Materials
For this paper you must have:
- Ruler
- Pencil, Rubber, Protractor and Compass
- Scientific calculator, which you are expected to use when appropriate

Instructions
- Answer all questions
- Answer questions in the space provided
- All working must be shown
- Do all rough work in this book. Cross out any rough work you don’t want to be marked

Information
- The marks for the questions are shown in brackets
The photograph below shows the lower surface of a leaf magnified 800 times.

(a) Name hole A in the leaf surface.

___________________________________________________________________

(b) Name cell B.

___________________________________________________________________

(c) Cell B can lose or gain water.

Complete the sentences.

Choose answers from the box.

<table>
<thead>
<tr>
<th>active transport</th>
<th>condensation</th>
</tr>
</thead>
<tbody>
<tr>
<td>osmosis</td>
<td>photosynthesis</td>
</tr>
</tbody>
</table>

Cell B can gain water by _______________________________.

Water vapour can escape from the leaf through hole A by _______________________________.

(2)
(d) Which factors increase the rate of water loss from hole A?

Tick two boxes.

- Increasing acidity
- Increasing nitrogen concentration
- Increasing oxygen concentration
- Increasing temperature
- Increasing wind speed

(e) Give one reason why the movement of water in a plant is important.

___________________________________________________________________
___________________________________________________________________

(1)

(f) The African Baobab tree has no leaves for up to 9 months of the year.

Suggest how this helps the tree to survive in an area where there is not much rain.

___________________________________________________________________
___________________________________________________________________

(1)
(g) The photograph above is a photograph taken through a microscope.
The image is magnified 800 times.
One of the cells in the image has a width of 12 mm

Calculate the real width of this cell in micrometres.
Complete the following steps.

Use the equation to work out the real width of the cell in millimetres.

\[
\text{real width of object} = \frac{\text{width of image}}{\text{magnification}}
\]

Real width of cell = ____________________ millimetres

Convert the real width of the cell from millimetres to micrometres.

1 millimetre = 1000 micrometres.

Real width of cell = ____________________ millimetres

(Total 11 marks)

Osmosis is the movement of water through partially permeable cell membranes.

A group of students investigated the effect of temperature on the rate of osmosis in potato cells. The students used five potato chips all cut to the same size.

**Figure 1** shows one chip.

![Figure 1](image)

This is the method used.

1. Half fill a boiling tube with distilled water.
2. Heat the water to 25 °C
3. Place one potato chip in the boiling tube.
4. Keep the boiling tube and potato chip at 25 °C for 30 minutes.
5. Repeat steps 1–4 at four other temperatures.
(a) All of the potato chips gained water by osmosis.

Explain how the students would find out the rate of water uptake by osmosis in each potato chip.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
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___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(b) One of the students used a knife to cut the potato chips.

Suggest how the student could improve the method of cutting the potato chips to make sure they are all the same size.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(c) Another student cut their potato chips as shown in Figure 2.

Figure 2

Suggest how the rate of water uptake by osmosis in this investigation was different from the investigation with the chips shown in Figure 2.

Give a reason for your answer.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)
(d) The students carried out the experiment at 25 °C, 30 °C, 35 °C, 40 °C and 45 °C

Predict what you would expect the results to show as the temperature increases.

Give a reason for your answer.

Prediction __________________________________________________________
___________________________________________________________________
___________________________________________________________________

Reason ____________________________________________________________
___________________________________________________________________

(2)
(Total 8 marks)

The diagram shows how cells from human embryos can be used to grow ‘replacement body parts’ for humans.
(a) How many chromosomes are in a fertilised human egg?

Tick one box.

12 [ ] 23 [ ] 46 [ ] 92 [ ]

(b) What is the process labelled G?

Tick one box.

Fertilisation [ ]
Inheritance [ ]
Meiosis [ ]
Mitosis [ ]

(c) When the embryo is three days old, it contains eight cells.

How many times has the fertilised egg cell divided by day three?

Tick one box.

2 [ ] 3 [ ] 4 [ ] 8 [ ]

(d) Stem cells become specialised in the process labelled H in the diagram.

What is the process labelled H?

Tick one box.

Differentiation [ ]
Evolution [ ]
Genetic modification [ ]
Selective breeding [ ]
(e) Which **two** parts would be found in all the cells in the diagram.

Tick **two** boxes.

- Cell membrane
- Cell wall
- Chloroplasts
- Cytoplasm
- Plasmids

(f) Why might stem cells from human embryos be more useful than stem cells from adults?

___________________________________________________________________
___________________________________________________________________

(g) Some parents have stem cells from the umbilical cord of their baby collected and stored. These stem cells can be used to treat diseases in the child later in life.

Why might stem cells from their own umbilical cord be used rather than stem cells from another embryo?

Tick **one** box.

- Less risk of rejection of umbilical cord stem cells.
- Stem cells from another embryo can treat more diseases.
- Umbilical cord stem cells are older.

(h) Some medical uses of stem cells are still experimental.

Why do some scientists have concerns about the use of stem cells?

___________________________________________________________________
___________________________________________________________________

___________________________________________________________________
(i) Some people object to the use of embryonic stem cells because of religious beliefs.

Give **one** other ethical concern about the use of embryonic stem cells?

___________________________________________________________________

___________________________________________________________________

(Total 10 marks)

Food poisoning can be caused by eating food that is contaminated with *Salmonella* bacteria.

(a) Give **one** difference between a bacterial cell and an animal cell.

___________________________________________________________________

___________________________________________________________________

(Total 1 marks)

The table shows the number of confirmed cases of salmonella food poisoning in the UK.

<table>
<thead>
<tr>
<th>Year</th>
<th>Confirmed cases per 100 000 population</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>23.82</td>
</tr>
<tr>
<td>2007</td>
<td>22.24</td>
</tr>
<tr>
<td>2008</td>
<td>18.82</td>
</tr>
<tr>
<td>2009</td>
<td>17.17</td>
</tr>
<tr>
<td>2010</td>
<td>15.39</td>
</tr>
<tr>
<td>2011</td>
<td>15.12</td>
</tr>
<tr>
<td>2012</td>
<td>14.00</td>
</tr>
<tr>
<td>2013</td>
<td>13.16</td>
</tr>
<tr>
<td>2014</td>
<td>12.63</td>
</tr>
<tr>
<td>2015</td>
<td>14.50</td>
</tr>
</tbody>
</table>

It is estimated that in the UK, for every confirmed case of salmonella poisoning there are another 3 unconfirmed cases.
(b) Estimate the total probability of suffering from salmonella food poisoning in 2015.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(3)

(c) Describe the trend in the number of confirmed cases of salmonella food poisoning between 2006 and 2014.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(1)

(d) Suggest two reasons for the trend in the data between 2006 and 2014.
  1. ___________________________________________________________________
      ___________________________________________________________________
  2. ___________________________________________________________________
      ___________________________________________________________________
(e) The graph shows the number of confirmed cases of salmonella food poisoning in the UK during one year.

Suggest **one** reason for the high number of cases of salmonella food poisoning in the summer.

___________________________________________________________________

___________________________________________________________________

(1)

(Total 8 marks)
A student investigated the effect of different concentrations of a salt solution on the mass of pieces of potato.

This is the method used.

1. Weigh five pieces of potato.
2. Put each piece of potato into a different concentration of salt solution.
3. Leave the potato pieces for 24 hours.
4. Remove each piece of potato, dry it and re-weigh it.
5. Calculate the change in mass of each piece of potato.

The table shows the results.

<table>
<thead>
<tr>
<th>Concentration of salt solution in arbitrary units</th>
<th>Mass at start in g</th>
<th>Final mass in g</th>
<th>Change in mass in g</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2.60</td>
<td>3.04</td>
<td>0.44</td>
</tr>
<tr>
<td>1</td>
<td>2.71</td>
<td>2.98</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>2.60</td>
<td>2.70</td>
<td>0.10</td>
</tr>
<tr>
<td>3</td>
<td>2.63</td>
<td>2.56</td>
<td>-0.07</td>
</tr>
<tr>
<td>4</td>
<td>2.46</td>
<td>2.22</td>
<td>-0.24</td>
</tr>
</tbody>
</table>

(a) Calculate value X in the table.

___________________________________________________________________
___________________________________________________________________

X = ____________________ g

(1)

(b) Two of the numbers for the change in mass have a negative value.

What do these negative values indicate?

___________________________________________________________________
___________________________________________________________________

(1)
(c) Complete the graph.
- Plot data from the table and your answer to part (a).
- Draw a line of best fit.

(d) Which concentration of salt solution would give no change in mass?

Use the graph.

Concentration = ____________________ arbitrary units
(e) Explain why there would be no change in mass of a piece of potato at the salt concentration you gave in part (d).

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(3)
(Total 9 marks)

Figure 1 shows part of the lungs.

Figure 1

![Diagram of lungs with bronchiole, blood vessel, and alveoli]

(a) Give two ways the lungs are adapted for efficient exchange of gases.

Describe how each adaptation helps to maintain efficient gas exchange.

Adaptation 1 ________________________________________________________
___________________________________________________________________
___________________________________________________________________
Description _________________________________________________________
___________________________________________________________________
___________________________________________________________________

Adaptation 2 ________________________________________________________
___________________________________________________________________
___________________________________________________________________
Description _________________________________________________________
___________________________________________________________________
___________________________________________________________________

(4)
(b) There are 5.4 million people with asthma in the UK.

What type of disease is asthma?

Tick one box.

An allergy  
A bacterial infection  
A cancer  
A viral infection

(c) **Figure 2** shows cross-sections of bronchioles of two people.

**Figure 2**

Suggest why people with asthma often find it difficult to breathe.

___________________________________________________________________

___________________________________________________________________

(1)
People with asthma often have a reduced lung volume.

Figure 3 shows the apparatus a student used to measure his lung volume.

Figure 3

This is the method used.

1. Fill the bottle with water.
2. Breathe out through the tube.

The volume of water pushed out of the bottle is equal to his lung volume.

What is the student’s lung volume?

\[
\text{Volume} = \underline{\text{_____________}} \text{ dm}^3
\]  

Scientists tested a new drug to treat asthma.

The scientists measured the lung volume of:
- volunteers without asthma
- some volunteers during a mild asthma attack
- other volunteers during a severe asthma attack.

Half the people in each group were given a placebo.

The other half of the people in each group were given the new drug.

The tests were carried out as a double blind trial.

(e) What is a placebo?

___________________________________________________________________

___________________________________________________________________

(1)
(f) Who knows which volunteers in a double blind trial are given the drug and which volunteers are given the placebo?

Tick one box.

- The scientists but not the volunteers
- The scientists and the volunteers
- The volunteers but not the scientists
- Neither the volunteers nor the scientists

(g) Suggest why it is a good idea that double blind trials should be used in drug testing?

___________________________________________________________________
___________________________________________________________________

(1)
(h) **Figure 4** shows the results of the drug tests.

![Figure 4](image)

**Key**

- Placebo
- Drug

<table>
<thead>
<tr>
<th>Type of volunteer</th>
<th>Mean lung volume in dm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>No asthma</td>
<td>3.0</td>
</tr>
<tr>
<td>Mild asthma attack</td>
<td>2.5</td>
</tr>
<tr>
<td>Severe asthma attack</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Give **two** conclusions that can be made about the usefulness of the drug.

1. _________________________________________________________________  
   _________________________________________________________________

2. _________________________________________________________________  
   _________________________________________________________________

(Total 12 marks)

**Figure 1** shows an animal cell and a bacterial cell.

![Figure 1](image)

- **Animal cell**
- **Bacterial cell**
  - Genetic material
(a) Compare the structure of the cells in Figure 1.

Complete the sentences.

Choose the answers from the box.

<table>
<thead>
<tr>
<th>cell membrane</th>
<th>cell wall</th>
<th>chloroplast</th>
</tr>
</thead>
<tbody>
<tr>
<td>cytoplasm</td>
<td>nucleus</td>
<td></td>
</tr>
</tbody>
</table>

Only the animal cell contains a ________________________________________.

Only the bacterial cell contains a _______________________________________.

(2)

Figure 2 shows a section through a leaf.

(b) The function of palisade cells is to photosynthesise.

Describe one way palisade cells are adapted to carry out their function.

___________________________________________________________________
___________________________________________________________________

(1)
(c) Complete **Table 1** to show whether each structure is a tissue, an organ or an organ system.

Tick one box for each structure.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Tissue</th>
<th>Organ</th>
<th>Organ system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaf</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xylem</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roots, stem and leaves</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A student observed palisade cells using a microscope.

The microscope had four objective lenses, each with a different magnification.

(d) Which objective lens should the student use first?

Tick one box.

Give a reason for your answer.

- ×4 magnification
- ×10 magnification
- ×40 magnification
- ×100 magnification

Reason __________________________________________________________
__________________________________________________________________

(2)
The student measured the width of 5 different palisade cells at a total magnification of ×400.

(e) Eyepiece lenses are usually ×5 or ×10 magnification.

What combination of eyepiece and objective lenses would give a total magnification of ×400?

Eyepiece lens ____________________

Objective lens ____________________

(f) Table 2 shows the student’s results.

<table>
<thead>
<tr>
<th>Cell</th>
<th>Width of cell image in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>11</td>
</tr>
</tbody>
</table>

(f) Calculate the mean width of the palisade cell images.

___________________________________________________________________
___________________________________________________________________

Mean width = ____________________ mm

(g) Calculate the real width of a palisade cell.

Use the mean width you calculated in part (f).

Use the equation:

real width = \frac{\text{image width}}{\text{magnification}}

___________________________________________________________________
___________________________________________________________________

Real width = ____________________ mm

(Total 11 marks)