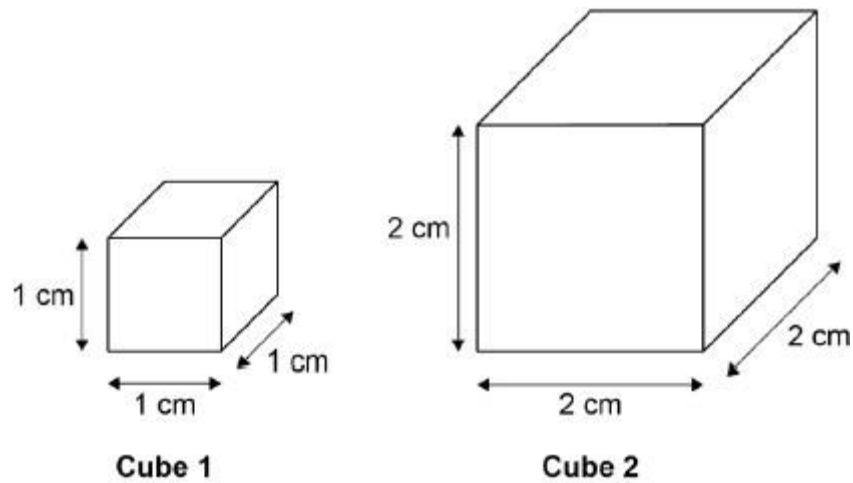


- 1 A student used cubes of potato to investigate the effect of surface area and volume on the rate of osmosis.

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** = _____ cm²

(1)

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

Volume of **cube 2** = _____ cm³

(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.

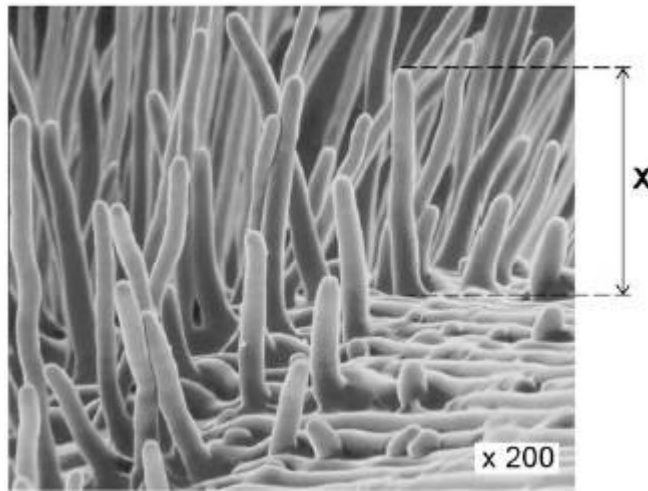
(1)

- (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)

2

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 $\times 200$.
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)

3

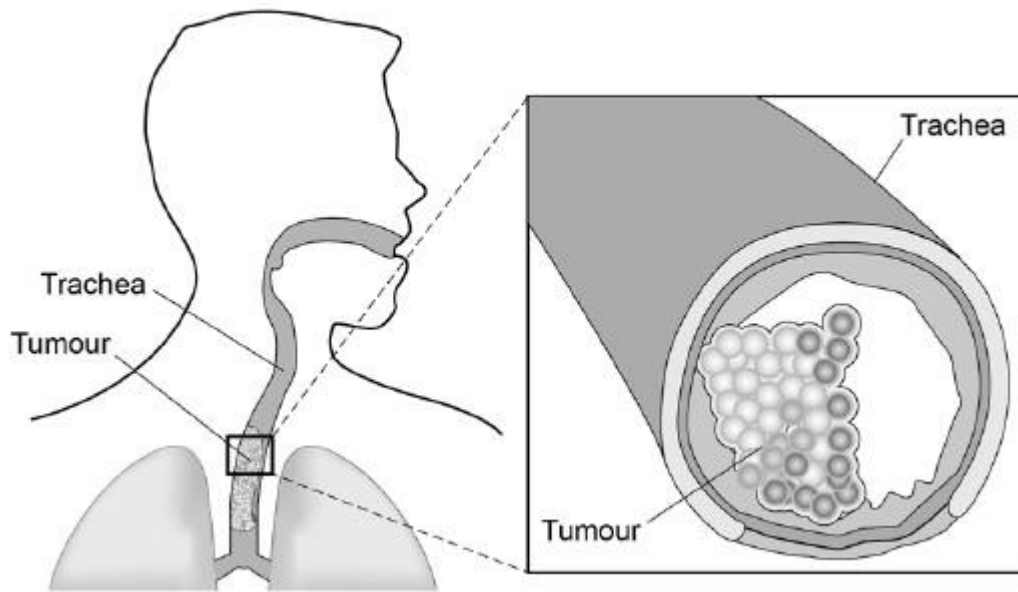
Stem cells can be used to treat some diseases.

(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.

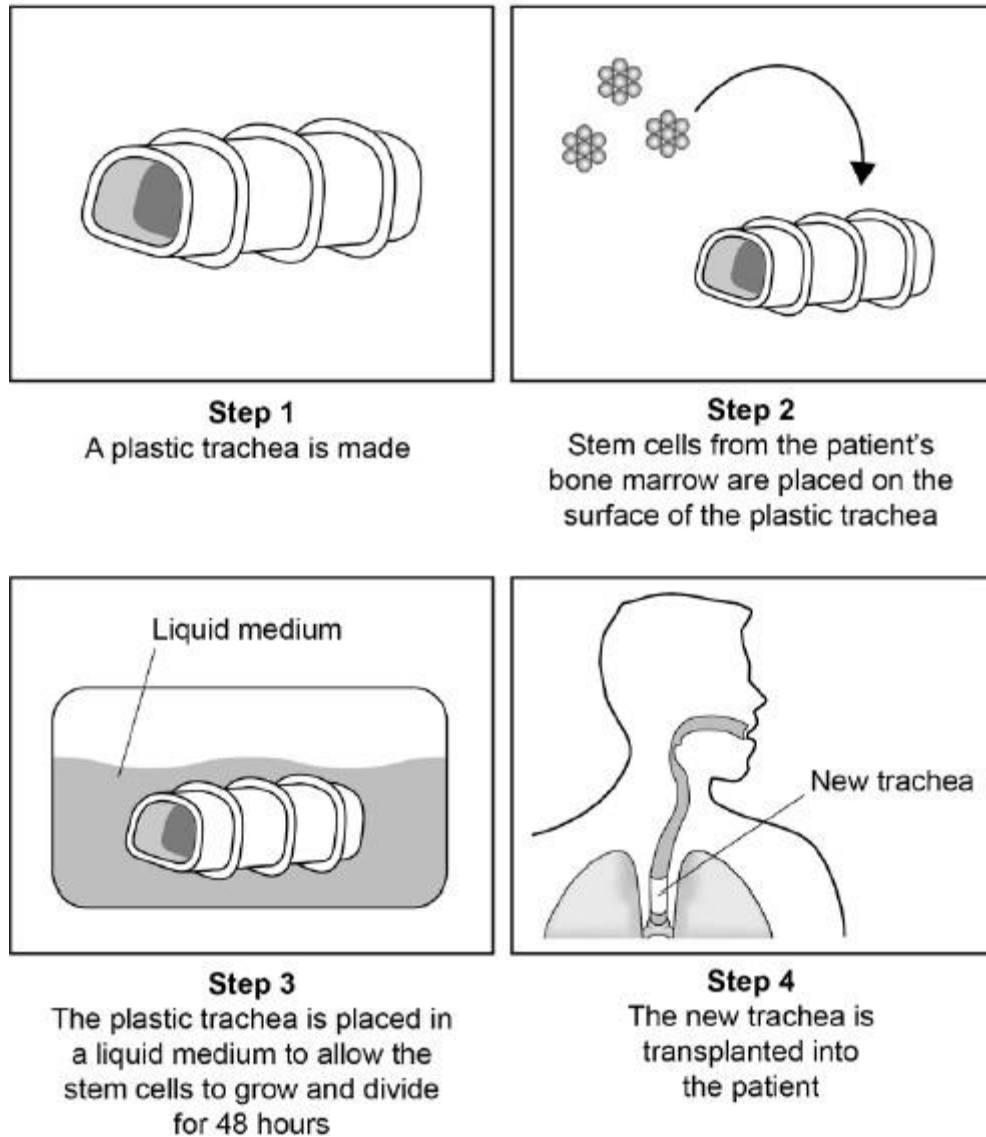
(1)

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)

4 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 dm³	Concentration inside cells in mmol per dm³
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 _____.

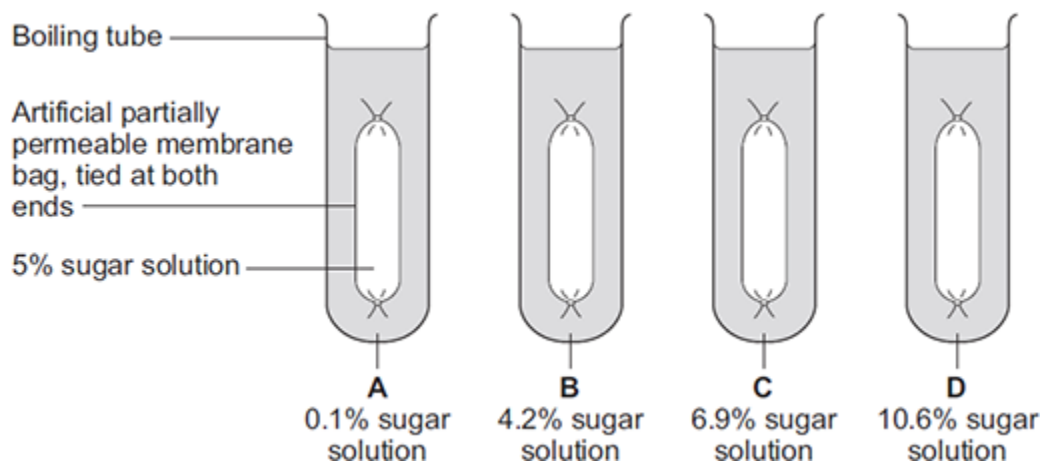
(2)

- (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)

5

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)

Mark schemes

- 1 (a) (surface area =) 24 (cm²) 1
- (b) (volume =) 8 (cm³) 1
- (c) 3 (:1)
allow ecf from (a) and (b) 1
- (d) to keep the volume (of the cubes) the same in both sets
allow to compare with the 2 × 2 × 2 cube
or
so both sets of cubes are 8 cm³
ignore to keep it fair 1
- (e) so that excess water does not contribute to the mass of the cubes 1
- (f) 0.8 (g)
if no answer given, check for answer in the table 1
- (g) (because) water moved into the cubes (by osmosis)
allow water moves in by diffusion 1
- because the solution outside the cubes was more dilute than inside the cells
allow converse
allow because the concentration of water was higher outside the cubes / in the beaker / solution than inside the cells 1
- (h) because the samples of cubes were different masses at the start of the investigation 1
- (i) more water was taken in
allow ecf for answer to (d) 1
- because they had a larger surface area to volume ratio
allow more / faster osmosis happened 1
- [11]
- 2 (a) electron (microscope) 1

(b) $\frac{30000}{200}$

an answer of 150 (µm) scores 2 marks

1

150 (µm)

*if answer is incorrect allow for 1 mark sight of 0.015 / 0.15 / 1.5 / 15
allow ecf for incorrect measurement of line X for max 1 mark*

1

(c) **either**

large surface area

allow (vacuole contains) cell sap that is more concentrated than soil water (1)

1

for more / faster osmosis

create / maintain concentration / water potential gradient (1)

or

allow thin (cell) walls

for short(er) diffusion distance

1

(d) (on hot day) more water lost

allow converse for a cold day if clearly indicated

1

more transpiration

or

more evaporation

1

so more water taken up (by roots) to replace (water) loss (from leaves)

1

(e) (aerobic) respiration occurs in mitochondria

*do **not** accept anaerobic respiration*

1

(mitochondria / respiration) release energy

*do **not** accept energy produced / made / created*

1

(energy used for) active transport

1

to transport ions, against the concentration gradient

or

from a low concentration to a high concentration

1

[12]

- 3 (a) an undifferentiated / unspecialised cell 1
- that can differentiate / become / change into (many) other cell types 1
- (b) (malignant tumours) invade / spread to other tissues via the blood (benign don't) **or**
 (malignant tumours) form secondary tumours in other organs
ignore cancer unqualified
allow converse
allow metastasises 1
- (c) mitosis
correct spelling only 1
- (d) glucose
answers in any order
ignore sugar 1
- protein / amino acids 1
- (e) no need to wait for a donor **or**
 can be done immediately 1
- (so) no risk of rejection **or**
 no need for immunosuppressant drugs
if no other marks awarded, allow for 1 mark idea of ethics surrounding the use of tissue from another / dead person 1
- (f) stent opens up the trachea 1
- allowing air to flow through **or**
 allowing patient to breathe 1

(g) Level 3 (5-6 marks):

A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.

Level 2 (3-4 marks):

Some logically linked reasons are given. There may also be a simple judgement.

Level 1 (1-2 marks):

Relevant points are made. They are not logically linked.

Level 0

No relevant content

Indicative content

embryos advantages

- can create many embryos in a lab
- painless technique
- can treat many diseases / stem cells are pluripotent / can become any type of cell (whereas bone marrow can treat a limited number)

embryos disadvantages

- *harm / death to embryo*
- *embryo rights / embryo cannot consent*
- *unreliable technique / may not work*

bone marrow advantages

- no ethical issues / patient can give permission
- can treat **some** diseases
- procedure is (relatively) safe / doesn't kill donor
- tried and tested / reliable technique
- patients recover quickly from procedure

bone marrow disadvantages

- *risk of infection from procedure*
- *can only treat a few diseases*
- *procedure can be painful*

both procedures advantage

can treat the disease / problem

both procedures disadvantages

- *risk of transfer of viral infection*
- *some stem cells can grow out of control / become cancerous*

[16]

4

(a) diffusion

1

active transport

1

this order only

- (b) (i) concentration (of sugar) in the bag was higher (than in the drink)
allow concentration (of sugar) in the drink was lower (than in the bag)

or

higher concentration of water outside the bag **or** in the drink / boiling tube
*allow higher water potential outside the bag **or** lower water potential inside the bag*

1

- (so) water moved in (to the tubing)
*allow water moves down **its** concentration gradient*
*do **not** allow sugar moving*

1

by osmosis

allow diffusion (of water)
*do **not** allow sugar moving by osmosis **or** water moving by active transport*

1

- (ii) **B**

1

- (iii) close(st) to the concentration in the bag **or** to 5%
*allow small(est) diffusion gradient **or** close(st) to an equilibrium*

1

(so rate of) diffusion / osmosis is slow
allow (so) less water moves in (to the bag)
ignore ref. to sugar

1

[8]

5

- (a) active transport

1

- (b) by transpiration stream / pull

1

in xylem

1

- (c) any **three** in the correct order from:
- mount epidermis on a slide
 - count stomata in one area
 - repeat in four more areas
 - repeat method on other surface of leaf
 - calculate mean

allow nail varnish film

3

(d) 1

allow numbers written out in a line with middle number circled

1

(e) $(44 + 41 + 40 + 42 + 39) / 5 = 41.2$

1

41

allow 41 with no working shown for 2 marks

1

allow 41.2 for 1 mark

(f) less water lost

1

so it does not wilt

1

[11]