<table>
<thead>
<tr>
<th><strong>Cell Biology Higher</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name:</strong></td>
<td>__________________________</td>
</tr>
<tr>
<td><strong>Class:</strong></td>
<td>__________________________</td>
</tr>
<tr>
<td><strong>Date:</strong></td>
<td>__________________________</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Time:</strong></th>
<th><strong>230 minutes</strong></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Marks:</strong></th>
<th><strong>229 marks</strong></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Comments:</strong></th>
<th></th>
</tr>
</thead>
</table>
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.

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

Q2.
The diagram shows some of the structures involved in a reflex action.

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

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

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(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.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(3) (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.

<table>
<thead>
<tr>
<th>chromosome</th>
<th>nucleus</th>
<th>gene</th>
<th>cell</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(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

_______________________________________________________________________

_______________________________________________________________________

_______________________________________________________________________

_______________________________________________________________________

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

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.

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

(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.
Q7.
In the cell shown in the diagram as a box, one chromosome pair has alleles \( \text{Aa} \). The other chromosome pair has alleles \( \text{Bb} \). The cell undergoes meiosis.

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

\[
\begin{array}{c}
\text{A} \\
\text{a} \\
\text{B} \\
\text{b}
\end{array}
\]

\[
\begin{array}{c}
\text{A} \\
\text{a} \\
\text{B} \\
\text{b}
\end{array}
\]

\[
\begin{array}{c}
\text{A} \\
\text{a} \\
\text{B} \\
\text{b}
\end{array}
\]

\[
\begin{array}{c}
\text{A} \\
\text{a} \\
\text{B} \\
\text{b}
\end{array}
\]

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

\[
\begin{array}{c}
\text{A} \\
\text{a} \\
\text{B} \\
\text{b}
\end{array}
\]

\[
\begin{array}{c}
\text{A} \\
\text{a} \\
\text{B} \\
\text{b}
\end{array}
\]

(c) State the number of chromosomes in:

(i) a normal human cell;

(ii) a human gamete;

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

![Diagram of a cell produced by mitosis](image1)

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

![Diagram of a cell produced by meiosis](image2)

(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]
Q9.

The diagram shows a plant leaf during photosynthesis.

(a) Name:
   (i) gas X: _______________
   (ii) gas Y: _______________

(b) Why is sunlight necessary for photosynthesis?
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________

(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.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

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).

[Diagram showing a piece of moist fruit with fine sugar on top, leading to syrup formation after two hours]

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

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

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

Their results are shown in the table below.

<table>
<thead>
<tr>
<th></th>
<th>Beaker 1</th>
<th>Beaker 2</th>
<th>Beaker 3</th>
<th>Beaker 4</th>
<th>Beaker 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final mass in g</td>
<td>13.0</td>
<td>12.2</td>
<td>9.0</td>
<td>7.9</td>
<td>7.3</td>
</tr>
<tr>
<td>Initial mass in g</td>
<td>10.0</td>
<td>10.6</td>
<td>10.0</td>
<td>10.1</td>
<td>10.4</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Beaker 1</th>
<th>Beaker 2</th>
<th>Beaker 3</th>
<th>Beaker 4</th>
<th>Beaker 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 – 10.0 = 3.0</td>
<td>9.0 – 10.0 = –1.0</td>
<td>–1.0 ( \times 100% ) = –10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \frac{3.0}{10.0} \times 100% = 30% )</td>
<td></td>
<td>Gain in mass = 30%</td>
<td>Loss in mass = 10%</td>
<td></td>
</tr>
</tbody>
</table>

Draw a graph of % Gain or Loss in mass against sucrose concentration.
(ii) Use the graph to find the concentration of potato cell sap.

Concentration of cell sap = _____________________ % sucrose solution

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

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

(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.
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.

___________________________________________________________________
___________________________________________________________________

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

_______________________________________________________________

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) Name the process in which an egg and sperm join together.

_____________________________________________________________________

1

(c) Cell 1 contains 46 chromosomes. How many chromosomes will there be in:

(i) cell 10: _______________________________________________________

1

(ii) cell 14? ___________________________________________________

1

(Total 5 marks)

Q15.

The diagram shows how an immature egg could be used either to produce cells to treat some human diseases or to produce a baby.

Immature egg extracted from ovary

Egg treated chemically so that it starts to divide

Blastocyst – a group of about 100 cells

Cells used to treat some human diseases

Blastocyst could be implanted into the mother’s womb. She would later give birth

Scientists may be allowed to use this technique to produce cells to treat some human diseases, but not to produce babies.

Using information from the diagram, suggest an explanation for this.
Q16.
Meiosis and mitosis are different types of division in human cells. Compare the two processes by referring to where each takes place and the kind of products that are made.

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

(Total 4 marks)

Q17.
(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.

<table>
<thead>
<tr>
<th></th>
<th>Concentration of sulfate ions in mmol per dm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roots of barley plants</td>
<td>1.4</td>
</tr>
<tr>
<td>Soil</td>
<td>0.15</td>
</tr>
</tbody>
</table>

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.

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

(Total 6 marks)
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.
Q18.

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

<table>
<thead>
<tr>
<th>Species</th>
<th>Number of chromosomes in each body cell</th>
<th>Species</th>
<th>Number of chromosomes in each body cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit fly</td>
<td>8</td>
<td>Tomato</td>
<td>24</td>
</tr>
<tr>
<td>Goat</td>
<td>60</td>
<td>Potato</td>
<td>44</td>
</tr>
<tr>
<td>Human</td>
<td>46</td>
<td>Rice</td>
<td>24</td>
</tr>
</tbody>
</table>

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

Suggest why.

______________________________________________________________________________

(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?

(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)
(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.

<table>
<thead>
<tr>
<th>Sugar</th>
<th>Normal intestine</th>
<th>Intestine poisoned by cyanide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose</td>
<td>1.00</td>
<td>0.33</td>
</tr>
<tr>
<td>Galactose</td>
<td>1.10</td>
<td>0.53</td>
</tr>
<tr>
<td>Xylose</td>
<td>0.30</td>
<td>0.31</td>
</tr>
<tr>
<td>Arabinose</td>
<td>0.29</td>
<td>0.29</td>
</tr>
</tbody>
</table>

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

1. ____________________________

2. ____________________________

(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.
Q21.
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.
Q22.
The diagram shows the same plant cell:

- 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. ________________________________________________________________
   ___________________________________________________________________

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

   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________

(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.

<table>
<thead>
<tr>
<th>Mineral ion</th>
<th>Concentration in millimoles per kilogram</th>
</tr>
</thead>
</table>

(Total 4 marks)
<table>
<thead>
<tr>
<th></th>
<th>Plant root</th>
<th>Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>120</td>
<td>2.0</td>
</tr>
<tr>
<td>Magnesium</td>
<td>80</td>
<td>3.1</td>
</tr>
<tr>
<td>Potassium</td>
<td>250</td>
<td>1.2</td>
</tr>
</tbody>
</table>

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

(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.

(ii) A root hair cell contains many mitochondria.

(iii) Many of the cells in the root store starch.
Q24.

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.

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

(5)
(Total 5 marks)

Q25.

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.

___________________________________________________________________

(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:

\[
magnification = \frac{\text{image size}}{\text{real size}}
\]

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.

___________________________________________________________________
What is meant by the transpiration stream?

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

Rate of mass loss = _______________ milligrams per gram of leaf per minute

(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.

Q28.
The photographs show the flowers of two closely-related species of plant.

Species A  Species B

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

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

(i) How does a chromosome become two strands?

________________________________________________________________________
________________________________________________________________________

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

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

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

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

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

\[ \text{Species A} \quad \text{Species B} \]

(1)

(iii) It is possible for gametes from \textbf{Species A} to combine with gametes from \textbf{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 \textbf{Species A} and \textbf{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

(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.

___________________________________________________________________
___________________________________________________________________

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

Name the enzyme produced by the salivary glands.

___________________________________________________________________

(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.

(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.

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

Remember to give a conclusion to your evaluation.

(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.
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

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.
___________________________________________________________________

(b) Some antibiotics prevent ribosomes functioning. Suggest how this damages the bacterium.
___________________________________________________________________

(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.
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
(c) Scientists investigated the effect of two toxins on the way in which information passes across synapses. The table below shows the results.

<table>
<thead>
<tr>
<th>Toxin</th>
<th>Effect at the synapse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curare</td>
<td>Decreases the effect of the chemical on neurone X</td>
</tr>
<tr>
<td>Strychnine</td>
<td>Increases the amount of the chemical made in the relay neurone</td>
</tr>
</tbody>
</table>

Describe the effect of each of the toxins on the response by muscles.

Curare

Strychnine

Q33.

Plants need nitrate ions in order to make proteins.

A plant is growing in soil flooded with water.

Explain why the plant cannot absorb enough nitrate ions.
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?

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

(iii) Person 7 has CADASIL.

Is person 7 homozygous or heterozygous for the CADASIL allele?

Give evidence for your answer from the diagram.

(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.

\[ \text{D} = \text{allele for CADASIL} \]
\[ \text{d} = \text{allele for not having CADASIL} \]
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?

(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.

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.

(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.

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

Magnification = ________________

(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.

(ii) Explain the advantages of red blood cells passing through a capillary one at a time.
Q36.

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

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

(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?

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

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

(ii) Suggest an explanation for this.
(iii) Add the two missing figures to the right-hand column of the table. 

(2) 
(Total 8 marks)
Q1.

(i) \[ C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O \]

*energy is neutral*

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)*

(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*

Q2.

(a) X – relay (neurone)
Y – motor (neurone)

*both required for mark*

*must be in correct order*

(b) chemical (released from X)

*do not accept electrical impulse*

*accept chemical messenger / transmitter*

*accept neurotransmitter*

*accept named transmitter substance eg acetylcholine*

(crosses) synapse

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

Q3.

(a) water enters (funnel / sugar solution) *or* water diffuses in (to the funnel)

*do not accept if diffusion of sugar*
membrane partially / selectively / semi permeable or by osmosis

allow description

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

(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

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

accept due to lower diffusion / concentration gradient / described

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)

Q5.

(a) 23

(b) chromosome nucleus gene cell

2 3 1 4
(c) (i) any one from
(cells which are bigger) take up more space
(cells) have to get bigger or mature to divide

(ii) chromosomes duplicate or
make exact copies of self
accept forms pairs of chromatids

nuclei divide
accept chromatids or
chromosomes separate

identical (daughter) cells formed
accept for example, skin cells make
more skin cells or cells are clones

(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

Q6.
(a) (i) water (molecules) enter(s) (the cell)
or water (molecules) pass(es) through the (semi-permeable) cell membrane

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
(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

(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

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

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

water is drawn out of the cell

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)

(iii) 46
  accept save as c(i)

Q8.
(a) (i) if two nuclei drawn then maximum two marks

6 chromosomes

same 3 homologous pairs

nuclear membrane drawn

(ii) 3 chromosomes

1 from each homologous pair

(b) (i) parent line must be separate

heterozygous parents Tt × Tt

maximum of 2 marks if parental genotype is wrong

gametes correct T  t  T t

genotypes TT  Tt Tt tt

(ii) correct analysis of chance i.e. 1 in 4

or 25%

(iii) 50% or 1 in 2

Q9.
(a) (i) carbon dioxide / CO₂ (reject CO)

(ii) oxygen / O₂ / O (water vapour neutral)

  for 1 mark each

(b) (provides) energy

  for one mark
(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

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*

Q11.

(a) mutation
   *for 1 mark*

(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*

(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*

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'*

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

   beaker 4 = 21.8(5) loss
   *not 21.7*
allow –22%
if no minus or no ‘loss’ check graph

beaker 5 = 29.8(%) loss
allow –30%

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

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

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

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

(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)

Q13.
(i) in diffusion: material moves high to low concentration
here: concentration in cells > concentration in water or
uptake is against the concentration gradient or by diffusion ions would move out

(ii) active transport / active uptake
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

<table>
<thead>
<tr>
<th>meiosis</th>
<th>mitosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>sexual</td>
<td>asexual</td>
</tr>
</tbody>
</table>
gametes growth
ovary or testes all other cells
or gonads
half number same number
of chromosomes of chromosomes
haploid or diploid or
23 chromosomes 46 chromosomes
reassortment or no reassortment
variation possible or no variation
or not identical or identical
4 cells produced 2 cells produced
2 divisions 1 division

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

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

(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

(c) (i) C

(ii) 30

(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

(ii) 44 or 22 pairs

Q19.
(a) (i) glucose and galactose

(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
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)

Q21.

active transport needs energy or diffusion is not energy-dependent

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

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

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

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

  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

Q23.

(a) (i) diffusion is down the concentration gradient

  **for a description of diffusion**
  **ignore along / across gradients**

  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
(ii) active transport
   allow active uptake  

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

(ii) (aerobic) respiration
   do not allow anaerobic
   releases / supplies / provides / gives energy
   accept make ATP (for active transport)
   do not allow ‘makes / produces / creates’ energy

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

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

Conclusion to evaluation:
A reasoned conclusion from the evidence

Q25.
(a) oxygen / O₂
  allow O₂
  do not accept O²

or

carbon dioxide / CO₂
  allow CO2
  do not accept CO²

(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
Q26.

(a) **D**

any one from:
- has chloroplasts
- has a (large) vacuole
  *ignore has a (cell) wall*

(b) **B**

does not have a (cell) wall
*allow has only a nucleus, (cell) membrane and cytoplasm*

(c) **C**

any one from:
- genetic material is not in a nucleus
  *allow no nucleus*
- has a single loop of DNA

(d) real size = 25 / 100 000

0.00025

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

Q27.

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

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*

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

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

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

(c) (i) 0.67/0.7
- accept 0.66, 0.6666666... or ⅔ or 0.6
- correct answer gains 2 marks with or without working
- \[
\frac{100}{100}
\]
- if answer incorrect allow evidence of 150 for 1 mark
do not accept 0.6 or 0.70

(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

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)

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
(ii) one copy of each (chromosome / chromatid / strand) to each offspring cell

*ignore ref. to gametes and fertilisation*

each offspring cell receives a complete set of / the same genetic material

*allow ‘so offspring (cells) are identical’*

(b) (i) meiosis

*allow meiosis as the only alternative spelling*

(ii) Species A = 4 and Species B = 8

(iii) sum of A + B from (b)(ii) e.g. 12

(c) (i) similarities between chromosomes

*or*
similarities between flowers described

*e.g. shape of petals / pattern on petals / colour / stamens*

can breed / can sexually reproduce

*allow can reproduce with each other / they can produce offspring*

(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

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*
(b)  
(i) any one from:
   • (salivary) amylase
   • carbohydrate

(ii) many ribosomes
   *do not mix routes. If both routes given award marks for the greater.*

   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*

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*

   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*

   offspring aa identified as having cystic fibrosis
   *may be the only offspring shown or circled / highlighted / described*

(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
(ii) advantages

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

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

(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*

**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

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

(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

(active transport) requires energy from respiration

(respiration) requires oxygen

no / little oxygen / air in water-logged soil

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

(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

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

(b) genetic diagram including:
accept alternative symbols, if defined

correct gametes:
D and d
and d (and d)
ignore 7 / 8 or male / female
derivation of offspring genotypes:
Dd Dd dd dd
allow just Dd dd if ½-diagram
allow ecf if correct for student’s gametes

identification of Dd as CADASIL
or dd as unaffected
allow ecf if correct for student’s gametes
correct probability: 0.5 / ½ / 1 in 2 / 50% / 1 : 1

(c) (i) stem cells can differentiate or are undifferentiated / unspecialised
can form blood vessel cells / brain cells
or
stem cells can divide

(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

Q35.
(a) hold cells together or prevent flow of cells or trap cells

(b) 12500
if correct answer, ignore working / lack of working
\[
\frac{400}{0.008} \text{ for 1 mark}
\]
ignore any units

(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

(ii) more oxygen released (to tissues) or
more oxygen taken up (from lungs)
and any two from:
• slows flow or more time available
• shorter distance (for exchange) or close to cells / capillary wall
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_

(ii) _idea that more/faster diffusion with higher concentration_

_for 1 mark_

_or_

with more oxygen particles/molecules (in same space)

(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

(ii) more red blood cells develop

_or_

more haemoglobin in the blood

_(not just ‘acclimatises’)_

_for 1 mark_

(iii) 75

60

_each for 1 mark_