Q1.

The drawing shows part of a root hair cell.

(a) Use words from the list to label the parts of the root hair cell.

- cell membrane
- cell wall
- cytoplasm
- nucleus
- vacuole

(b) The diagram shows four ways in which molecules may move into and out of a cell. The dots show the concentration of molecules.

The cell is respiring aerobically.
Which arrow, A, B, C or D represents:

(i) movement of oxygen molecules; ____________
(ii) movement of carbon dioxide molecules? ____________

(c) Name the process by which these gases move into and out of the cell.

___________________________________________________________________

(Total 7 marks)

Q2.

Some students set up the equipment below to investigate osmosis.
(a) What is osmosis?

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

(b) (i) What will happen to the water level in the capillary tube during the investigation because of osmosis?

___________________________________________________________________

(ii) Use your knowledge of osmosis to explain why this happens.

___________________________________________________________________

(Total 6 marks)

Q3.
The genetic diagram shows how the chromosomes divide and combine in human reproduction.

(a) Draw circles around the symbols for the two male gametes.
(b) State the chance of a child being a girl.

___________________________________________________________________ (1)

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

___________________________________________________________________ (1)

(ii) How many chromosomes are there in a human egg cell?

___________________________________________________________________ (1)

(d) Chromosomes contain genes. From what substance are genes made?

___________________________________________________________________ (1)

(e) In the process of mitosis, how do the number of chromosomes in the daughter cells compare to that in the original cell?

___________________________________________________________________ (1)

(Total 7 marks)

Q4.

(a) Balance the following equation for photosynthesis.

\[ \text{______ CO}_2 + \text{______ H}_2\text{O} \rightarrow \text{C}_6\text{H}_12\text{O}_6 + \text{______ O}_2 \] (1)

(b) Give two conditions necessary for photosynthesis apart from a suitable temperature range and the availability of water and carbon dioxide.

1. _______________________________________________________________
2. _______________________________________________________________ (2)

(a) Plants have leaves which contain guard cells and palisade cells. Explain how each of these kinds of cell assists photosynthesis.

Guard cells _______________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________ (2)

Palisade cells _______________________________________________________
___________________________________________________________________
___________________________________________________________________
(d) Glucose is a product of photosynthesis. Give three uses which green plants make of glucose.

1. _________________________________________________________________
2. _________________________________________________________________
3. _________________________________________________________________

(Total 10 marks)

Q5.

(a) The diagram shows a light receptor cell.

Label structures A, B and C on the diagram.

(b) It is important that the nervous system can detect stimuli.

Give two reasons why.

(Total 5 marks)

Q6.

Oxygen from our lungs is carried, by our blood, to cells in our body where aerobic respiration takes place.

(i) Complete the two spaces to balance the chemical reaction for aerobic respiration.

\[ C_6H_{12}O_6 + 6O_2 \rightarrow \underline{\text{____}} \text{CO}_2 + \underline{\text{____}} \text{H}_2\text{O} \]

(ii) Name the substance with the formula \( C_6H_{12}O_6 \).
(iii) Name the structures in the cytoplasm of our cells where aerobic respiration takes place.

_______________________________________

(Total 3 marks)

Q7.

The diagrams show a cheek cell from a human and a leaf cell from a plant.

![Cheek cell and Leaf cell diagrams]

(a) The two cells have a number of parts in common.

(i) On the cheek cell, label three of these parts which both cells have.

(ii) In the table, write the names of the three parts you have labelled above and describe the main function of each part.

<table>
<thead>
<tr>
<th>Part</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Total 8 marks)

(b) Blood contains white cells and red cells. State the function of each type of cell in the blood.

White cells __________________________________________________________

Red cells __________________________________________________________

(Total 8 marks)
Q8.
Starfish can split in half. Each half can then grow new arms to form offspring. This process is shown in the figure below.

(a) What process produces the starfish offspring?
Tick one box.

Asexual reproduction
Fertilisation
Selective breeding
Sexual reproduction

(b) More cells are produced as the starfish grows more arms.
What process will produce more cells in the starfish as they grow?

(c) All the offspring produced are genetically identical.
What name is given to genetically identical organisms?

(d) Each body cell of the parent starfish contains 44 chromosomes.
How many chromosomes are in each body cell of the offspring?
Q9.
(a) The diagram shows four ways in which molecules may move into and out of a cell. The dots show the concentration of molecules.

The cell is respiring aerobically. Which arrow, A, B, C or D, represents:

(i) movement of oxygen molecules; 
(ii) movement of carbon dioxide molecules?

(b) Name the process by which these gases move into and out of the cell.

(c) Which arrow, A, B, C or D, represents the active uptake of sugar molecules by the cell?

Explain the reason for your answer.

Q10.
The drawing shows an animal cell, seen at a very high magnification using an electron microscope.
(a)  
(i) Label a mitochondrion [plural = mitochondria].  

(1) 

(ii) What happens in the mitochondria?  

______________________________________________________________  

(1) 

(b)  
(i) Name and label the structure where you would find chromosomes.  

(1) 

(ii) What are chromosomes made of?  

______________________________________________________________  

(1) 

(c) What controls the rate of chemical reactions in the cytoplasm?  

______________________________________________________________  

(1) 

(Total 5 marks) 

Q11. 

The diagram shows a human sperm. Inside the tail of the sperm is a filament mechanism that causes the side to side movement of the tail, which moves the sperm.
(a) Describe the function of the mitochondria and suggest a reason why they are arranged around the filament near the tail of the sperm.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(3)

(b) Explain the significance of the nucleus in determining the characteristics of the offspring.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(2)

(Total 5 marks)

Q12.
Capillaries are blood vessels in the body which join the arteries to the veins. They have walls which are one cell thick and so are able to exchange substances with the body cells.

(i) Name two substances that travel from the muscle cells to the blood in the capillaries.

1. _________________________________________________________________

2. ___________________________ _______________________________________
(ii) Glucose is one substance that travels from the blood in the capillaries to the body cells. Explain how this happens.

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

(2) (Total 4 marks)

Q13.

(a) (i) Name the red pigment found in red blood cells.

___________________________________________________________________

(1)

(ii) Describe, in detail, the function of this red pigment.

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

(2)

(b) Describe one other way in which the structure of a red blood cell is different from the structure of a white blood cell.

___________________________________________________________________

___________________________________________________________________

(1) (Total 4 marks)

Q14.

The graph shows the concentration of glucose in the blood of two people. Person A is a non-diabetic. Person B has diabetes. Each person ate 75 grams of glucose at 1.0 hours.
(a)  (i)  What was the maximum concentration of glucose in the blood of Person A?

_________________________________ mmol per dm$^3$

(1)

(ii) After eating the glucose, how long did it take for the concentration of glucose in the blood of Person B to return to normal?

________________________________________ hours

(1)

(b) A diabetic person does not produce enough insulin.

(i) Which organ produces insulin?

______________________________________________________________

(1)

(ii) Write the letter X on the graph to show one time when the blood of Person A would contain large amounts of insulin.

(1)
Q15.
Some students set up this experiment to investigate osmosis. They filled two pieces of dialysis [visking] tubing with different liquids and left them both in a beaker of 5% sucrose solution for an hour.

(a) Describe and explain the likely results after one hour.
(b) Describe two examples where osmosis is used in living things.

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

(Total 8 marks)

Q16.

The diagram shows an animal cell.

(a) Name each labelled part and give its function.

A  Name ____________________________

Function _______________________________________________________

___________________________________________________________________

B  Name ____________________________

Function _______________________________________________________

___________________________________________________________________

C  Name ____________________________

Function _______________________________________________________

___________________________________________________________________

(b) (i) This plant cell also contains chloroplasts, a cell wall and a vacuole. Label each of these parts on the diagram.
Q17.

The diagram shows a cell from a plant leaf.

(ii) Give the function of these parts of a plant cell.

Chloroplast function

Cell wall function

Vacuole function

(Total 12 marks)
(a) Name structures A and B.

A
_________________________________________________________________
B
_________________________________________________________________

(2)

(b) Structure C is a chloroplast. What is the function of a chloroplast?

_________________________________________________________________

(1)

(c) The table gives one difference between a plant cell and an animal cell.

Complete the table to give two more differences.

<table>
<thead>
<tr>
<th>Plant cell</th>
<th>Animal cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Has chloroplasts</td>
<td>1. No chloroplasts</td>
</tr>
<tr>
<td>2.</td>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
<td>3.</td>
</tr>
</tbody>
</table>

(2) (Total 5 marks)

Q18.
Cells contain a solution of salts and sugars.

A student is investigating how cells change when they are put into water.

(a) The student:

• looks at a plant cell using a microscope
• adds water to the cell.
The plant cell swells up.

Explain why, as fully as you can.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(b) When animal cells are put in water, they swell up, and then burst. When plant cells are put in water, they swell up, but do not burst.

How does the structure of plant cells prevent them from bursting?

___________________________________________________________________
___________________________________________________________________

Q19.

The small intestine is lined with millions of villi. The diagram shows the structure of a villus.

In the small intestine, some of the products of digestion are absorbed into the blood by active transport.

(a) Explain what is meant by active transport.
How do microvilli and mitochondria help in the active transport of the products of digestion from the small intestine into the blood?

Microvilli

Mitochondria

Q20.

Diagram 1 shows two villi in the small intestine of a healthy person.

(a) Describe two features of the villi which help the small intestine to function.

1. _________________________________________________________________

2. _________________________________________________________________

(b) Diagram 2 shows two villi in the small intestine of a person with coeliac disease.
Q21.
The pancreas is involved in digestion and controlling the internal conditions of the body.

(a) Name two digestive enzymes produced by the pancreas.

1. ___________  

2. _________________________________________________________________

(b) Diabetes may be caused by a lack of insulin.

Part of the treatment for someone with diabetes is to pay careful attention to the diet.

(i) Give one symptom of diabetes.

________________________________________________________________________

(ii) Give one way in which a diabetic may be advised to change their diet.

________________________________________________________________________

(iii) How does this change in diet help the diabetic?

________________________________________________________________________

(iv) State one other way in which the symptoms of diabetes may be treated.

________________________________________________________________________
(c) Many of the cells in the pancreas contain large numbers of ribosomes.

What is the function of ribosomes in a cell?

__________________________________________________________________

__________________________________________________________________

(1)

Q22.

Cells in the human body are specialised to carry out their particular function.

(a) The diagram shows a sperm cell.

![Diagram of a sperm cell with labeled parts: Nucleus, Cell membrane, Mitochondria]

The sperm cell is adapted for travelling to, then fertilising, an egg.

(i) How do the mitochondria help the sperm to carry out its function?

__________________________________________________________________

__________________________________________________________________

(1)

(ii) The nucleus of the sperm cell is different from the nucleus of body cells.

Give one way in which the nucleus is different.

__________________________________________________________________

__________________________________________________________________

(1)

(b) Stem cells from human embryos are used to treat some diseases in humans.

Explain why.

__________________________________________________________________

__________________________________________________________________

__________________________________________________________________

__________________________________________________________________

(1)
Q23.

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

(a) Which cell, A, B or C, appears to have adaptations to increase diffusion into or out of the cell?

Give one reason for your choice.

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

(1)

(b) (i) Cell C is found in the pancreas.

Name one useful substance produced by the pancreas.

___________________________________________________________________

(1)

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

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

(2)

(Total 4 marks)
Q24.
The human lung has about 80 million alveoli. The diagram shows some alveoli in a human lung.

(a) Give three features of the alveoli that allow large amounts of oxygen to enter the blood.
1. _________________________________________________________________
   _________________________________________________________________
2. _________________________________________________________________
   _________________________________________________________________
3. _________________________________________________________________
   _________________________________________________________________

(b) (i) Name the process by which oxygen passes from the air into the blood.
   _________________________________________________________________

(ii) Breathing allows large amounts of oxygen to enter the blood.
    Explain how breathing does this.
    _________________________________________________________________
    _________________________________________________________________
    _________________________________________________________________
    _________________________________________________________________

(Total 6 marks)

Q25.
(a) The diagrams show the structures of a yeast cell and a bacterial cell.
(i) Both the yeast cell and the bacterial cell have structures A and B.

Name structures A and B.

A _____________________________

B _____________________________

(ii) The yeast cell and the bacterial cell have different shapes and sizes.

Give one other way in which the structure of the bacterial cell is different from the structure of the yeast cell.

______________________________________________________________

______________________________________________________________

(b) Sourdough bread is light in texture and tastes slightly sour. The bread is made using two types of microorganism, a yeast and a bacterium. The bacterium can make acids such as lactic acid. The acid makes the bread taste sour.

The graph shows how the growth rates of the yeast and the bacteria change with temperature.
(i) Sourdough bread rises fastest at 27°C.

Use information from the graph to explain why.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

(2)

(ii) The bread tastes most sour if it rises at 32°C.

Use information from the graph to explain why.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

(2)

(Total 7 marks)

Q26.

The photograph shows some cells in the root of an onion plant.
(a) Cells X and Y have just been produced by cell division.

(i) Name the type of cell division that produced cells X and Y.

________________________________________________________________________

(1)

(ii) What happens to the genetic material before the cell divides?

________________________________________________________________________

(1)

(b) A gardener wanted to produce a new variety of onion.

Explain why sexual reproduction could produce a new variety of onion.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

(3)

(Total 5 marks)
(a) (i) Both the bacterial cell and the plant cell contain ribosomes.
What is the function of a ribosome?

(ii) The plant cell contains mitochondria but the bacterial cell does not contain mitochondria.

Give one other way in which the plant cell is different from the bacterial cell.

(b) (i) Both cells are drawn the same length, but the magnification of each cell is different.

The real length of the bacterial cell is 2 micrometres.
Calculate the real length, X, of the plant cell. Give your answer in micrometres.

Show clearly how you work out your answer.
Most mitochondria are about 3 micrometres in length.

The plant cell contains mitochondria but the bacterial cell does not contain mitochondria.

Use your answer to part (b)(i) and the information in the diagram to suggest why.

Q28.

The lugworm lives in a U-shaped burrow in the sand on the seashore.

The diagram below shows a lugworm in its burrow.

(a) Some scientists investigated the effect of different salt concentrations on lugworms. The scientists:

• collected 50 lugworms from the seashore
• separated them into five groups of 10 lugworms
• weighed each group of 10 lugworms
• placed each group into a different concentration of salt solution and left them for 8 hours
• took each lugworm out of the solution and placed it on blotting paper for 30 seconds
• re-weighed each group of 10 lugworms.

(i) Why did the scientists use groups of 10 lugworms and not just 1 lugworm at each concentration?
(ii) Suggest why the scientists placed each lugworm on blotting paper for 30 seconds before they reweighed the groups of lugworms.

(iii) How might the method of blotting have caused errors in the results?

(iv) Suggest one improvement the scientists could make to their investigation.

(b) The table below shows the scientists’ results.

<table>
<thead>
<tr>
<th>Concentration of salt in arbitrary units</th>
<th>Mass of 10 lugworms at start in grams</th>
<th>Mass of 10 lugworms after 8 hours in grams</th>
<th>Change in mass in grams</th>
<th>Percentage (%) change in mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>41.2</td>
<td>61.8</td>
<td>+20.6</td>
<td>+50</td>
</tr>
<tr>
<td>2.0</td>
<td>37.5</td>
<td>45.0</td>
<td>+7.5</td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>55.0</td>
<td>56.1</td>
<td>+1.1</td>
<td>+2</td>
</tr>
<tr>
<td>4.0</td>
<td>46.2</td>
<td>22.2</td>
<td>-24.0</td>
<td>-52</td>
</tr>
<tr>
<td>5.0</td>
<td>45.3</td>
<td>22.6</td>
<td>-22.7</td>
<td>-50</td>
</tr>
</tbody>
</table>

(i) The scientists calculated the percentage change in mass at each salt concentration.

Why is the percentage change in mass more useful than just the change in mass in grams?

Use information from the table in your answer.
(ii) Calculate the percentage change in mass for the 10 lugworms in the salt solution with a concentration of 2.0 arbitrary units.

Percentage change in mass = ______________________ %

(c) (i) On the graph paper below, draw a graph to show the scientists’ results:

- plot the percentage change in mass
- label the horizontal axis
- draw a line of best fit.

(ii) The scientists thought one of their results was anomalous.

Draw a ring around the anomalous result on your graph.

(iii) Suggest what might have happened to cause this anomalous result.
(d) (i) What do you think is the concentration of salts in the lugworm’s natural environment?

Use information from your graph to give the reason for your answer.

Concentration = ______________________ %

Reason _______________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

(ii) The mass of the lugworms decreased in the salt solution with a concentration of 5.0 arbitrary units.

Explain what caused this.
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________

(3)

(Total 19 marks)

Q29.

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Diffusion is an important process in animals and plants.

The movement of many substances into and out of cells occurs by diffusion.

Describe why diffusion is important to animals and plants.

In your answer you should refer to:

• animals
• plants
• examples of the diffusion of named substances.
_________________________________________________________________
_________________________________________________________________
_________________________________________________________________
Plant roots absorb water from the soil by osmosis.

(a) What is osmosis?

(b) The image below shows part of a plant root.
The plant root is adapted for absorbing water from the soil.

Use information from the diagram to explain how this plant root is adapted for absorbing water.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Q31.
Gas exchange takes place in the lungs.

The diagram shows an alveolus next to a blood capillary in a lung.

The arrows show the movement of two gases, A and B.

(a) (i) Draw a ring around the correct answer to complete the sentence.

Gases A and B move by diffusion.
(ii) Gas A moves from the blood to the air in the lungs.
Gas A is then breathed out.
Name Gas A.

______________________________________________________________

(iii) Which cells in the blood carry Gas B?
Draw a ring around the correct answer.

platelets red blood cells white blood cells

(b) The average number of alveoli in each human lung is 280 million.
The average surface area of 1 million alveoli is 0.25 m².
Calculate the total surface area of a human lung.

___________________________________________________________________
Answer ___________________________________ m²

(2)

(c) An athlete trains to run a marathon. The surface area of each of the athlete's lungs has increased to 80 m².
Give one way in which this increase will help the athlete.

___________________________________________________________________
___________________________________________________________________

(Total 6 marks)

Q32.
Some infections are caused by bacteria.

(a) The genetic material is arranged differently in the cells of bacteria compared with animal and plant cells.
Describe two differences.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
(b) Tuberculosis (TB) is an infection caused by bacteria.

The table below shows the number of cases of TB in different regions of southern England from 2000–2011.

<table>
<thead>
<tr>
<th>Year</th>
<th>London</th>
<th>South East</th>
<th>South West</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>37</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>2001</td>
<td>36</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>2002</td>
<td>42</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>2003</td>
<td>42</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>2004</td>
<td>42</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>2005</td>
<td>49</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>2006</td>
<td>44</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>2007</td>
<td>43</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>2008</td>
<td>44</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>2009</td>
<td>44</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>2010</td>
<td>42</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>2011</td>
<td>45</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

(i) How does the number of cases of TB for London compare with the rest of southern England?

(ii) Describe the pattern in the data for cases of TB in the South East.

(iii) Describe the pattern in the data for cases of TB in the South West.
(c)  
(i) On the graph paper below:
   - plot the number of cases of TB in London
   - label both the axes on the graph
   - draw a line of best fit.

(ii) Suggest why a student thought the value for 2005 in London was anomalous.

(d) People can be vaccinated against TB.
   Suggest how a vaccination programme would reduce the number of people with TB.
   Details of how a vaccine works are not required.
Q33.
The diagram below shows a single-celled alga which lives in fresh water.

![Diagram of a single-celled alga with labeled parts: Flagellum, Light-sensitive spot, Vacuole, Nucleus, Cytoplasm, Chloroplast, Cell wall.]

(a) Which part of the cell labelled above:
   (i) traps light for photosynthesis
       ________________________________________________________________
   (1)
   (ii) is made of cellulose?
       ________________________________________________________________
   (1)

(b) In the freshwater environment water enters the algal cell.
   (i) What is the name of the process by which water moves into cells?
       ________________________________________________________________
   (1)
   (ii) Give the reason why the algal cell does not burst.
       ________________________________________________________________
       ________________________________________________________________
   (1)

(c) (i) The alga can photosynthesise.

   Complete the **word** equation for photosynthesis.

   \[ \text{water} + \underline{\text{________}} \xrightarrow{\text{Light energy}} \underline{\text{________}} + \text{oxygen} \]
   (2)

   (ii) The flagellum helps the cell to move through water. Scientists think that the flagellum and the light-sensitive spot work together to increase photosynthesis.

   Suggest how this might happen.
   ________________________________________________________________
Multicellular organisms often have complex structures, such as lungs, for gas exchange.

Explain why single-celled organisms, like algae, do **not** need complex structures for gas exchange.

Q34.

The diagram below shows a cross-section of a plant root. The transport tissues are labelled.

(a) (i) What is tissue A?

Draw a ring around the correct answer.

- cuticle
- epidermis
- xylem

(ii) Name **two** substances transported by tissue A.

1. ____________________________________________________________
2. ____________________________________________________________
(b) Phloem is involved in a process called translocation.

(i) What is translocation?

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

(1)

(ii) Explain why translocation is important to plants.

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

(2)

(c) Plants must use active transport to move some substances from the soil into root hair cells.

(i) Active transport needs energy.

Which part of the cell releases most of this energy?

Tick (✓) one box.

- mitochondria
- nucleus
- ribosome

(1)

(ii) Explain why active transport is necessary in root hair cells.

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

(2)

(Total 9 marks)
Q35.

The image below shows some muscle cells from the wall of the stomach, as seen through a light microscope.

(a) Describe the function of muscle cells in the wall of the stomach.
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
(2)

(b) **Figure above** is highly magnified.
The scale bar in **Figure above** represents 0.1 mm.
Use a ruler to measure the length of the scale bar and then calculate the magnification of **Figure above**.
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
Magnification = _______________ times
(2)

(c) The muscle cells in **Figure above** contain many mitochondria.
What is the function of mitochondria?
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
(2)

(d) The muscle cells also contain many ribosomes. The ribosomes cannot be seen in **Figure above**.
(i) What is the function of a ribosome?
___________________________________________________________________
Q36.

Students used quadrats to estimate the population of dandelion plants on a field.

(a) Describe how quadrats should be used to estimate the number of dandelion plants in a field.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(b) The field measured 40 m by 145 m.

The students used 0.25 m$^2$ quadrats.

The students found a mean of 0.42 dandelions per quadrat.

Estimate the population of dandelions on the field.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Estimated population of dandelions = ______________

(c) In one area of the field there is a lot of grass growing in the same area as dandelions.

Suggest why the dandelions may not grow well in this area.

___________________________________________________________________
Q37.

Figure 1 shows a cell viewed through a light microscope.

The size of the real cell is 0.03 mm.

(a) Calculate the magnification of the microscope.

Use Figure 1 to help you answer.

Magnification = ____________________

(b) A light microscope uses light waves to observe objects.

Light waves can be modelled using water waves.

Figure 2 shows a water wave.
Give one similarity between a light wave and a water wave.

___________________________________________________________________

(1)

(c) Write down the equation that links frequency, wave speed and wavelength.

___________________________________________________________________

(1)

(d) The wave in Figure 2 has a wavelength of 75 cm.
The wave moves at a speed of 1.6 m/s.
Calculate the frequency of the wave.

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

Frequency = __________________ Hz

(4)

(Total 8 marks)

Q38.
(a) In humans there are two types of cell division: **mitosis** and **meiosis**.
The table below gives statements about cell division.
Tick (✓) one box in each row to show if the statement is true for mitosis only, for meiosis only, or for both mitosis and meiosis.
The first row has been done for you.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Mitosis only</th>
<th>Meiosis only</th>
<th>Both mitosis and meiosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>How cells are replaced</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How gametes are made

How a fertilised egg undergoes cell division

How copies of the genetic information are made

How genetically identical cells are produced

(b) Stem cells can be taken from human embryos.

In therapeutic cloning, an embryo is produced that has the same genes as the patient.

(i) Name one source of human stem cells, other than human embryos.

______________________________________________________________

(ii) Stem cells from embryos can be transplanted into patients for medical treatment.

Give one advantage of using stem cells from embryos, compared with cells from the source you named in part (i).

______________________________________________________________

______________________________________________________________

(Total 6 marks)

Q39.

The image below shows an epithelial cell from the lining of the small intestine.

(a) (i) In the image above, the part of the cell labelled A contains chromosomes.

What is the name of part A?
(ii) How are most soluble food molecules absorbed into the epithelial cells of the small intestine?

Draw a ring around the correct answer.

**diffusion**  **osmosis**  **respiration**

(b) Suggest how the highly folded cell surface helps the epithelial cell to absorb soluble food.

___________________________________________________________________
___________________________________________________________________

(c) Epithelial cells also carry out active transport.

(i) Name one food molecule absorbed into epithelial cells by active transport.

___________________________________________________________________

(ii) Why is it necessary to absorb some food molecules by active transport?

___________________________________________________________________
___________________________________________________________________

(ii) Suggest why epithelial cells have many mitochondria.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(d) Some plants also carry out active transport.

Give one substance that plants absorb by active transport.

___________________________________________________________________

(Total 8 marks)
Mark schemes

Q1.
(a) (cell) wall
(cell) membrane
cytoplasm
vacuole

for 1 mark each

(b) (i) A
(ii) B

for 1 mark each

(c) diffusion (reject osmosis)

for 1 mark

[7]

Q2.
(a) movement of water [1]

from high concentration (of water) to low concentration (of water)
or
from (an area of) dilute solution to an area of concentrated solution [1]

through a differentially or partially or selectively or semi permeable membrane [1]

(b) (i) it will rise

1

(ii) water enters visking tubing [1]

because the concentration of water outside is greater than the concentration inside
or
because the concentration of salt or solute is greater inside the tubing than outside [1]
or
to equalise concentration water has to enter visking tubing [2]

[6]

Q3.
(a) circles round right hand X and Y gametes

put two ticks or crosses by the circles

2

(b) 50:50 or 1:1 or 50% or 0.5 or ½ equal or evens

credit even
do not accept 2:1 or 50 / 50
(c) (i) 23

(ii) 23
credit the same as the one above to be marked consequential

(d) DNA

do not accept nucleic acid

(e) same

Q4.

(a) 6 6 6
all required
accept a '6n 6 n 6n' version of the balanced equation provided it is correct in every detail

(b) any two of
- (presence of) chlorophyll or (amount of) chloroplasts
  accept green leaves (or other green parts)
- (sufficient) light (intensity)
- (light) of a suitable wavelength
  any light other than green light
do not credit Sun's energy or sunshine or Sun

(c) guard cells
any two of
* control by osmosis
* the movement of gases
  accept movement of carbon dioxide or oxygen or water vapour beware movement of CO₂ out
  accept a diagram or description
* through the stoma

palisade cells
any two of
* near the upper surface
* contain (a great) many or more chloroplasts
* (so) contain the most chlorophyll
(d) any three of
* for respiration
* conversion to (insoluble) starch
or to food store or to (other) carbohydrates
* (conversion to) sucrose or to food store or to (other) carbohydrates
or polysaccharides

do not credit just to grow or live
or survive
accept conversion to food store
or to (other) carbohydrates once only
* (conversion to) lipids or fats or oils
* (conversion to) amino acids or (plant) proteins or auxins or (plant) hormones or enzymes

Q5.
(a) A – (cell) membrane
   allow phonetic spelling

B – cytoplasm

C – nucleus

(b) any two from:
• to react / respond (to the surroundings)
  ignore brain / nervous system reacts
  ignore adapt

• avoid dangers / prevent harm to body
  allow examples eg to prevent body being burned by hot object

• to coordinate behaviour / process information
  ignore send messages

Q6.
(i) 6 in both spaces
   do not credit if any formula has been altered

(ii) glucose
   allow fructose or dextrose

(iii) mitochondria
Q7.

(a) (i) the three features correctly labelled on cheek cell (which are referred to in part (ii)

label lines should touch or end very close to part no marks if leaf cell labelled

nucleus

cytoplasm

cell membrane

mitochondrion

accept mitochondria or one of these could be labelled vacuole

(ii) any three from

<table>
<thead>
<tr>
<th>feature</th>
<th>function</th>
</tr>
</thead>
<tbody>
<tr>
<td>nucleus</td>
<td>controls cell</td>
</tr>
<tr>
<td>cytoplasm</td>
<td>where respiration occurs</td>
</tr>
<tr>
<td>membrane</td>
<td>less water or chemicals</td>
</tr>
<tr>
<td>mitochondria</td>
<td>where energy released</td>
</tr>
</tbody>
</table>

ecf from leaf cell labelling

accept chloroplasts make sugar or glucose

accept vacuole contains sap

accept if cell wall mis labelled on cheek cell, support or hold together

(b) fight or ingest or kill bacteria or germs or viruses or microbes

accept produce antitoxins or antibodies fight disease (organisms)
do not credit fungus

(transport) oxygen or carry haemoglobin

accept transport carbon dioxide or helps form scabs

Q8.

(a) asexual reproduction

(b) mitosis

(c) clones

(d) 44

Q9.

(a) (i) A
(ii) B

for 1 mark each

(b) diffusion

(reject osmosis)

for one mark

(c) C

because uptake against a concentration / diffusion gradient (reject osmosis)

(if C not given, then idea of movement essential)

for 1 mark each

Q10.

(a) (i)
award 1 mark for any of the mitochondria correctly labelled if a number are labelled and one is incorrect award 0 marks

(ii) respiration or the release or transfer of energy or it contains the enzymes for respiration
do not accept energy produced

(b) (i) nucleus (named and correctly labelled)

arrow or line must touch or go inside the nuclear membrane

(ii) DNA or genes or nucleic acids
accept protein or histones or nucleotides or ATGC

(c) enzymes or nucleus
do not accept factors that affect the rate rather than control it eg pH or temperature

Q11.
(a) award one mark for each key idea
energy released or energy transferred or respiration
allow provides or gives
do not allow produces or makes

near to the site of movement or
energy available quickly or more
energy
accept allows more mitochondria to fit in

(mitochondria) packed (around filament) or efficient arrangement or spiral arrangement

(b) contains chromosomes or genes or DNA
not genetic material

(which) contribute half (the genes) to the fetus or offspring
23 chromosomes or half the genes or reference to X,Y chromosome determining sex (if the notion of halfness is there)
nucleus contains half genes for the offspring = 2 marks

Q12.
(i) any two from:
urea
carbon dioxide
water
lactic acid

(ii) higher concentration of glucose or more glucose in blood than cells
diffuses across

Q13.
(a) (i) haemoglobin / oxyhaemoglobin
must be phonetic

(ii) carries oxygen or forms oxyhaemoglobin
Ignore references to CO₂ / iron
cancel if extras like food / glucose

from lungs to tissues
(b) no nucleus or biconcave disc (described)
   ignore references to size
   ignore vague references to being ‘round’ / ‘donut’ shaped etc.

Q14.

(a) (i) 6

(ii) 4

(b) (i) pancreas
   ignore islets of langerhans

(ii) ‘X’ anywhere between >1 and ≤ 2 hours
    anywhere in that column

(c) any four from:

water movement
   do not accept solution

out of cells

dilute to concentrated solution
   accept reference to correct gradient - high $\uparrow$ to low $\downarrow$
or high to low ‘water concentration’
   must be unambiguous – i.e. not ‘high to low concentration’
   accept low to high concentration

reference to partially / selectively permeable membranes or described

cells shrink / get smaller
   allow crenated
   ignore plasmolysed / flaccid / floppy
   etc

Q15.

(a) award 3 marks per tube for each key idea

for tube 1:

expands or gets firmer or bigger or inflates

it gains water

because the concentration of water is less than its surroundings
   make sure answer is about water movement and not sucrose
solution

for tube 2
gets floppy or flaccid or contracts
it loses water
because the concentration of water is greater than its surroundings

(b) any 2 from:
uptake of water by root (hair) or
movement from cell to cell within plant

*do not* credit references to diffusion unless it is clear that the candidate is referring to the diffusion of water

guard cell function
maintain turgor
water absorption in the large intestine
reabsorption of water from the nephron or collecting duct or in kidney or osmoregulation in kidney

*allow osmosis in other animals if some use is shown*

Q16.
(a) A cytoplasm

where (chemical) reactions take place

*do not* accept where cell functions take place

or
carries/holds the organelles/named organelles / named chemicals (including nutrients)

*do not* accept keeps the shape of the cell

or
contains water

or
presses out on the membrane

*allow: keeps cell turgid
allows transport through the cell*

B membrane

*do not* accept by themselves:

*protects cell*

gives shape
controls what enters/leaves the cell

**or**
contains the cell/holds the cell together
  *do not accept* keeps harmful substances out

**or**
allows movement into and out of the cell

contains the genetic material/DNA/genes/chromosomes
  *do not accept:*
  brain of the cell
  stores information/instructions
  tells cell what to do

**or**
controls (the activity) of the cell

(b) (i) one mark for each correctly labelled part

  cell wall
  *do not accept anything inboard of the inner edge*
  vacuole
  *accept anything inboard of transplant*

chloroplast: site of photosynthesis/ for photosynthesis
  *accept word equation or balanced equation*

cell wall: supports the cell/keeps the shape/keeps it rigid
  *do not accept* protects the cells

(ii) vacuole: acts as reservoir for water / chemicals/(cell)/sap

  *or*
  keeps cell turgid/pushes content to edge
  *or*
  maintains concentration gradient
  *or*
  allows cell elongation (not growth)

Q17.
(a) **A** = nucleus
  *accept phonetic spelling only*

**B** = (cell) membrane
  *accept plasma membrane*
(b) any **one** from:

photosynthesis

**makes** sugar / starch / carbohydrate / organic material

*accept* ‘**makes food**’

do **not** accept makes chlorophyll

ignore stores starch / food / light / chlorophyll

traps or absorbs light

(c) any **two** from:

<table>
<thead>
<tr>
<th>Plant cell</th>
<th>Animal cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>• (has) vacuole <strong>or</strong> has cell sap</td>
<td>• no vacuole <strong>or</strong> small/temporary vacuole <strong>or</strong> no cell sap</td>
</tr>
<tr>
<td>• (has) wall/cellulose</td>
<td>• no wall/cellulose <strong>or</strong> only membrane</td>
</tr>
<tr>
<td>• (stores) starch <strong>or</strong> doesn't store</td>
<td>• doesn't store/have starch <strong>or</strong> stores glycogen</td>
</tr>
<tr>
<td>glycogen</td>
<td></td>
</tr>
</tbody>
</table>

ignore reference to shape

must be clear indication in all four boxes

ignore reference to chlorophyll

---

**Q18.**

(a) because water enters (the cell / it / named cell)

*do not** accept salt / sugar / solution entering

by osmosis / diffusion

*if osmosis / diffusion not given accept concentration inside cell greater than outside cell*

*assume concentration refers to solute concentration unless answer indicates otherwise*

*allow water goes **up** the concentration gradient*

*allow water goes **down** its concentration gradient*

*do not** accept if diffusion of salt / sugar

through a partially permeable membrane

*allow semi / selectively permeable membrane **or** description*

(b) (plant cells) have (cell) **wall**

*accept animal cells have no (cell) wall*

ignore reference to cell membrane

*do not** accept reference to other organelles **or** any implication that animal cells have a cell wall eg plant cells have a thicker cell wall
Q19.
(a) any two from:
- transport up / against concentration gradient / low to high concentration
- uses energy
- use of protein / carrier

(b) microvilli – large(r) surface area
   accept have carriers

mitochondria – release energy or make ATP
   do not accept ‘makes energy’

Q20.
(a) any two from:
- large surface / area or many villi or have microvilli
  accept big surface / area
- thin surface or thin wall or surface 1-cell thick or capillaries near surface or permeable or partially permeable
  accept they are thin
  do not allow thin cell wall
- many blood vessels or many capillaries or capillary network or good blood supply
  ignore ‘constant blood flow’ owtte
  ignore extras eg moist or reference to gases
- have enzymes
  ignore release enzymes
  • accept reference to lacteal as 5th point
  • allow reference to having mitochondria

(b) (i) small(er) (surface area) / flat(ter) / short(er)
   or not as folded
   or fewer capillaries owtte
   allow small(er) lacteal
   ignore references to wide / thick / spread out etc

(ii) less absorption (of digested food) / less digestion / diffusion
   accept slower for less
   accept description of less digestion
accept less food can get in
*do not* allow zero absorption
*do not* allow 'collection' of nutrients

Q21.
(a) any two from:
   - amylase / carbohydrase
   - protease
     *allow trypsin*
   - lipase

(b) (i) high / above normal blood sugar
     or cannot control blood sugar
     *allow other symptoms*
     eg frequent / plentiful urination or sugar in urine or thirst or weight loss or coma
     *ignore consequential effects eg blood pressure / circulation / glaucoma / tiredness*

(ii) any one from:
   - small / regular meals
   - low sugar (meals) or low GI / GL or carbohydrates as starch
     *allow high fibre*
     *ignore reference to low carbohydrate*

(iii) any one from:
   - keep constant( blood) sugar or prevent high (blood) sugar
     or reduces surge / rush of sugar into blood
   - reduce the need for insulin

(iv) (take) insulin
    *allow pancreas transplant*

(c) protein / hormone / enzyme synthesis or synthesis of named example
    or combine amino acids

Q22.
(a) (i) release energy
    *allow provide / supply / give energy*
    *do not* accept produce / create / generate / make energy
do not allow release energy for respiration

(ii) contain half the (number of) chromosomes or contains one set of chromosomes or contains 23 chromosomes
   allow genetic information / DNA / genes / alleles instead of chromosomes
   accept haploid

(b) any two from:
   • (stem cells) are unspecialised / undifferentiated
     allow description eg 'no particular job'
   • are able to become differentiated or can form other types of cell / tissue / organ
   • stem cells can / able to divide / multiply

Q23.
(a) B
no mark for ÉBÉ, alone
large(r) surface / area or large(r) membrane
accept reference to microvilli
accept reasonable descriptions of the surface
do not accept wall / cell wall
ignore villi / hairs / cilia

(b) (i) any one from:
   • insulin / hormone
     if named hormone / enzyme must be correct for pancreas
   • enzyme / named enzyme

(ii) many ribosomes
(ribosomes) produce protein
accept insulin / hormone / enzyme named is (made of) protein
or
allow many mitochondria (1)
provide energy to build protein or to make protein (1)
accept ATP for energy
Q24.
(a) large surface / large area
thin / short distance (from air to blood) / one cell thick / two cells thick

good blood supply / many capillaries / capillary network / many blood vessels
ignore moist surface

(b) (i) diffusion
ignore gaseous exchange

(ii) brings (more) oxygen / air into the lungs / alveoli

keeps O\textsubscript{2} level high in alveoli
or
maintains concentration difference (between alveoli and blood) / keeps O\textsubscript{2} concentration in alveoli > O\textsubscript{2} concentration in blood gains 2 marks

Q25.
(a) (i) A = (cell) wall
ignore cellulose

B = cytoplasm

(ii) any one from:
accept has DNA instead of a nucleus, but not just has DNA

• bacterial cell / it has no nucleus
allow no mitochondria

• DNA free in cytoplasm
ignore size

• has no vacuole / no vesicles
ignore strands of DNA

(b) (i) yeast grows best / better / well or optimum temperature for yeast / more yeast present
allow yeast works best / better / well

(yeast) makes CO\textsubscript{2} or respires / respiration
allow fermentation

(ii) bacterium grows best / better / well / more bacteria present or optimum
temperature for bacterium
ignore microorganisms / microbes
allow works / respires best / better / well

(bacterium) makes (lactic) acid
do not allow wrong acid

Q26.
(a) (i) mitosis
correct spelling only

(ii) replicates / doubles / is copied / duplicates
accept cloned
ignore multiplied / reproduced

(b) fertilisation occurs / fusion (of gametes)
accept converse for asexual, eg none in asexual / just division in asexual
so leading to mixing of genetic information / genes / DNA / chromosomes
genes / DNA / chromosomes / genetic information comes from 1 parent in asexual
ignore characteristics
one copy (of each allele / gene / chromosome) from each parent
or gametes produced by meiosis
or meiosis causes variation
meiosis must be spelt correctly

Q27.
(a) (i) makes / produces / synthesises protein / enzyme

(ii) plant cell has nucleus / vacuole / chloroplasts / chlorophyll
or plant cell is much larger
'It' = plant cell
allow correct reference to DNA or chromosomes
allow plant cell has fewer ribosomes
allow cellulose (cell wall)

(b) (i) 200
correct answer with or without working gains 2 marks
if answer incorrect, allow 1 mark for \[\frac{2 \times 50,000}{100,000} \quad \text{or} \quad \frac{500}{100}\]

(ii) bacterial cell is too small / bacterial cell about same size as a mitochondrion / ‘no room’
    ignore references to respiration

Q28.

(a) (i) variation in masses / more representative / more typical / more reliable / average / mean / reference to anomalies
    or
    one worm to light to measure change
    do not allow more accurate / more precise
    ignore fair test / valid / repeatable / reproducible

(ii) remove solution / liquid (on outside of worm)
    allow ‘water’

(iii) variable amounts removed from each worm
    ignore reference to length of timing

(iv) equal sizes of worm / more worms (in each group) / wash off all the sand / repeats / use more accurate balance / use smaller concentration intervals
    allow reference to improve blotting technique eg blot before / blot more thoroughly

(b) (i) different (starting) masses / sizes / weights (at different concentrations)
    allows comparisons / shows pattern / shows trend

(ii) (+)20
    correct answer = 2 marks, with or without working
    or
    \[
    \frac{7.5 \times 100}{37.5} \quad \text{or} \quad \frac{7.5}{37.5} \quad \text{or} \quad (45.0 - 1) \times 100 \quad \text{or} \quad \frac{37.5}{37.5}
    \]
    for 1 mark

(c) (i) graph:
    points correct
allow ± 1 mm
-1 mark per error
allow ecf from part b(ii)

label on x-axis including units – ie Concentration of salt in arbitrary units

line of best fit = smooth curve / ruled straight line
anomaly (4.0, -52) either plotted and ignored re. line
or not plotted
do not allow point to point
allow best fit for ecf from 2bii

(ii) on graph:
ring drawn around point at (4.0, -52)
allow (5.0, -50) if cand. line indicates this

(iii) sensible suggestion – eg used wrong solution / used 5.0% instead of 4.0% / different length of time in solutions / ref to error in blotting / balance not zeroed / error in weighing
allow some lugworms died
allow error in calculation

(d) (i) 2.9 to 3.0 / correct for candidate’s graph ± 0.1

value of no change in mass / worms in equilibrium with soln / described
allow small(est) mass change

(ii) water loss
by osmosis / diffusion
from dilute region in the worm to more concentrated solution outside
allow correct description in terms of high to low water concentration / high to low water potential
salt solution is hypertonic
concentration unqualified = salt concentration

Q29.
Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a ‘best-fit’ approach to the marking.

0 marks
No relevant content.
An example is given of a named substance or a process or there is an idea of why diffusion is important eg definition.

At least one example of a substance is given and correctly linked to a process in either animals or plants.

There is a description of a process occurring in either animals or plants that is correctly linked to a substance and a process occurring in the other type of organism that is correctly linked to a substance.

Importance of diffusion:

- to take in substances for use in cell processes
- products from cell processes removed

Examples of processes and substances:

- for gas exchange / respiration: O₂ in / CO₂ out
- for gas exchange / photosynthesis: CO₂ in / O₂ out
- food molecules absorbed: glucose, amino acids, etc
- water absorption in the large intestine
- water lost from leaves / transpiration
- water absorption by roots
- mineral ions absorbed by roots

Extra information

Description of processes might include:

- movement of particles / molecules / ions
- through a partially permeable membrane
- (movement of substance) down a concentration gradient
- osmosis: turgor / support / stomatal movements

Q30.
(a) any three from:

- (water through a) partially permeable
  accept ‘semi permeable’ / selectively permeable
- membrane
- from dilute to (more) concentrated solution
  allow ‘from a high concentration of water to a lower concentration (of water)’
  allow ‘from high water potential to low water potential’
  allow ‘down a concentration gradient of water’
  do not accept ‘along a concentration gradient of water’
• (it's a) passive (process)  
   allow requires no energy

(b) (there are) many hairs or thin hairs or hairs are one cell thick

(which gives) large / increased surface area or short diffusion pathway

(so there is) more diffusion / osmosis (of water into the root)  
   ignore absorption

Q31.
(a) (i) diffusion

(ii) carbon dioxide  
   accept CO$_2$ / CO2  
   do not accept CO$_2$

(iii) red blood cells

(b) 70  
   if no / incorrect answer then  
   70 000 000  
   or  
   280 x 0.25 gains 1 mark  
   ignore doubling the answer

(c) allows more gas / oxygen / CO$_2$ (exchange)  
   do not accept air

Q32.
(a) any two from:
   • only one ‘chromosome’  
     allow one strand of DNA
   • circular  
     allow loop
   • may have plasmids
   • not in a nucleus / no nucleus

(b) (i) any one from:
   • London is much higher  
     or converse
• more variable / wider range
  allow ‘on average it is 5 / 6 times greater’

(ii) increases
  Included figures must be correct

(iii) overall slight increase
  accept ‘doesn’t change much’

variable / goes up and down

(c) (i) both axes correctly labelled
  x = Year
  y = Number of cases

  correct points
  all correct = 2 marks
  1-2 errors = 1 mark
  > 2 errors = 0 marks

  suitable line of best fit
  accept straight line or smooth curve

(ii) doesn’t fit the pattern / line of best fit

(d) provides immunity / protection (to TB)
  ignore ‘stops people catching it’
  ignore ‘resistance’

  prevents TB spreading
  accept ref to herd immunity

Q33.
(a) (i) chloroplast

(ii) cell wall

(b) (i) osmosis
  accept diffusion

(ii) cell wall (prevents bursting)
(c)  (i)  carbon dioxide
   
   \[ \text{allow correct formula} \]

   glucose
   
   \[ \text{allow sugar / starch} \]

   (ii)  any two from:
      
      •  light sensitive spot detects light
      •  tells flagellum to move towards light
      •  more light = more photosynthesis

(d)  (cell has) larger SA:volume ratio

   short (diffusion) distance
   
   \[ \text{allow correct description} \]

   (diffusion) via cell membrane is sufficient / good enough

   or

   flow of water maintains concentration gradient

   [11]

Q34.

(a)  (i)  xylem

(ii)  water

   minerals / ions / named example(s)
   
   \[ \text{ignore nutrients} \]

(b)  (i)  movement of (dissolved) sugar
   
   \[ \text{allow additional substances, eg amino acids / correct named sugar (allow sucrose / glucose)} \]

   \[ \text{allow nutrients / substances / food molecules if sufficiently qualified} \]

   \[ \text{ignore food alone} \]

(ii)  sugars are made in the leaves

   so they need to be moved to other parts of the plant for respiration / growth / storage

(c)  (i)  mitochondria
(ii) for movement of minerals / ions

\[ \text{Do not accept 'water'} \]

against their concentration gradient

Q35.

(a) contract / shorten

\[ \text{ignore relax} \]

\[ \text{do not allow expand} \]

to churn / move / mix food

\[ \text{accept peristalsis / mechanical digestion} \]

\[ \text{ignore movement unqualified} \]

(b) 400

\[ \text{acceptable range 390-410} \]

allow 1 mark for answer in range of 39 to 41

allow 1 mark for answer in range of 3900 to 4100

(c) to transfer energy for use

\[ \text{allow to release / give / supply / provide energy} \]

\[ \text{do not allow to 'make' / 'produce' / 'create' energy} \]

allow to make ATP

ignore to store energy

by (aerobic) respiration or from glucose

\[ \text{do not allow anaerobic} \]

\[ \text{energy released for respiration} = \text{max 1 mark} \]

(d) (i) to make protein / enzyme

\[ \text{ignore 'antibody' or other named protein} \]

(ii) too small / very small

\[ \text{allow light microscope does not have sufficient magnification} \]

\[ \text{resolution} \]

\[ \text{allow ribosomes are smaller than mitochondria} \]

\[ \text{ignore not sensitive enough} \]

\[ \text{ignore ribosomes are transparent} \]

Q36.

(a) (placed) randomly

\[ \text{allow description of placement} \]
sufficient number (of quadrats) used

count (dandelions) in each quadrat

use mean number of dandelions, area of quadrat and area of field to estimate population

\[ \text{accept (area of field / area quadrat)} \times \text{mean number of dandelions per quadrat} \]

(b) \( (40 \times 145) / 0.25 = 23\,200 \)

\[ (0.42 \times 23\,200 = )\ 9744 \]

allow 9744 with no working shown for 2 marks

allow ecf from correct attempt at the previous step) \times 0.42 for 1 mark

(c) Level 2 (3–4 marks):
A detailed and coherent explanation is given. Logical links between clearly identified relevant points are made to explain why dandelion growth may be limited.

Level 1 (1–2 marks):
Discrete relevant points are made. The logic may be unclear.

0 marks:
No relevant content

Indicative content

factors that may be considered:
competition for resources including:
- light
- water
- space
- mineral ions (allow nutrients / salts / ions from the soil)

reference to why growth may be limited:
- (light) energy for photosynthesis
- water as a raw material for photosynthesis / support
- surface area exposed to light
- sugar / glucose produced in photosynthesis
- (space) to grow bigger
- (space) for growth of root system
- (mineral ions) for growth
- (mineral ions / sugar) for production of larger molecules or named example

Q37.

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

\[ = 29 \div 0.03 \]
allow 967 with no working shown for 2 marks

(b) they are transverse

(c) wave speed = frequency × wavelength
   allow \( v = f \lambda \)

(d) \( 75 \text{ cm} = 0.75 \text{ m} \)

\[ 1.6 = f \times 0.75 \]
\[ f = 1.6 \div 0.75 \]
\[ = 2.13 \text{ (Hz)} \]

allow 2.13 (Hz) with no working shown for 4 marks

Q38.

(a) | Mitosis only | Meiosis only | Both mitosis and meiosis |
---|---|---|---|
How cells are replaced | ✓ | | |
How gametes are made | | ✓ | |
How a fertilised egg undergoes cell division | ✓ | | |
How copies of the genetic information are made | | ✓ | |
How genetically identical cells are produced | ✓ | | |

if more than one tick per row then no mark
ignore first row

[8]
(b) (i) (adult) bone marrow
    accept (umbilical) cord blood, skin, amniotic fluid / membrane

(ii) cells will not be rejected by the patient's body (if they have been produced by therapeutic cloning)
    allow easier to obtain linked to embryo stem cells
    or
    (embryo stem cells) can develop into many different types of cells
    allow doesn't need an operation linked to bone marrow
    or
    (embryo stem cells) not yet differentiated / specialised or undifferentiated
    accept embryo cells are pluripotent

Q39.

(a) (i) nucleus

(ii) diffusion

(b) increases / larger surface area (for diffusion)
    ignore large surface area to volume ratio

(c) (i) sugar / glucose
    accept amino acids / other named monosaccharides

(ii) against a concentration gradient
    or
    from low to high concentration

(iii) (active transport requires) energy
    (from) respiration

(d) minerals / ions
    accept named ion ignore nutrients
    do not accept water