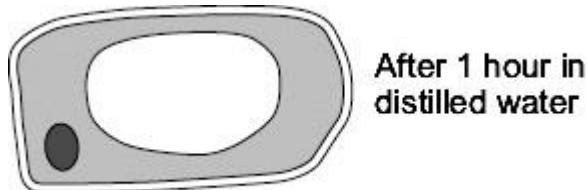


1 The diagram shows the same plant cell:

- after 1 hour in distilled water
- after 1 hour in strong sugar solution.



After 1 hour in  
distilled water



After 1 hour in  
strong sugar solution

- (a) Describe **two** ways in which the cell in the strong sugar solution is different from the cell in distilled water.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

(2)

- (b) Explain how the differences between the cell in the strong sugar solution and the cell in distilled water were caused.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2)

(Total 4 marks)

**2** Read the following information about how the small intestine absorbs sugars.

- The blood absorbs glucose and some other sugars, like xylose, from the small intestine.
- Glucose molecules are the same size as xylose molecules, but glucose is absorbed more quickly than xylose.
- Experiments with pieces of intestine show that the uptake of oxygen by the intestine is 50 % higher in the presence of glucose than in the absence of glucose. Xylose does not have this effect on the uptake of oxygen.
- The cells lining the small intestine have many mitochondria.

Explain how this information provides evidence that glucose is absorbed by the small intestine using *active transport*.

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**(Total 4 marks)**

- 3** (a) The concentration of sulfate ions was measured in the roots of barley plants and in the water in the surrounding soil.

The table shows the results.

Concentration of sulfate ions in mmol per dm <sup>3</sup>	
Roots of barley plants	1.4
Soil	0.15

Is it possible for the barley roots to take up sulfate ions from the soil by diffusion?

Draw a ring around your answer. **Yes / No**

Explain your answer.

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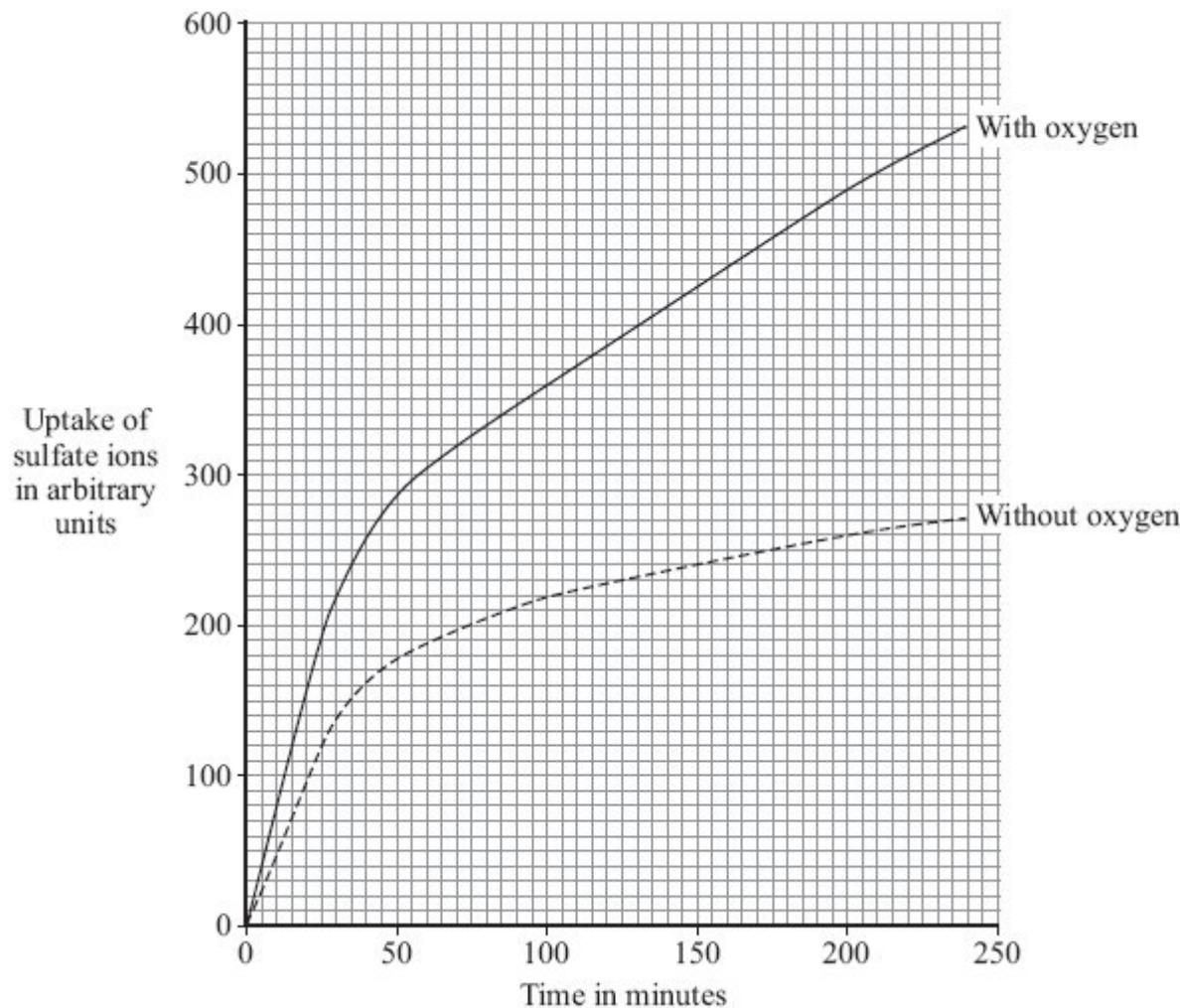
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(2)

- (b) Some scientists investigated the amounts of sulfate ions taken up by barley roots in the presence of oxygen and when no oxygen was present.

The graph below shows the results.



- (i) The graph shows that the rate of sulfate ion uptake between 100 and 200 minutes, **without** oxygen, was 0.4 arbitrary units per minute.

The rate of sulfate ion uptake between 100 and 200 minutes, **with** oxygen, was greater.

How much greater was it? Show clearly how you work out your answer.

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Answer \_\_\_\_\_ arbitrary units

(2)

- (ii) The barley roots were able to take up more sulfate ions with oxygen than without oxygen.

Explain how.

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(3)

(Total 7 marks)

- 4 (a) Some scientists investigated the rates of absorption of different sugars by the small intestine.

In one experiment they used a piece of normal intestine.

In a second experiment they used a piece of intestine poisoned by cyanide. Cyanide is poisonous because it prevents respiration.

The results are shown in the table.

Sugar	Relative rates of absorption	
	Normal intestine	Intestine poisoned by cyanide
Glucose	1.00	0.33
Galactose	1.10	0.53
Xylose	0.30	0.31
Arabinose	0.29	0.29

- (i) Name **two** sugars from the table which can be absorbed by active transport.

1. \_\_\_\_\_  
2. \_\_\_\_\_

(1)

- (ii) Use evidence from the table to explain why you chose these sugars.

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(3)

- (b) All of the sugars named in the table can be absorbed by diffusion.

Explain how information from the table provides evidence for this.

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(2)

(Total 6 marks)

- 5** The table shows the number of chromosomes found in each body cell of some different organisms.

Animals		Plants	
Species	Number of chromosomes in each body cell	Species	Number of chromosomes in each body cell
Fruit fly	8	Tomato	24
Goat	60	Potato	44
Human	46	Rice	24

- (a) Nearly every organism on earth has an even number of chromosomes in its body cells.

Suggest why.

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(1)

- (b) Chromosomes contain DNA molecules.

Describe the function of DNA.

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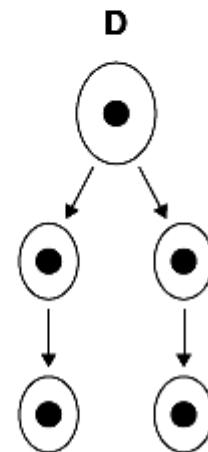
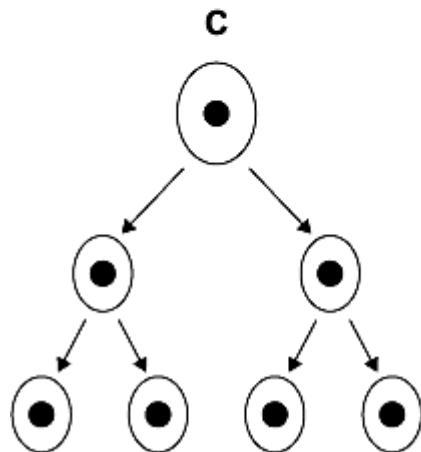
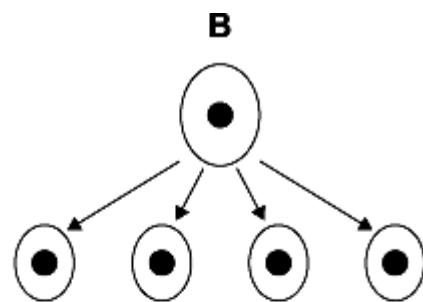
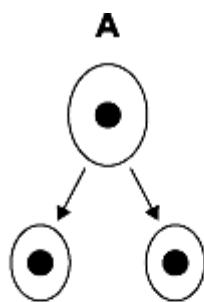
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(2)

- (c) Gametes are made in the testes by meiosis.

(i) Look at the diagrams.



Which diagram, A, B, C or D, represents how cell division by meiosis

produces gametes in the testes?

1

(1)

- (ii) How many chromosomes will each goat gamete contain?

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(1)

- (d) Body cells divide by mitosis.

- (i) Why is the ability of body cells to divide important?

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(1)

- (ii) When a body cell of a potato plant divides, how many chromosomes will each of the new cells contain?

(1)

(Total 7 marks)

6

Plants exchange substances with the environment.

- (a) Plant roots absorb water mainly by osmosis.  
Plant roots absorb ions mainly by active transport.

Explain why roots need to use the two different methods to absorb water and ions.

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(4)

- (b) What is meant by the *transpiration stream*?

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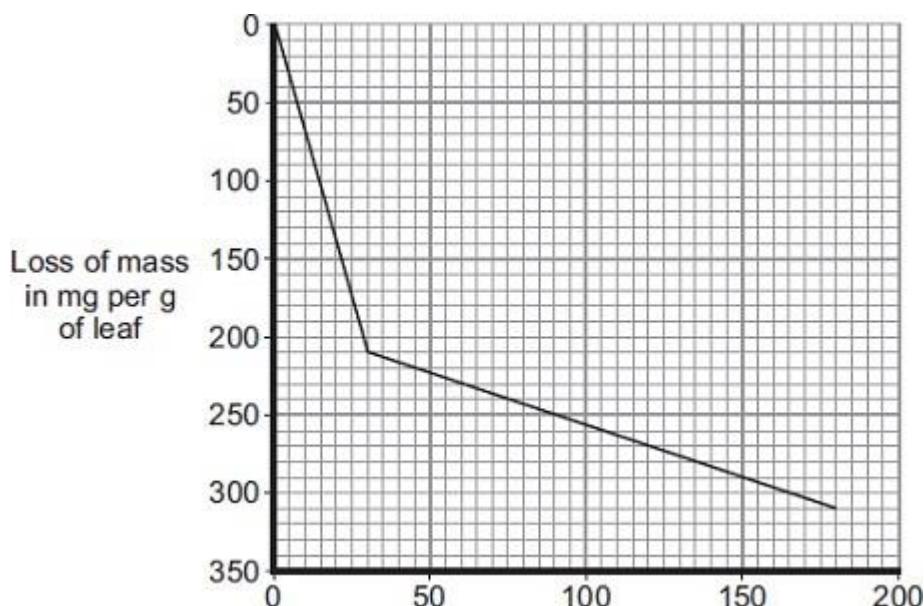
(3)

- (c) Students investigated the loss of water vapour from leaves.

The students:

- cut some leaves off a plant
- measured the mass of these leaves every 30 minutes for 180 minutes.

The graph shows the students' results.



- (i) The rate of mass loss in the first 30 minutes was 7 milligrams per gram of leaf per minute.

Calculate the rate of mass loss between 30 minutes and 180 minutes.

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Rate of mass loss = \_\_\_\_\_ milligrams per gram of leaf per minute

(2)

- (ii) The rate of mass loss between 0 and 30 minutes was very different from the rate of mass loss between 30 and 180 minutes.

Suggest an explanation for the difference between the two rates.

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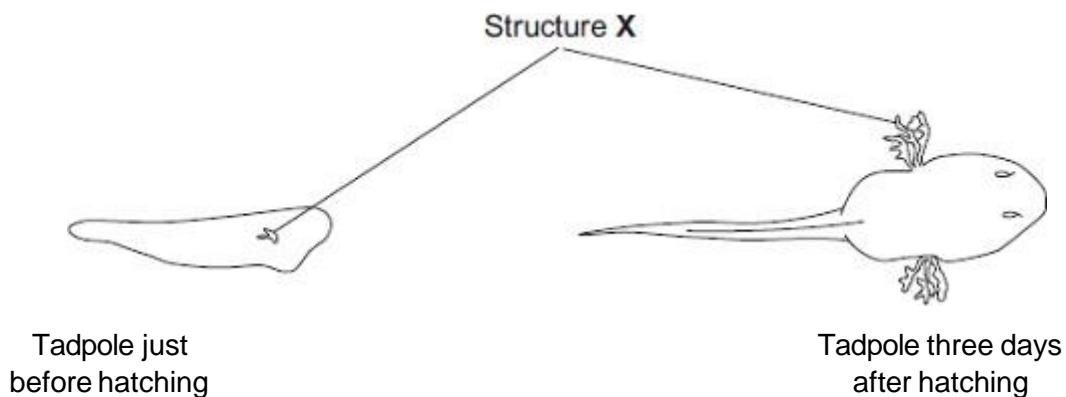
(2)

**(Total 11 marks)**

- 7** The young stages of frogs are called tadpoles. The tadpoles live in fresh water.

The drawings show a tadpole just before hatching and three days after hatching.

Structure X helps in the exchange of substances between the tadpole and the water.



- (a) Name **one** substance, other than food, that the tadpole needs to exchange with the water in order to grow.

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(1)

- (b) Suggest how the changes in the tadpole shown in the drawings help it to survive as it grows larger.

You should **not** refer to movement in your answer.

To gain full marks you should refer to structure X.

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(4)

**(Total 5 marks)**

- 8** The table shows the concentrations of three mineral ions in the roots of a plant and in the water in the surrounding soil.

Mineral ion	Concentration in millimoles per kilogram	
	Plant root	Soil
Calcium	120	2.0
Magnesium	80	3.1
Potassium	250	1.2

- (a) (i) The plant roots could **not** have absorbed these mineral ions by diffusion.

Explain why.

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(2)

(ii) Name the process by which the plant roots absorb mineral ions.

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(1)

(b) How do the following features of plant roots help the plant to absorb mineral ions from the soil?

(i) A plant root has thousands of root hairs.

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(1)

(ii) A root hair cell contains many mitochondria.

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(2)

(iii) Many of the cells in the root store starch.

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(1)

**(Total 7 marks)**

**9** Read the information about stem cells.

Stem cells are used to treat some human diseases.

Stem cells can be collected from early embryos. These stem cells have not begun to differentiate, so they could be used to produce any kind of cell, tissue or organ. The use of embryonic stem cells to treat human diseases is new and, for some diseases, trials on patients are happening now.

Stem cells can also be collected from adult bone marrow. The operation is simple but may be painful. Stem cells in bone marrow mainly differentiate to form blood cells.

These stem cells have been used successfully for many years to treat some kinds of blood disease. Recently there have been trials of other types of stem cell from bone marrow. These stem cells are used to treat diseases such as heart disease.

Evaluate the use of stem cells from embryos or from adult bone marrow for treating human diseases.

You should give a conclusion to your evaluation.

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(Total 5 marks)

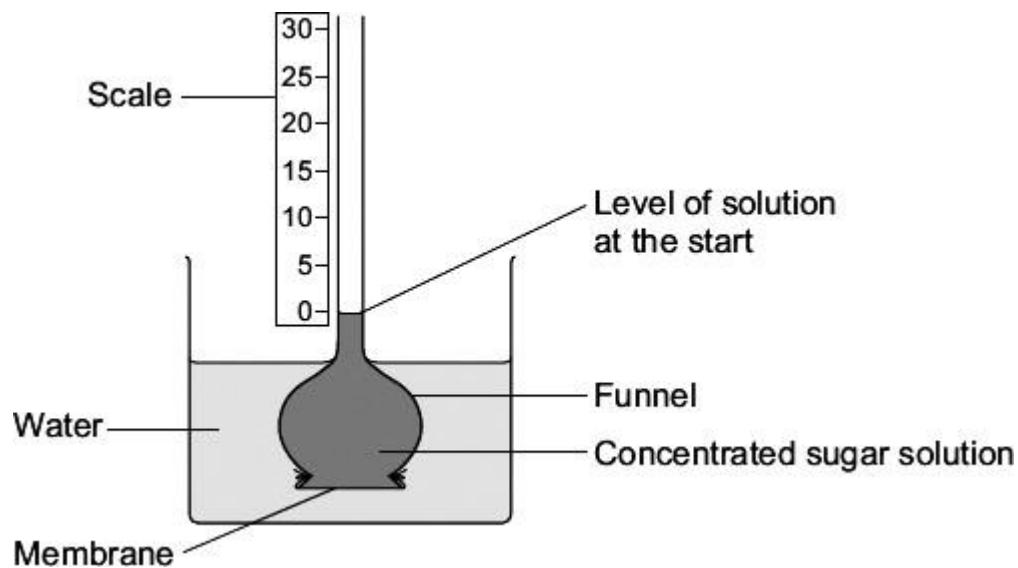
**10** Some substances move through membranes.

A student set up an investigation.

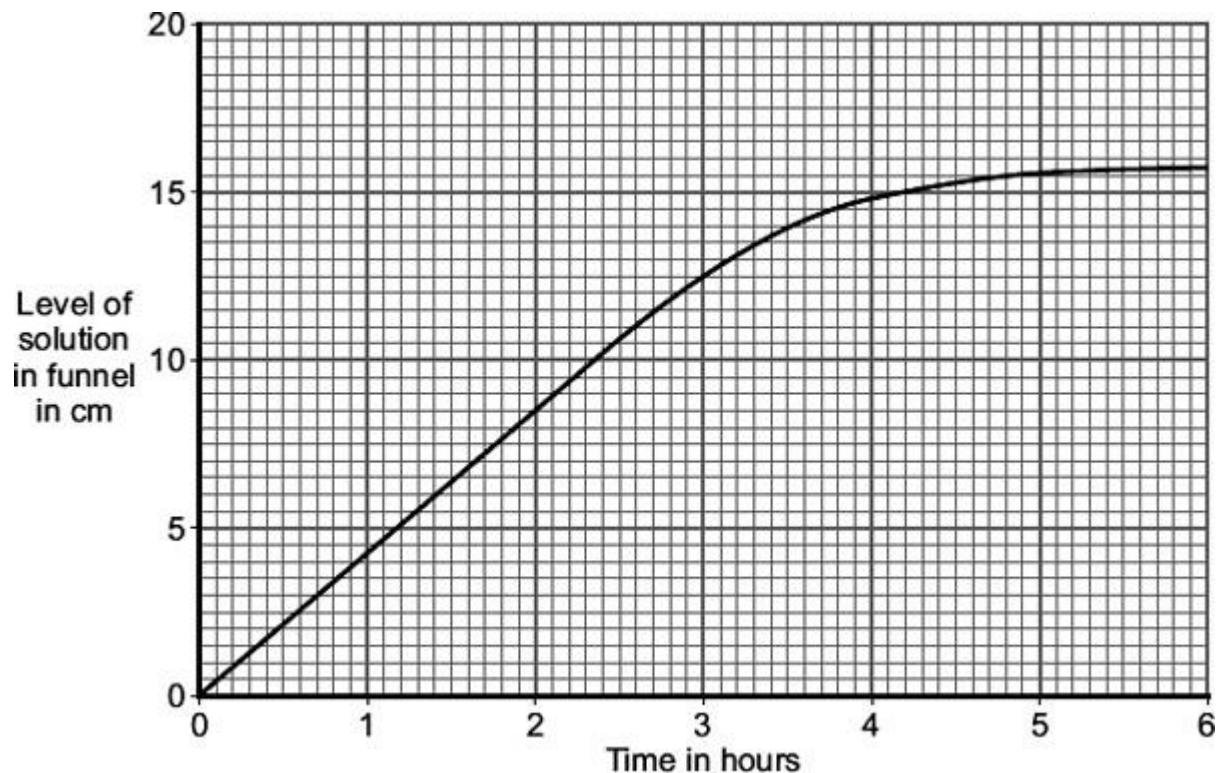
The student:

- tied a thin membrane across the end of a funnel
- put concentrated sugar solution in the funnel
- put the funnel in a beaker of water
- measured the level of the solution in the funnel every 30 minutes.

The diagram shows the apparatus.



The graph shows the results.



- (a) After 3 hours, the level of the solution in the funnel is different from the level at the start.

Explain why, as fully as you can.

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(3)

- (b) The student repeated the investigation using dilute sugar solution instead of concentrated sugar solution.

In what way would you expect the results using dilute sugar solution to be different from the results using concentrated sugar solution?

Give the reason for your answer.

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(2)

**(Total 5 marks)**

## Mark schemes

1 (a) *correct names of cell components are required  
it = cell in sugar solution*

any **two** from:

*accept reverse only if clearly stated answer refers to cell in distilled water*

- smaller vacuole
- smaller / less cytoplasm  
*allow protoplasm for cytoplasm*
- cell membrane / cytoplasm not (fully) against cell wall  
*accept plasmolysed / flaccid / less turgid*

**or**

cell membrane / cytoplasm (partly) pulled away from cell wall

*ignore reference to nucleus / water*

*ignore explanations*

**or**

space / liquid / sugar solution between cell membrane / cytoplasm and cell wall

2

(b) water passed / moved out (of cell) by osmosis / diffusion

*accept reverse answer if clearly refers to cell in distilled water*

1

more concentrated (solution) outside

*assume reference to*

*concentration refers to solute*

*concentration unless answer refers to water concentration*

**or**

less concentrated (solution) inside

**or**

lower water concentration outside

*accept references to hypertonic / hypotonic solutions or water potential*

**or**

higher water concentration inside

1

[4]

2 active transport needs energy **or** diffusion is not energy-dependent

1

any **three** from:

- (energy from) aerobic respiration
- more respiration with O<sub>2</sub> **or** more energy release with O<sub>2</sub>
- (aerobic) respiration / energy release occurs in mitochondria  
*do not allow anaerobic*
- xylose / other sugars absorbed by diffusion / not by active transport  
*allow active transport is selective / specific*  
**or** *active transport can distinguish glucose and xylose*

3

[4]

3 (a) No

*no mark*

*if yes max 1 for correct statement*

diffusion is down the concentration gradient

*accept by diffusion ions would leave the root*

1

to enter must go up / against the concentration gradient

**or** concentration higher in the root

**or** concentration lower in the soil

1

(b) (i) 0.9 **or** 3.25

*for correct answer with or without working*

*if answer incorrect 1.3 **or** their rate – 0.4 gains 1 mark*

**or** 130 – 40 **or** 90 gains 1 mark

2

(ii) (uptake) by active transport

1

requires energy

more energy from aerobic respiration

1

**or**

more energy when oxygen is present

1

[7]

**4** (a) (i) glucose **and** galactose

1

(ii) any **three** from:

Evidence:

- absorption reduced by cyanide  
*allow converse*
- absorb faster (than other sugars)

Explanation:

- active transport needs energy
- less / no energy available / released if cyanide is there  
**or** less / no energy if no / less respiration  
*allow energy produced*  
*ignore cyanide prevents respiration*

3

(b) all / the sugars / they can be absorbed when gut poisoned / with cyanide **or** when no respiration

1

(diffusion) does not need an energy supply

1

[6]

**5** (a) any **one** from

- chromosomes in pairs
- inherited one of each pair from each parent
- one of each pair in egg **and** one of each pair in sperm
- so sex cells / gametes can have half the number  
*allow need to pair during cell division / meiosis*

1

(b) any **two** from:

- code
- combination / sequence of amino acids
- forming specific / particular proteins / examples  
*If no other mark gained allow reference to controlling characteristics / appearance for 1 mark*

2

(c) (i) C

1

(ii) 30

1

- (d) (i) for growth / repair / replacement / asexual reproduction  
*do not accept incorrect qualification, eg growth of cells or repair of cells*  
*they equals cells therefore do not accept they grow etc*

1

(ii) 44 or 22 pairs

1

[7]

- 6 (a) solution in soil is more dilute (than in root cells)  
*concentration of water higher in the soil (than in root cells)*

1

so water moves from the dilute to the more concentrated region

*so water moves down (its) concentration gradient or water moves from a high concentration of water to a lower concentration*

1

concentration of ions in soil less (than that in root cells)

1

so energy needed to move ions

or

ions are moved against concentration gradient

*the direction of the concentration gradient must be expressed clearly*

*accept correct reference to water potential or to concentrations of water*

1

- (b) any **three** from:

- movement of water from roots / root hairs (up stem)
- via xylem
- to the leaves
- (water) evaporates
- via stomata

3

(c) (i) 0.67/0.7

accept 0.66, 0.666666... or  $\frac{2}{3}$  or 0.6

correct answer gains 2 marks with or without working

if answer incorrect allow evidence of  $\frac{100}{150}$  for 1 mark

do **not** accept 0.6 or 0.70

2

(ii) during the first 30 minutes

any **one** from:

- it was warmer
- it was windier
- it was less humid
- there was more water (vapour) in the leaves

1

so there was more evaporation

ignore 'water loss'

or

stomata open during first 30 minutes **or** closed after 30 minutes (1)

so faster (rate of) evaporation in first 30 min **or** reducing (rate of) evaporation after 30 min (1)

1

[11]

7 (a) oxygen / O<sub>2</sub>

allow O<sub>2</sub>

do **not** accept O<sup>2</sup>

or

carbon dioxide / CO<sub>2</sub>

allow CO<sub>2</sub>

do **not** accept CO<sup>2</sup>

1

(b) any four from:

*ignore references to tail used for locomotion*

*ignore reference to nostrils*

- because structure X / gills has threads / filaments **or** is thin **or** tadpole has longer tail
- there is an increased surface area
- there is a shorter diffusion pathway
- therefore an increase in exchange  
*ignore food*
- eyes (now visible in older tadpole)
- so that food / danger etc can be seen  
*accept reference to a good blood supply*  
*accept increased water flow over gills / tail will increase diffusion of gases*

4

[5]

8 (a) (i) diffusion is down the concentration gradient  
*for a description of diffusion*  
*ignore along / across gradients*

1

to enter must go up / against the concentration gradient

*accept by diffusion ions would leave the root*

**or**

concentration higher in the root / plant

**or**

concentration lower in the soil

1

(ii) active transport  
*allow active uptake*

1

(b) (i) (root hairs →) large surface / area

1

(ii) (aerobic) respiration  
*do not allow anaerobic*

1

releases / supplies / provides / gives energy  
*accept make ATP (for active transport)*  
**do not allow** 'makes / produces / creates' energy

1

(iii) starch is energy source / store (for active transport)  
*allow starch can be used in respiration*  
**do not allow** 'makes / produces / creates' energy

1

[7]

**9** Marks should **not** be awarded for simply copying the information provided  
A mark may be awarded for a comparison between treatments if the answer only involves copied information

any **four** from:

*For all 4 marks to be awarded, there must be at least 1 pro and 1 con*

embryo stem cells – examples of

pros

- can treat a wide variety / lots of diseases / problems
- many available / plentiful
- using them better than wasting them
- painless

cons

- (possible) harm / death to embryo
- (relatively) untested / unreliable / may not work
  - allow long term effects not known*
  - or may be more risky*
- embryo can't be 'asked' / 'embryo rights' idea

## adult bone marrow stem cells – examples of

pros

- no ethical issues (in collection) **or** permission given
- quick recovery
- (relatively) safe  
*allow does not kill (donor) / low risk*
- well tried / tested / know they work

cons

- operation hazards eg infection
- few types of cell / tissue produced **or** few diseases / problems treated
- painful so may deter donors

4

Conclusion to evaluation:

A reasoned conclusion from the evidence

1

[5]

10

- (a) water enters (funnel / sugar solution) **or** water diffuses in (to the funnel)  
*do not accept if diffusion of sugar*

1

membrane partially / selectively / semi permeable **or** by osmosis

*allow description*

1

because concentration (of sugar) greater  
inside funnel than outside / water / in beaker

*assume 'concentration' refers to sugar unless candidate indicates  
otherwise  
the position of the solutions may be implied*

1

- (b) (level / it) rises more slowly **or** levels out earlier **or** does not rise as much

*accept inference of less steep gradient (of graph)*

*allow less / slower osmosis / diffusion / less water passes through  
or less water enters funnel*

*allow water enters / passes through slower*

1

less difference in concentration (between solution / funnel and water / beaker)

*accept due to lower diffusion / concentration gradient / described*

1

[5]