Question: 1

Fig. 4.1 shows diagrams of two different types of cells, X and Y.

The cells are not drawn to scale.

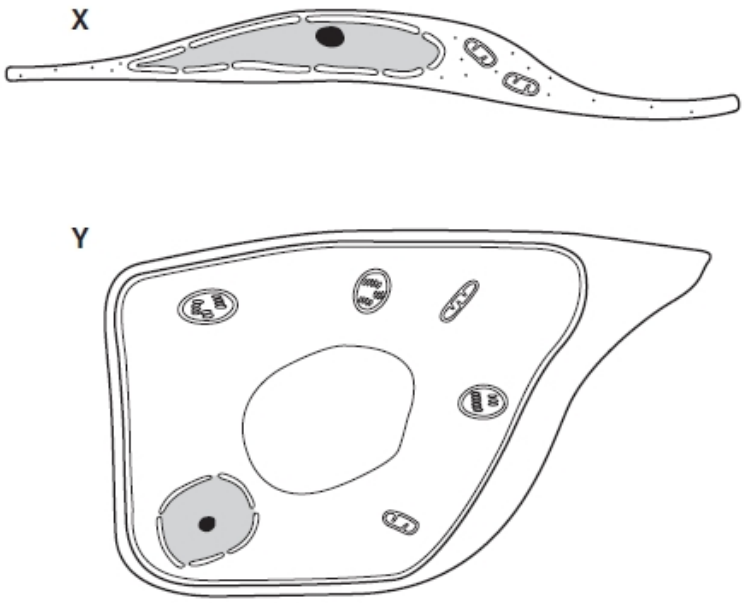


Fig. 4.1

(a) (i) State, using only the information in Fig. 4.1, two differences between plant cells and animal cells.

1 .....

_____

_____

_____

_____

_____

2 .....

_____

_____

_____

_____

_____

[2]

(ii) Cell Y is a guard cell.

State, using only the information in Fig. 4.1, one adaptation of this cell and explain how the adaptation allows the cell to carry out its function.

adaptation .....

_____

_____

_____

_____

_____

explanation .....

_____

_____

_____

_____

_____

[2]

(b) Fig. 4.2 shows drawings of the six chromosomes inside an animal cell viewed during late prophase of mitosis.

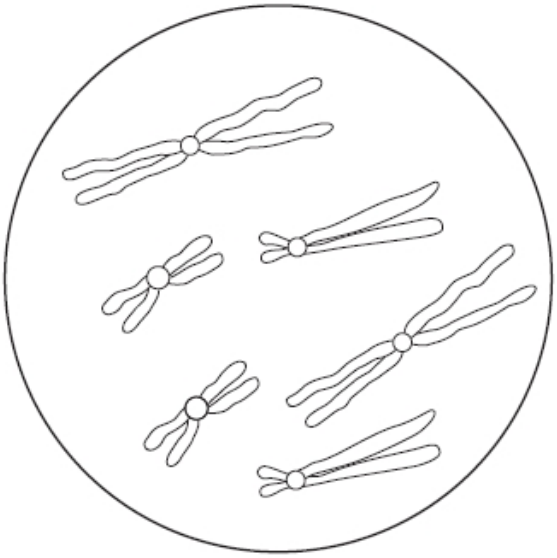


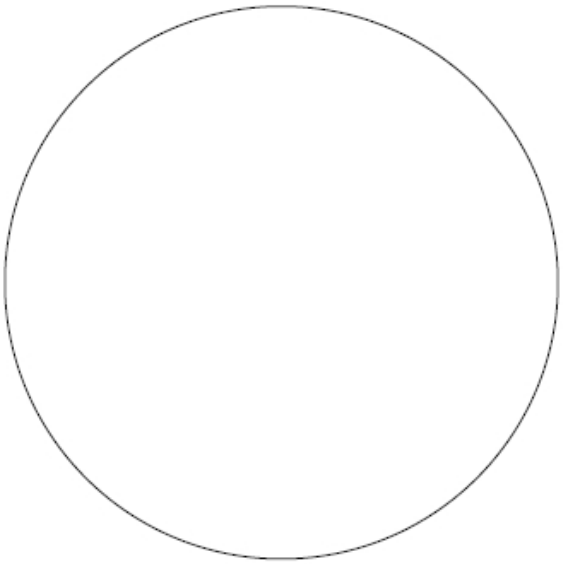
Fig. 4.2

(i) Identify one pair of *homologous chromosomes* in Fig. 4.2 by drawing around each chromosome in the pair on the diagram.

[1]

(ii) The nucleus of a sperm cell is produced by meiosis.

Draw a diagram in the space below to represent the chromosomes that are present in the nucleus of a sperm cell from the same animal.



[2]

[Total: 7]

Question: 2

(a) (i) Name the process by which water leaves a cell.

[1]

(ii) Describe the routes that water molecules take through the cell surface membrane.

[2]

A student carried out an investigation to determine the effects of different sucrose concentrations on cells from pieces of onion epidermis.

• Strips of epidermis were taken from an onion.

• Separate pieces of epidermis were placed into water and a range of sucrose solutions.

• The pieces of epidermis were left for 30 minutes before being removed.

• The pieces of epidermis were then viewed at high power under the microscope.

The student counted 100 cells from each piece of epidermis. The student noted how many cells had become plasmolysed.

The results are shown in Table 6.1.

Table 6.1

concentration of sucrose solution ($mol\,dm^{-3}$)	water potential of sucrose solution (kPa)	percentage of cells plasmolysed (%)
0.0	0	0
0.1	–260	0
0.3	–860	3
0.4	–1120	7
0.5	–1450	39
0.6	–1800	57
0.7	–2180	83
0.8	–2580	94
1.0	–3500	100

(b) None of the onion epidermis cells this student observed had burst when left in pure water.

Explain why plant cells do not burst when they are left in pure water.

[2]

(c) (i) The water potential of the onion epidermis cells can be assumed to be the same as the water potential of a solution that causes 50% plasmolysis.

Use the information in Table 6.1 to estimate the water potential inside these onion epidermis cells.

[1]

(ii) Suggest how the student could construct and use a graph to obtain a better estimate of the water potential.

[2]

(d) Suggest how the student could modify the procedure to make the results more reliable and accurate.

reliable

accurate

[4]
[Total: 12]

Question: 3

(a) Name the type of nuclear division that produces two genetically identical nuclei.

_____

_____

_____

_____

_____

[1]

(b) There are a number of stages during cell division.

The list, J to N, describes some processes that occur during the division of an animal cell.

J	the cell surface membrane is constricted
K	the nuclear envelope reforms
L	sister chromatids are pulled apart
M	the chromosomes condense
N	the chromosomes move to the equator

Match each letter, J to N, with a stage of cell division in the list below.

The first one has been completed for you.

prophase [M]

metaphase [ ]

anaphase [ ]

telophase [ ]

cytokinesis [ ]

[4]

(c) During interphase the genetic material is copied.

State two other processes that occur during interphase.

_____

_____

_____

_____

_____

[2]

(d) Suggest two ways that cell division in plants differs from cell division in animals.

_____

_____

_____

_____

_____

[2]
[Total: 9]

Question: 4

Fig. 2.1 shows a drawing of a part of the lung.

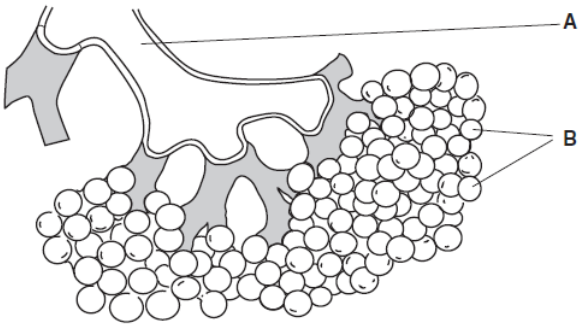


Fig. 2.1

(a) Name the structures labelled A and B.

A

B

[2]

(b) State two features of the structures labelled B that enable efficient gaseous exchange.

[2]

(c) As part of an allergic response, certain cells in the lungs release histamine.

Histamine is a cell signalling molecule that stimulates smooth muscle in the wall of structure A to contract.

Suggest how histamine stimulates smooth muscle contraction.

[2]

(d) Another action of histamine is to make capillary walls more permeable.

Suggest two effects this increased permeability may have on the surrounding tissues.

_____

_____

_____

_____

_____

[2]
[Total: 8]

Question: 5

Read the following passage and complete each sentence by writing the most appropriate term or phrase in the spaces provided.

Large, active organisms need a circulatory system because they have a small _____.

Haemoglobin is a pigment found in red blood cells. These cells are also known as _____ Haemoglobin has a high _____ for oxygen. In the lungs, the haemoglobin associates with oxygen to form _____.

In respiring tissues, the oxygen is released by dissociation. In very active tissues, the amount of oxygen released can be increased by the presence of more _____.

This is called the _____ effect.

[6]

[Total: 6]

Question: 6

The use of microscopy has greatly enhanced our knowledge of cell structure.

(a) Explain the difference between *magnification* and *resolution.*

[2]

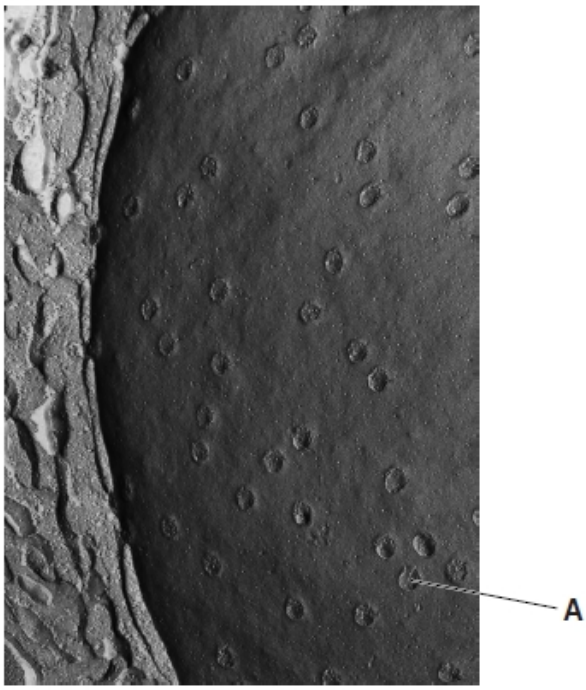
(b) State the resolution that can be achieved by each of the following types of microscope.

light microscope

transmission electron microscope

[2]

(c) Fig. 4.1 is an electron micrograph showing part of a nucleus.



x 25000

Fig. 4.1

(i) A student stated that Fig. 4.1 was taken using a scanning electron microscope.

What evidence supports the student's statement?

_____

_____

_____

_____

_____

[1]

(ii) On Fig. 4.1, the nuclear pore complex, labelled A, is 3 mm wide.

Calculate the actual diameter of the pore, in nanometres.

Answer

_____

_____

_____

_____

_____ nm

[2]

(iii) State the function of the nuclear pores.

_____

_____

_____

_____

[1]

(d) State two features of a eukaryotic cell, other than nuclear pores, that would not be visible using medium power of a light microscope.

[2]

[Total: 10]

Question: 7

(a) A student used a potometer to investigate the effect of light intensity on the rate of transpiration in a healthy leafy shoot.

The results obtained are shown in Table 5.1.

Table 5.1

light intensity in arbitrary units (a.u.)	rate of transpiration (mm min^{-1})			
	trial 1	trial 2	trial 3	mean
10	5.0	7.0	5.0	5.7
20	5.0	7.0	5.0	5.7
30	12.0	12.0	11.0	11.7
40	24.0	23.0	26.0	24.3
50	32.0	33.0	32.0	32.3

(i) Describe the trend shown in the mean rate of transpiration as light intensity increases from 20 to 50 a.u.

[2]

(ii) Suggest why the rate of transpiration did not change between light intensities 10 a.u. and 20 a.u.

[1]

(b) (i) Explain why transpiration is unavoidable during the day.

[3]

(ii) Fig. 5.1, on the insert, is a photograph of a transverse section of a leaf taken from a xerophyte.

Describe the xerophytic features of this leaf and explain how each feature reduces loss of water vapour.

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

_____

_____

_____

_____

_____

[5]

[Total: 11]

Question: 8

Fig. 1.1 shows an air sac and a capillary in the mammalian lung.

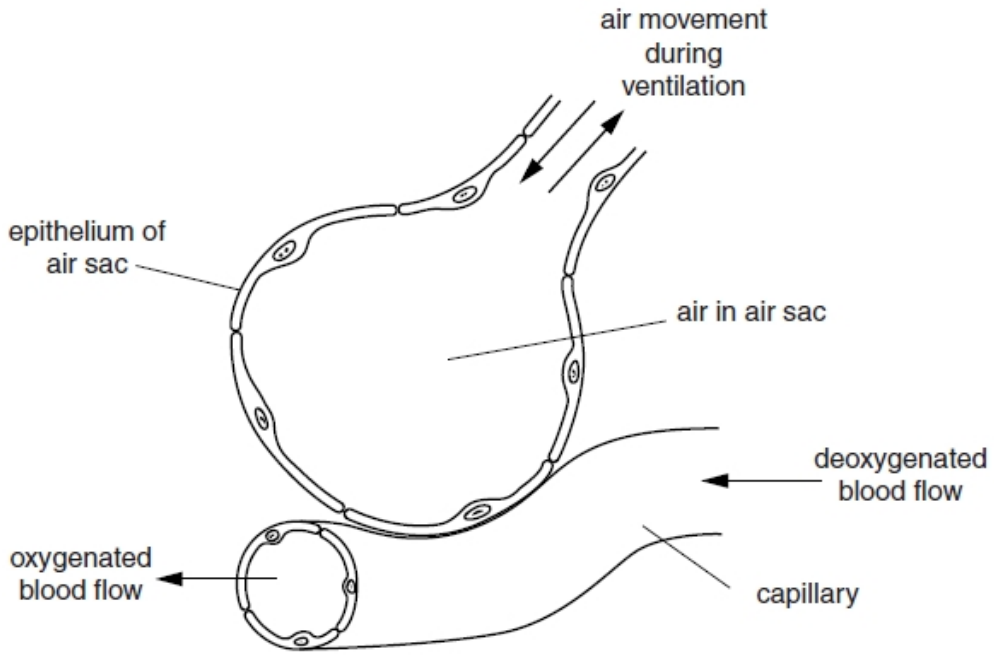


Fig. 1.1

(a) The mammalian lungs contain many air sacs.

(i) Name the air sacs and state why there are many air sacs in the lungs.

[2]

(ii) Name the type of epithelium in the walls of the air sacs.

[1]

(iii) The air sacs contain many elastic fibres.

Explain the role of these elastic fibres during ventilation.

[2]

(b) For efficient gaseous exchange to occur, a steep diffusion gradient must be maintained between the air in the air sacs and the blood.

A steep diffusion gradient can be maintained by ventilating the lungs. This refreshes the air in the air sacs.

(i) Explain how refreshing the air in the air sacs helps to maintain a steep diffusion gradient.

[2]

(ii) Describe and explain one other way in which a steep diffusion gradient is maintained in the lungs.

[2]

[Total: 9]

Question: 9

(a) Complete the following paragraph about cells by using the most appropriate term(s).

Cells that are not specialised but still have the ability to divide are called

[ ] cells. Such cells can be found in the

[ ] of the long bones of mammals. These cells can

[ ] into other types of cell, such as erythrocytes that carry

oxygen in the blood. In plants, [ ] tissue also contains cells that are not specialised.

[4]

(b) Sponges are simple eukaryotic multicellular organisms that live underwater on the surface of rocks.

Sponges have a cellular level of organisation. This means that they have no tissues.

Each cell type is specialised to perform a particular function.

One type of cell found in a sponge is a collar cell. Collar cells are held in position on the inner surface of the body of the sponge.

Fig. 2.1 is a diagram showing a vertical section through the body of a sponge and an enlarged drawing of a collar cell.

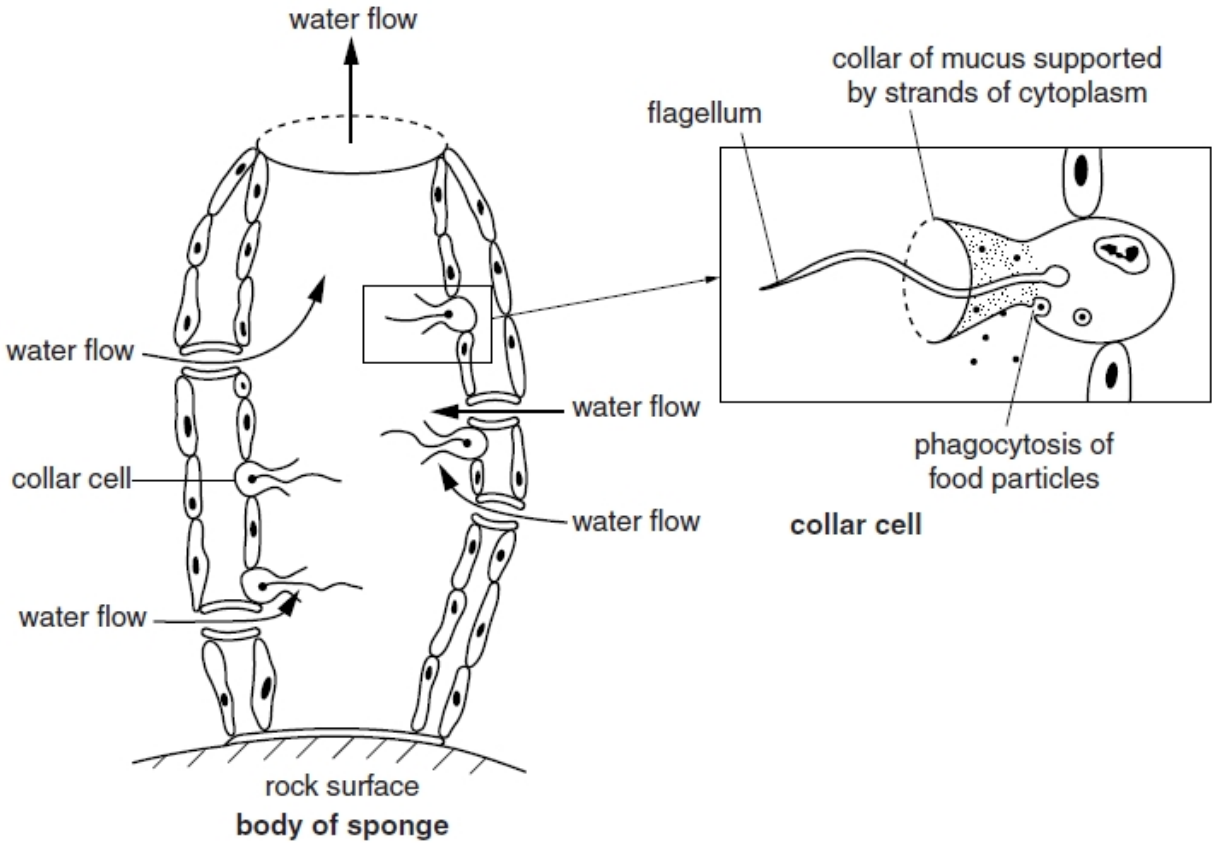


Fig. 2.1

(i) Suggest one function of the flagellum in the collar cell.

_____

_____

[1]

(ii) Suggest one possible role for the collar of mucus in the cell.

[1]

(c) In more advanced organisms, cells are organised into tissues consisting of one or more types of specialised cells.

Describe how cells are organised into tissues, using xylem and phloem as examples.

[4]

[Total: 10]

Question: 10

Three examples of fluids in the mammalian body are blood, tissue fluid and lymph.

(a) Complete Table 3.1 below comparing different features of arterial blood, tissue fluid and lymph.

Table 3.1

feature	arterial blood	tissue fluid	lymph
hydrostatic pressure		low	
presence of large proteins	yes		
presence of neutrophils	yes		
presence of erythrocytes			no

[4]

(b) In a closed circulatory system, blood is kept inside blood vessels.

(i) Suggest two advantages of keeping the blood inside vessels.

1

2

[2]

(ii) Describe and explain how the wall of an artery is adapted both to withstand and maintain high hydrostatic pressure.

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

to withstand pressure

to maintain pressure

[5]

[Total: 11]

Question: 11

Membranes are a fundamental part of the cell. They are found both at the surface of a cell and inside a cell.

(a) State three roles of membranes inside cells.

[3]

(b) Cells contain a large number of membrane-bound vesicles. Many of these vesicles transport substances between organelles.

(i) Outline how the vesicles are moved from one organelle to another.

[2]

(ii) The proteins embedded in the membranes of vesicles have different functions.

- COPI and COPII proteins are known as 'address proteins'
- Vesicles that transport materials from the Golgi to the rough endoplasmic reticulum (RER) are coated in COPI proteins.
- Vesicles that transport materials to the Golgi from the RER are coated in COPII proteins.

Suggest how these proteins ensure that a vesicle is transported to the correct target organelle.

[2]

(c) Cells in the pancreas secrete proteins such as the enzymes pancreatic amylase and protease.

Describe how these extracellular enzymes are secreted from the cells.

[2]

[Total: 9]

Question: 12

Fig. 4.1 shows a potometer, a piece of apparatus used for estimating the rate of transpiration.

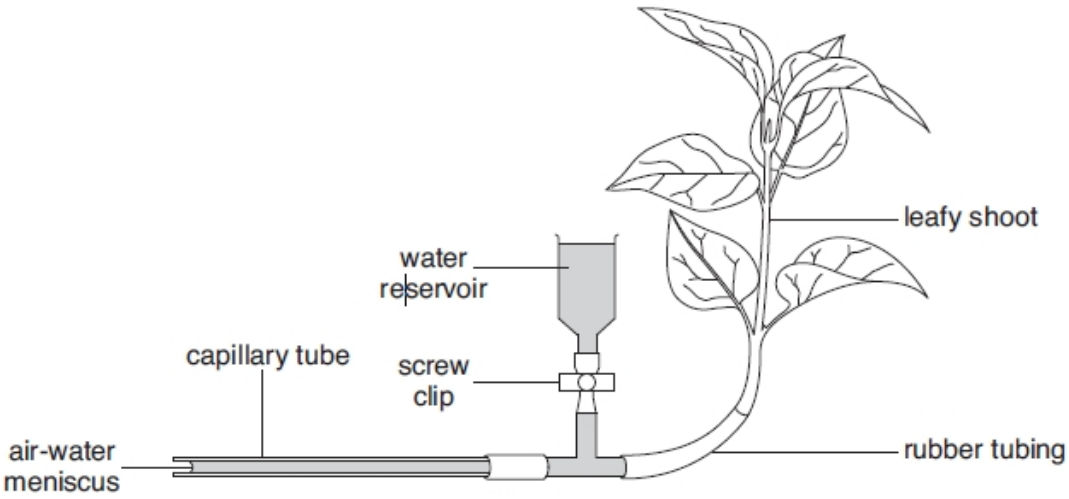


Fig. 4.1

(a) State one essential component of the apparatus, not shown in Fig. 4.1, 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 Fig. 4.1 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 Table 4.1.

Table 4.1

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]

Question: 13

(a) Fig. 4.1 is a diagram showing the position of the vascular bundles in a transverse section of the stem of a young dicotyledonous plant.

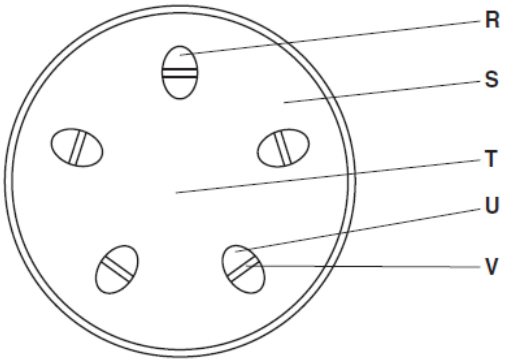


Fig. 4.1

Select the correct letter from Fig. 4.1 to identify each of the following tissues in the stem.

xylem

phloem

cambium

[3]

(b) Fig. 4.2, on the insert, shows the cut end of a stem from a woody plant. The other end of the stem is being heated in a fire. Steam can be seen coming from the vascular tissue at the cut end of the stem.

Describe the features of the xylem that enable the steam to pass from the heated end of the stem to the cut end.

[2]

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

[2]

(ii) Describe and explain how transpiration contributes to the mechanism of water transport up the stem.

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

(iii) Suggest why a bunch of flowers may survive longer if the ends of the stems are removed immediately before the flowers are placed in water.

[2]
[Total: 14]

Question: 14

(a) Fig. 5.1 is provided for you on the insert.

(i) State two features of the cell shown in Fig. 5.1 that indicate it is eukaryotic.

[2]

(ii) The line A–B on Fig. 5.1 represents 20 μm.

Calculate the magnification of the cell shown in Fig. 5.1.

Show your working.

Answer = ... x

[2]

(iii) Microtubules and microfilaments are part of the cytoskeleton.

Suggest two roles of the cytoskeleton in the type of cell shown in Fig. 5.1.

[2]

(b) The cells of a multicellular organism are usually specialised to perform a particular function.

(i) Name the process in which a cell becomes specialised.

_____

_____

_____

_____

_____

[1]

(ii) Neutrophils are phagocytic blood cells that can engulf and digest foreign cells found in the blood.

Describe how the ultrastructure of a neutrophil is specialised to enable it to perform this function.

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

_____

_____

_____

_____

_____

[4]
[Total: 11]

Question: 15

(a) Fig. 1.1 is a diagram of a bacterium as seen under an electron microscope.

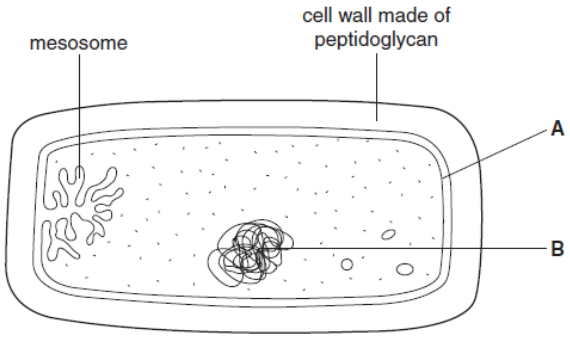


Fig.1.1

(i) Name the structures labelled A and B.

A

B

[2]

(ii) It has been suggested that the mesosome has the same role as mitochondria in eukaryotic cells.

Suggest the role of the mesosome in prokaryotic cells, such as bacteria.

[1]

(iii) Eukaryotic cells, such as *Euglena*, contain membrane-bound organelles. Each organelle has a specific function in the cell.

State the **process** that is carried out in each of the organelles listed below.

ribosome

_____

_____

_____

_____

_____

chloroplast

_____

_____

_____

_____

_____

[2]

(b) Explain why a single-celled organism, such as *Euglena*, does **not** need a specialised area to carry out gaseous exchange.

_____

_____

_____

_____

_____

[2]

(c) The mammalian gas exchange system contains a variety of types of cells and tissues.

Complete Table 1.1, stating the function of each of the cells and tissues. The first row has been completed for you.

Table 1.1

cell / tissue	function
squamous epithelium	to provide a thin surface for a short diffusion distance
elastic tissue	
ciliated epithelium	
goblet cells	
smooth muscle	

[4]
[Total: 11]

Question: 16

Fig. 2.1, on the insert, is a photomicrograph of a blood smear. The smear has been stained.

(a) State two reasons why the blood smear has been stained.

[2]

(b) Suggest one detail that would be made visible if the micrograph were taken using:

(i) a scanning electron microscope

(ii) a transmission electron microscope.

[2]

(c) The red colouration of the red blood cells is caused by the pigment haemoglobin. The main function of haemoglobin is to transport oxygen in the form of oxyhaemoglobin.

Fig. 2.2 shows the dissociation curves of adult oxyhaemoglobin (curve A) and fetal oxyhaemoglobin (curve F).

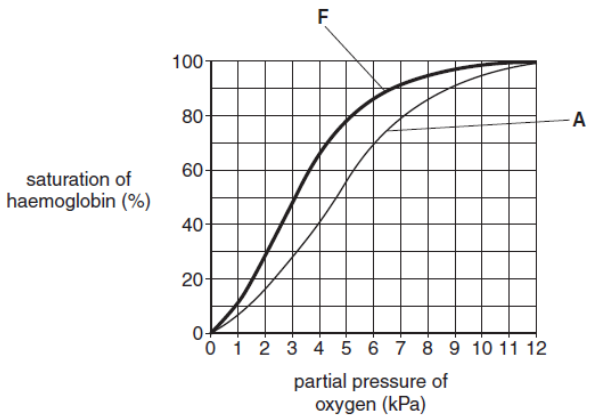


Fig. 2.2

Explain why the curve for fetal oxyhaemoglobin is to the left of the curve for adult oxyhaemoglobin.

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

[4]

(d) In high partial pressures of carbon dioxide, the oxyhaemoglobin dissociation curve undergoes a change known as the Bohr shift.

(i) Draw a curve on Fig. 2.2 to show the effect of the Bohr shift.

[2]

(ii) Outline the benefits of the Bohr shift to actively respiring tissue.

[2]
[Total: 12]

Question: 17

A student carried out an investigation involving uptake of the stain methylene blue by yeast cells.

The investigation involved adding methylene blue to a suspension of yeast cells. Samples of the stained yeast cells were heated to different temperatures.

The student then observed the cells at high power under a light microscope.

The results are shown in Table 3.1.

Table 3.1

temperature (°C)	cells observed stained blue (%)	colour of solution surrounding cells
10	98	colourless
20	96	colourless
30	97	colourless
40	96	colourless
50	73	colourless
60	12	light blue
70	2	blue
80	0	blue

(a) (i) Yeast cells take up methylene blue by active transport.

Using only the information provided in Table 3.1, outline the evidence that supports this statement.

[2]

(ii) Suggest why some cells did not stain blue at 20 °C.

[1]

(b) (i) Suggest one change that occurred to the plasma (cell surface) membranes of the yeast cells at temperatures above 60 °C.

[1]

(ii) Explain why the stained yeast cells lost their colour at higher temperatures.

[2]

(c) The student concluded that yeast cells are killed between 50 °C and 70 °C.

Suggest one way in which the student could have improved the accuracy of this experiment and one way in which he could have improved the reliability.

accuracy

reliability

[2]

(d) The student placed a small sample of the yeast suspension on a microscope slide and observed it under high power.

Fig. 3.1 shows what the student observed.

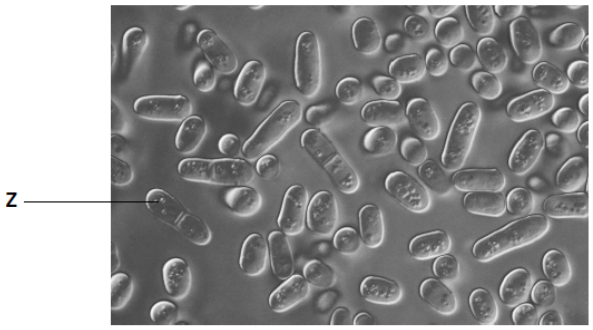


Fig. 3.1

Cell Z is undergoing a process called *budding*.

Outline the process of budding in yeast.

_____

_____

_____

_____

_____

[2]
[Total: 10]

Question: 18

Fig. 5.1 shows the possible pathways taken by water across the root of a plant.

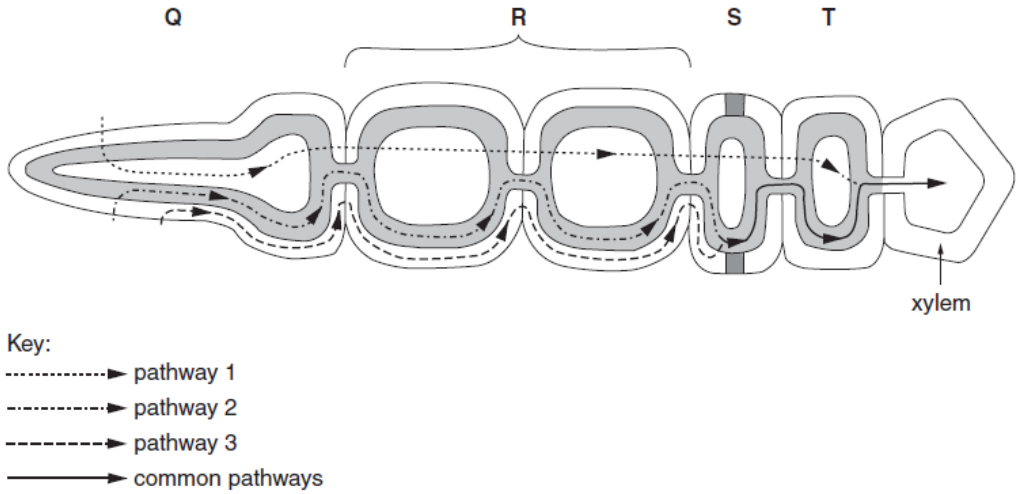


Fig. 5.1

(a) (i) Name the process by which water enters cell Q from the soil.

[1]

(ii) Pathway 1 is known as the vacuolar pathway, as the water passes into and through the cell vacuoles.

Name pathway 2 and pathway 3.

pathway 2

pathway 3

[2]

(iii) State which letter, Q, R, S or T, on Fig. 5.1, represents the endodermis.

[1]

(b) Describe and explain how water is moved up the xylem from the roots to the leaves.

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

[5]

(c) Table 5.1 shows a comparison of xylem vessels and phloem sieve tube elements.

Complete the table. The first row has been done for you.

Table 5.1

feature	xylem vessel	phloem sieve tube element
cells living or dead	dead	living
bordered pits present or absent		
lignin present or absent		
substances transported		
direction of transport		

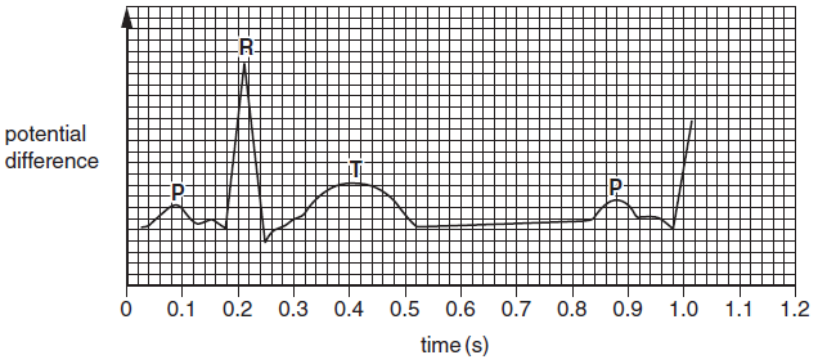
[4]
[Total: 13]

Question: 19

Fig. 6.1 shows two electrocardiogram (ECG) traces.

- Trace A is a normal trace.
- Trace B is a trace from a heart after treatment with the drug digitalis.

Trace **A** – an electrocardiogram from a normal heart



Trace **B** – an electrocardiogram from a heart after treatment with digitalis

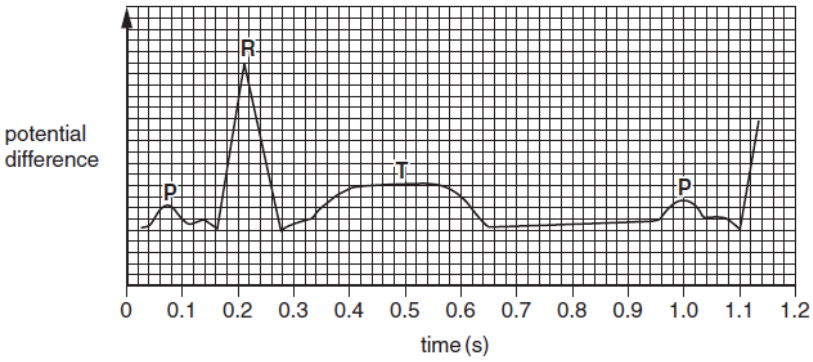


Fig. 6.1

(a) Calculate the heart rate using the information in Trace A.

Show your working.

Answer = ... beats per minute

[2]

(b) Using the information in Fig. 6.1, state two effects of digitalis on the activity of the heart.

1

2

[2]

(c) Describe the roles of the sinoatrial node (SAN) and the atrioventricular node (AVN) in coordinating the cardiac cycle.

[3]
[Total: 7]

Question: 20

Fig. 1.1 (a) is a diagram of a part of a mammalian lung.

Fig. 1.1 (b) is an enlargement of part of the lining of the bronchus.

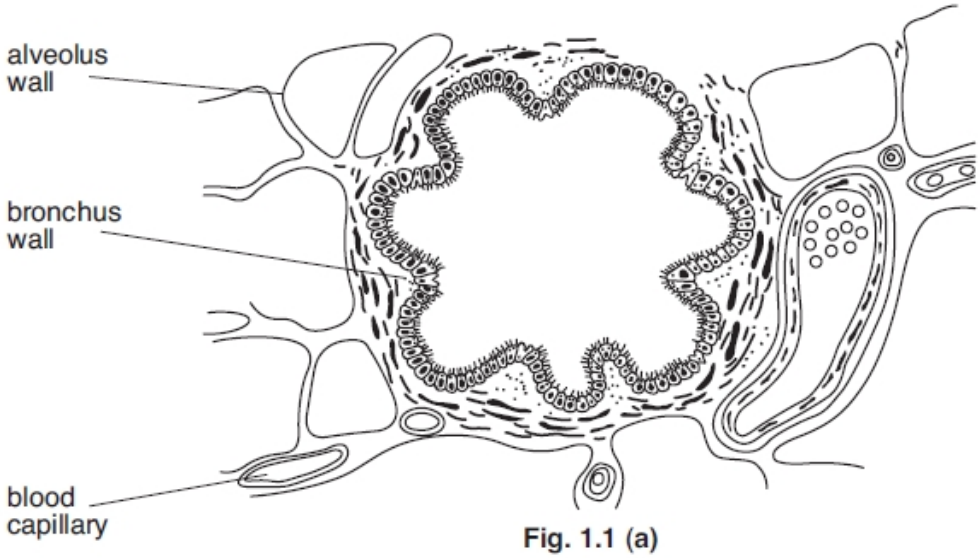


Fig. 1.1 (a)

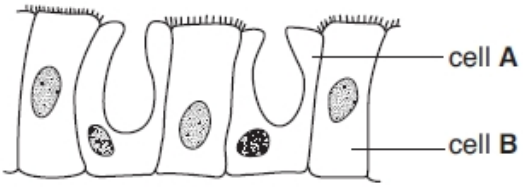


Fig. 1.1 (b)

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

A

_____

_____

_____

_____

_____

B

_____

_____

_____

_____

_____

[

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

[

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

State the function of the smooth muscle fibres.

[

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

[

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

State the function of these elastic fibres.

[

[Total:

Question: 21

(a) Table 4.1 compares the structures of prokaryotic and eukaryotic cells.

Complete the table.

Table 4.1

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

[4]

(b) 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: 7]

Question: 22

(a) Fig. 5.1, on the insert, shows some drawings of a cell during different stages of mitosis.

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

The first stage has been identified for you.

S

[4]

(b) Mitosis is part of the cell cycle.

Fig. 5.2 shows a diagram of the cell cycle.

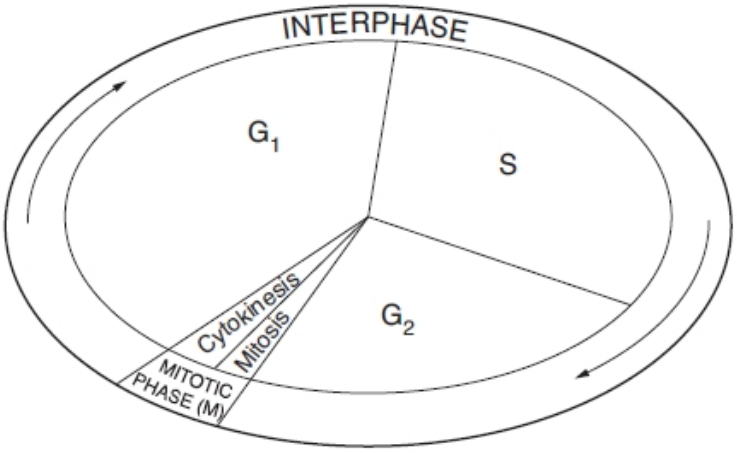


Fig. 5.2

(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]

(c) During meiosis a cell undergoes two divisions.

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

[2]

[Total: 9]

Question: 23

(a) (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]

(b) Fig. 6.1 shows the changes in pressure inside the heart chambers during one heart beat.

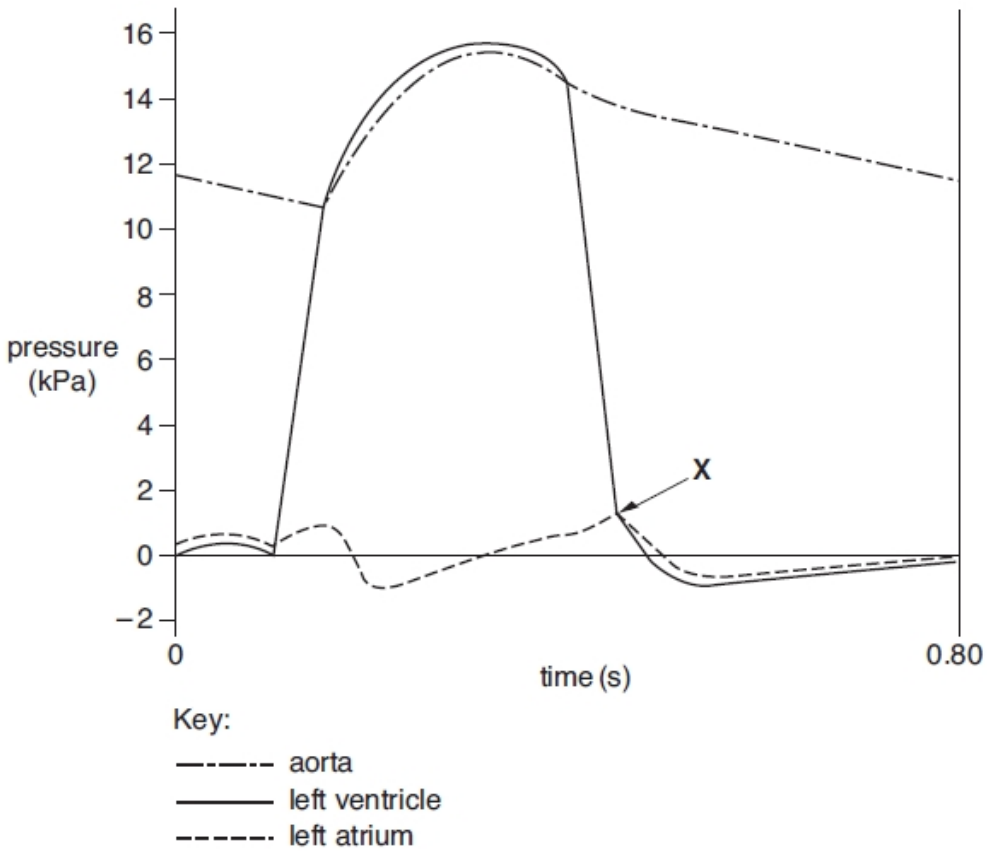


Fig. 6.1

(i) Calculate the heart rate from the information in Fig. 6.1.

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 Fig. 6.1.

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

[4]

[Total: 8]

Question: 24

(a) Fig. 1.1, on the insert, shows an electron micrograph of cells from the liver.

(i) Some cells, such as liver cells, contain a lot of Golgi apparatus.

State one function of the Golgi apparatus.

[1]

(ii) Suggest why the nuclear envelope contains pores.

[2]

(iii) State the function of the lysosomes.

[1]

(b) The liver is an organ.

Explain what is meant by the term *organ*.

[2]

(c) Using the mammalian gaseous exchange system as an example, explain how the different cells and tissues enable the effective exchange of gases.

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

[5]
[Total: 11]

Question: 25

The cell surface membrane allows different substances to enter and leave the cell.

(a) List three components of a cell surface membrane.

[3]

(b) (i) Explain what is meant by the term *active* transport.

[2]

(ii) State two examples of active transport in cells.

For each example, you should name the substance that is transported and the cell involved.

[2]

(c) In addition to active transport, substances can pass through cell surface membranes by:

• diffusion

• facilitated diffusion

• osmosis

• bulk transport (endocytosis / exocytosis)

For each example described in Table 2.1 below, state how the substance crosses the cell surface membrane. The first one has been done for you.

Table 2.1

example	mechanism of movement across cell surface membrane
release of enzymes into the gut	bulk transport
a plant cell taking up water	
calcium ions entering a nerve cell down a concentration gradient	
oxygen entering a red blood cell	

[3]
[Total: 10]

Question: 26

Large animals, such as mammals, need efficient transport systems.

(a) Fig. 3.1 shows a section through the mammalian heart.

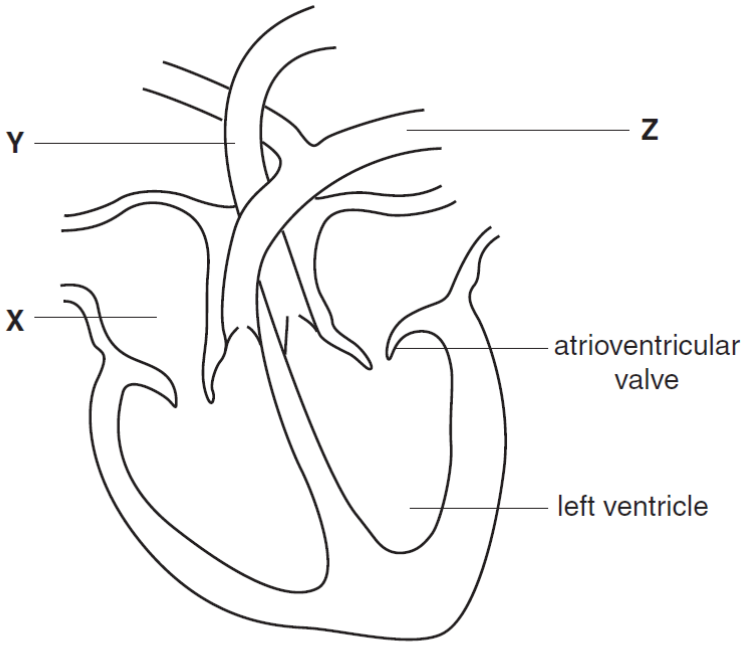


Fig. 3.1

(i) Name the parts labelled X, Y and Z.

X

Y

Z

[3]

(ii) Explain why the wall of the left ventricle is thicker than the wall of the left atrium.

[3]

(iii) Explain how pressure changes in the heart bring about the closure of the atrioventricular (bicuspid) valve.

[2]

(b) The mammalian transport system is a double circulatory system.

An efficient circulatory system consists of a pump, a means of maintaining pressure, a transport medium and exchange surfaces.

State the component of the mammalian circulatory system that fulfils each of these roles.

The first one has been done for you.

pump heart

means of maintaining pressure

transport medium

exchange surface

[3]
[Total: 11]

Question: 27

In plants, dividing cells can be found in meristematic tissue.

(a) Name two parts of a plant where meristematic tissue can be found.

[2]

(b) In an investigation, a student observed the cells in a stained section of meristematic tissue.
The student counted how many cells could be seen in each stage of the cell cycle.

Table 4.1 shows the results.

Table 4.1

stage of cell cycle	percentage cells in stage (%)
interphase	82.00
prophase	4.34
metaphase	3.23
anaphase	3.23
telophase	7.20

(i) Explain why the meristematic tissue needed to be stained for this investigation.

[2]

(ii) Name the type of nuclear division that occurs in a plant meristem.

[1]

(c) Using the results shown in Table 4.1, calculate the percentage of the cell cycle taken up by nuclear division.

Show your working.

Answer = ... %

[2]

(d) State one way in which the products of meiosis are different from the products of nuclear division in meristematic tissue.

[1]
[Total: 8]

Question: 28

Fig. 5.1 shows a spirometer, which is used to investigate lung function.

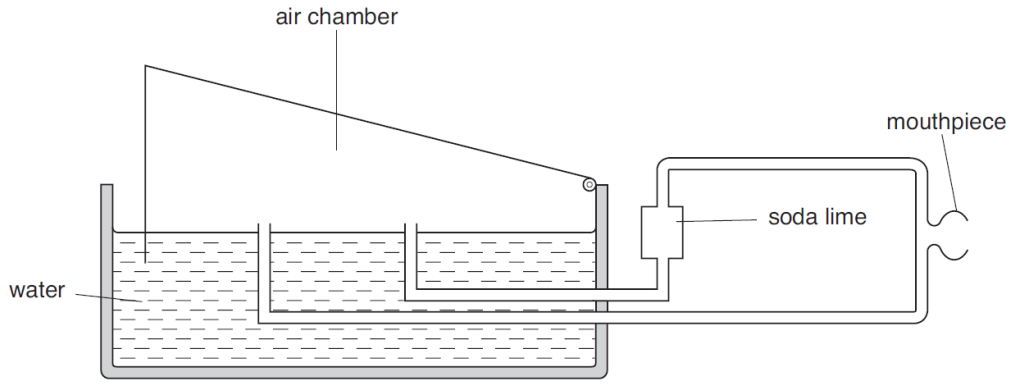
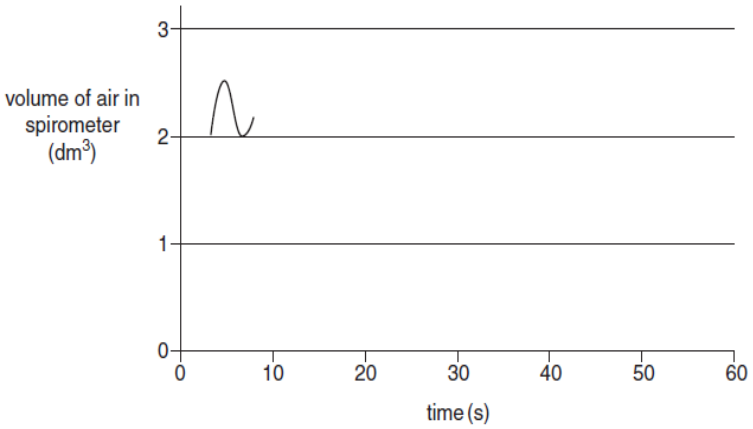


Fig. 5.1

(a) (i) Describe how the spirometer would be used to measure tidal volume.

[3]

(ii) Using the axes below, complete the spirometer trace that you expect to see recorded from a healthy sixteen year old over ten further breaths, while at rest.



[2]

(iii) Describe how you could use a spirometer trace to measure the rate of oxygen uptake.

[3]

(b) Suggest two factors that should be considered when carrying out a risk assessment for an experiment using a spirometer.

_____

_____

_____

_____

_____

[2]
[Total: 10]

Question: 29

Fig. 2.1 is a diagram of a cell showing the organelles involved in the production and secretion of an extracellular protein. The rough endoplasmic reticulum (RER) is shown enlarged at the side of the diagram.

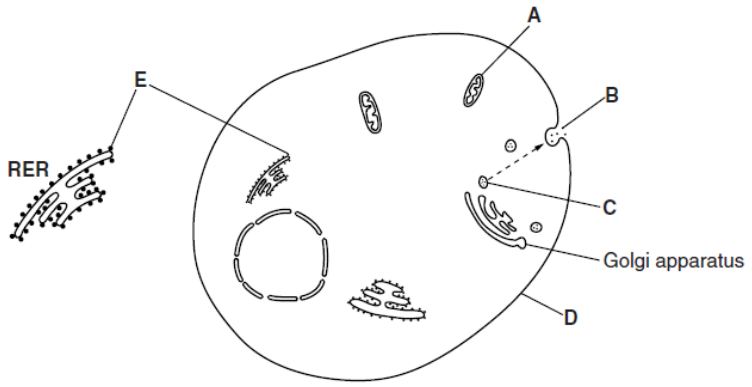


Fig. 2.1

(a) (i) Name the structures labelled C, D and E.

C

D

E

[3]

(ii) Suggest one type of extracellular protein secreted at B.

[1]

(iii) Organelle A provides ATP which is a source of energy.

Suggest one stage during the secretion of a protein that requires energy.

[1]

(iv) Outline the role of the Golgi apparatus.

[2]

(b) The cell shown in Fig. 2.1 is a eukaryotic cell.

(i) Identify two features, visible in Fig. 2.1, which would not be present in a prokaryotic cell.

[2]

(ii) Name one feature that would be present in the cytoplasm of a prokaryotic cell that is not found in a eukaryotic cell.

[1]
[Total: 10]

Question: 30

Fig. 3.1 provides information about the blood pressure in different parts of the mammalian blood circulatory system.

Fig. 3.1 also shows the total cross-sectional area of the vessels, relative to one another, in parts of the blood circulatory system.

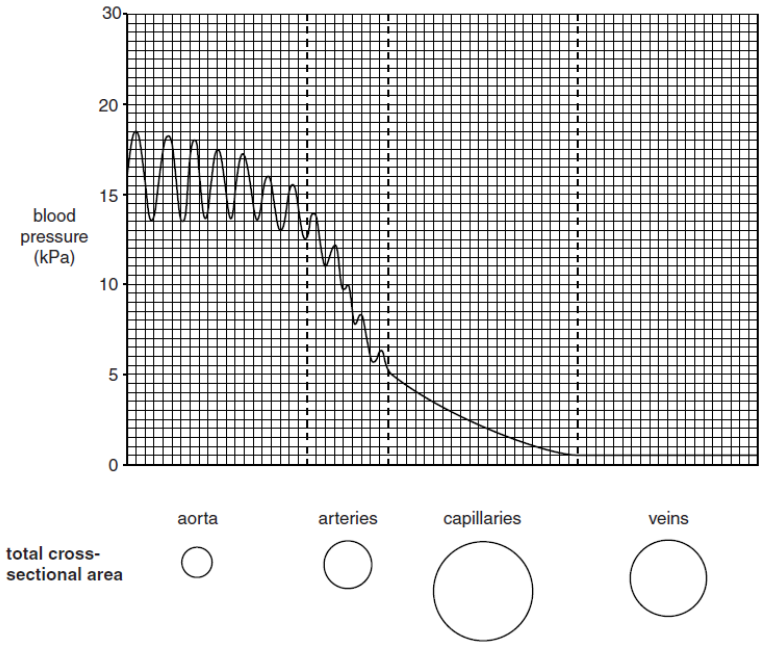


Fig. 3.1

(a) Place a tick (✓) in the box below that most closely describes the mammalian blood circulatory system.

	open circulatory system	closed circulatory system
single circulatory system	☐	☐
double circulatory system	☐	☐

[1]

(b) The pressure fluctuates as the blood flows along the aorta, as shown in Fig. 3.1.

(i) Explain what causes this fluctuation.

_____

_____

_____

_____

_____

[2]

(ii) State the term used to describe the number of fluctuations per minute.

[1]

(c) Using the information in Fig. 3.1, describe the pressure changes in the blood as it flows through the circulatory system from the aorta to the veins.

[3]

(d) (i) Using the information in Fig. 3.1, explain what causes the overall change in pressure as blood flows from the aorta to the arteries and from the arteries to the capillaries.

[2]

(ii) Explain why it is important that the pressure changes as blood flows from the aorta to the capillaries.

[2]
[Total: 11]

Question: 31

(a) 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.

[5]

(b) 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.

_____

_____

_____

_____

_____

[5]

[Total: 10]

Question: 32

Fig. 6.1 is a diagram of a spirometer, a piece of apparatus used to measure some aspects of breathing, such as breathing rate and vital capacity.

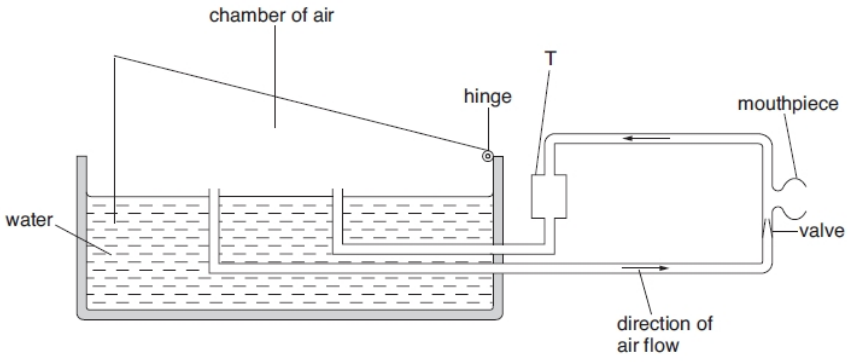


Fig. 6.1

(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 Fig. 6.1 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]

Question: 33

(a) 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

[2]

(b) Describe what is meant by the term *resolution*.

_____

_____

_____

_____

_____

[2]

(c) Fig. 1.1 is an electron micrograph of xylem tissue in the stem of a plant.

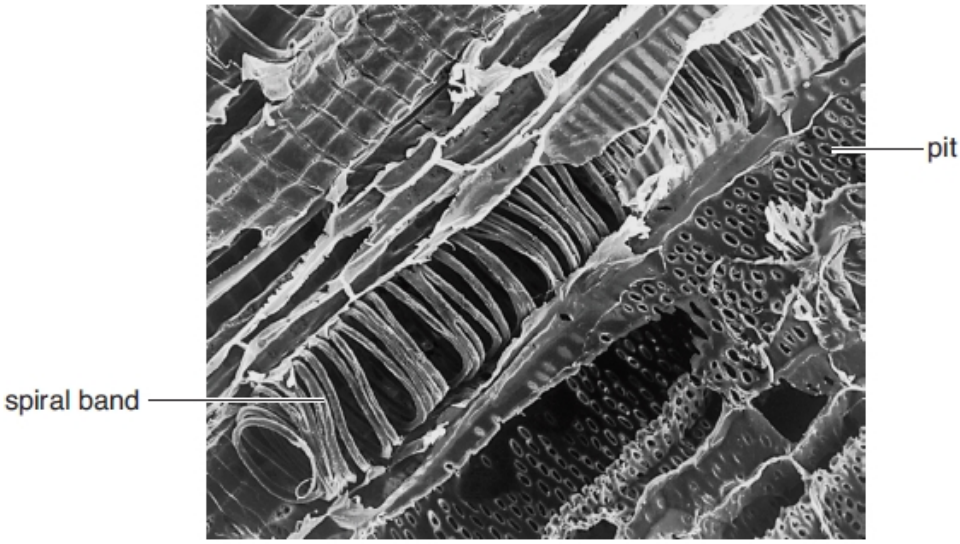


Fig. 1.1

(i) State one function of xylem tissue.

_____

_____

_____

_____

_____

[1]

(ii) The spiral band in the xylem vessel shown in Fig. 1.1 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 Fig. 1.1.

[2]

[Total: 10]

Question: 34

Fig. 2.1 shows the structure of a plasma (cell surface) membrane.

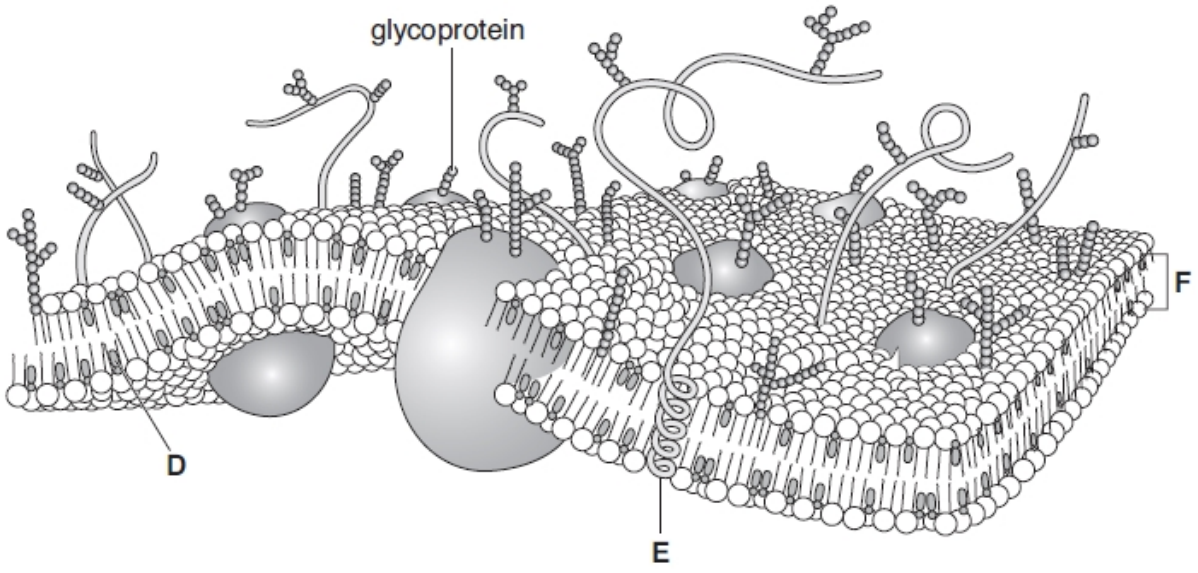


Fig. 2.1

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

D

_____

_____

_____

_____

_____

E

_____

_____

_____

_____

_____

F

_____

_____

_____

_____

_____

[

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

D

E

F

[

(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*.

[

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

[

(c) 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 i
Table 2.1.

Table 2.1

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.

[

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

1

2

3

[

[Total: 1

Question: 35

(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]

Question: 36

(a) Translocation is the movement of assimilates along the phloem from one part of a plant to another.

(i) Name the sugar molecule most commonly translocated.

[1]

(ii) A tissue may act as a source or a sink at different times.

For each tissue listed below, state whether it is acting as a source, a sink or neither. The first one has been done for you.

tissue	source, sink or neither
a leaf in summer	source
a developing bud	
xylem	
an actively growing root tip	

[3]

(b) The sap in the phloem sieve tubes is moved by mass flow.

State two adaptations of sieve tubes that enable mass flow to occur.

[2]

(c) Describe how assimilates are loaded into the phloem.

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

[4]
[Total: 10]

Question: 37

(a) Yeast reproduces asexually by a process called budding. During this process, cell division occurs.

(i) Name the type of cell division that occurs in asexual reproduction.

[1]

(ii) Before the division of the nucleus of a cell, the genetic material must replicate.

Explain why this is essential.

[2]

(b) Unlike yeast, the nuclei of most eukaryotic organisms contain homologous pairs of chromosomes.

Explain what is meant by a *homologous pair of chromosomes.*

[3]

(c) In most multicellular organisms, the cells produced by cell division are organised into tissues.

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

[2]

(ii) Complete Table 1.1 below comparing two types of epithelium, squamous epithelium and ciliated epithelium.

For each type of epithelium, state one function of the tissue and one specific location in the human body where it is found.

Table 1.1

type of epithelium	function of tissue	specific location in the human body
squamous		
ciliated		

[4]
[Total: 12]

Question: 38

(a) A student wanted to observe some red blood cells under the microscope. The student placed a small sample of blood onto a microscope slide and added a drop of distilled water. When viewed at high power, the student observed that the red blood cells had burst.

In a similar procedure using plant epidermis, the student observed that the plant cells did not burst.

(i) Explain these observations.

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

[5]

(ii) Suggest how the student could modify the procedure to observe red blood cells without them bursting.

[1]

(b) Oxygen enters red blood cells as they pass through the capillaries in the lungs.

Name the mechanism by which oxygen enters the red blood cells.

[1]

(c) The cells in the epidermis of a plant root are specialised to absorb minerals from the surrounding soil.

State the process by which root epidermal cells absorb minerals from the soil and describe how these cells are specialised to achieve absorption.

[3]
[Total: 10]

Question: 39

Fig. 5.1 shows the changes in the volume of air in the lungs of a student at rest during one breath.

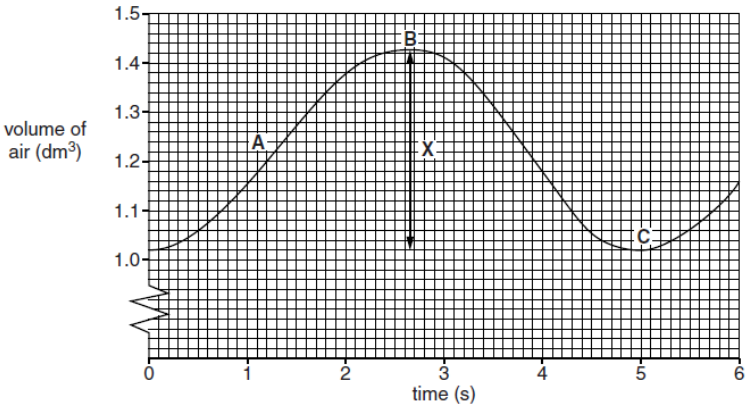


Fig. 5.1

(a) (i) Name the measurement represented by the line X.

[1]

(ii) What is happening to the elastic fibres in the walls of the alveoli at point A?

[1]

(b) Explain what causes the change in the volume of air between points B and C on Fig. 5.1.

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

[4]

(c) Using Fig. 5.1, calculate the breathing rate of this student in breaths per minute.

Answer = ... breaths per minute

[2]

(d) About $1dm^3$ of air cannot be expelled from the lungs. This is known as the residual volume.

Suggest why it is not possible to expel all the air from the lungs.

[2]
[Total: 10]

Question: 40

Fig. 6.1 shows an aphid feeding from a plant stem. The aphid feeds by inserting its tube-like mouthparts into the tissue that transports sugar solution. Some details of this transport tissue are shown in the vertical section.

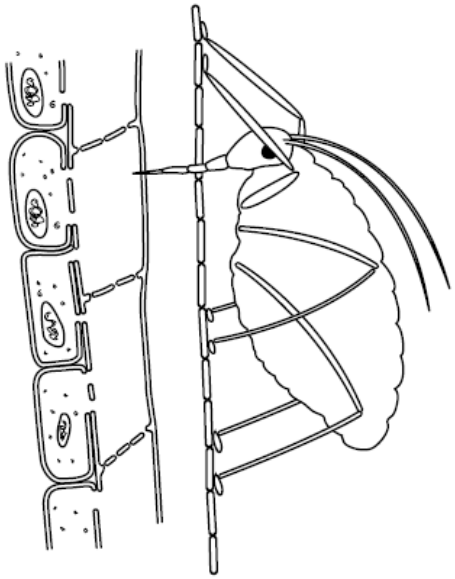


Fig. 6.1

(a) (i) Name the sugar most commonly transported through the stem of a plant and the tissue that transports this sugar.

Sugar

_____

_____

_____

_____

_____

Tissue

_____

_____

_____

_____

_____

[1]

(ii) Sugar molecules are actively loaded into the transport tissue.

Describe how active loading takes place.

[3]

(b) A classic experiment investigated the effect of temperature on the rate of sugar transport in a potted plant.

Aphid mouthparts were used to take samples of sugar solution from the transport tissue in the stem. The sugary solution dripped from the mouthparts. The number of drips per minute was counted.

The procedure was repeated at different temperatures.

Table 6.1 shows the results obtained.

Table 6.1

temperature (°C)	number of drips per minute
5	3
10	6
20	14
30	26
40	19
50	0

Suggest brief explanations for these results.

[3]
[Total: 7]

Question: 41

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

[2]

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

[1]

(b) Explain why the lungs can be considered to be an organ.

[2]

(c) 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

[3]

[Total: 8]

Question: 42

(a) (i) Fig. 5.1 represents a transverse section of an artery and a vein.

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

Fig. 5.1

[1]
[Total: 12]

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

1

_____

_____

_____

_____

_____

2

_____

_____

_____

_____

_____

[

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

State how this hydrostatic pressure is generated in the heart.

_____

_____

_____

_____

_____

[

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

[

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

Fig. 5.2 shows how the hydrostatic pressure of the blood changes as it moves through a capillary.

Fig. 5.2 also shows the water potential of the blood, due largely to the plasma proteins, which tends to move water into the blood.

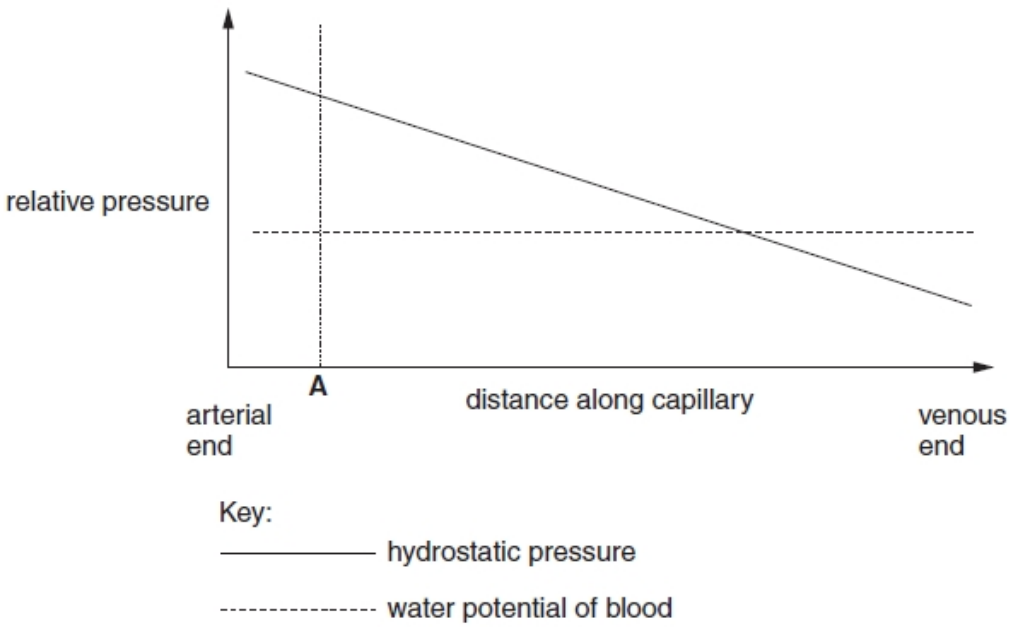


Fig. 5.2

Describe and explain what happens to the blood plasma at point A along the capillary in Fig. 5.2.

[

(c) 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.

Fig. 5.3 shows the chemical pathway in which carbon dioxide is converted into HCO_3^- in a red blood cell.

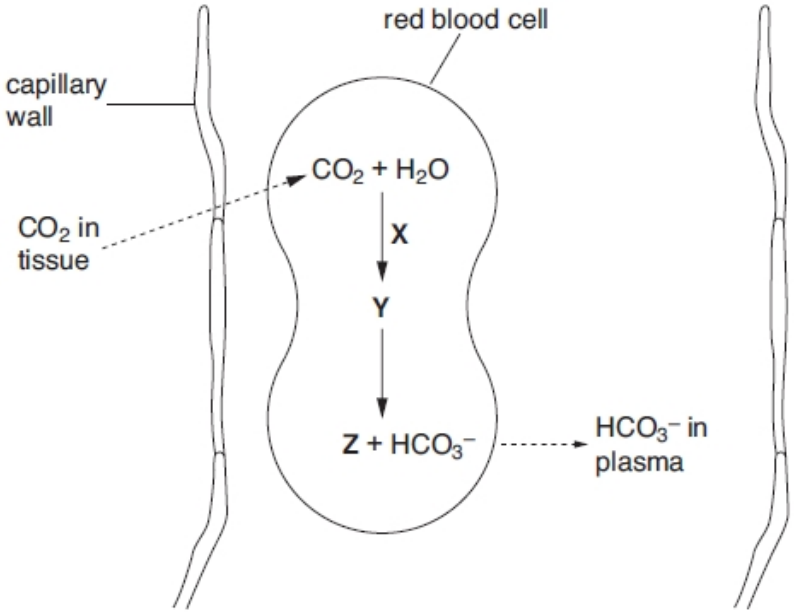


Fig. 5.3

Identify the following:

enzyme X

_____

_____

_____

_____

_____

substance Y

_____

_____

_____

_____

_____

ion Z

_____

_____

_____

_____

_____

[

Question: 43

1 Fig. 1.1 is a diagram of a plant cell.

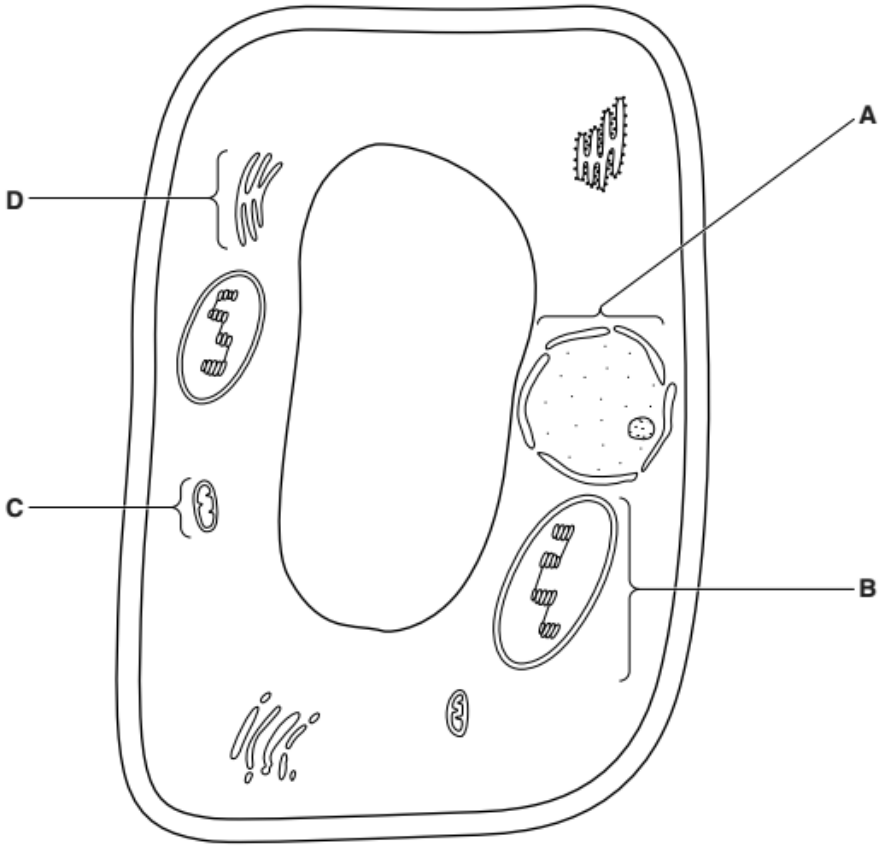


Fig. 1.1

(a) (i) Name the cell components labelled A and B.

A .....

B .....

[2]

(ii) State the functions of the components labelled C and D.

C .....

D .....

[2]

(b) A student suggested that the details of component C could be seen clearly with a very good light microscope.

Explain why the student is not correct.

[2]

(c) Staining is a process often used in microscopy.

Describe the advantages of staining specimens to be viewed under a microscope.

[2]
[Total: 8]

Question: 44

(a) (i) Name the type of nuclear division that occurs in plant growth.

_____

_____

_____

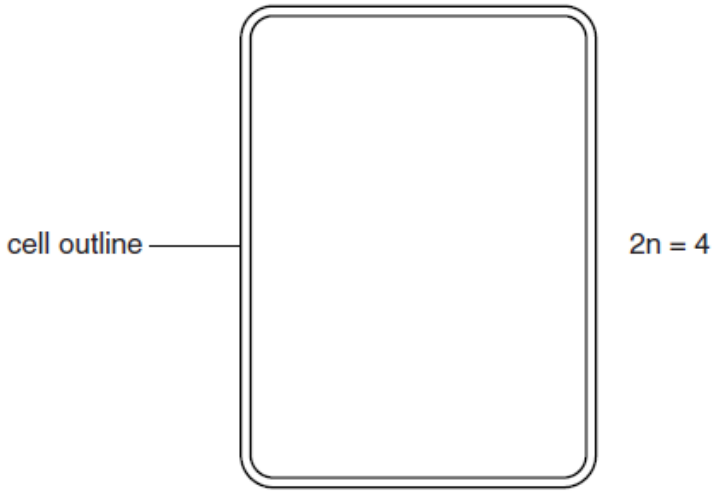
_____

_____

[1]

(ii) Draw the chromosomes within the cell outline below as they would appear during metaphase of nuclear division.

Assume the diploid number of chromosomes is Assume the diploid number of chromosomes is four.



[2]

(iii) Cytokinesis follows nuclear division. After cytokinesis, the cells elongate due to water uptake by osmosis.

Fig. 3.1 shows three plant cells. The value shown in each cell refers to the water potential, Ψ, in kPa.

Draw arrows on Fig. 3.1 below to show the movement of water between cells R, S and T.

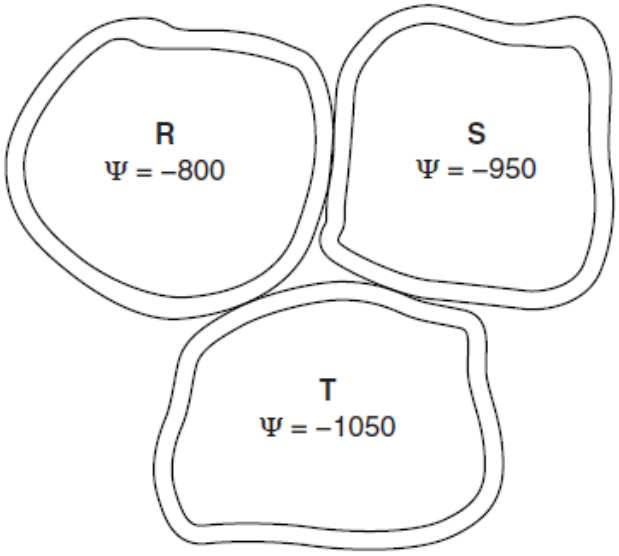


Fig. 3.1

[2]

(b) Fig. 3.2, on the insert, shows the stump of a tree with new branches growing from the stump.

New growth in a stem or trunk comes from the cambium, which is situated between the xylem and phloem tissues.

Explain why the new branches in Fig. 3.2 are seen growing from a position just under the bark of the cut surface.

_____

_____

_____

_____

_____

[2]

(c) Name one other location where growth occurs in a plant.

_____

_____

_____

_____

_____

[1]

(d) Look at the areas labelled L on Fig. 3.2. These are areas of loosely packed cells in the bark called lenticels. Lenticels allow gases to diffuse into the living tissues of the trunk.

Suggest why lenticels are essential to the survival of large multicellular plants and explain why similar structures are not found in large multicellular animals.

_____

_____

_____

_____

_____

[2]
[Total: 10]

Question: 45

4 Fig. 4.1 shows the oxygen dissociation curves for fetal haemoglobin (A) and adult haemoglobin (B) .

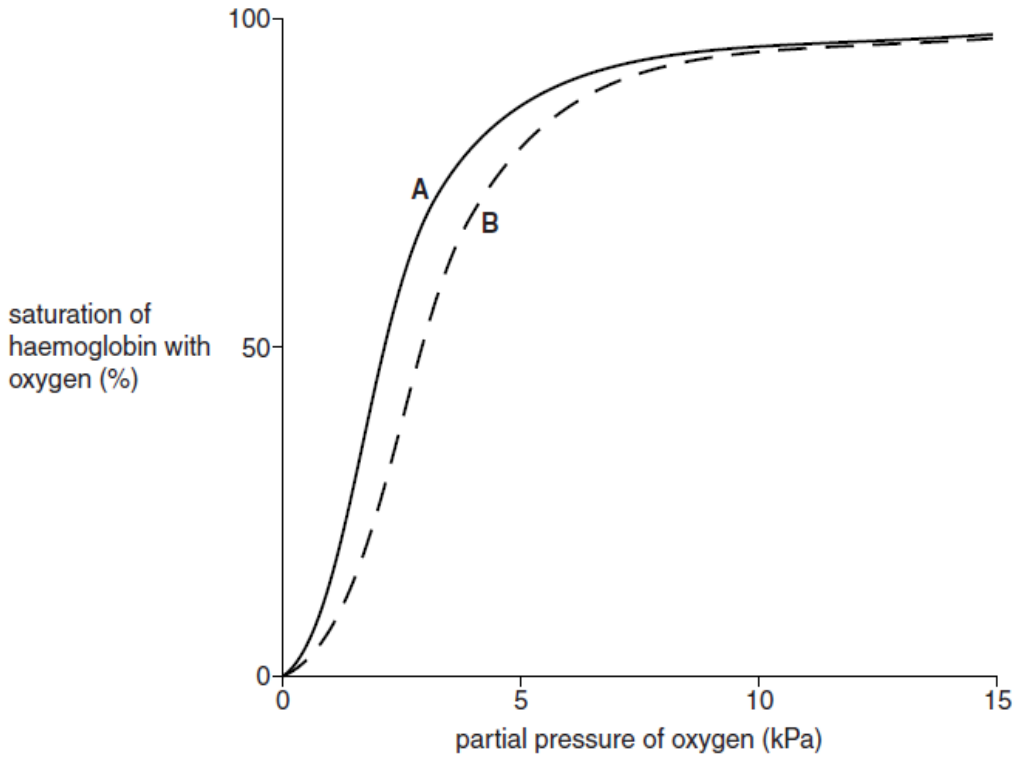


Fig. 4.1

(a) (i) Curve A represents fetal haemoglobin.

Explain why the fetal haemoglobin curve is to the left of the adult haemoglobin curve.

_____

_____

_____

_____

_____

[3]

(ii) Sickle cell anaemia is an inherited disorder in which haemoglobin crystallises when the partial pressure of oxygen (pO_2) is low. The red blood cells change shape and oxygen transport is disrupted.

Treatment with drugs, such as hydroxyurea, can stimulate adults to produce fetal haemoglobin rather than adult haemoglobin.

Suggest why this treatment might be of benefit to adults with sickle cell anaemia.

_____

_____

_____

_____

_____

[2]

(b) Describe and explain how substances that are dissolved in the blood plasma, such as oxygen or glucose, enter the tissue fluid from the capillaries.

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

_____

_____

_____

_____

_____

[4]
[Total: 9]

Question: 46

(a) List three reasons why a large, multicellular animal, such as a mammal, needs a transport system.

_____

_____

_____

_____

_____

[3]

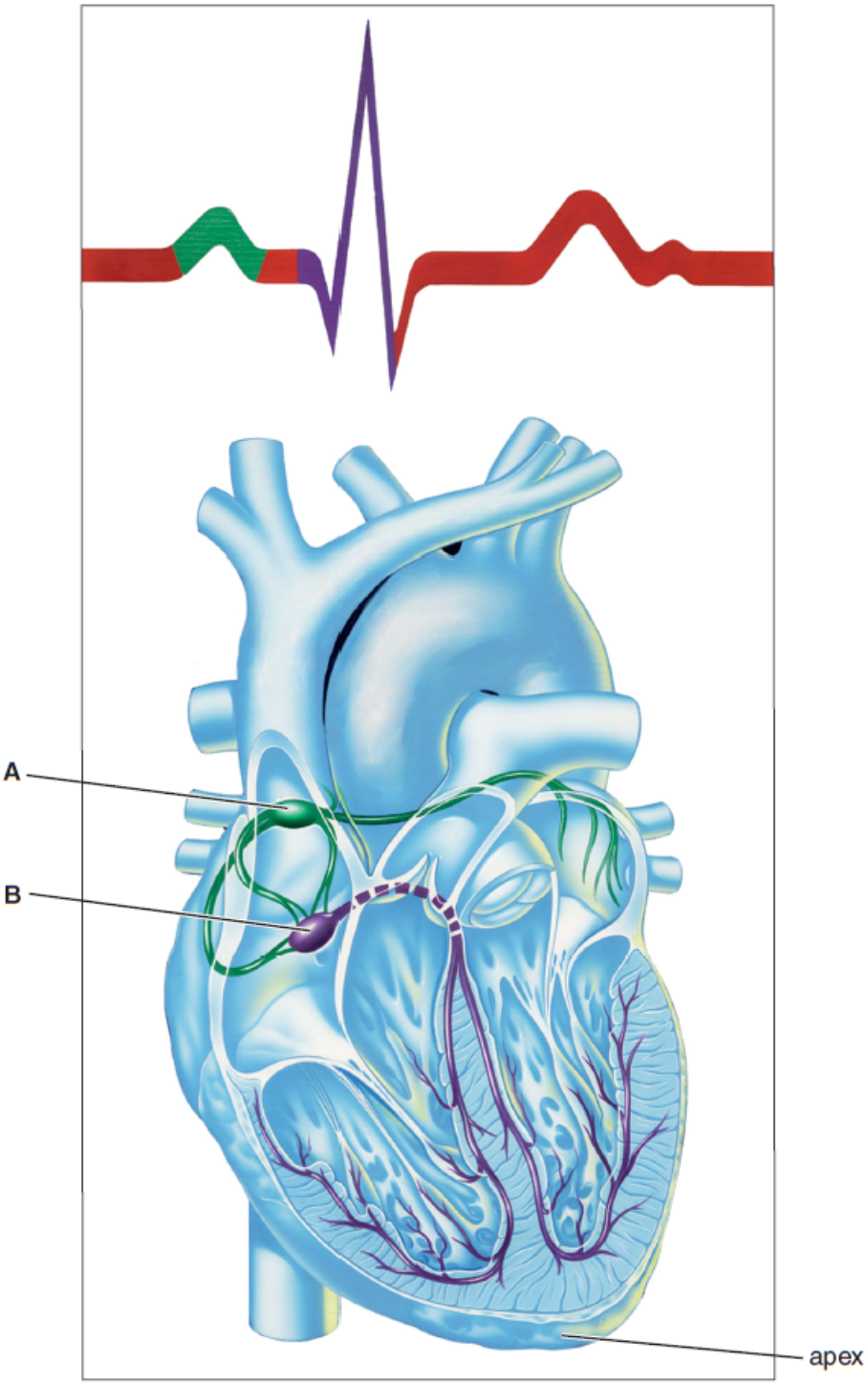


Fig. 1.1

Fig. 1.1, shows the nervous pathways that coordinate heart action.

Above the diagram is a trace showing the electrical activity associated with one heart beat.

(b) (i) State the full name given to a trace showing the electrical activity of the heart.

[1]

(ii) Identify the components of the heart labelled A and B on Fig. 1.1.

A .....

B .....

[2]

(c) (i) During the electrical stimulation of the heart, there is a short delay between the excitation of the atria and excitation of the ventricles.

Explain why this delay is essential.

[2]

(ii) The Purkyne tissue carries the excitation wave down the septum to the apex of the heart.

Explain why the excitation wave is carried to the apex.

[2]
[Total: 10]

Question: 47

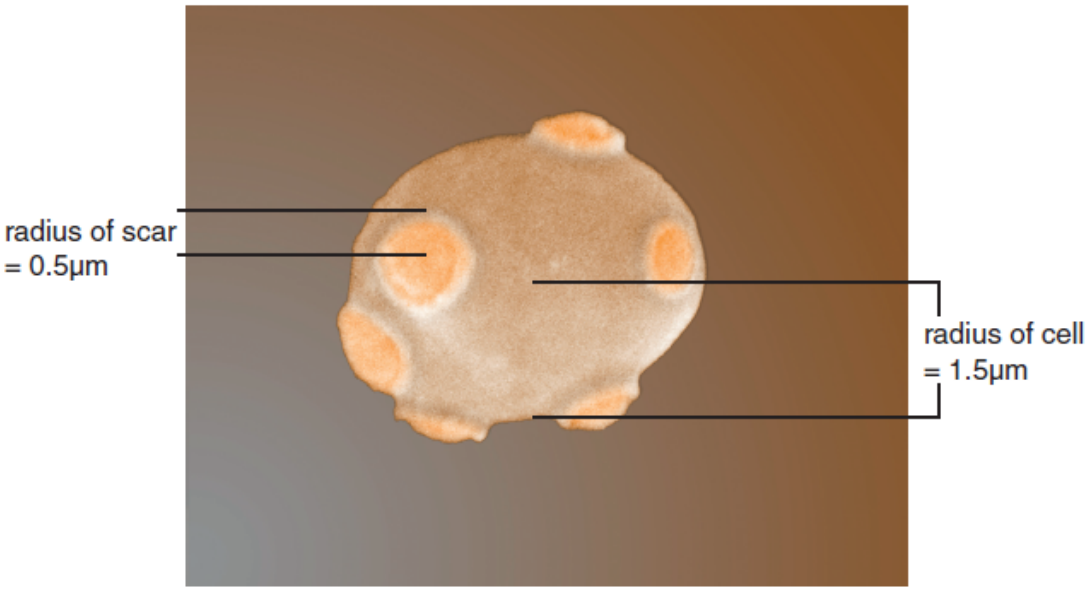


Fig. 2.1

(a) Fig. 2.1, shows a yeast cell with scars resulting from its reproductive process.

(i) Name the process of asexual reproduction in yeast.

[1]

(ii) Outline the process of asexual reproduction in yeast.

[2]

(b) (i) A yeast cell can continue producing new cells until its surface is covered by scars.

The surface area of a sphere is given by the formula $4\pi r^2$, where π = 3.14.

The area of a circle is given by the formula πr^2.

Assuming that the cell in Fig. 2.1 contained no scars, calculate how many potential new cells could be produced by this cell.

Show your working.

Answer =

[2]

(ii) Even when the environmental conditions are perfect, one yeast cell rarely produces the calculated number of potential new cells.

Suggest why the reproductive potential of the yeast cell is not reached.

[1]

(c) Yeast cells separate after cell division. In a multicellular organism, the cells do not separate but become organised to form the body structure.

Describe how the cells in a multicellular organism are organised.

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

[5]
[Total: 11]

Question: 48

(a) The structure of cell membranes can be described as ‘proteins floating in a sea of lipids’. This membrane structure allows certain substances to pass through freely whereas other substances cannot.

State the term used to describe a membrane through which some substances can pass freely but others cannot.

[1]

(b) Complete the following paragraph about cell membranes, using the most appropriate terms.

The model of cell membrane structure is called the _____ _____ model. Phospholipid bilayers with specific membrane proteins account for the ability of the membrane to allow both passive and _____ transport mechanisms. Ions and most polar molecules are insoluble in the phospholipid bilayer. However, the bilayer allows diffusion of most non-polar molecules such as _____ Protein channels, which may be gated, and _____ proteins enable the cell to control the movement of most polar substances.

[4]

(c) One function of membranes that is not mentioned in (b) is cell signalling.

(i) State what is meant by *cell signalling*.

[1]

(ii) Explain how cell surface membranes contribute to the process of cell signalling.

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

[4]
[Total: 10]

Question: 49

(a) A student used a potometer to investigate the effect of leaf area on the rate of transpiration.

This apparatus is shown in Fig. 4.1.

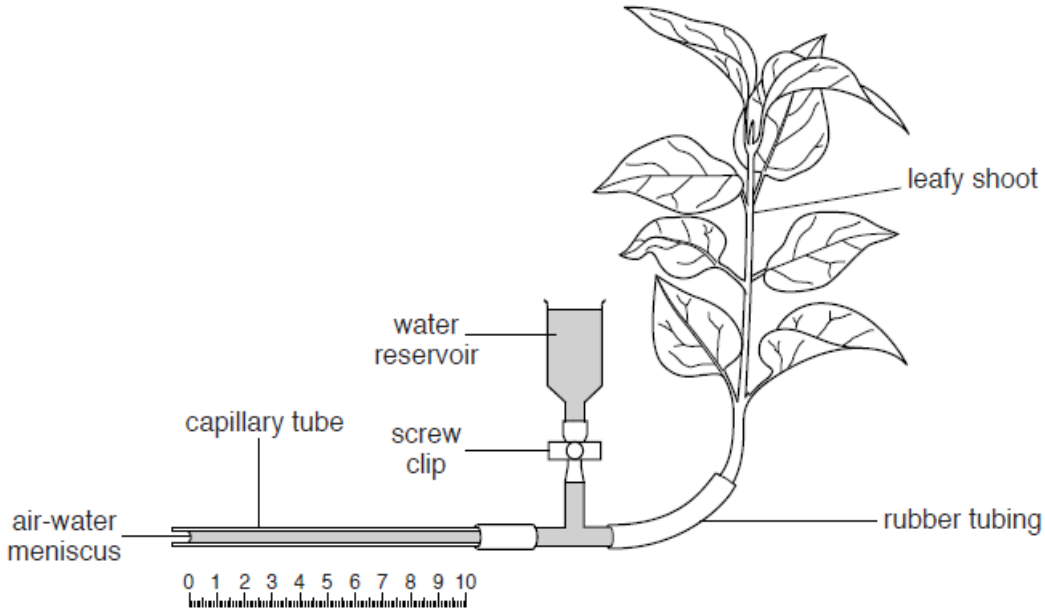


Fig. 4.1

The student presented the results of their investigation in a table, as shown below.

Number of leaves present on shoot attached to potometer	Mean rate of bubble movement
0	7
2	28
4	49
6	73
8	92

Table 4.1

(i) State what information the student has not included in their table of results.

_____

_____

_____

_____

_____

[2]

(ii) Describe and explain the data shown by the student's results.

[3]

(b) As part of the evaluation of the investigation, the student wrote the following statements:

1 *One limitation is that the leaves were not all the same size.*

2 *I assembled the potometer under water and the leaves got wet.*

3 *During my investigation the sun came out and the lab warmed up very quickly.*

For each statement, explain why this may affect the results and suggest how the student could improve the investigation.

Statement 1.....

Statement 2.....

Statement 3.....

[6]
[Total: 11]

Question: 50

In an experiment to measure the rate of diffusion, a student placed cubes of agar jelly containing an indicator into dilute hydrochloric acid. The indicator changes from pink to colourless in acidic conditions.

The student used cubes of different sizes and recorded the time taken for the pink colour of each cube to disappear completely.

The student's results are recorded in Table 2.1.

Length of side of cube (mm)	Surface area of cube (mm^2)	Volume of cube (mm^3)	Surface area to volume ratio	Time taken for pink colour to disappear (s)	Rate of diffusion ($mm\,s^{-1}$)
2	24	8	3.0:1	50	0.020
5	150	125	1.2:1	120	0.021
10	600	1000		300	0.017
20	2400	8000	0.3:1	700	0.014
30	5400	27000	0.2:1	1200	0.013

Table 2.1

(a) (i) Calculate the surface area to volume ratio of the cube with 10 mm sides.

Show your working.

Answer = ...

[2]

(ii) Using the data in Table 2.1, describe the relationship between the rate of diffusion and the surface area to volume ratio.

[2]

(iii) Explain the significance of the relationship between rate of diffusion and the surface area to volume ratio for large plants.

[2]

(b) Another student used the same raw data obtained in the experiment but calculated a different rate of diffusion for each cube. This student's results are shown in Table 2.2.

Length of side of cube (mm)	Time taken for pink colour to disappear (s)	Rate of diffusion ($mm\ s^{-1}$)
2	50	0.040
5	120	0.042
10	300	0.033
20	700	0.029
30	1200	0.025

Table 2.2

In this student's table, the calculation of the rate of diffusion is incorrect.

(i) Suggest the method used to calculate the rate of diffusion in Table 2.2.

[1]

(ii) State why the method in (b)(i) is not correct.

[1]

(c) In mammals, the lungs are adapted to enable efficient gaseous exchange.

The table below lists some of the adaptations of the lungs.

Complete the table explaining how each adaptation improves efficiency of gaseous exchange.

Adaptation	How this adaptation improves efficiency of gaseous exchange
squamous epithelium	
large number of alveoli	
good blood supply	
good ventilation	

[4]
[Total: 12]

Question: 51

(a) Distinguish between the term *transpiration* and the *transpiration stream.*

_____

_____

_____

_____

_____

[3]

(b) Xerophytes are plants that are adapted to living in dry conditions.

The lists below describe four general features of leaves. From each list, select the leaf that belongs to a xerophyte.

Plase a tick (✓) in the correct box. The first one has been done for you.

Presence of hairs on leaves

Leaf A	no	☐
Leaf B	yes	☐
Leaf C	no	☐

Mean number of stomata (cm^{-2})

Leaf D	30 000	☐
Leaf E	23 000	☐
Leaf F	13 000	☐

Mean surface area of one leaf (cm^2)

Leaf G	0.2	☐
Leaf H	10.0	☐
Leaf I	23.0	☐

Thickness of cuticle (µm)

Leaf J	4.25	☐
Leaf K	8.50	☐
Leaf L	2.00	☐

[3]

(c) The transport system of multicellular plants consists of xylem and phloem tissue.

The table below contrasts the structure and roles of xylem and phloem.

Complete the table using the most appropriate word or words.

Xylem	Phloem
xylem transports water and	phloem transports assimilates such as
	sieve tubes contain perforated cross walls
xylem vessel walls are impregnated with	sieve tube walls have no additional support
xylem vessel walls contain that allow water to pass into adjacent vessels	there are many gaps in the cell walls between companion cells and sieve tube elements called

[4]
[Total: 10]

Question: 52

Fig. 2.1 represents the structure of a plasma (cell surface) membrane.

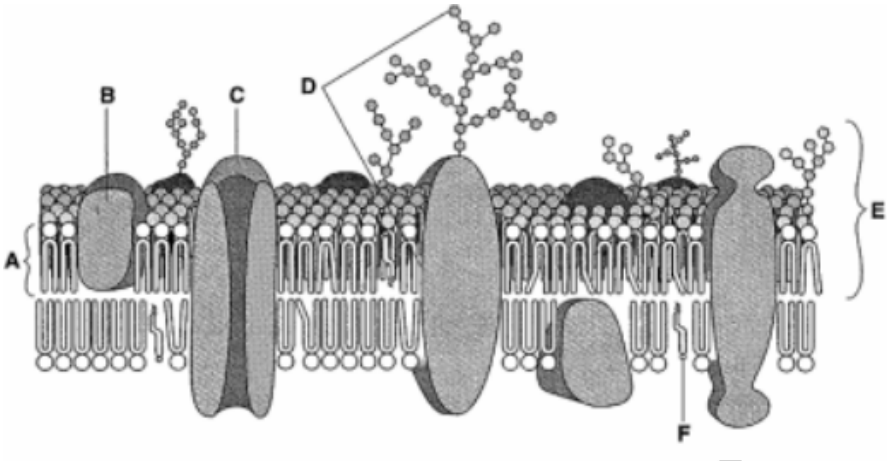


Fig. 2.1

(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.....

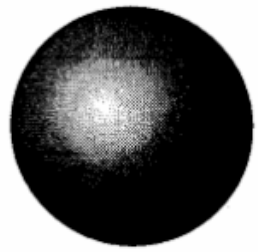
[3]
[Total: 10]

Question: 53

(a) 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 Table 3.1.

Table 3.1

	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]

(b) 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.

[5]

(c) Fig. 3.1 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.

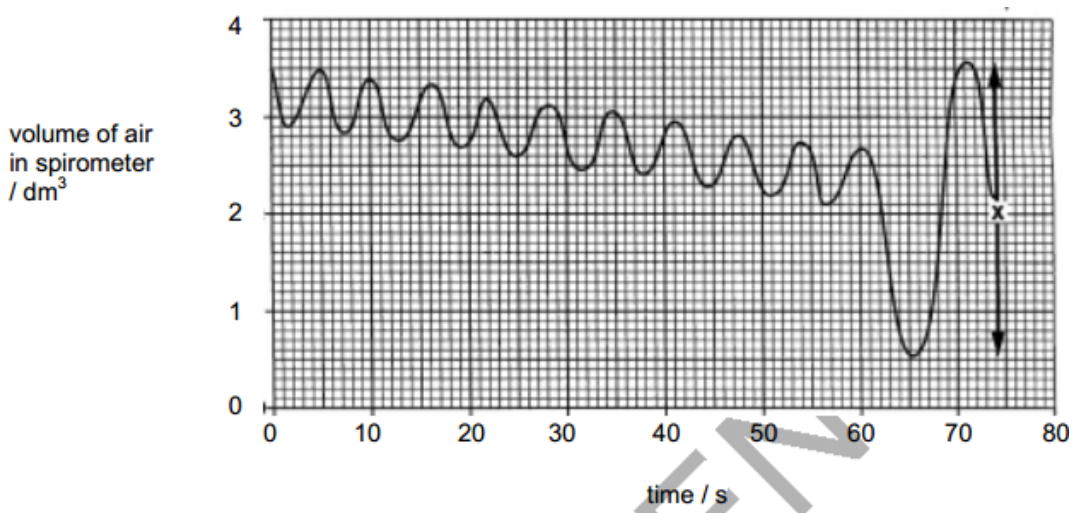


Fig 3.1

(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 Fig. 3.2 as X.

State the term given to measurement X.

_____

_____

_____

_____

_____

[1]
[Total: 13]

Question: 54

(a) 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*.

_____

_____

_____

_____

_____

[2]

(b) Fig. 4.1 gives information about the relative thickness of the walls of three chambers of the heart:

• left ventricle

• right ventricle

• right atrium

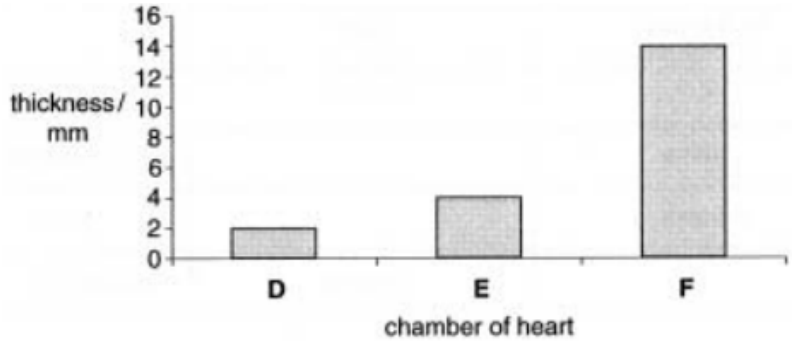


Fig. 4.1

(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]

(c) 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.

[5]

[Total: 13]

Question: 55

Transpiration is the loss of water from plants by evaporation. Fig. 5.1 shows a potometer, an apparatus used to estimate transpiration rates.

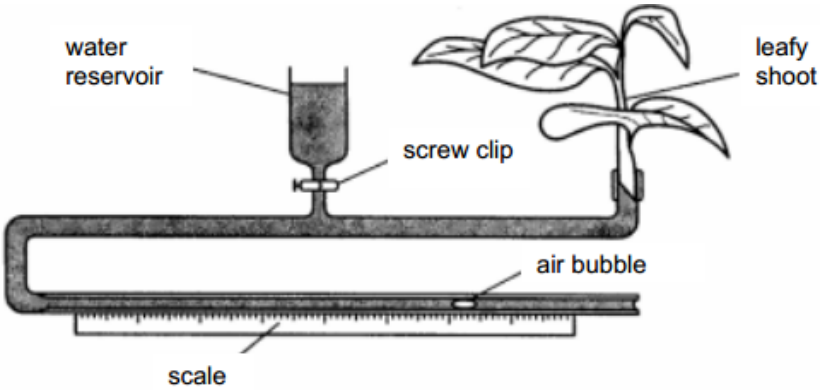


Fig. 5.1

(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]

(c) A student investigated the transpiration rates of two different plants A and B.

The results of the investigation are shown in Table 5.1.

Table 5.1

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 Table 5.1.

[1]

(ii) The student prepared a temporary slide of a transverse section through one of the leaves. Fig. 5.2 shows a diagram the student drew of the lower epidermis from one of the leaves.

Fig. 5.2

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

Plant.....

_____

_____

_____

_____

_____

Explanation .....

_____

_____

_____

_____

_____

[3]

[Total: 12]

Question: 56

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

(a) (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]

(b) Fig. 1.1 is a diagram of a mammalian sperm cell.

Fig. 1.1

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

_____

_____

_____

_____

_____

[3]

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

_____

_____

_____

_____

_____

[2]

(ii) Name one example of a plant tissue.

_____

_____

_____

_____

_____

[1]

[Total: 12]

Question: 57

(a) Complete Table 5.1 below which compares different types of cell.

Place a tick (✓) or a cross (✗) in each box to indicate whether the feature is present or absent.

The first row has been completed for you.

	Cell type		
Feature	**Plant cell**	**Animal cell**	**Bacterial cell**
mitochondria	✓	✓	✗
chloroplasts			
cellulose cell wall			
centrioles			
ribosomes			

Table 5.1

[4]

(b) In an investigation, cells were broken up (homogenised) and the component organelles were separated into tubes.

Each tube was then tested to determine the identity of the component organelle(s).

The observations are shown in Table 5.2.

Test for the...	Tube			
	1	2	3	4
ability to make ATP	no ATP produced	ATP produced	no ATP produced	no ATP produced
presence of DNA	DNA present	trace amount	no DNA present	no DNA present
ability to produce proteins	no proteins made	no proteins made	no proteins made	proteins made
ability to digest bacteria	none	some ability	none	none

Table 5.2

(i) Identify the tube that contains the following organelles:

nuclei _____

ribosomes _____

mitochondria _____

lysosomes _____

[4]

(ii) Which of the organelles listed in (i) is the smallest in size?

_____

_____

_____

_____

_____

[1]
[Total: 9]

Question: 58

(a) The lignin in the xylem vessel walls of plants and the C-rings of cartilage in the mammalian trachea perform an important role.

(i) Explain why lignin is essential in the wall of a xylem vessel.

[3]

(ii) Explain why cartilage is essential in the trachea.

[3]

(b) All living organisms exchange substances with their external environment.

The following data apply to an average person:

- the surface area of the body is approximately 1.8 m^2
- the volume of the body is approximately 0.07 m^3
- the surface area of the lungs is approximately 70 m^2.

Comment on the significance of this information for gas exchange.

[3]
[Total: 9]

Question: 59

Membranes are found both at the surface of cells and within cells.

(a) State two functions of membranes within cells.

[2]

(b) Describe the arrangement and functions of two named components of a cell surface membrane.

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

[5]

(c) (i) Which component of a cell membrane becomes more fluid as temperature increases?

[1]

(ii) Which component of a cell membrane denatures as temperature increases?

[1]

(iii) Liver cells contain membrane-bound organelles called peroxisomes. These organelles contain catalase, an enzyme that breaks down hydrogen peroxide to release oxygen gas.

A student carried out an investigation on catalase using the following procedure:

• two identical sized cubes were cut from a piece of fresh liver

• one cube was frozen overnight and then defrosted

• the other cube was stored in the refrigerator

• both cubes were returned to room temperature and were placed in separate test tubes containing equal volumes of 2% hydrogen peroxide solution.

The student observed that the cube of liver that had been frozen and defrosted, bubbled significantly more than the cube that had been refrigerated.

Suggest an explanation for this result.

_____

_____

_____

_____

_____

[2]
[Total: 11]