Q1. Diffusion is an important process in animals and plants.

The movement of many substances into and out of cells occurs by diffusion.

Describe why diffusion is important to animals and plants.

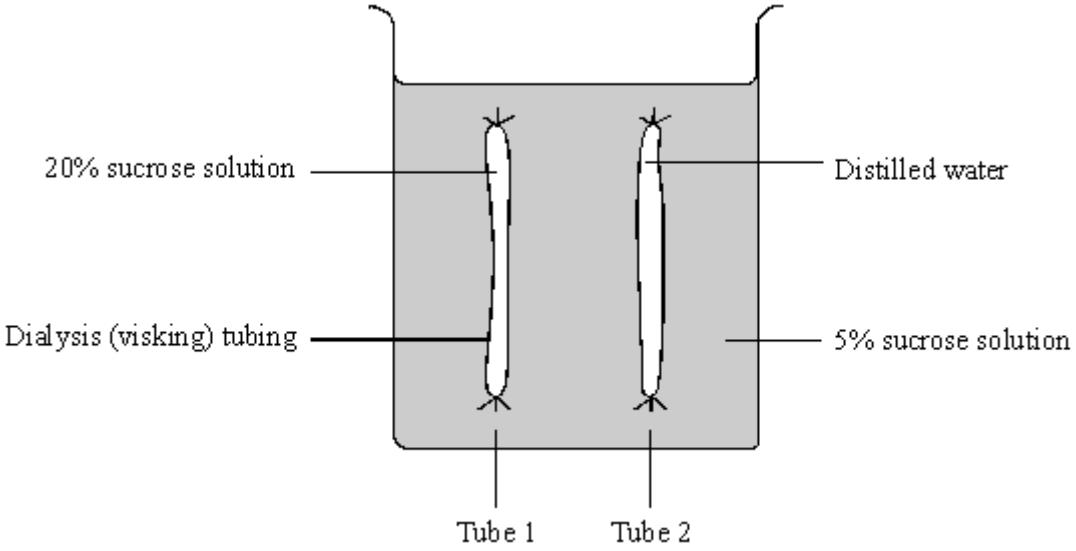
In your answer you should refer to:

- animals
- plants
- examples of the diffusion of named substances.

Extra space

(Total 6 marks)

Q2. Some students set up this experiment to investigate osmosis. They filled two pieces of dialysis [visking] tubing with different liquids and left them both in a beaker of *5%* sucrose solution for an hour.



(a) Describe and explain the likely results after one hour.

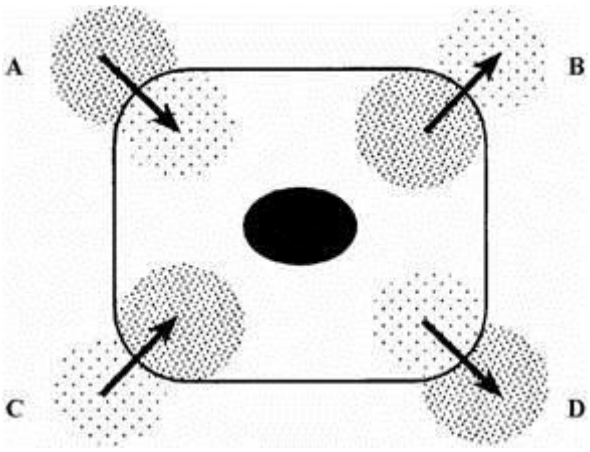
(6)

(b) Describe **two** examples where osmosis is used in living things.

(2)

(Total 8 marks)

Q3. (a) The diagram shows four ways in which molecules may move into and out of a cell. The dots show the concentration of molecules.



The cell is respiring aerobically.
Which arrow, **A**, **B**, **C** or **D**, represents:

(i) movement of oxygen molecules; _____

(ii) movement of carbon dioxide molecules? _____

(2)

(b) Name the process by which these gases move into and out of the cell.

_____

(1)

(c) Which arrow, **A**, **B**, **C** or **D**, represents the active uptake of sugar molecules by the cell?

_____

Explain the reason for your answer.

_____

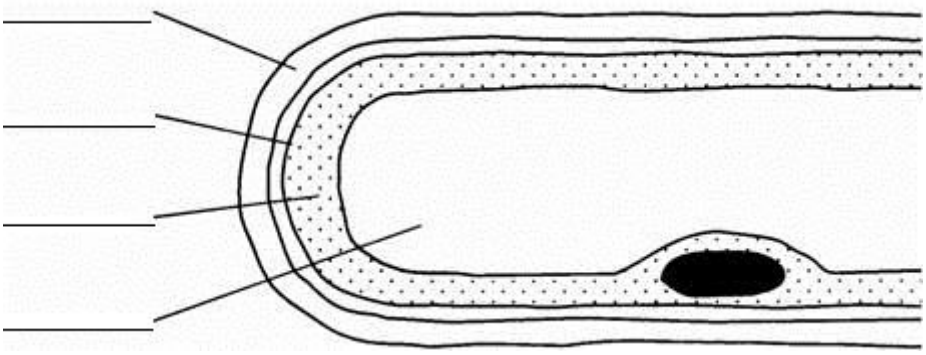
_____

_____

(2)

(Total 5 marks)

Q4. The drawing shows part of a root hair cell.

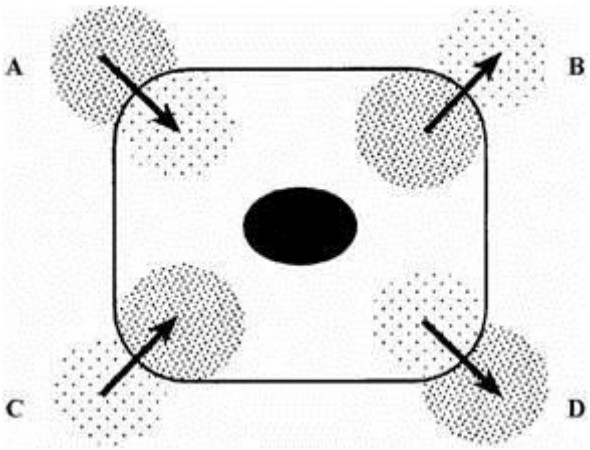


(a) Use words from the list to label the parts of the root hair cell.

cell membrane **cell wall** **cytoplasm** **nucleus** **vacuole**

(4)

(b) The diagram shows four ways in which molecules may move into and out of a cell. The dots show the concentration of molecules.



The cell is respiring aerobically.
Which arrow, **A**, **B**, **C** or **D** represents:

(i) movement of oxygen molecules; _____

(ii) movement of carbon dioxide molecules? _____

(2)

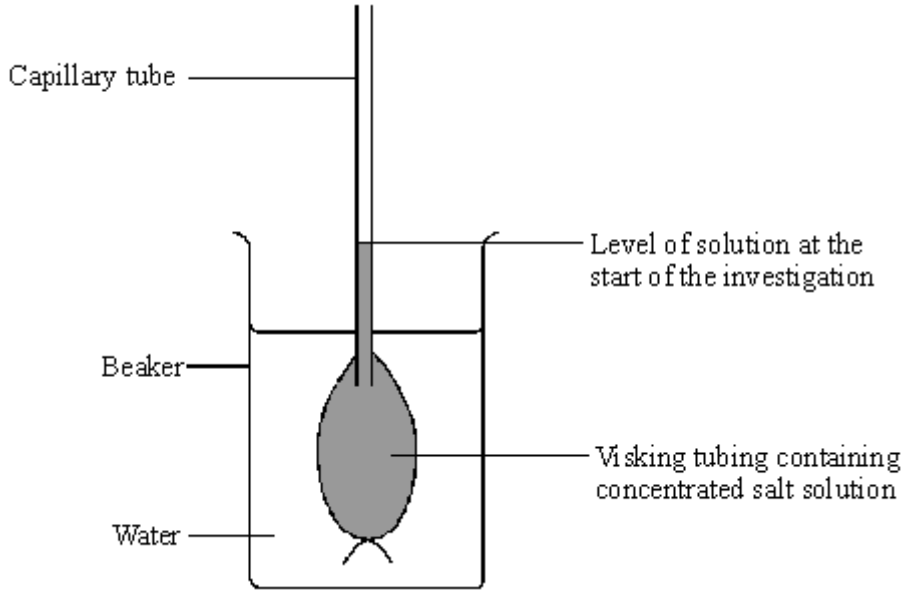
(c) Name the process by which these gases move into and out of the cell.

_____

(1)

(Total 7 marks)

Q5. Some students set up the equipment below to investigate osmosis.



(a) What is osmosis?

_____

_____

_____

(3)

(b) (i) What will happen to the water level in the capillary tube during the investigation because of osmosis?

_____

(1)

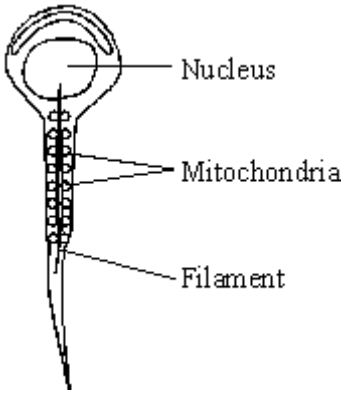
(ii) Use your knowledge of osmosis to explain why this happens.

_____

(2)

(Total 6 marks)

Q6. The diagram shows a human sperm. Inside the tail of the sperm is a filament mechanism that causes the side to side movement of the tail, which moves the sperm.



(a) Describe the function of the mitochondria and suggest a reason why they are arranged around the filament near the tail of the sperm.

_____

_____

_____

_____

(3)

(b) Explain the significance of the nucleus in determining the characteristics of the offspring.

_____

_____

_____

(2)

(Total 5 marks)

Q7. (a) (i) Name the red pigment found in red blood cells.

_____

(1)

(ii) Describe, in detail, the function of this red pigment.

_____

_____

_____

(2)

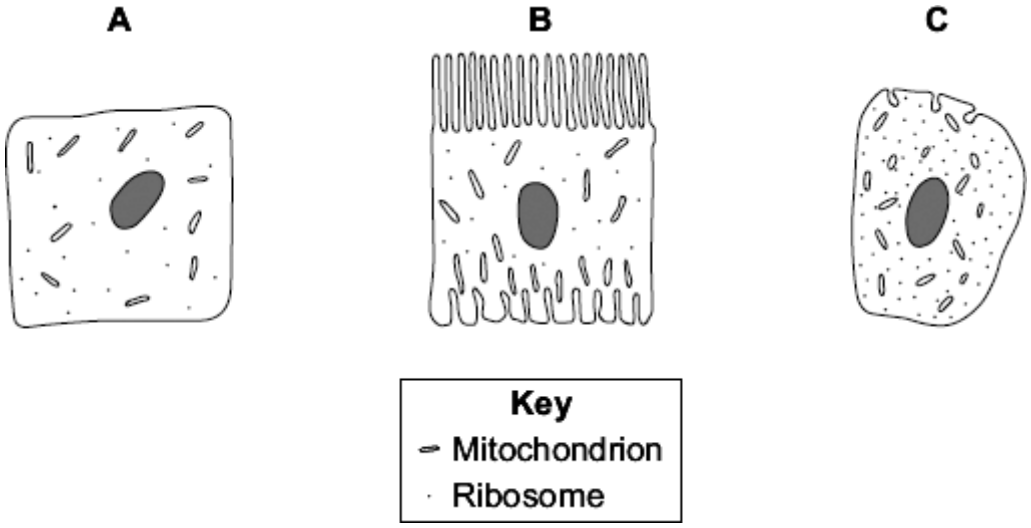
(b) Describe **one** other way in which the structure of a red blood cell is different from the structure of a white blood cell.

_____

_____

(1)

Q8. Diagrams **A**, **B** and **C** show cells from different parts of the human body, all drawn to the same scale.



(a) Which cell, **A**, **B** or **C**, appears to have adaptations to increase diffusion into or out of the cell? ☐

Give **one** reason for your choice.

_____

_____

(1)

(b) (i) Cell **C** is found in the pancreas.

Name **one** useful substance produced by the pancreas.

_____

(1)

(ii) Use information from the diagram to explain how cell **C** is adapted for producing this substance.

_____

_____

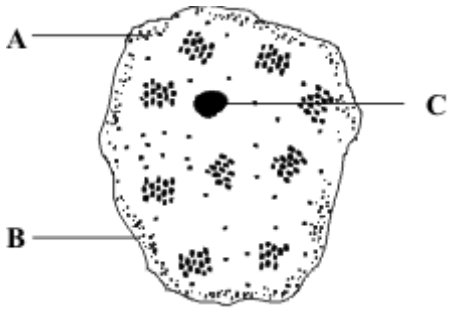
_____

_____

(2)

(Total 4 marks)

Q9. The diagram shows an animal cell.



(a) Name **each** labelled part and give its function.

A Name _____

Function _____

_____

B Name _____

Function _____

_____

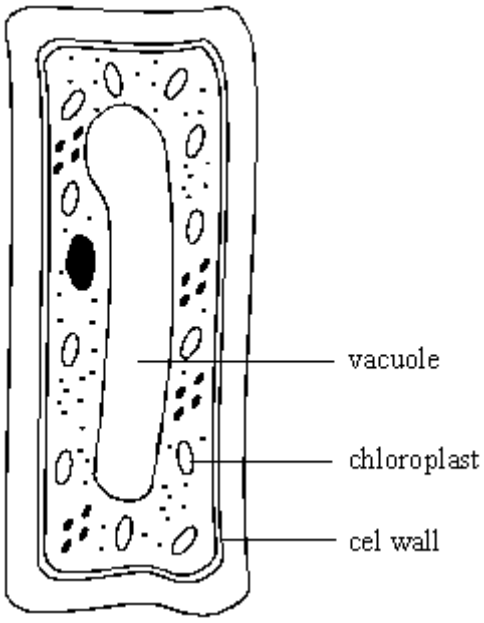
C Name _____

Function _____

_____

(6)

(b) (i) This plant cell also contains chloroplasts, a cell wall and a vacuole. Label **each** of these parts on the diagram.



(3)

(ii) Give the function of these parts of a plant cell.

Chloroplast function _____

_____

Cell wall function _____

_____

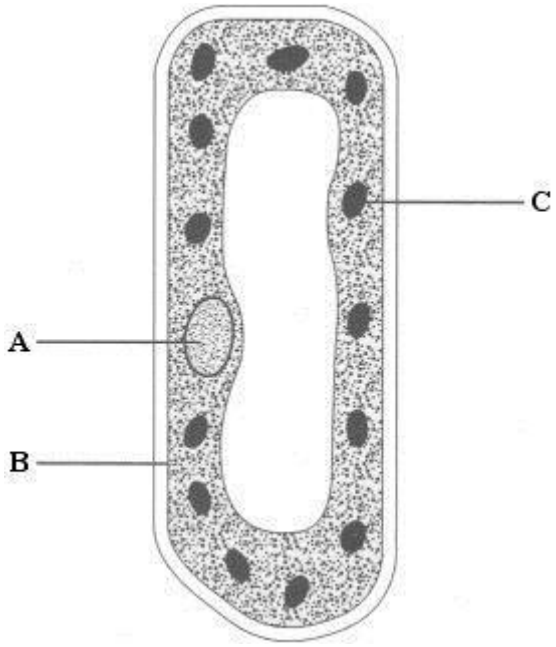
Vacuole function _____

_____

(3)

(Total 12 marks)

Q10. The diagram shows a cell from a plant leaf.



(a) Name structures **A** and **B**.

A _____

B _____

(2)

(b) Structure **C** is a chloroplast. What is the function of a chloroplast?

_____

(1)

(c) The table gives one difference between a plant cell and an animal cell.

Complete the table to give **two** more differences.

Plant cell	Animal cell
1. Has chloroplasts	1. No chloroplasts
2.	2.
3.	3.

(2)

(Total 5 marks)

Q11. Plant roots absorb water from the soil by osmosis.

(a) What is osmosis?

_____

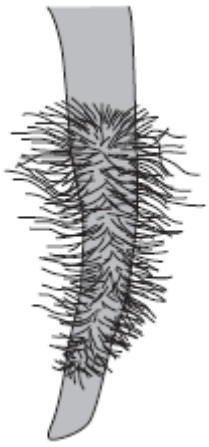
_____

_____

_____

(3)

(b) The image below shows part of a plant root.



The plant root is adapted for absorbing water from the soil.

Use information from the diagram to explain how this plant root is adapted for absorbing water.

_____

_____

_____

_____

_____

(3)

Q12. Cells contain a solution of salts and sugars.

A student is investigating how cells change when they are put into water.

(a) The student:

- looks at a plant cell using a microscope
- adds water to the cell.

The plant cell swells up.

Explain why, as fully as you can.

_____

_____

_____

_____

_____

_____

(3)

(b) When **animal** cells are put in water, they swell up, and then burst.
When **plant** cells are put in water, they swell up, but do **not** burst.

How does the structure of plant cells prevent them from bursting?

_____

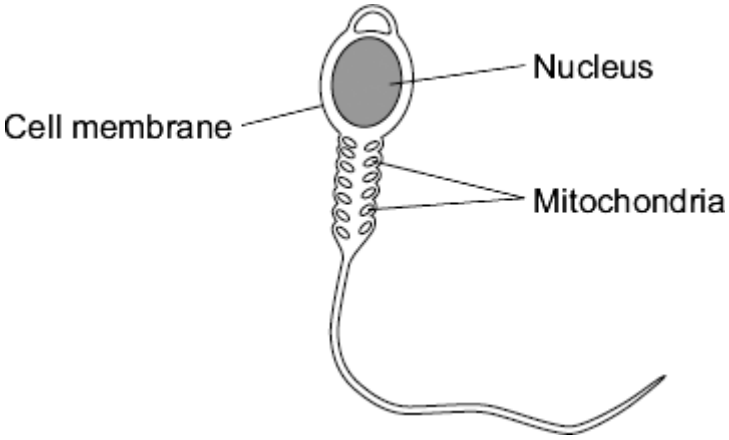
_____

(1)

(Total 4 marks)

Q13. Cells in the human body are specialised to carry out their particular function.

(a) The diagram shows a sperm cell.



The sperm cell is adapted for travelling to, then fertilising, an egg.

(i) How do the mitochondria help the sperm to carry out its function?

_____

_____

(1)

(ii) The nucleus of the sperm cell is different from the nucleus of body cells.

Give **one** way in which the nucleus is different.

_____

_____

(1)

(b) Stem cells from human embryos are used to treat some diseases in humans.

Explain why.

_____

_____

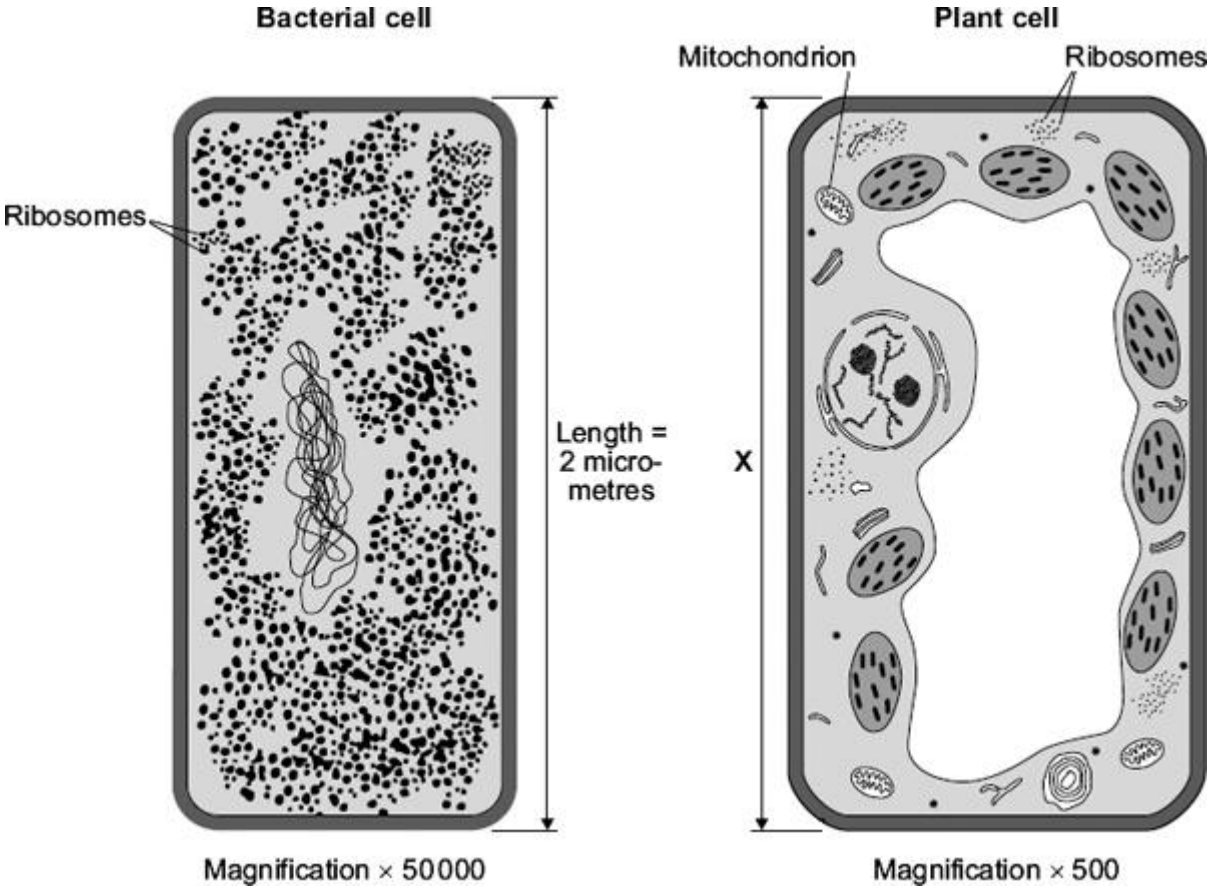
_____

_____

(2)

(Total 4 marks)

Q14. The diagram shows two cells, a bacterial cell and a plant cell.



(a) (i) Both the bacterial cell and the plant cell contain ribosomes. What is the function of a ribosome?

_____

_____

(1)

(ii) The plant cell contains mitochondria but the bacterial cell does **not** contain mitochondria.

Give **one** other way in which the plant cell is different from the bacterial cell.

_____

_____

(1)

(b) (i) Both cells are drawn the same length, but the magnification of each cell is different.

The real length of the bacterial cell is 2 micrometres.
Calculate the real length, **X**, of the plant cell. Give your answer in micrometres.

Show clearly how you work out your answer.

_____

_____

X = _____ micrometres **(2)**

(ii) Most mitochondria are about 3 micrometres in length.

The plant cell contains mitochondria but the bacterial cell does **not** contain mitochondria.

Use your answer to part (b)(i) and the information in the diagram to suggest why.

_____

_____

(1)

(Total 5 marks)

Q15. Stem cells can be used to treat some diseases.

(a) What is a stem cell?

_____

_____

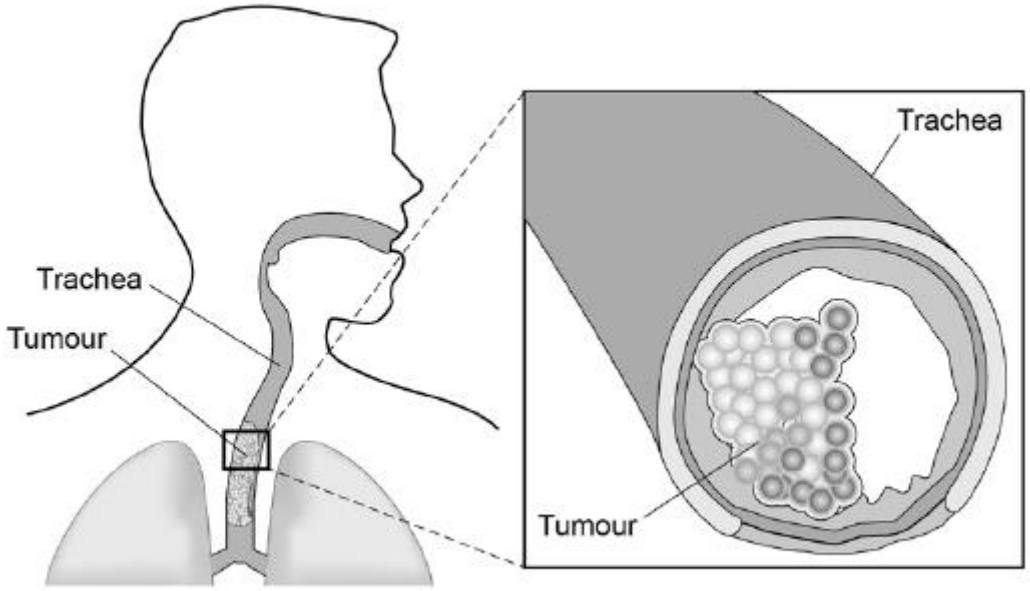
_____

_____

(2)

Figure 1 shows a malignant tumour in the trachea of a patient.

Figure 1



(b) Give **one** way a malignant tumour differs from a benign tumour.

_____

_____

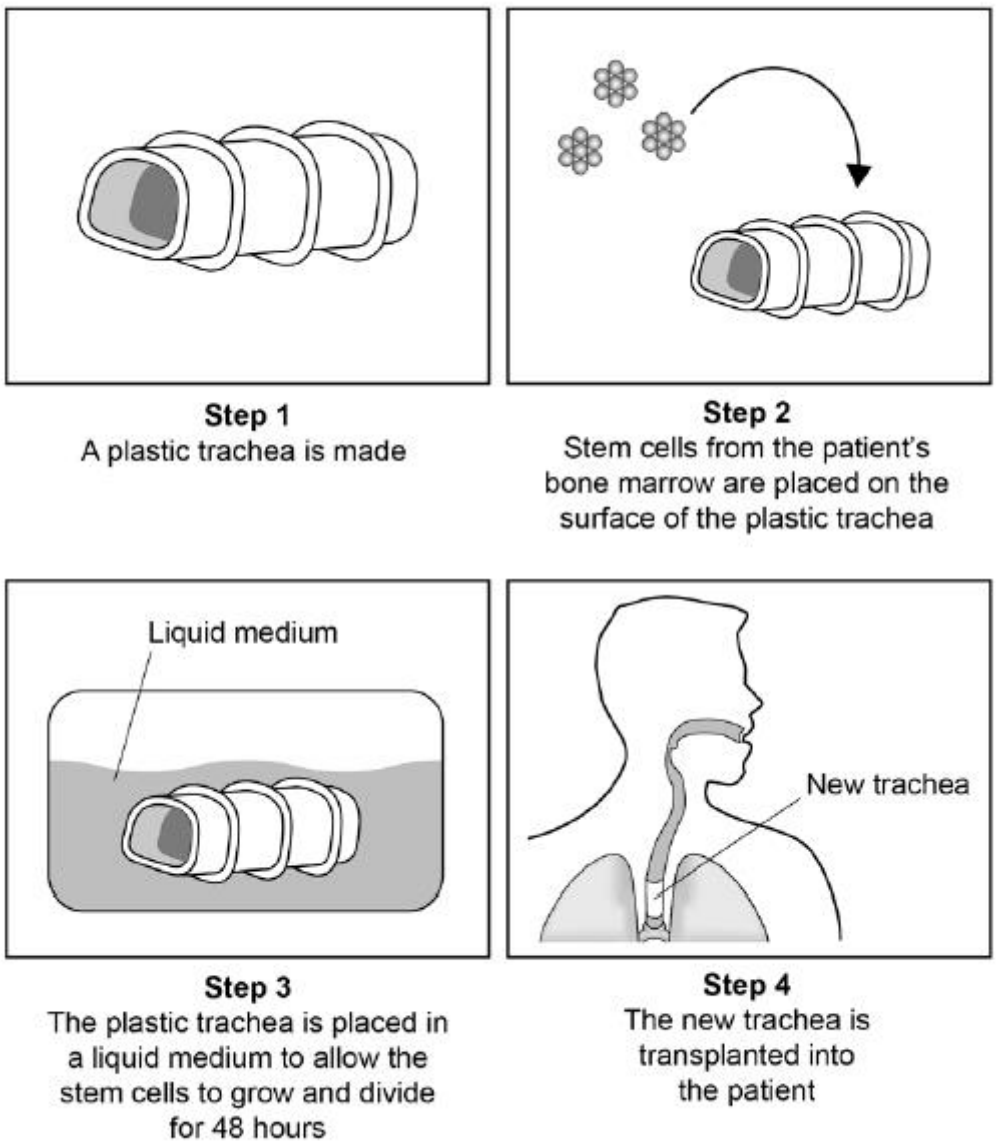
(1)

Scientists can treat the patient's tumour by replacing the trachea with a plastic trachea.

The plastic trachea has a layer of the patient's own stem cells covering it.

Figure 2 shows the procedure.

Figure 2



(c) In **Step 3** the cells are left for 48 hours to divide.

Name the type of cell division in **Step 3**.

_____

(1)

(d) In **Step 3** the cells are given oxygen and water.

Name **two** other substances the cells need so they can grow and divide.

1. _____

2. _____

(2)

(e) Give **two** advantages of using the stem cell trachea compared with a trachea from a dead human donor.

1. _____

2. _____

_____

(2)

(f) Sometimes the stem cell trachea is not strong enough.

Doctors can put a stent into the trachea.

Suggest how a stent in the trachea helps to keep the patient alive.

_____

_____

_____

_____

(2)

(g) Stem cells can also be obtained from human embryos.

Evaluate the use of stem cells from a patient's own bone marrow instead of stem cells from an embryo.

Give a conclusion to your answer.

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(Total 16 marks)

Q16. Cells, tissues and organs are adapted to take in different substances and get rid of different substances.

The table shows the concentration of four ions outside cells and inside cells.

Ion	Concentration outside cells in mmol per dm^3	Concentration inside cells in mmol per dm^3
Sodium	140	9
Potassium	7	138
Calcium	2	27
Chloride	118	3

(a) Use information from the table above to complete the following sentences.

Sodium ions will move into cells by the process

of _____ .

Potassium ions will move into cells by the process

of _____ .

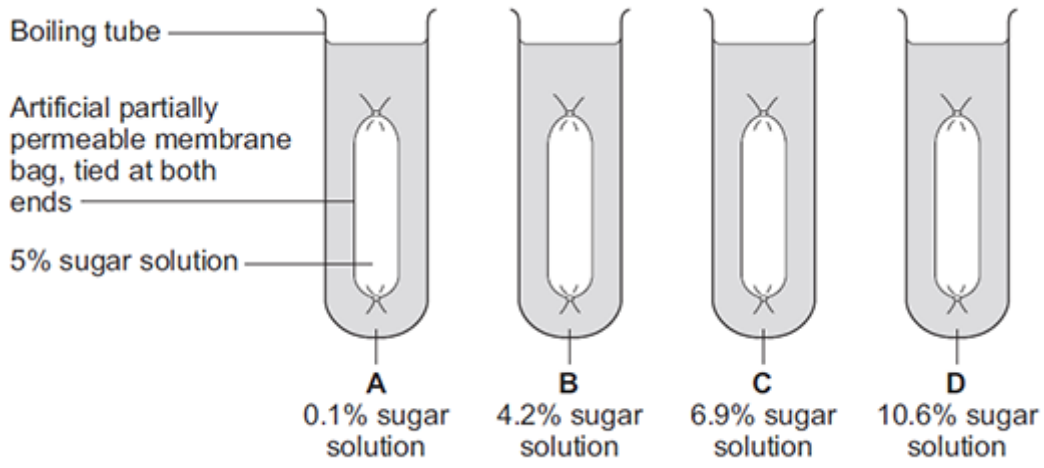
(2)

(b) Some students investigated the effect of the different concentrations of sugar in four drinks, **A**, **B**, **C** and **D**, on the movement of water across a partially permeable membrane.

The students:

- made four bags from artificial partially permeable membrane
- put equal volumes of 5% sugar solution in each bag
- weighed each bag containing the sugar solution
- placed one bag in each of the drinks, **A**, **B**, **C** and **D**
- after 20 minutes removed the bags containing the sugar solution and weighed them again.

The diagram below shows how they set up the investigation.



(i) The bag in drink **A** got heavier after 20 minutes.

Explain why.

_____

_____

_____

_____

(3)

(ii) In which drink, **A**, **B**, **C** or **D**, would you expect the bag to show the smallest change in mass?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(iii) Explain why you think the bag you chose in part **(b)(ii)** would show the smallest change.

_____

_____

_____

_____

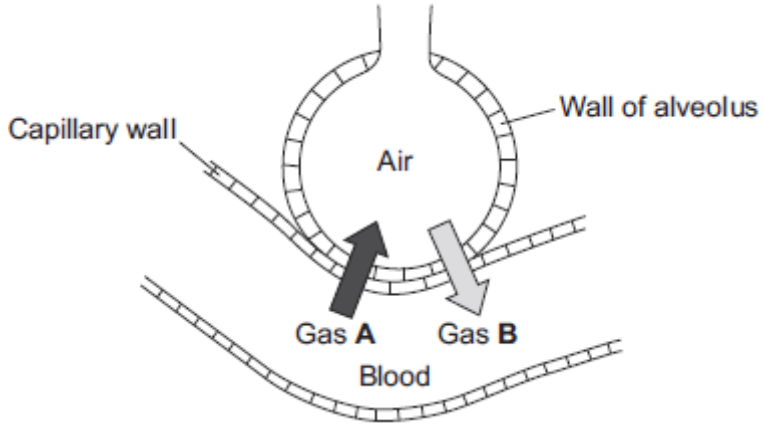
(2)

(Total 8 marks)

Q17. Gas exchange takes place in the lungs.

The diagram shows an alveolus next to a blood capillary in a lung.

The arrows show the movement of two gases, **A** and **B**.



(a) (i) Draw a ring around the correct answer to complete the sentence.

Gases **A** and **B** move by

diffusion.
osmosis.
respiration.

(1)

(ii) Gas **A** moves from the blood to the air in the lungs.

Gas **A** is then breathed out.

Name Gas **A**.

_____

(1)

(iii) Which cells in the blood carry Gas **B**?

Draw a ring around the correct answer.

platelets **red blood cells** **white blood cells**

(1)

(b) The average number of alveoli in each human lung is 280 million.

The average surface area of 1 million alveoli is 0.25 m^2.

Calculate the total surface area of a human lung.

_____

Answer _____ m^2

(2)

(c) An athlete trains to run a marathon. The surface area of each of the athlete's lungs has increased to 80 m^2.

Give **one** way in which this increase will help the athlete.

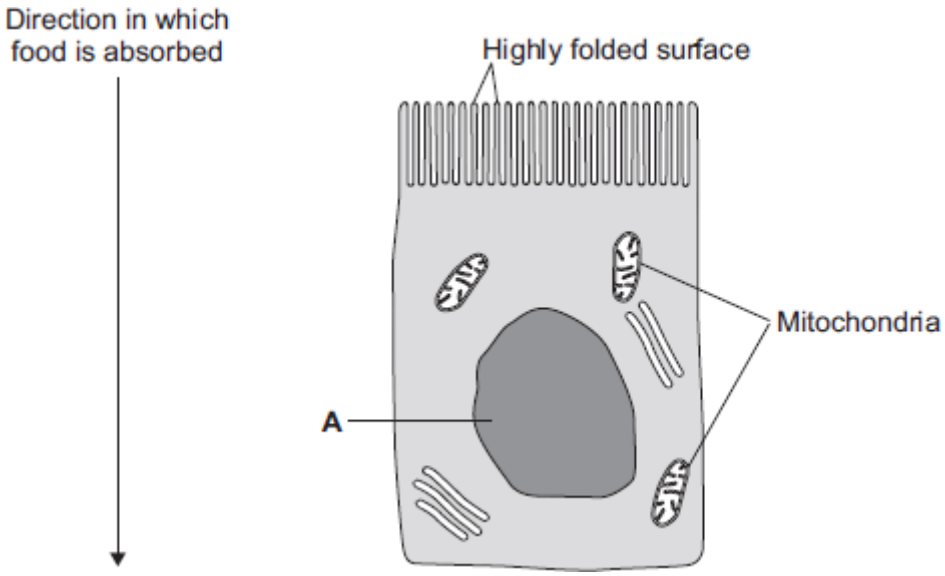
_____

_____

(1)

(Total 6 marks)

Q18. The image below shows an epithelial cell from the lining of the small intestine.



(a) (i) In the image above, the part of the cell labelled **A** contains chromosomes.

What is the name of part **A**?

_____

(1)

(ii) How are most soluble food molecules absorbed into the epithelial cells of the small intestine?

Draw a ring around the correct answer.

diffusion **osmosis** **respiration**

(1)

(b) Suggest how the highly folded cell surface helps the epithelial cell to absorb soluble food.

_____

_____

(1)

(c) Epithelial cells also carry out active transport.

(i) Name **one** food molecule absorbed into epithelial cells by active transport.

_____

(1)

(ii) Why is it necessary to absorb some food molecules by active transport?

_____

_____

(1)

(ii) Suggest why epithelial cells have many mitochondria.

_____

_____

_____

_____

(2)

(d) Some plants also carry out active transport.

Give **one** substance that plants absorb by active transport.

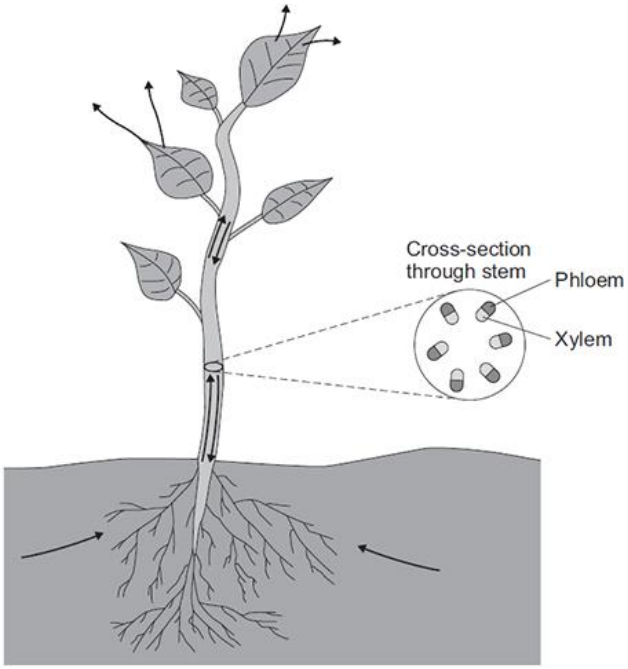
_____

(1)

(Total 8 marks)

Q19. Plants transport many substances between their leaves and roots.

The diagram below shows the direction of movement of substances through a plant.



Describe how **ions**, **water** and **sugar** are obtained and transported through plants.

In your answer you should refer to materials moving upwards in a plant and to materials moving downwards in a plant.

(Total 6 marks)

Q20. **Figure 1** shows an animal cell viewed using a microscope.

Figure 1

(a) The cell contains a nucleus.

What is the function of the nucleus?

_____

(1)

(b) Name **one** type of cell that does **not** contain a nucleus.

_____

(1)

(c) Draw a simple diagram of the cell in **Figure 1**.

Label **two** parts of the cell.

(2)

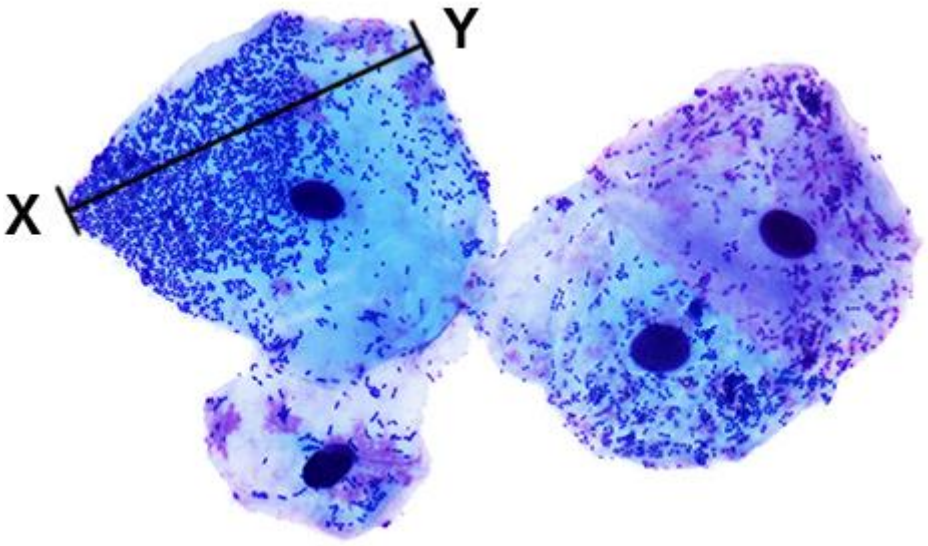
(d) Name **one** structure found in a plant cell but **not** found in an animal cell.

_____

(1)

Figure 2 shows some different cells.

Figure 2



(e) The real length from point **X** to point **Y** is 0.06 mm

Calculate the magnification.

Use the equation:

$$\text{magnification} = \frac{\text{size of image}}{\text{real size of object}}$$

_____

_____

_____

_____

_____

_____

Magnification = × _____

(3)

(f) The cells shown in **Figure 2** were viewed using a light microscope.

Give **two** advantages of using an electron microscope instead of a light microscope.

1 _____

_____

2 _____

_____

(2)

(Total 10 marks)

Q21. Plants transport water and mineral ions from the roots to the leaves.

(a) Plants move mineral ions:

- from a low concentration in the soil
- to a high concentration in the root cells.

What process do plants use to move these minerals ions into root cells?

Tick **one** box.

Active transport ☐

Diffusion ☐

Evaporation ☐

Osmosis ☐

(1)

(b) Describe how water moves from roots to the leaves.

_____

_____

_____

_____

(2)

(c) Plants lose water through the stomata in the leaves.

The epidermis can be peeled from a leaf.

The stomata can be seen using a light microscope.

The table below shows the data a student collected from five areas on one leaf.

Leaf area	**Number of stomata**	
	Upper surface	**Lower surface**
1	3	44
2	0	41
3	1	40
4	5	42
5	1	39
Mean	**2**	**X**

Describe how the student might have collected the data.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(d) What is the median number of stomata on the upper surface of the leaf?

_____

(1)

(e) Calculate the value of **X** in the table.

Give your answer to 2 significant figures.

_____

_____

Mean number of stomata on lower surface of leaf = _____

(2)

(f) The plant used in this investigation has very few stomata on the upper surface of the leaf.

Explain why this is an **advantage** to the plant.

_____

_____

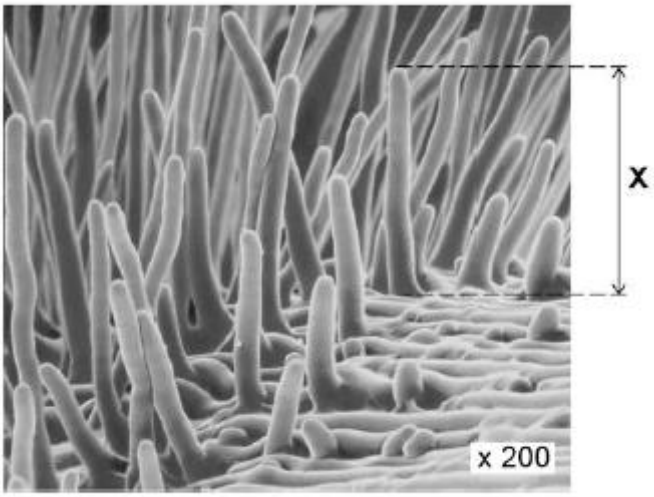
_____

_____

(2)

(Total 11 marks)

Q22. The image below shows part of a root from a cress plant.



(a) What type of microscope was used to create the image above?

_____

(1)

(b) The magnification of the cress root in the image above is × 200.
There are 1000 micrometres (μm) in a millimetre (mm).

Calculate the real length of the root hair, **X**.
Give your answer in micrometres (μm).

_____

_____

_____

_____

Real length **X** = _____ μm

(2)

(c) Root hair cells take up water from the soil.

Explain **one** way in which the root hair cell is adapted to this function.

_____

_____

_____

_____

(2)

The table shows the water uptake by a plant's roots on two different days.

	Mean water uptake in cm^3 per hour
Cold day	1.8
Hot day	3.4

(d) Explain why the mean rate of water uptake is higher on a hot day than on a cold day.

(3)

(e) The concentration of mineral ions in the soil is lower than in root hair cells.
Root hair cells take up mineral ions from the soil.
Root hair cells contain mitochondria.

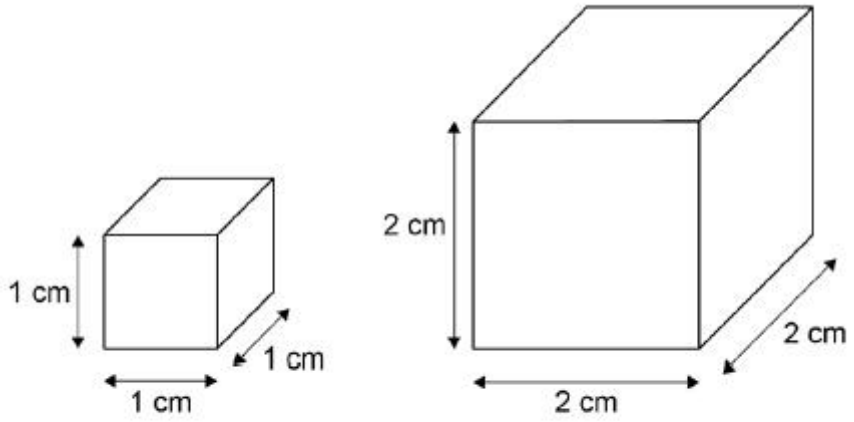
Explain why root hair cells contain mitochondria.

(4)

(Total 12 marks)

Q23. A student used cubes of potato to investigate the effect of surface area and volume on the rate of osmosis.

The diagram shows two of the cubes of potato the student used.



The surface area to volume ratio of **cube 1** is 6:1.

(a) Calculate the total surface area of **cube 2**.

_____

_____

Total surface area of **cube 2** = _____ cm^2

(1)

(b) Calculate the volume of **cube 2**.

_____

_____

Volume of **cube 2** = _____ cm^3

(1)

(c) Calculate the surface area to volume ratio of **cube 2**.

Use the equation:

$$\text{surface area to volume ratio} = \frac{\text{surface area}}{\text{volume}}$$

_____

_____

Surface area to volume ratio of **cube 2** = _____ : 1

(1)

This is the method used.

1. Cut two cubes of potato of size 2 cm × 2 cm × 2 cm
   - Cut one of these cubes into 8 cubes of potato of size 1 cm × 1 cm × 1 cm (sample **A**).
   - Do not cut the other cube (sample **B**).
2. Measure the mass of each sample **A** and the mass of sample **B**.
3. Place all the cubes into a beaker of distilled water.
4. Leave for 30 minutes.
5. Remove the cubes from the beaker and dry the surfaces with a paper towel.
6. Measure the mass of each sample of cubes.

(d) Why were 8 cubes of size 1 cm × 1 cm × 1 cm but only one cube of size 2 cm × 2 cm × 2 cm cube used?

_____

_____

(1)

(e) Why did the student dry the surface of each potato cube in step **5** of the method?

_____

_____

(1)

The table below shows the student's results.

	Mass at start in g	**Mass at end in g**	**Mass change in g**
Sample A **Eight cubes, each measuring 1 cm × 1 cm × 1 cm**	10.4	12.2	1.8
Sample B **One cube, measuring 2 cm × 2 cm × 2 cm**	9.9	10.7	**X**

(f) Calculate mass change **X** in the table above.

_____

_____

Mass change **X** = _____ g

(1)

(g) Explain why the masses of both samples of cubes increased.

_____

_____

_____

_____

(2)

(h) It would be better to calculate percentage change in mass rather than change in mass.

Why is this a more valid method?

Tick **one** box.

Because it makes it a fair test.	☐
Because it makes the investigation of the samples of cubes more accurate.	☐
Because the samples of cubes were different masses at the start of the investigation.	☐

(1)

(i) Explain why the mass of the cubes in sample **A** increased more than the mass of the cube in sample **B**.

_____

_____

_____

_____

(2)

(Total 11 marks)