



Cell Biology Higher

Name: _____

Class: _____

Date: _____

Time: **230 minutes**

Marks: **229 marks**

Comments:

Q1.

Plants need chemical energy for respiration and for active transport.

- (i) Write a balanced chemical equation which represents the process of respiration in plants.

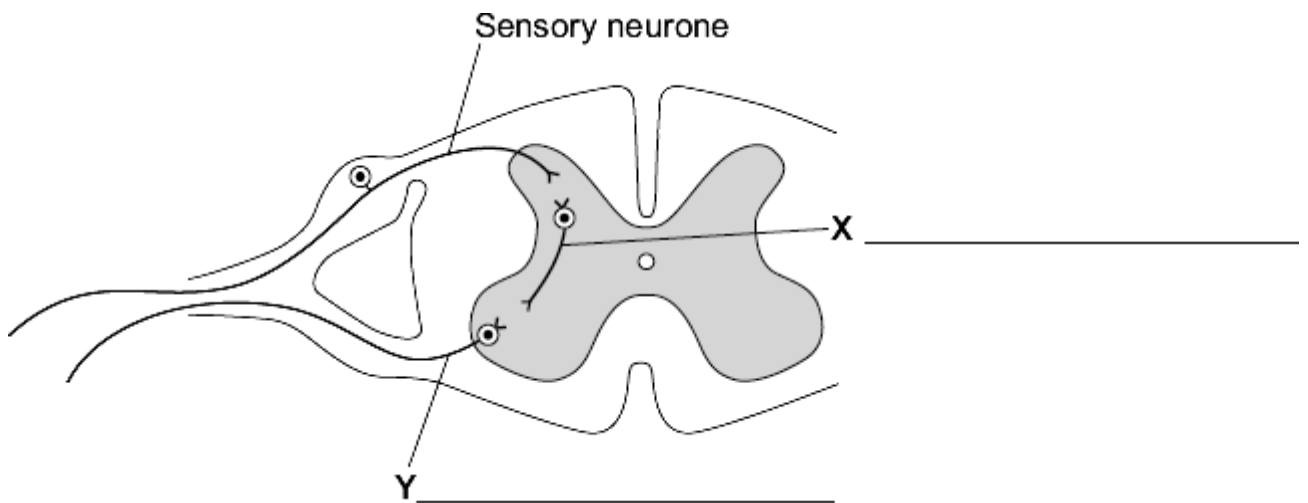
_____ (2)

- (ii) Describe the process of active transport in the root hair cells of plants.

(3)
(Total 5 marks)

Q2.

The diagram shows some of the structures involved in a reflex action.



- (a) On the diagram, name the neurones labelled X and Y.

(1)

- (b) Describe how information is transmitted from neurone X to neurone Y.

(2)
(Total 3 marks)

Q3.

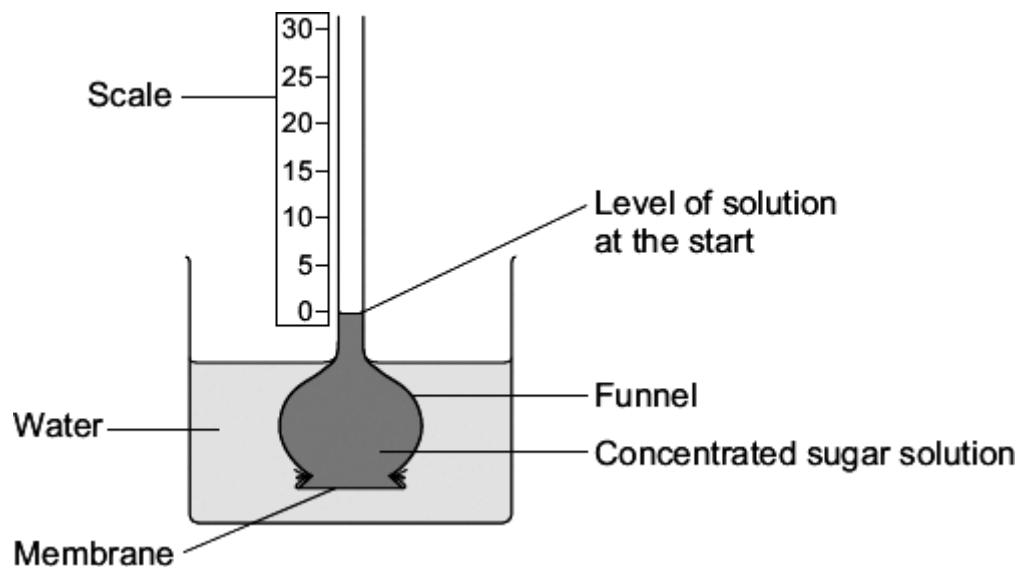
Some substances move through membranes.

A student set up an investigation.

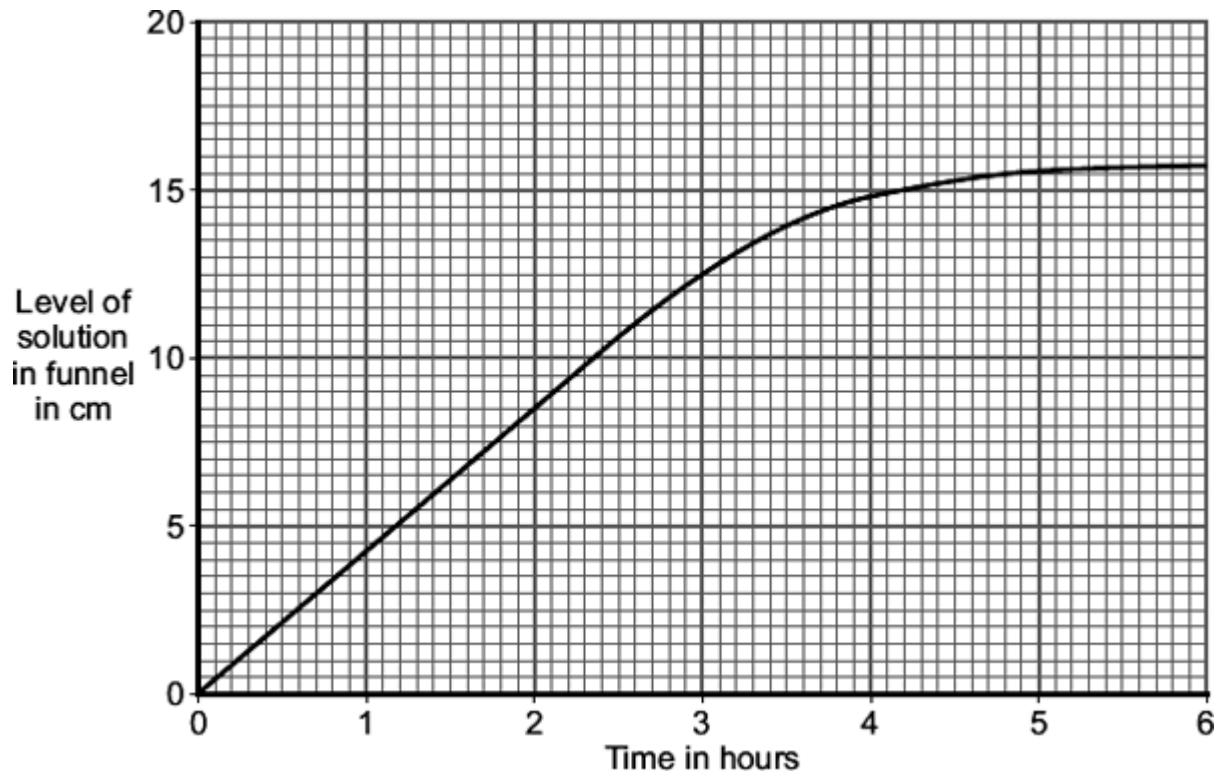
The student:

- 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.

(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.

(2)

(Total 5 marks)

Q4.

Plant roots obtain some of their mineral salts from the soil by active transport.

What is involved in *active transport*?

(Total 4 marks)

Q5.

(a) How many pairs of chromosomes are there in a body cell of a human baby?

(1)

(b) Place the following in order of size, **starting with the smallest**, by writing numbers **1 – 4** in the boxes underneath the words.

chromosome

nucleus

gene

cell

(1)

(c) For a baby to grow, its cells must develop in a number of ways.

Explain how each of the following is part of the growth process of a baby.

(i) Cell enlargement

(1)

(ii) The process of cell division by mitosis

(3)

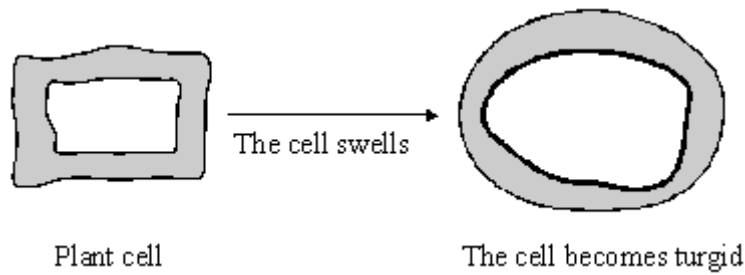
- (d) Why is cell specialisation (differentiation) important for the development and growth of a healthy baby from a fertilised egg?

(2)

(Total 8 marks)

Q6.

- (a) The diagrams show what happens to the shape of a plant cell placed in distilled water.



- (i) Explain why the cell swells and becomes turgid. Name the process involved.

(2)

- (ii) Give **one** feature of the cell wall which allows the cell to become turgid.

(1)

- (b) Describe the change which will occur if a piece of peeled potato is placed in a concentrated sugar solution and explain why this change occurs.

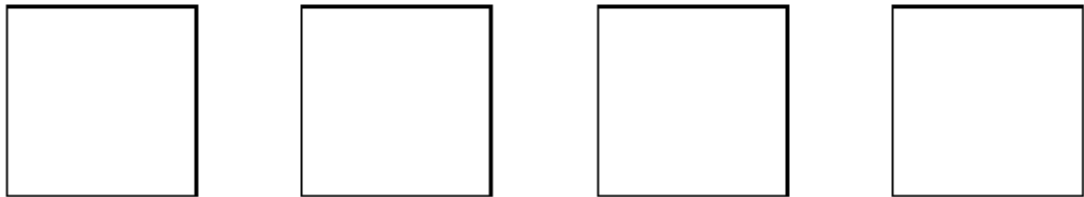
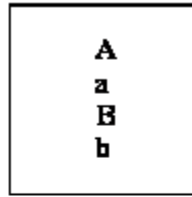
(3)

(Total 6 marks)

Q7.

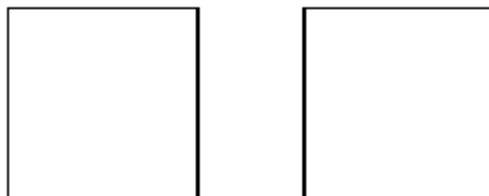
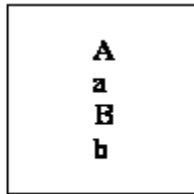
In the cell shown in the diagram as a box, one chromosome pair has alleles **Aa**. The other chromosome pair has alleles **Bb**. The cell undergoes meiosis.

- (a) Complete the diagram of the four gametes to show the independent assortment, or reassortment, of genetic material during meiosis.



(2)

- (b) If the cell undergoes mitosis instead of meiosis, draw the two daughter cells which result to show the chromosomes in each.



(2)

- (c) State the number of chromosomes in:

- (i) a normal human cell;

(1)

- (ii) a human gamete;

(1)

- (iii) the daughter cell from mitosis of a human cell.

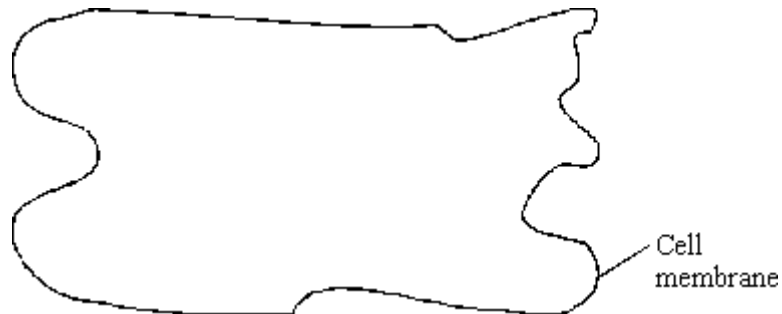
(1)

Q8.

- (a) The diagram shows a normal body cell which has six chromosomes.



- (i) Complete the diagram below to show **one** cell produced from this cell by *mitosis*.



(3)

- (ii) Complete the diagram below to show **one** cell produced from the original cell by *meiosis*.



(2)

- (b) Thalassaemia is a blood disease. It is determined by a single recessive allele. A person with one recessive allele does **not** get the disease but does act as a carrier. People with this pair of recessive alleles can become ill.

- (i) Draw a genetic diagram to show the inheritance of this disease if both parents are heterozygous.

[Use the symbols T = dominant allele and t = recessive allele]

(3)

(ii) What are the chances of a baby inheriting the disease?

(1)

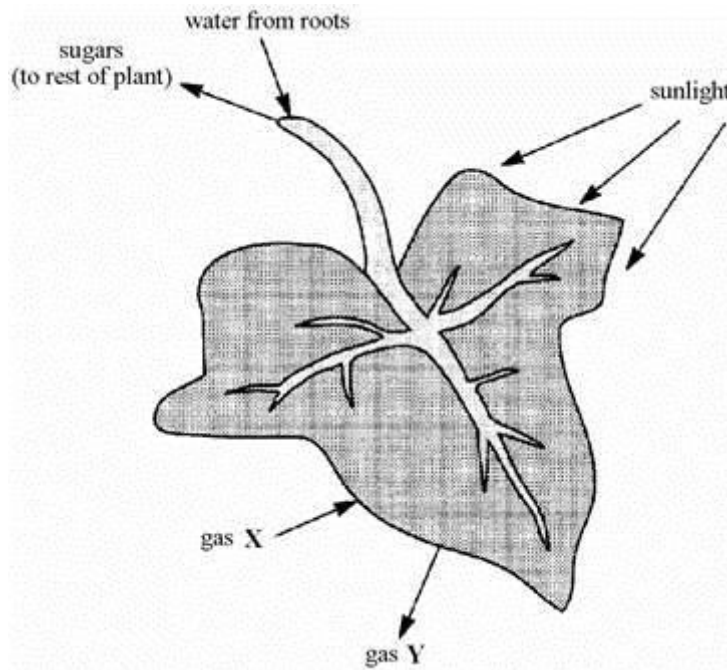
(iii) What are the chances of a baby being a carrier if both parents are heterozygous?

(1)

(Total 10 marks)

Q9.

The diagram shows a plant leaf during photosynthesis.



(a) Name:

(i) gas X; _____

(ii) gas Y. _____

(2)

(b) Why is sunlight necessary for photosynthesis?

(1)

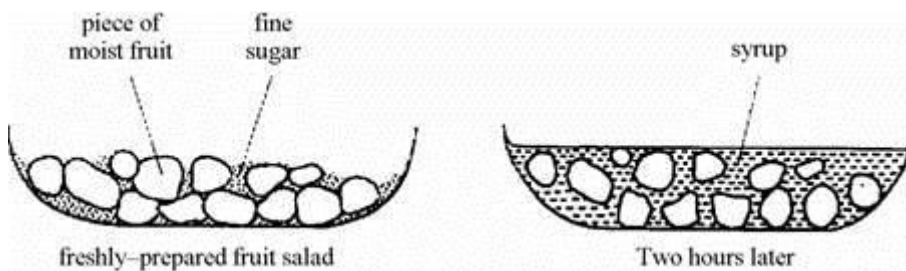
(c) Some of the sugars produced by photosynthesis are stored as starch in the roots.

Explain, as fully as you can, why it is an advantage to the plant to store carbohydrate as starch rather than as sugar.

(3)
(Total 6 marks)

Q10.

A cook prepares a fresh fruit salad by cutting up a variety of fruits and placing them in a bowl with layers of sugar in between. After two hours the fruit is surrounded by syrup (concentrated sugar solution).



Explain, as fully as you can, why syrup (concentrated sugar solution) was produced after two hours.

(Total 4 marks)

Q11.

Read the extract.

Super-bug may hit the price of coffee

The coffee bean borer, a pest of the coffee crop, can be controlled by the pesticide endosulphan. However, strains of the insect that are up to 100 times more resistant to the pesticide have emerged on the South Pacific island of New Caledonia.

For full resistance to be passed on to an offspring two copies of the new resistance allele

5 should be inherited, one from each parent. There is much inbreeding with brother-sister matings happening in every generation, so it takes only a few generations before all the descendants of a single resistant female have inherited two copies of the resistance allele.

If this resistance spreads from New Caledonia, it will mean the loss of a major control

10 method. This will present a serious threat to the international coffee industry.

(a) Suggest how the allele for resistance to endosulfan may have arisen.

(1)

(b) (i) How would you expect the proportion of normal coffee bean borers on New Caledonia to change over the next few years?

(ii) Explain why this change will take place.

(3)

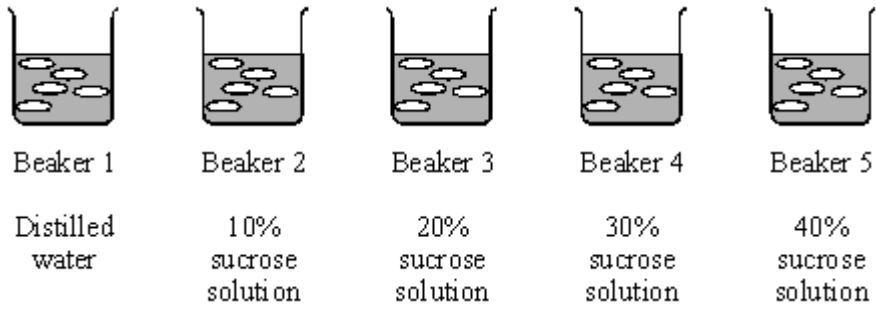
(c) Explain why "it takes only a few generations before all the descendants of a single resistant female have inherited two copies of the resistance allele." (lines 6-8)

(3)

(Total 7 marks)

Q12.

Some students set up an experiment using osmosis to find the concentration of sucrose solution in potato cell sap. They used discs of potato cut to the same size and weighing approximately 10 gms. The discs were put into each of five beakers.



- (a) (i) After two hours they reweighed the discs after carefully blotting them first. Why did the students blot the potato before weighing it?

(1)

- (ii) Their results are shown in the table below.

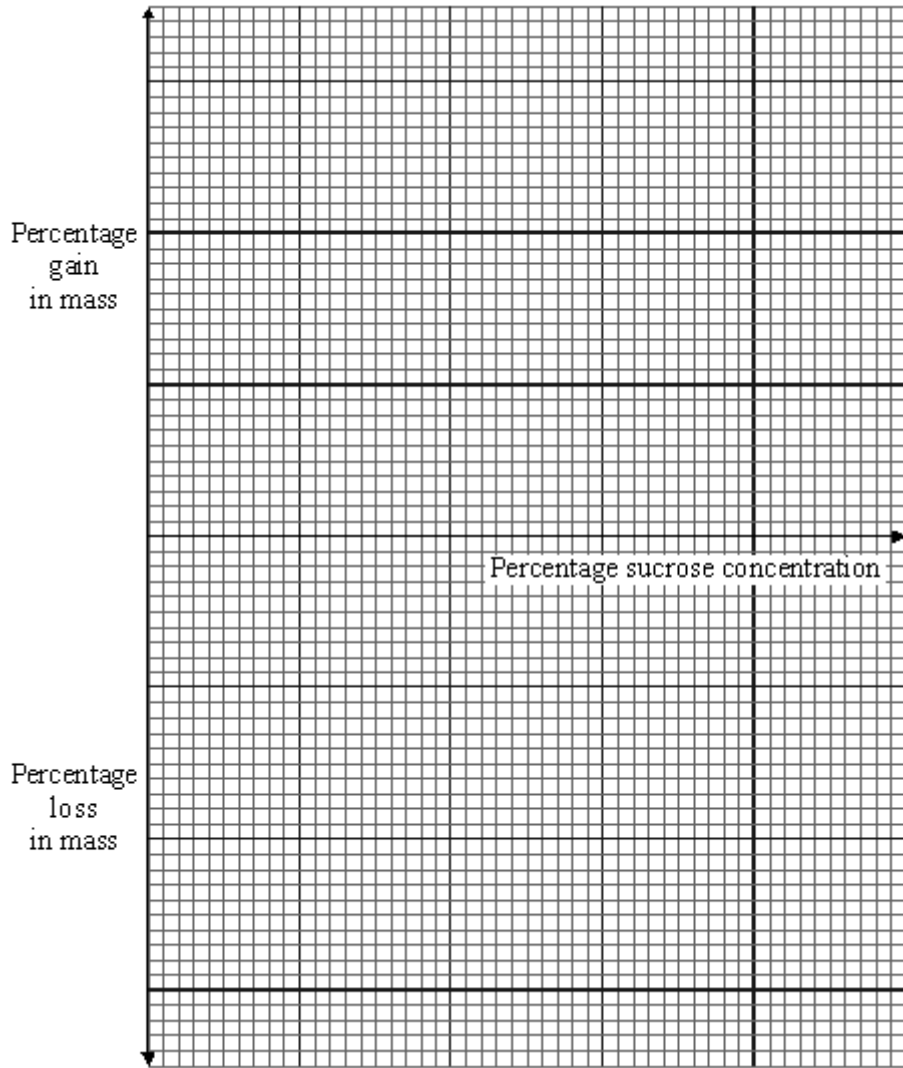
	Beaker 1	Beaker 2	Beaker 3	Beaker 4	Beaker 5
Final mass in g	13.0	12.2	9.0	7.9	7.3
Initial mass in g	10.0	10.6	10.0	10.1	10.4

The students calculated the % gain or loss in mass of potato. Complete this table of results for Beakers 2, 4 and 5.

Beaker 1	Beaker 2	Beaker 3	Beaker 4	Beaker 5
$13 - 10.0 = 3.0$ $\frac{3.0}{10.0} \times 100\% = 30\%$		$9.0 - 10.0 =$ -1.0 $\frac{-1.0}{10.0} \times 100\%$ $= -10\%$		
Gain in mass = 30%		Loss in mass = 10%		

(3)

- (b) (i) Draw a graph of % Gain or Loss in mass against sucrose concentration.



(3)

(ii) Use the graph to find the concentration of potato cell sap.

Concentration of cell sap = _____ % sucrose solution

(1)

(iii) Explain in terms of osmosis how you chose this value.

(2)

(Total 10 marks)

Q13.

The table shows the concentrations of some mineral ions in the cells of a pond plant and in the surrounding pond water.

Concentration in mmol per dm³

	Potassium	Calcium	Sulphate
Plant cells	49.0	7.0	7.0
Pond water	0.5	0.7	0.4

- (i) The plant cells would not have been able to absorb these mineral ions from the pond water by diffusion. Explain why not.

(2)

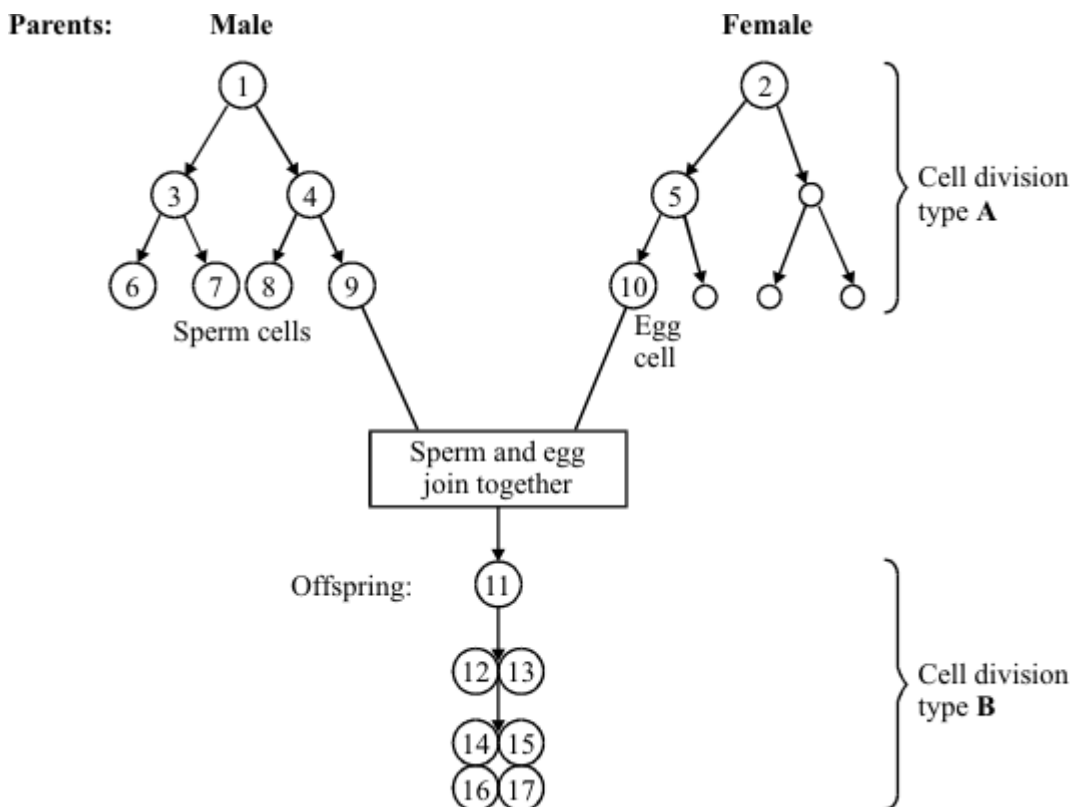
- (ii) Suggest a process which would allow these ions to be absorbed from the pond water by the plant cells.

(1)

(Total 3 marks)

Q14.

The diagram shows two patterns of cell division. Cell division type **A** is used in gamete formation. Cell division type **B** is used in normal growth.



- (a) Name the two types of cell division, **A** and **B**, shown in the diagram.

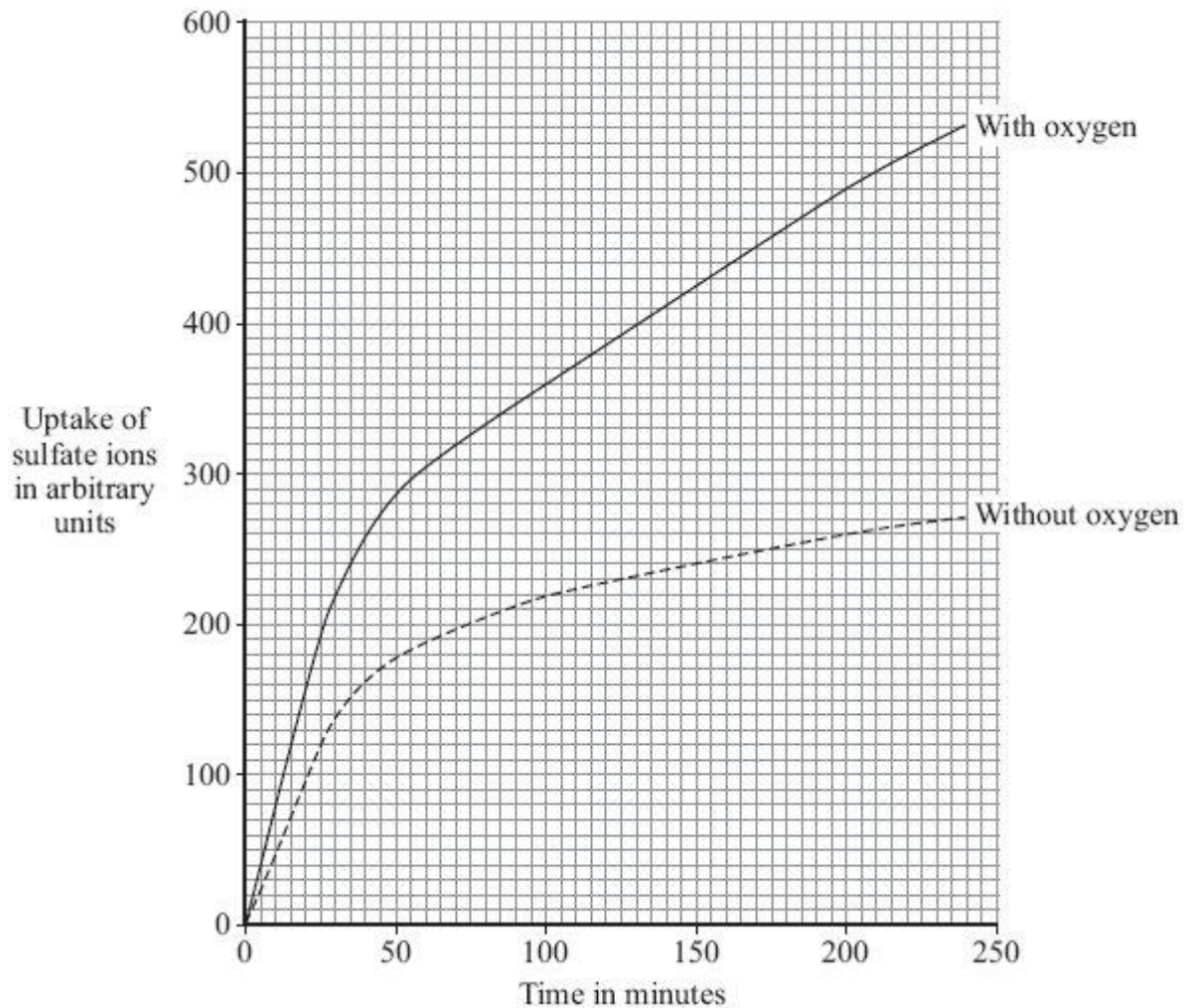
Type **A** _____

Type **B** _____

(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.

Answer _____ arbitrary units

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

Explain how.

(3)
(Total 7 marks)

Q18.

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.

(1)

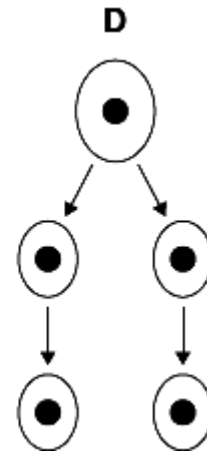
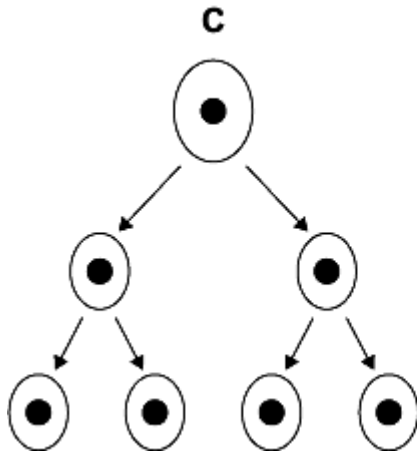
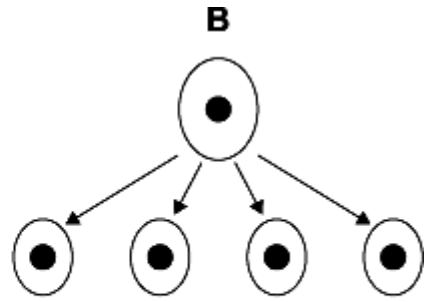
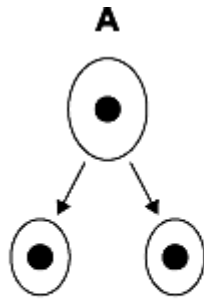
- (b) Chromosomes contain DNA molecules.

Describe the function of DNA.

(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)

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

(1)

(d) Body cells divide by mitosis.

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

(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)

Q19.

- (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.

(3)

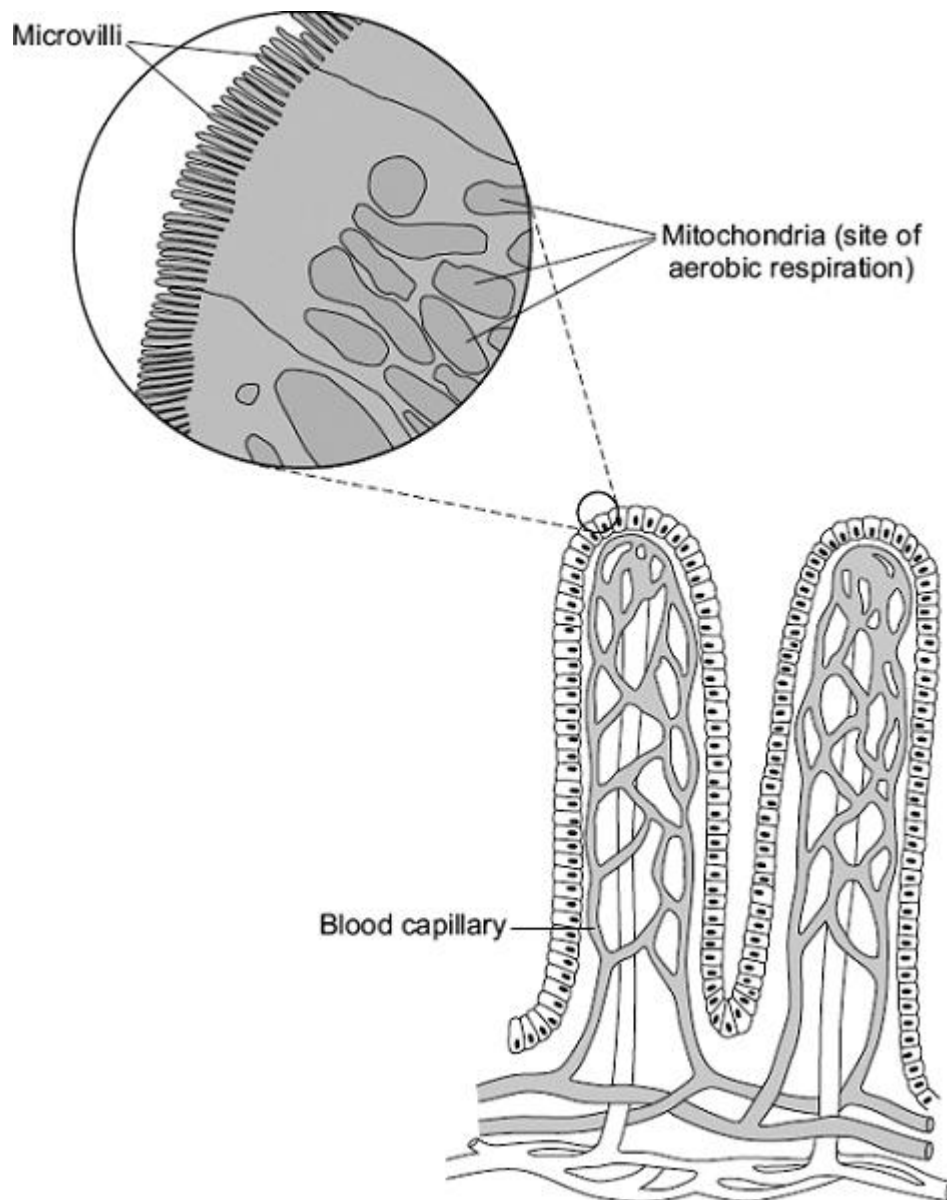
- (b) All of the sugars named in the table can be absorbed by diffusion.

Explain how information from the table provides evidence for this.

Q20.

The villi of the small intestine absorb the products of digestion.

The diagram shows two villi. It also shows parts of some of the surface cells of a villus, as seen with an electron microscope.

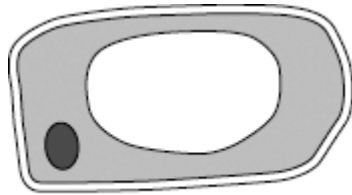


Describe and explain how the villi are adapted to maximise the rate of absorption of the products of digestion.

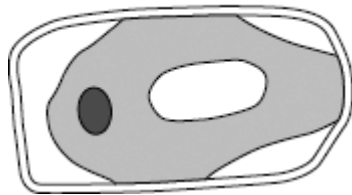
Q22.

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)

Q23.

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.

(2)

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

(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.

(1)

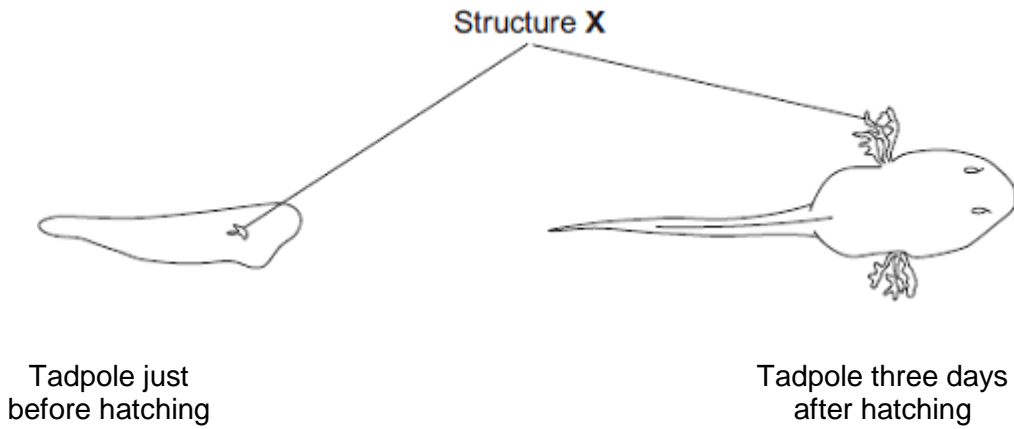
- (ii) A root hair cell contains many mitochondria.

(2)

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

(1)

(Total 7 marks)



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

(1)

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

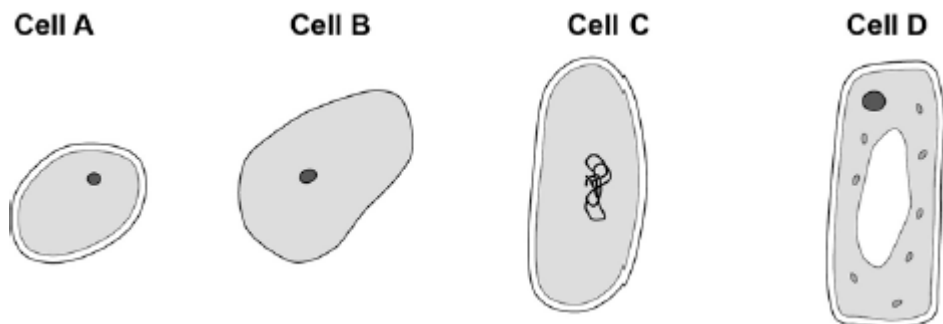
You should **not** refer to movement in your answer.
To gain full marks you should refer to structure **X**.

(4)

(Total 5 marks)

Q26.

The figure below shows four different types of cell.



- (a) Which cell is a plant cell?

Give **one** reason for your answer.

Cell _____

Reason _____

(2)

- (b) Which cell is an animal cell?

Give **one** reason for your answer.

Cell _____

Reason _____

(2)

- (c) Which cell is a prokaryotic cell?

Give **one** reason for your answer.

Cell _____

Reason _____

(2)

- (d) A scientist observed a cell using an electron microscope.

The size of the image was 25 mm.

The magnification was $\times 100\,000$

Calculate the real size of the cell.

Use the equation:

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

Give your answer in micrometres.

Real size = _____ micrometres

(3)

(Total 9 marks)

Q27.

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.

(4)

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

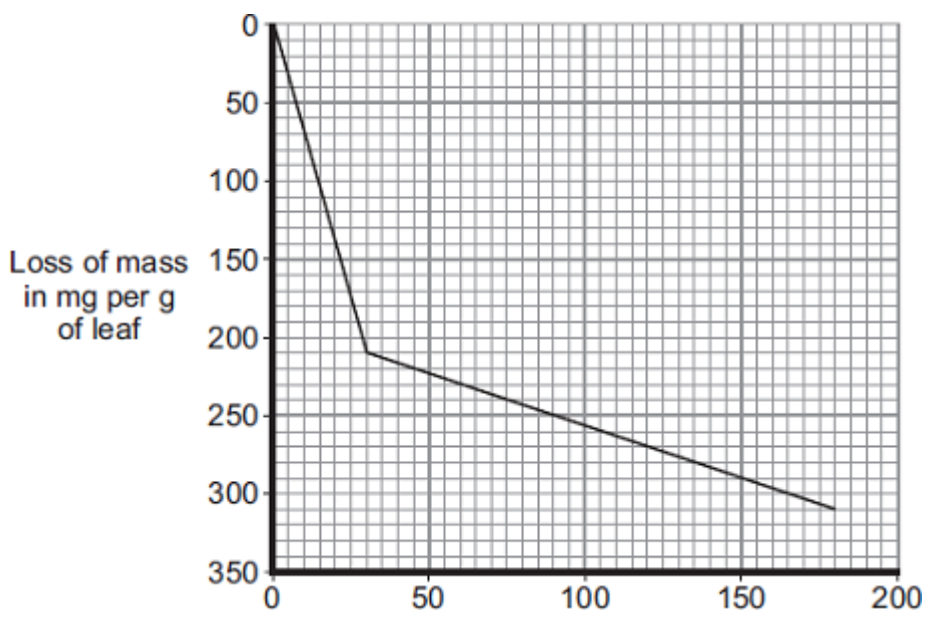
(3)

(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.

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.

(2)

(Total 11 marks)

Q28.

The photographs show the flowers of two closely-related species of plant.

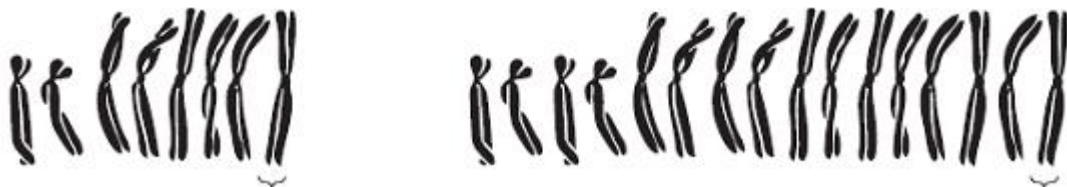
Species A Species B



Images: © iStock/Thinkstock

The drawings show chromosomes from one cell in the root of each plant during cell division.

Species A Species B



**One
chromosome**

**One
chromosome**

(a) The drawings show that each chromosome has two strands of genetic material.

(i) How does a chromosome become two strands?

(1)

(ii) Explain why each chromosome must become two strands before the cell divides.

(2)

(b) For sexual reproduction, the plants produce gametes.

(i) Name the type of cell division that produces gametes. _____

(1)

(ii) How many chromosomes would there be in a gamete from each of these two plant species?

Species A **Species B**

(1)

(iii) It is possible for gametes from **Species A** to combine with gametes from **Species B** to produce healthy offspring plants.

How many chromosomes would there be in each cell of one of the offspring plants?

(1)

(c) (i) Look back at the information at the start of the question and the information from part (b).

What evidence from these two pieces of information supports the belief that **Species A** and **Species B** evolved from a common ancestor?

(2)

- (ii) For successful gamete production to take place, chromosomes that contain the same genes must pair up.

The drawings showing the chromosomes of **Species A** and of **Species B** are repeated below.

Species A Species B



The offspring plants cannot reproduce sexually.

Suggest an explanation for this.

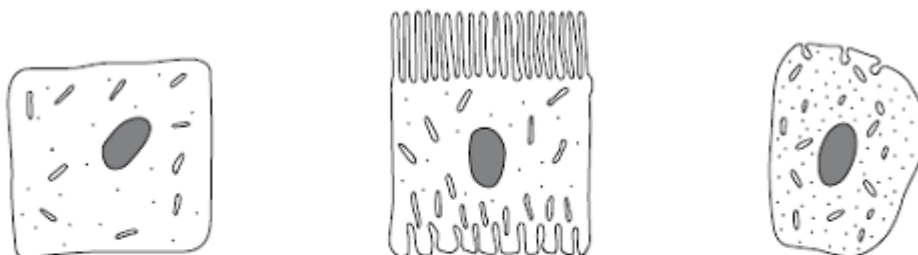
(2)

(Total 10 marks)

Q29.

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

A B C



Key	
-	Mitochondrion
.	Ribosome

- (a) Which cell, **A**, **B** or **C**, appears to be best adapted to increase diffusion into or out of the cell?

Give **one** reason for your choice.

(1)

- (b) (i) Cell **C** is found in the salivary glands.

Name the enzyme produced by the salivary glands.

(1)

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

(2)

(Total 4 marks)

Q30.

- (a) Mr and Mrs Smith both have a history of cystic fibrosis in their families. Neither of them has cystic fibrosis. Mr and Mrs Smith are concerned that they may have a child with cystic fibrosis.

Use a genetic diagram to show how they could have a child with cystic fibrosis.

Use the symbol **A** for the dominant allele and the symbol **a** for the recessive allele.

(3)

- (b) Mr and Mrs Smith decided to visit a genetic counsellor who discussed embryo screening.

Read the information which they received from the genetic counsellor.

- Five eggs will be removed from Mrs Smith's ovary while she is under an anaesthetic.
- The eggs will be fertilised in a dish using Mr Smith's sperm cells.
- The embryos will be grown in the dish until each embryo has about thirty cells.
- One cell will be removed from each embryo and tested for cystic fibrosis.
- A suitable embryo will be placed into Mrs Smith's uterus and she may become pregnant.
- Any unsuitable embryos will be destroyed.

(i) Suggest why it is helpful to take five eggs from the ovary and not just one egg.

(1)

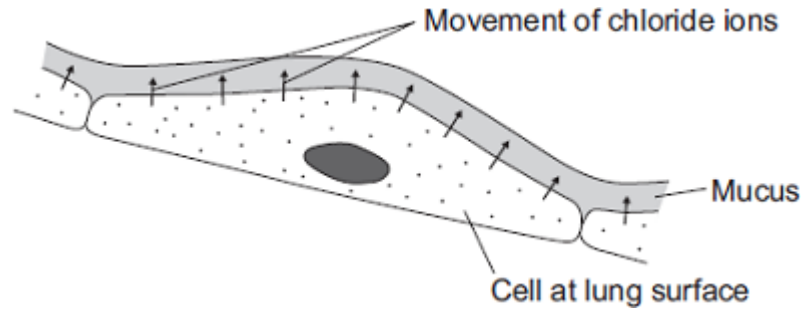
(ii) Evaluate the use of embryo screening in this case.

Remember to give a conclusion to your evaluation.

(4)

(c) In someone who has cystic fibrosis the person's mucus becomes thick.

The diagram shows how, in a healthy person, cells at the lung surface move chloride ions into the mucus surrounding the air passages.



The movement of chloride ions causes water to pass out of the cells into the mucus.

Explain why.

(3)

(Total 11 marks)

Q31.

Different antibiotics destroy bacteria in different ways.

- Some antibiotics disrupt the bacterial cell membrane.
 - Some antibiotics disrupt the bacterial cell wall.
- (a) Antibiotics that disrupt the bacterial cell membrane often cause more side effects in humans compared with antibiotics that disrupt bacterial cell walls.

Suggest why.

(1)

- (b) Some antibiotics prevent ribosomes functioning.

Suggest how this damages the bacterium.

(1)

- (c) Drug manufacturers are spending less on research into new antibiotics.

One reason why is because new antibiotics are rarely prescribed.

Some people think that governments should pay drug manufacturers to develop new

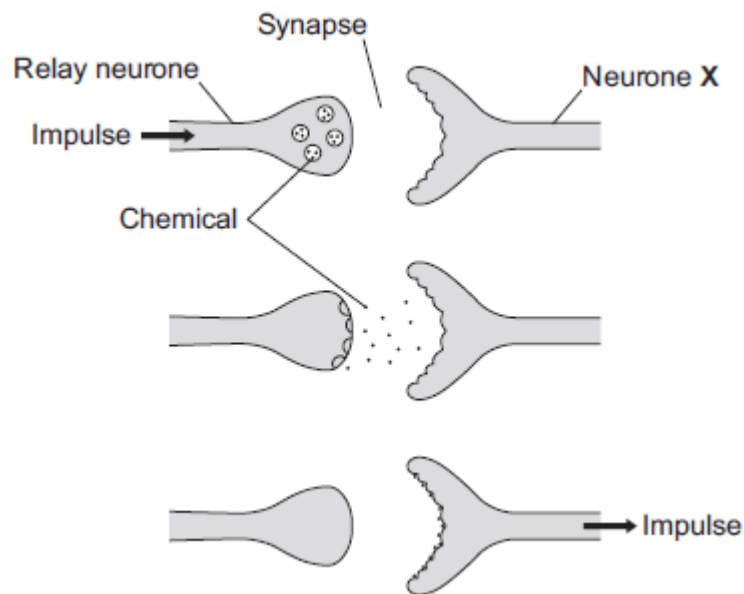
antibiotics.

Suggest why.

(3)
(Total 5 marks)

Q32.

The diagram below shows how a nerve impulse passing along a relay neurone causes an impulse to be sent along another type of neurone, neurone X.



(a) What type of neurone is neurone X?

(1)

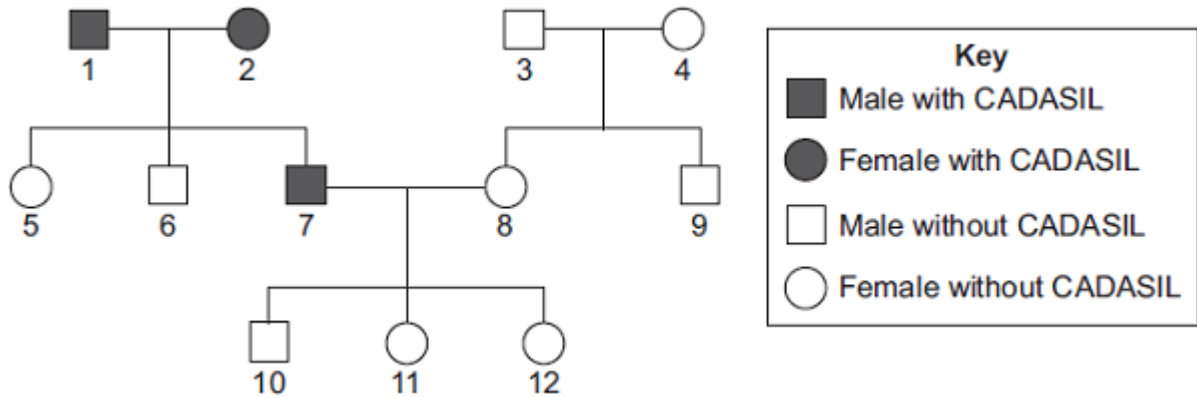
(b) Describe how information passes from the relay neurone to neurone X. Use the diagram to help you.

Q34.

CADASIL is an inherited disorder caused by a dominant allele.

CADASIL leads to weakening of blood vessels in the brain.

The diagram shows the inheritance of CADASIL in one family.



(a) CADASIL is caused by a *dominant allele*.

(i) What is a *dominant allele*?

(1)

(ii) What is the evidence in the diagram that CADASIL is caused by a dominant allele?

(1)

(iii) Person 7 has CADASIL.

Is person 7 homozygous or heterozygous for the CADASIL allele?

Give evidence for your answer from the diagram.

(1)

(b) Persons 7 and 8 are planning to have another baby.

Use a genetic diagram to find the probability that the new baby will develop into a person with CADASIL.

Use the following symbols to represent alleles.

D = allele for CADASIL

d = allele for not having CADASIL

Probability = _____

(4)

(c) Scientists are trying to develop a treatment for CADASIL using stem cells.

Specially treated stem cells would be injected into the damaged part of the brain.

(i) Why do the scientists use stem cells?

(2)

(ii) Embryonic stem cells can be obtained by removing a few cells from a human embryo. In 2006, scientists in Japan discovered how to change adult skin cells into stem cells. Suggest **one** advantage of using stem cells from adult skin cells.

(1)

(Total 10 marks)

Q35.

The photograph shows a red blood cell in part of a blood clot. The fibres labelled **X** are produced in the early stages of the clotting process.



- (a) Suggest how the fibres labelled X help in blood clot formation.

(1)

- (b) The average diameter of a real red blood cell is 0.008 millimetres.
On the photograph, the diameter of the red blood cell is 100 millimetres.

Use the formula to calculate the magnification of the photograph.

$$\text{Diameter on photograph} = \text{Real diameter} \times \text{Magnification}$$

$$\text{Magnification} = \underline{\hspace{10em}}$$

(2)

- (c) Some blood capillaries have an internal diameter of approximately 0.01 millimetres.

- (i) Use information given in part (b) to explain why only one red blood cell at a time can pass through a capillary.

(1)

- (ii) Explain the advantages of red blood cells passing through a capillary one at a time.

(3)
(Total 7 marks)

Q36.

As they go higher up a mountain, mountaineers take less oxygen into their bodies with each breath, as shown in the table below.

HEIGHT	MILLIGRAMS OF OXYGEN TAKEN INTO LUNGS WITH EACH NORMAL BREATH	MILLIGRAMS OF OXYGEN INTO BLOOD WITH EACH NORMAL BREATH	
		AT FIRST	AFTER STAYING AT 4500 METRES FOR TWO WEEKS
sea-level	300	60	90
1500 metres	250	50	
3000 metres	200	40	
4500 metres	150	30	45

- (a) (i) How does the amount of oxygen taken into the blood with each breath vary with the amount of oxygen breathed into the lungs with each breath?

(2)

- (ii) Use the idea of diffusion to explain why the amount of oxygen taken into the blood varies in this way.

(1)

- (b) (i) How does staying at an altitude of 4500 metres for two weeks affect the mountaineers?

(2)

- (ii) Suggest an explanation for this.

(1)

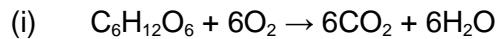
(iii) Add the two missing figures to the right-hand column of the table.

(2)

(Total 8 marks)

Mark schemes

Q1.



energy is neutral

1

formulae all correct

with no omissions / deletions

correctly balanced

credit 1 mark if the answer is the exact reverse of an incorrect answer for (a)

1

(ii) and **three** from

take up of (soluble) substances / ions against the concentration gradient

or when the concentration (of the substance / ions) is greater inside the cell / cytoplasm than outside it

through the (semi-permeable) (cell) membrane energy from mitochondria

*or energy from respiration
not just energy*

3

[5]

Q2.

(a) X – relay (neurone)

Y – motor (neurone)

both required for mark

must be in correct order

1

(b) chemical (released from **X**)

*do **not** accept electrical impulse*

accept chemical messenger / transmitter

accept neurotransmitter

accept named transmitter substance eg acetylcholine

1

(crosses) synapse

*allow for **2** marks diffusion of the chemical across the synapse*

1

[3]

Q3.

(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]

Q4.

any **four** from

molecules / ions

do not credit mineral salts

move(d) through / across the cell

wall / membrane

against (a / the) concentration

gradient

by a series of chemical

reactions

(because) diffusion cannot occur

energy (required)

(supplied by) respiration

oxygen required for respiration (to occur)

[4]

Q5.

(a) 23

1

(b) chromosome nucleus gene cell
 2 3 1 4

- 1
- (c) (i) any **one** from
- (cells which are bigger) take up more space
- (cells) have to get bigger **or** mature to divide
- 1
- (ii) chromosomes duplicate **or**
make exact copies of self
accept forms pairs of chromatids
- 1
- nuclei divide
*accept chromatids or
chromosomes separate*
- 1
- identical (daughter) cells formed
*accept for example, skin cells make
more skin cells or cells are clones*
- 1
- (d) any **two** from
- Differentiation mark*
babies need **or** are made of different types of cells **or** cells that have
different functions
*accept different cells are needed
for different organs*
- Division or specialisation mark*
as fertilised egg starts to divide each cell specialises to form a part of the body
*accept specialised cells make
different parts of the body*
- Growth mark*
specialised cells undergo mitosis to grow further cells
*accept cells divide or reproduce
to form identical cells*
- 2

[8]

Q6.

- (a) (i) water (molecules) enter(s) (the cell)
or water (molecules) pass(es) through the (semi-permeable)
cell membrane
- 1
- by osmosis
or because the concentration of water is
greater outside (the cell than inside it
the vacuole)
*accept because of the concentration
gradient provided there is no contradiction*
- 1

(ii) any **one** from

(it is) elastic

(it is) strong

(it is fully) permeable (to water)

or water can pass through it

do not credit semi-permeable

do not credit cell membrane is semi-permeable

1

(b) (the piece of) potato shrinks

or loses its turgor

or becomes flabby

or becomes flaccid

or plasmolysis occur

or cytoplasm pulls away from the cell wall

(because) concentration of sugar

or because concentration of water

1

(solution) is greater than concentration inside the cell / vacuole

inside the cell / vacuole is greater than concentration (of water) outside

1

water is drawn out of the cell

1

[6]

Q7.

(a) **A A a a**

Aa allele correctly separated

1

B b B b

Bb allele arranged to form four different pairings

all four pairings must be correct for the second mark

1

(b) **A A**

the two cells the same as the parent cell

a a

B B

b b

1 mark for each cell

2

(c) (i) 46

accept 23 pairs

1

- (ii) 23
accept half if c(i) 1
- (iii) 46
accept save as c(i) 1

[7]

Q8.

- (a) (i)
if two nuclei drawn then maximum two marks 1
- 6 chromosomes 1
- same 3 homologous pairs 1
- nuclear membrane drawn 1
- (ii) 3 chromosomes 1
- 1 from each homologous pair 1
- (b) (i)
parent line must be separate
- heterozygous parents Tt x Tt
maximum of 2 marks if parental genotype is wrong
- gametes correct T t T t 1
- genotypes TT Tt Tt tt 1
- (ii) correct analysis of chance i.e. 1 in 4
or 25% 1
- (iii) 50% **or** 1 in 2 1

[10]

Q9.

- (a) (i) carbon dioxide / CO₂ (*reject* CO)
- (ii) oxygen / O₂ / O (water vapour neutral)
for 1 mark each 2
- (b) (provides) energy
for one mark

1

- (c) starch insoluble therefore water not taken in by osmosis
or
 sugar is soluble / has small molecules may diffuse out therefore lost
(ignore ref. to cells bursting)

or
 starch has large molecules
 cannot diffuse therefore retained
for 1 mark each

3

[6]

Q10.

ideas that
 sugar has dissolved in moisture (on surface of fruit)
 this solution more concentrated than solution inside fruit
 osmosis / diffusion movement of water out of fruit
 through partially permeable membrane (of fruit cells)
any four for 1 mark each

allow explanations in terms of concentrations of water molecules for full marks

[4]

Q11.

- (a) mutation
for 1 mark

1

- (b) fall,
 idea that resistant beetles more likely to survive to breed,
 ∴ their offspring more likely to appear in the next generation
for 1 mark each

3

- (c) inbreeding between resistant brothers and sister,
 will produce some individuals with 2 copies of the resistance allele,
 if 2 of these individuals breed all their offspring will be resistant
for 1 mark each

3

[7]

Q12.

- (a) (i) change in weight was due to changes in potato
or osmosis **or** not due to outside liquid
ignore 'to make fair test'

1

- (ii) beaker 2 = 15.1(%) gain
allow 15%

1

beaker 4 = 21.8(5) loss
not 21.7

allow -22%
if no minus or no 'loss' check graph

1

beaker 5 = 29.8(%) loss
allow -30%

1

- (b) (i) both axes correct values
and scales > ½ of each axis
ignore lack of minus signs on vertical axis

1

points correct
< ± ½ square
allow answers in (a)(ii)

1

line correct
*allow curve of best fit which can miss 10, 15
or straight lines between points
do **not** allow one straight line or sketched line
bar graph zero marks*

1

- (ii) point where line crosses axis (eg 15-16% sucrose)
allow point from candidate's graph (± 0.5%)

1

- (iii) any **two** from:
looking for understanding that water in equilibrium

no change in mass

not **net** movement of water
or water entry and exit are equal

because sucrose solution same
concentration as cell sap **or** sucrose has
same water potential as cell contents

*allow because the concentrations are the same (inside and
out)*

2

[10]

Q13.

- (i) in diffusion: material moves high to low concentration

1

here: concentration in cells > concentration in water **or**
uptake is against the concentration gradient **or** by diffusion ions would move out

1

- (ii) active transport / active uptake

1

[3]

Q14.

(a) A = meiosis

accept 'mieosis'
*do **not** accept 'miosis'*

1

B = mitosis

*do **not** accept 'meitosis' etc*

1

(b) fertilisation allow conception

1

(c) (i) 23

1

(ii) 46

1

[5]

Q15.

any **four** from:

- cells used to treat diseases do not go on to produce a baby
- produces identical cells for research
- cells would not be rejected
- allow cells can form different types of cells
- (immature) egg contains only genetic information / DNA / genes / chromosomes from mother **or** there is only one parent
- asexual / no mixing of genetic material / no sperm involved / no fertilisation **or** chemical causes development
- baby is a clone
- reference to ethical / moral / religious issues
allow ethically wrong
***NB** cloning is illegal gains **2** marks*
ignore unnatural
- risk of damage to the baby
in correct context

[4]

Q16.

one mark for each of the following comparisons to a maximum of **6**

*candidates **must** make a clear comparison*

meiosis

mitosis

sexual

asexual

gametes	growth
ovary or testes or gonads	all other cells
half number of chromosomes	same number of chromosomes
haploid or 23 chromosomes	diploid or 46 chromosomes
reassortment or variation possible or not identical	no reassortment or no variation or identical
4 cells produced	2 cells produced
2 divisions	1 division

[6]

Q17.

(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]

Q18.

(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]

Q19.

(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]

Q20.

D – *many* microvilli (1)

Ex – provide large surface area (1)

five points made

max 3 descriptions

max 3 explanations

D – *many* capillaries / *good* blood supply (1)

Ex – maintain concentration / diffusion gradient **or** quickly removes food (1)

D – thin wall / one cell thick surface / capillaries near surface (1)

allow villi are thin

ignore villi are one cell thick

Ex – short distance for food to travel (1)

D – *many* mitochondria (1)

Ex – provide energy / ATP for active uptake / transport (1)

[5]

Q21.

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

1

any **three** from:

- (energy from) aerobic respiration
- more respiration with O₂ **or** more energy release with O₂
- (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]

Q22.

- (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]

Q23.

- (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]

Q24.

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]

Q25.

(a) oxygen / O₂

allow O₂
do not accept O²

or

carbon dioxide / CO₂

allow CO₂
do not accept CO²

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]

Q26.

(a) **D**

1

any **one** from:

- has chloroplasts
- has a (large) vacuole
ignore has a (cell) wall

1

(b) **B**

1

does **not** have a (cell) wall

*allow has only a nucleus, (cell) membrane **and** cytoplasm*

1

(c) **C**

1

any **one** from:

- genetic material is not in a nucleus
allow no nucleus
- has a single loop of DNA

1

(d) real size = 25 / 100 000

1

0.00025

1

(conversion to) 0.25 (µm)

allow 0.25 (µm) with no working shown for 3 marks

1

[9]

Q27.

(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]

Q28.

(a) (i) DNA replication / copies of genetic material were made

'it' = a chromosome

allow chromosomes replicate / duplicate / are copied

ignore chromosomes divide / split / double

1

- (ii) one copy of each (chromosome / chromatid / strand) to each offspring cell
ignore ref. to gametes and fertilisation 1
- each offspring cell receives a complete set of / the same genetic material
allow 'so offspring (cells) are identical' 1
- (b) (i) meiosis
allow mieosis as the only alternative spelling 1
- (ii) Species A = 4 **and** Species B = 8 1
- (iii) sum of A + B from (b)(ii) e.g. 12 1
- (c) (i) similarities between chromosomes
or
similarities between flowers described
e.g. shape of petals / pattern on petals / colour / stamens 1
- can breed / can sexually reproduce
allow can reproduce with each other / they can produce offspring 1
- (ii) any **two** from:
- offspring contain 3 copies of each gene / of each chromosome / odd number of each of the chromosomes
 - some chromosomes unable to pair (in meiosis)
 - (viable) gametes not formed / some gametes with extra / too many genes / chromosomes
- or**
some gametes with missing genes / chromosomes 2

[10]

Q29.

(a) **B**

*no mark for "B" alone, the mark is for B **and** the explanation.*

large(r) surface / area **or** large(r) membrane

accept reference to microvilli

ignore villi / hairs / cilia

accept reasonable descriptions of the surface eg folded membrane / surface

*do **not** accept wall / cell wall*

1

(b) (i) any **one** from:

- (salivary) amylase
- carbohydrase

1

(ii) many ribosomes

*do **not** mix routes. If both routes given award marks for the greater.*

1

ribosomes produce protein

accept amylase / enzyme / carbohydrase is made of protein

or

(allow)

many mitochondria (1)

mitochondria provide energy to build / make protein (1)

accept ATP instead of energy

1

[4]

Q30.

(a) both parents **Aa**

*accept other upper and lower case letter without key **or** symbols with a key*

allow as gametes shown in Punnett square

1

aa in offspring correctly derived from parents

or

aa correctly derived from the parents given

ignore other offspring / gametes

for this mark parents do not have to be correct

1

offspring **aa** identified as having cystic fibrosis

*may be the only offspring shown **or** circled / highlighted / described*

1

(b) (i) any **one** from:

accept converse if clear, eg if you (only) took one it might have cystic fibrosis / might not be fertilised

- (more) sure / greater chance of healthy / non-cystic fibrosis egg / embryo / child

accept some may have the allele

reference to 'suitable / good embryo' is insufficient

- greater chance of fertilisation

1

(ii) **advantages**

to gain 3 marks both advantage(s) and disadvantage(s) must be given

max 3

any **two** from:

ignore references to abortion unless qualified by later screening

- greater / certain chance of having child / embryo without cystic fibrosis / healthy
- child with cystic fibrosis difficult / expensive to bring up
- cystic fibrosis (gene / allele) not passed on to future generations

disadvantages

any **two** from:

- operation dangers / named eg infection
ignore risk unqualified
- ethical or religious issues linked with killing embryos
*accept wrong / cruel to embryos accept right to life argument
ignore embryos are destroyed*
- (high) cost of procedure
- possible damage to embryo (during testing for cystic fibrosis / operation)

plus

conclusion

a statement that implies a qualified value judgement

eg it is right because the child will (probably) not have cystic fibrosis even though it is expensive

or

eg it is wrong because embryos are killed despite a greater chance of having a healthy baby

note: *the conclusion mark cannot be given unless a reasonable attempt to give both an advantage and a disadvantage is made*

do not award the mark if the conclusion only states that advantages outweigh the disadvantages

1

(c) any **three** from:

- osmosis / diffusion
do not accept movement of ions / solution by osmosis / diffusion
- more concentrated solution outside cell / in mucus
assume concentration is concentration of solute unless answer indicates otherwise or accept correct description of

'water concentration'

- water moves from dilute to more concentrated solution
allow correct references to movement of water in relation to concentration gradient
- partially permeable membrane (of cell)
allow semi / selectively permeable

3

[11]

Q31.

- (a) human cells have cell membrane
or
human cells have no cell wall

1

- (b) can no longer synthesise proteins

1

- (c) antibiotics are being developed at a slower rate than emergence of new resistant strains

1

resistant strains mean we cannot treat (common) infections

1

reduce (future) cost of antibiotic resistant infections

1

[5]

Q32.

- (a) motor

allow efferent / postsynaptic
*allow **another** relay (neurone)*

1

- (b) release of chemical (from relay neurone)

allow ecf for 'motor' neurone from (a)
allow release of neurotransmitter / named example

1

chemical crosses gap / junction / synapse

allow diffuses across
allow chemical moves to X

1

chemical attaches to X / motor / next neurone (causing impulse)

1

- (c) (curare) decrease / no contraction

accept (muscle) relaxes

1

(strychnine) increase / more contraction

if no other mark awarded allow 1 mark for (curare) decrease
*/ no response **and** (strychnine) increase / more response*

Q33.

(nitrate) ions are absorbed by active transport

1

(active transport) is the movement of ions against the concentration gradient

allow (active transport) is the movement of ions from a dilute to a more concentrated solution

1

(active transport) requires energy from respiration

1

(respiration) requires oxygen

1

no / little oxygen / air in water-logged soil

1

[5]

Q34.

(a) (i) allele expressed even when other allele present **or** expressed if just one copy of allele is present **or** expressed if heterozygous
if present other allele not expressed

1

(ii) 2 affected parents have unaffected child **or** 1 and 2 → **5 / 6**

or if recessive all of **1** and **2**'s children would have CADASIL

1

(iii) heterozygous – has unaffected children **or** because if homozygous all children would have CADASIL

1

(b) genetic diagram including:

accept alternative symbols, if defined

1

correct gametes:

D and **d**

and d (and **d**)

ignore 7 / 8 or male / female

1

derivation of offspring genotypes:

Dd Dd dd dd

*allow just **Dd dd** if ½-diagram*

allow ecf if correct for student's gametes

1

identification **of Dd** as CADASIL

or dd as unaffected

allow ecf if correct for student's gametes

1

correct probability: 0.5 / 1/2 / 1 in 2 / 50% / 1 : 1

1

(c) (i) stem cells can differentiate **or** are undifferentiated / unspecialised

1

can form blood vessel cells / brain cells

or

stem cells can divide

1

(ii) ethical argument - eg no risk of damage to embryo or adult can give consent for removal of cells **or** adult can re-grow skin

more ethical qualified

ignore religion unqualified

or

if from a relative then less chance of rejection **or** if from self then no chance of rejection

or

skin cells more accessible

1

[10]

Q35.

(a) hold cells together **or** prevent flow of cells **or** trap cells

1

(b) 12500

if correct answer, ignore working / lack of working

$\frac{100}{0.008}$ for 1 mark

ignore any units

2

(c) (i) size RBC approximately same size capillary **or** no room for more than one cell **or** only one can fit **or** RBC is too big

allow use of numbers

*do **not** accept capillaries are narrow*

1

(ii) more oxygen released (to tissues) **or** more oxygen taken up (from lungs)

1

and any **two** from:

- slows flow **or** more time available
- shorter distance (for exchange) **or** close to cells / capillary wall

- more surface area exposed 2

[7]

Q36.

- (a) (i) increasing one increases the other
gains 1 mark
- but
they increase in proportion/ 1/5 taken in at first / 3/10 taken in after 2 weeks
gains 2 marks 2
- (ii) *idea that more/faster diffusion with higher concentration*
for 1 mark
- or**
with more oxygen particles/molecules (in same space) 1
- (b) (i) can take more oxygen from (the same) air/changes from 30 to 45/increases by 15
gains 1 mark
- but
takes 50% more or 1.5 times as much
gains 2 marks
- or**
increases by 15 mg breath 2
- (ii) more red blood cells develop
or
more haemoglobin in the blood
(*not just 'acclimatises'*)
for 1 mark 1
- (iii) 75
60
each for 1 mark 2

[8]