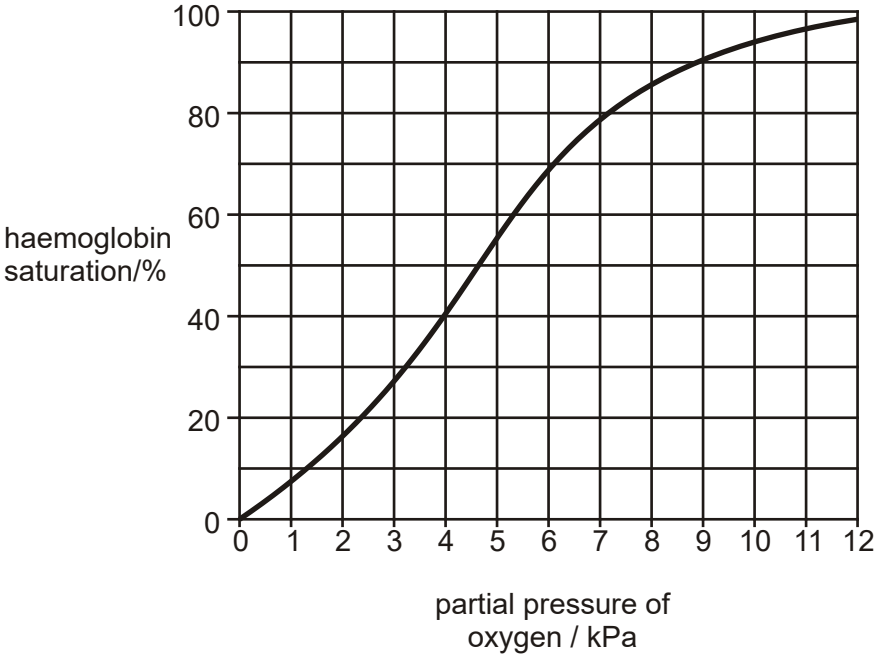
.....

.....

[Total 6 marks]

146. Haemoglobin is a pigment which can combine with oxygen and is found in red blood cells.

The graph below shows the sigmoid (S-shaped) dissociation curve for maternal haemoglobin.



Data from *'Exchange and Transport',* Fig. 158, p.85, by ABAL.
Published by Cambridge University Press, 1984 (ISBN 0 521 2882 3).

(i) Using the graph, state the likely partial pressure of oxygen in the pulmonary vein leaving the lungs and in a vein leaving a muscle during strenuous exercise.

pulmonary vein ..... kPa

vein leaving a muscle during strenuous exercise ..... kPa

[2]

(ii) On the graph, sketch the curve for fetal haemoglobin.

[2]

(iii) Using the graph, explain why it is important that fetal haemoglobin and maternal haemoglobin are different.

.....

.....

.....

.....

.....

[3]

[Total 7 marks]

147. Buffers are substances that regulate pH by releasing or accepting hydrogen ions (H^+). Haemoglobin acts as a buffer in the blood.

(i) Describe how the production of carbon dioxide during respiration leads to a higher concentration of hydrogen ions in the blood.

.....

.....

.....

.....

.....

.....

.....

(ii) Describe how haemoglobin acts to reduce the concentration of hydrogen ions in the blood.

.....

.....

.....

.....

[Total 4 marks]

148. State the word or phrase that best describes a structure made up of different types of tissue working together to perform a particular function.

.....

[Total 1 mark]

149. State the word or phrase that best describes the ability of a microscope to distinguish between two separate points.

.....

[Total 1 mark]

150. (a) Describe the role of mitosis.

.....

.....

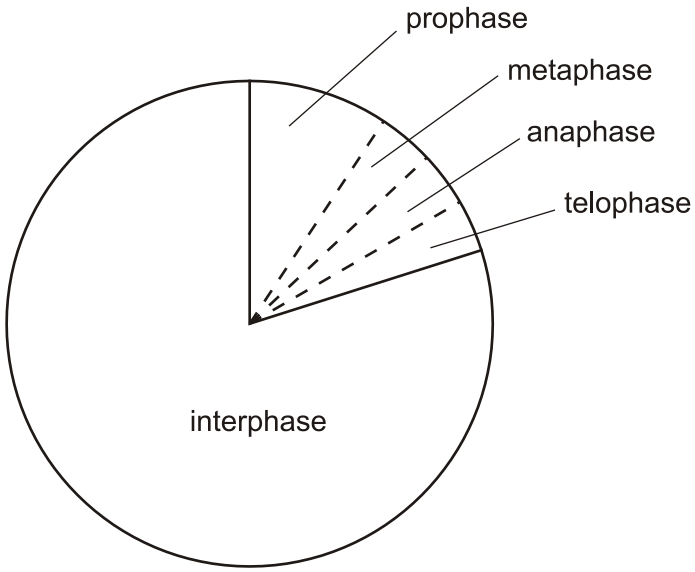
.....

.....

.....

[3]

Below is a diagram that shows the stages of the mitotic cell cycle.



(b) (i) Which processes must occur in a cell during interphase before mitosis can take place?

.....

.....

.....

.....

.....

[3]

(ii) Draw an arrow on the diagram to indicate the sequence in which the stages occur during the mitotic cell cycle.

[1]

(c) Name the stage of mitosis shown in the diagram in which each of the following events occurs.

(i) Chromosomes split at centromeres.

.....

[1]

(ii) Chromosomes become visible.

.....

[1]

(iii) Nuclear envelope re-forms.

.....

[1]

(iv) Chromatids move to opposite poles of the cell.

.....

[1]

(v) Chromosomes line up along the equator of the spindle.

.....

[1]

[Total 12 marks]

151. The following table compares some of the features of prokaryotic cells and eukaryotic **animal** cells.

Complete the table by placing a tick (✓) or a cross (✗) in each box. The first one has been done for you.

	prokaryotic cells	eukaryotic **animal** cells
DNA present	✓	✓
nuclear envelope (membrane) present		
cell wall present		
plasmids present in cytoplasm		
naked DNA present		

[Total 4 marks]

152. In this question, one mark is available for the quality of written communication.

Plant cells are also eukaryotic.

Outline the function(s) of each part of a **plant** cell.

(Allow one and a half lined pages).

[9]

Quality of Written Communication [1]

[Total 10 marks]

153. Red blood cells of mammals respond to changes in the concentration of salts in the fluid that surrounds them. If they are placed in a solution that has a lower concentration of salts than blood plasma, they swell and may burst. This bursting is known as haemolysis.

Explain why red blood cells may burst when they are placed in a solution that has a lower concentration of salts than blood plasma.

.....

.....

.....

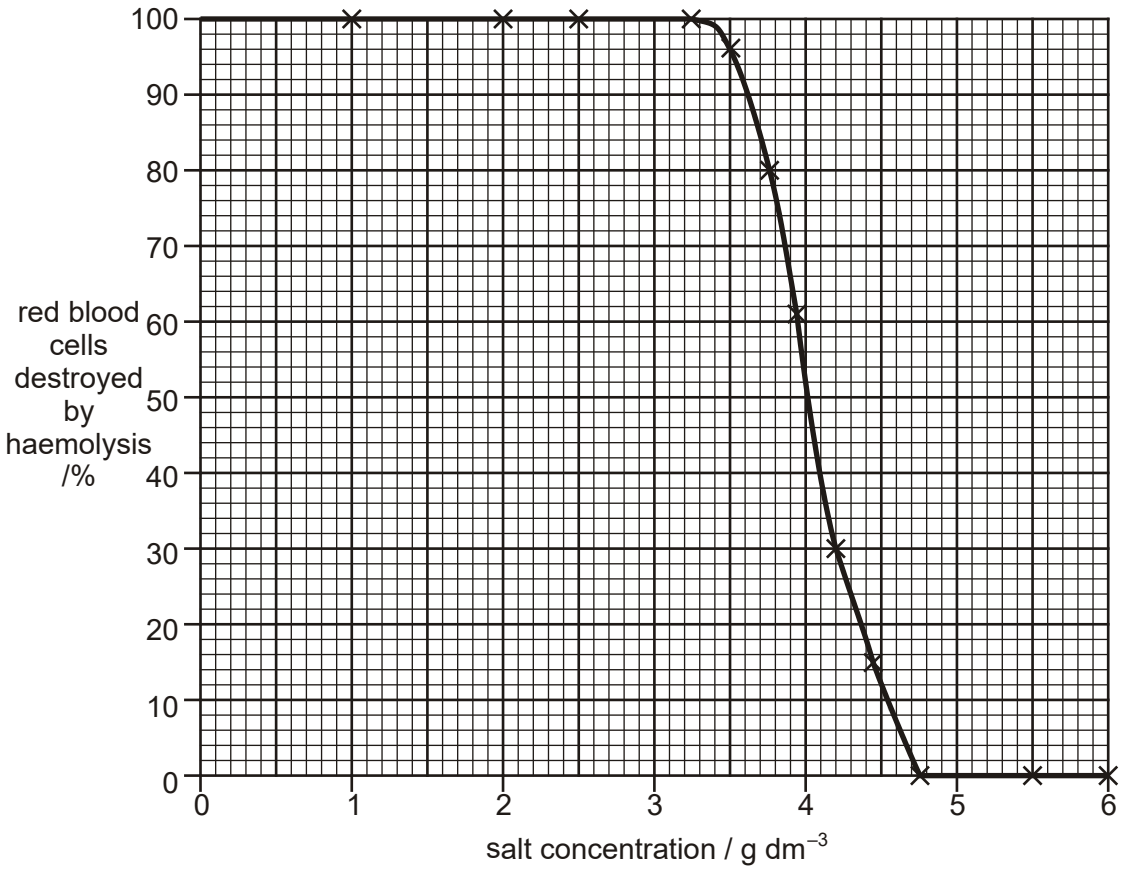
.....

.....

.....

[Total 3 marks]

154. An experiment was carried out in which red blood cells were placed in salt solutions of different concentrations. The percentage of cells which were destroyed by haemolysis was recorded. The results are shown in the graph below.



The graph shows that the red blood cells do not all haemolyse at the same salt concentration.

(i) Using the graph above, state the salt concentration at which the percentage of haemolysed red blood cells is equal to those that are not haemolysed.

..... g dm^{-3}

[1]

(ii) Suggest why different red blood cells haemolyse at different salt concentrations.

.....

.....

[1]

[Total 2 marks]

155. An experiment was carried out to investigate the uptake of potassium ions by carrot tissue. The experiment was carried out as follows:

- a carrot was cut into discs of uniform size
- the discs were divided into four groups
- equal volumes of a solution containing potassium ions were added.

The temperature remained constant at 21 °C and the experiment was carried out for the same length of time in each case. The experiment was carried out in different oxygen concentrations. The results are shown in the table below.

oxygen concentration / arbitrary units	0	4	11	20
rate of uptake of potassium ions/ arbitrary units	7	27	92	100

(i) Using the information given in the table, state the **main** process by which potassium ions enter the carrot cells.

.....

[1]

(ii) Give a reason for your answer to (i).

.....

.....

.....

[1]

(iii) Suggest an explanation for the uptake of potassium ions in the absence of oxygen.

.....

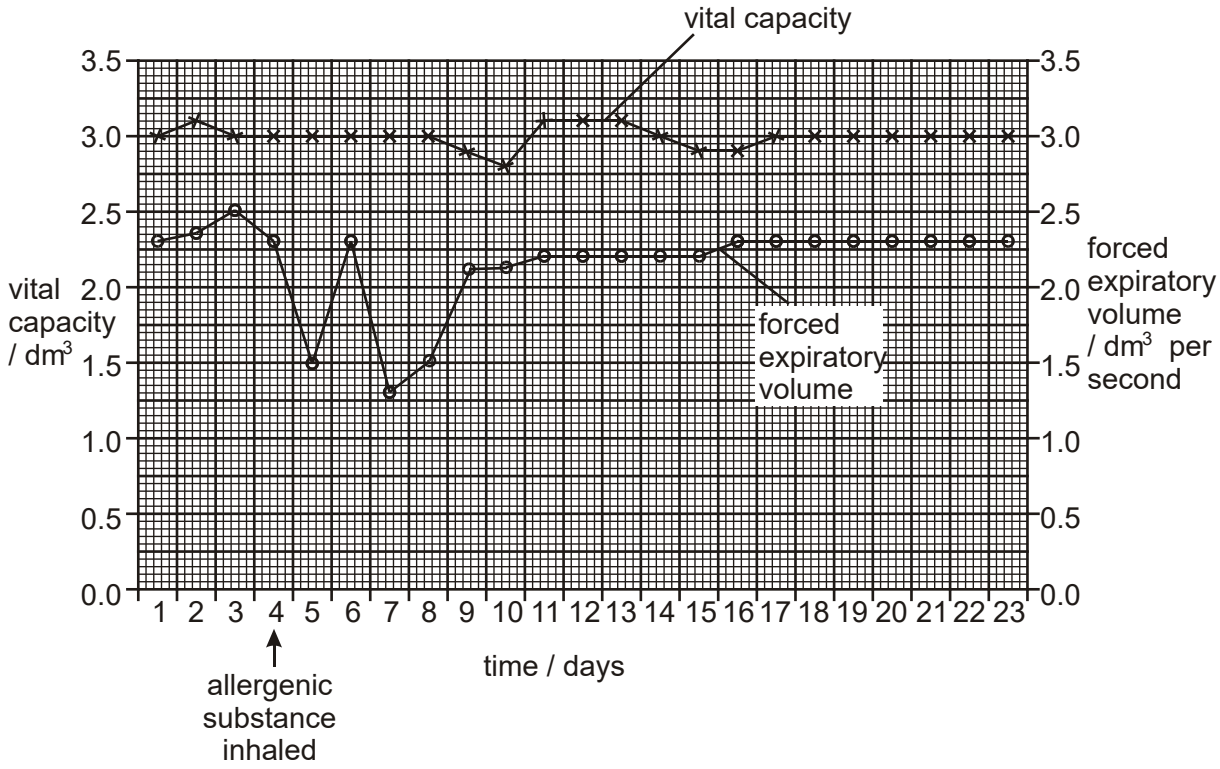
.....

[1]

[Total 3 marks]

156. 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 .....

.....

.....

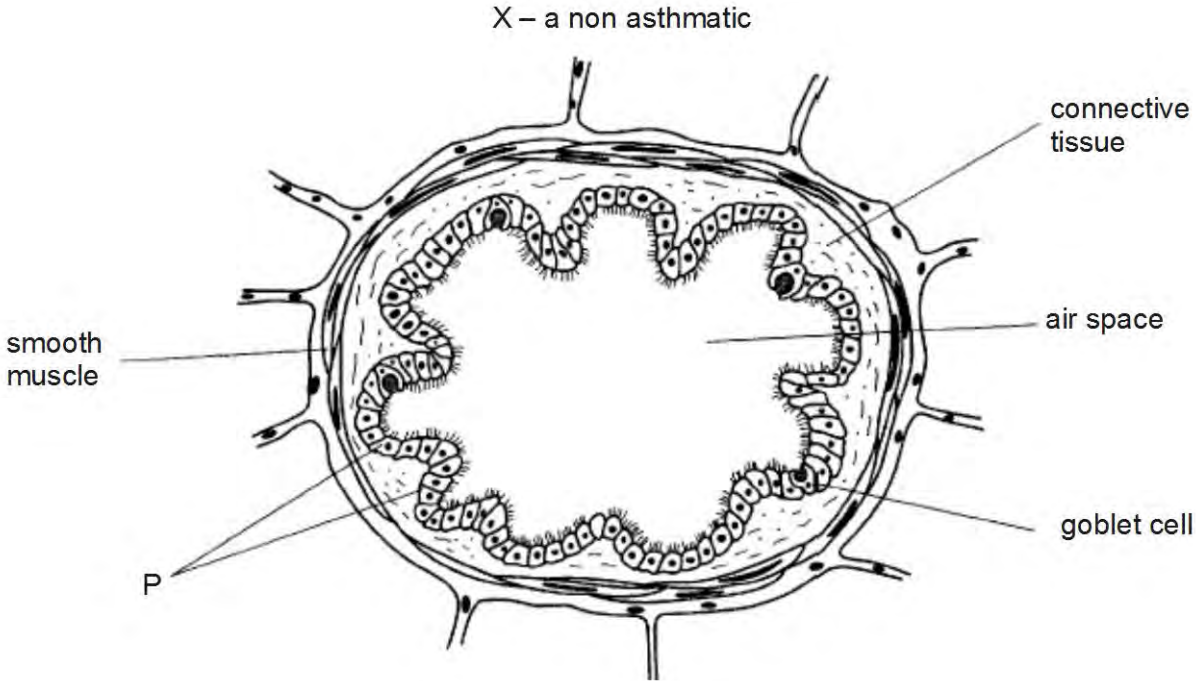
.....

[3]

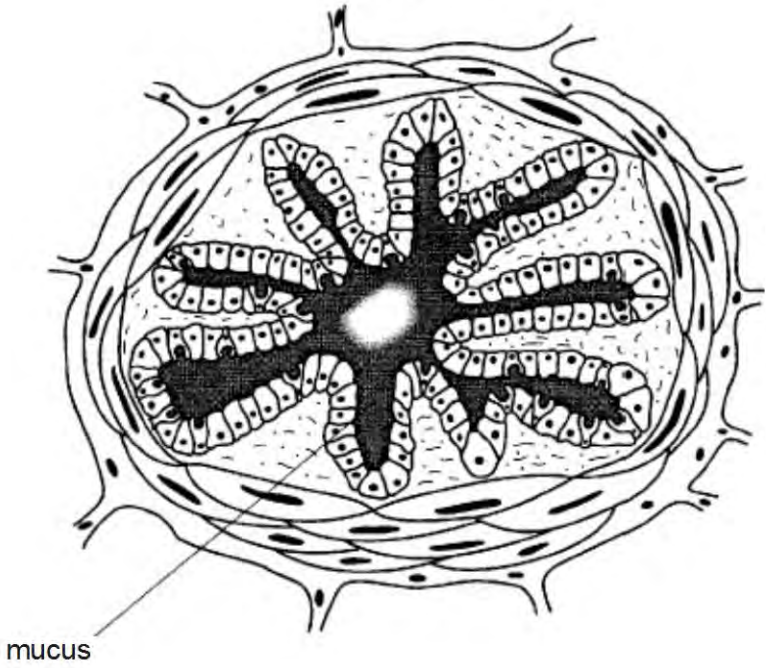
[Total 5 marks]

157. 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.



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.

.....

.....

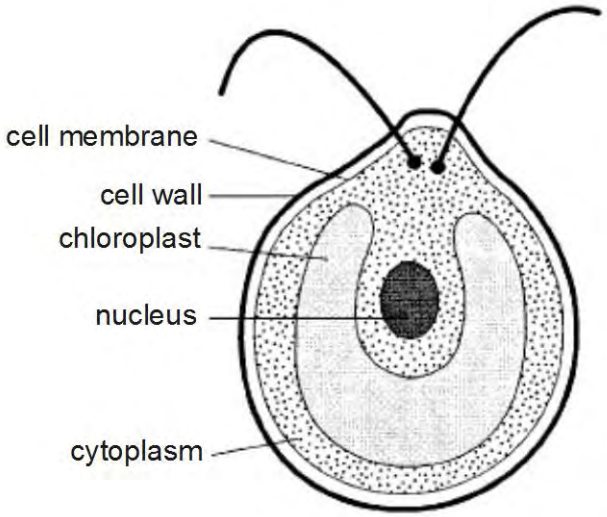
.....

.....

[3]

[Total 6 marks]

158. 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.

.....

.....

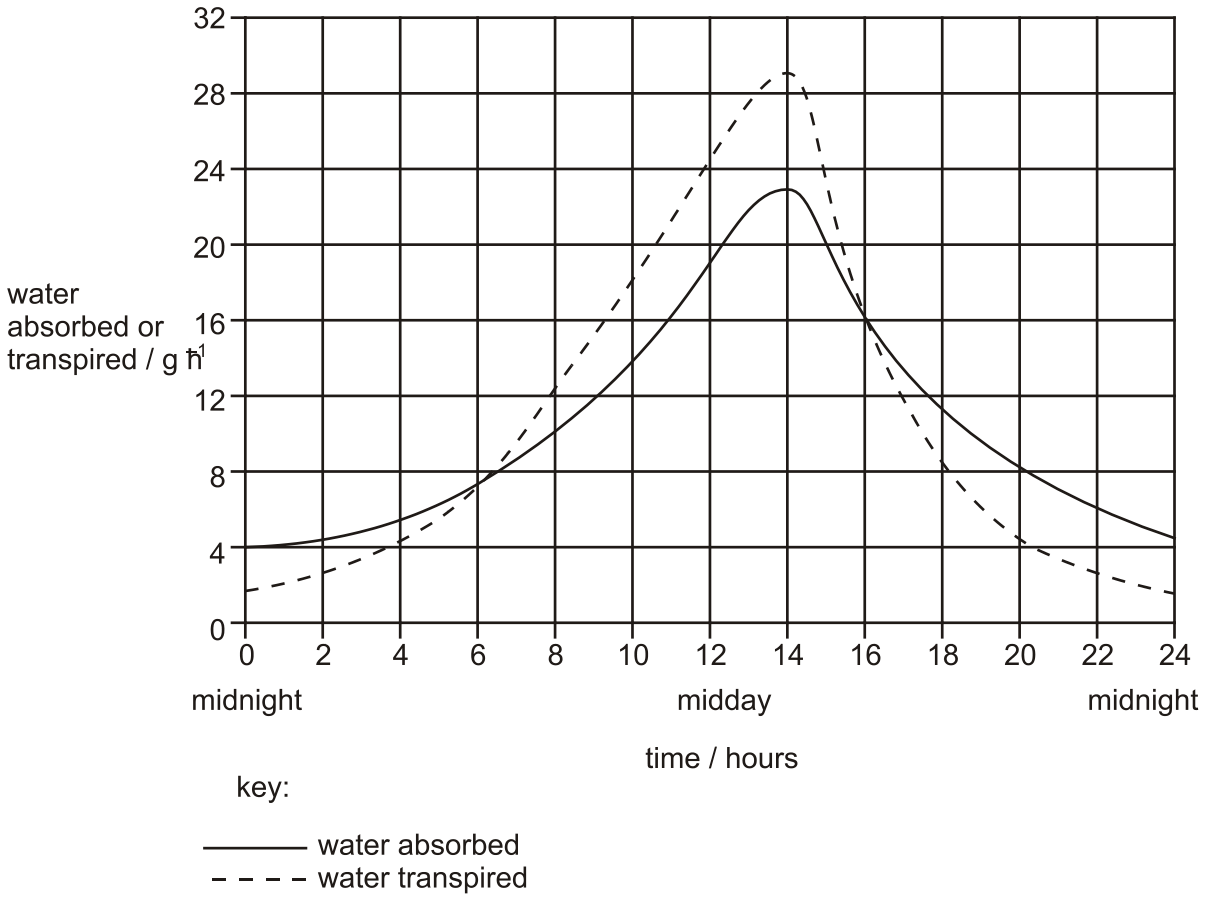
.....

.....

[3]

[Total 7 marks]

159. The graph below shows the results of an investigation to compare rates of transpiration and water absorption by a plant during a hot day in summer. There was no shortage of soil water available to the plant throughout the investigation, which was carried out over 24 hours starting at midnight.



(i) Define the term *transpiration.*

.....

.....

.....

.....

[2]

(ii) Using the graph above, describe how the rate of transpiration varied over the 24 hour period **and** compare it with the rate of water absorption.

.....

.....

.....

.....

.....

.....

.....

[4]

(iii) Calculate the percentage of the 24 hour day in which the rate of water absorption exceeds the rate of transpiration.

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

Answer ..... %

[2]

[Total 8 marks]

160. Explain how transpiration results in the movement of water up a plant stem.

.....

.....

.....

.....

.....

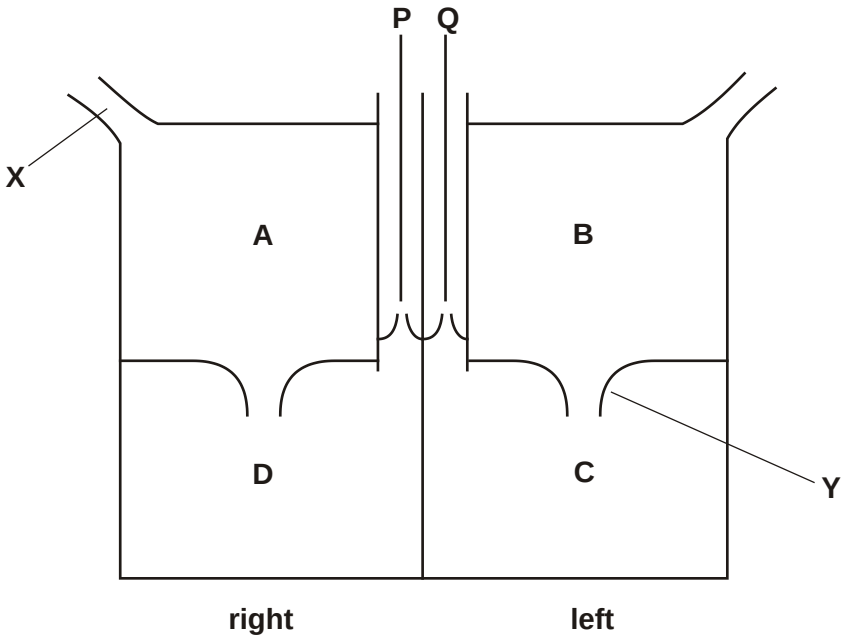
.....

.....

.....

[Total 4 marks]

161. Below is a simple diagram of a mammalian heart and associated blood vessels as seen in front (ventral) view.



(a) (i) Draw arrows on the diagram to show the direction of blood flow through the **left** side of the heart.

[1]

(ii) State the name of vessel **X** and valve **Y**.

vessel **X** .....

valve **Y** .....

[2]

(iii) Explain why there are valves at **P** and **Q**.

.....

.....

.....

.....

.....

[2]

(b) The maximum thickness of the **external** wall of each of the four chambers was measured. The measurements made are shown below.

2 mm 9 mm 16mm 2 mm

(i) From the list of measurements, select the one most likely to correspond to each of the chambers, A, C and D. Write your answers in the table.

chamber	thickness/mm
A	
C	
D	

[3]

(ii) Explain the differences in the wall thickness of chambers **A**, **C** and **D**.

.....

.....

.....

.....

.....

.....

.....

[3]

(c) In this question, one mark is available for the quality of written communication.

Describe how the heart beat is initiated **and** how the contractions of the four chambers are coordinated.

(Allow one and a half lined pages).

[6]

Quality of Written Communication [1]

[Total 18 marks]

162. Peru is a country in South America where people live at a wide range of altitudes. The table below shows:

- the partial pressure of oxygen in the atmosphere at sea level
- the partial pressure of oxygen in the atmosphere at 4 500 m
- the red blood cell count of an adult living at sea level
- the red blood cell count of another adult, born at sea level, but who has lived at 4 500 m for many years.

altitude	partial pressure of atmospheric oxygen/kPa	red blood cell count/ cells mm^{-3}
sea level	21	5.0×10^6
4 500 m	15	6.4×10^6

(i) Explain what is meant by partial pressure of oxygen, using the figures in the table to help you.

.....

.....

.....

.....

.....

[2]

(ii) Describe what would be likely to happen to people who move to high altitude if their red blood cell counts did **not** increase.

.....

.....

.....

.....

.....

.....

.....

.....

.....

[4]

[Total 6 marks]

163. The synthesis of red blood cells is stimulated by the hormone erythropoetin (EPO) which is secreted by the kidneys. Some long distance athletes have been known to take a course of EPO as part of a training programme.

Suggest why some athletes have taken erythropoetin.

.....

.....

.....

.....

.....

[Total 2 marks]