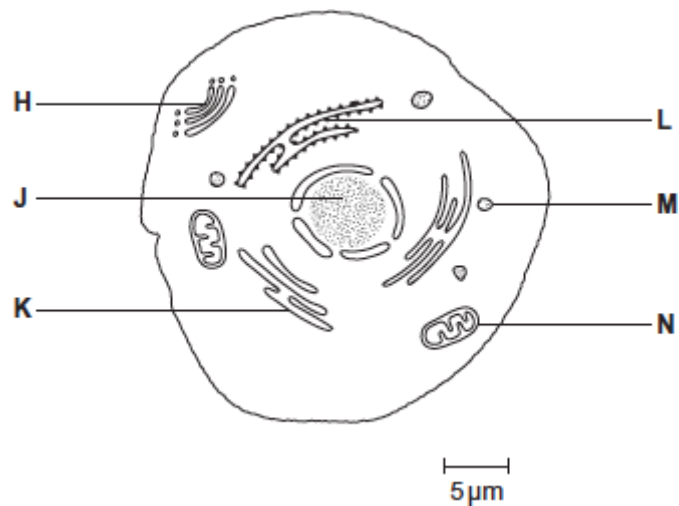


**Cells revision pack 218 minutes 142 marks**

**Q1.**

The diagram shows a eukaryotic cell.



- (a) Complete the table by giving the letter labelling the organelle that matches the function.

Function of organelle	Letter
Protein synthesis	
Modifies protein (for example, adds carbohydrate to protein)	
Aerobic respiration	

(3)

- (b) Use the scale bar in the diagram above to calculate the magnification of the drawing.  
Show your working.

Answer = \_\_\_\_\_

(2)

(Total 5 marks)

**Q2.**

Read the following passage.

Low-density lipoprotein (LDL) is a substance found in blood. A high concentration of LDL in a person's blood can increase the risk of atheroma formation. Liver cells have a receptor on their cell-surface membranes that LDL binds to. This leads to LDL entering the cell. A regulator protein, also found in blood, can bind to the same receptor as LDL. This prevents LDL entering the liver cell. People who have a high concentration of this regulator protein in their blood will have a high concentration of LDL in their blood. Scientists have made a monoclonal antibody that prevents this regulator protein working. They have suggested that these antibodies could be used to reduce the risk of coronary heart disease.

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10

A trial was carried out on a small number of healthy volunteers, divided into two groups. The scientists injected one group with the monoclonal antibody in salt solution. The other group was a control group. They measured the concentration of LDL in the blood of each volunteer at the start and after 3 months. They found that the mean LDL concentration in the volunteers injected with the antibody was 64% lower than in the control group.

15

Use the information in the passage and your own knowledge to answer the following questions.

- (a) The scientists gave an injection to a mouse to make it produce the monoclonal antibody used in this investigation (line 7).

What should this injection have contained?

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(1)

- (b) LDL enters the liver cells (lines 3–4).

Using your knowledge of the structure of the cell-surface membrane, suggest how LDL enters the cell.

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(2)

- (c) Explain how the monoclonal antibody would prevent the regulator protein from working (lines 7–8).

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(2)

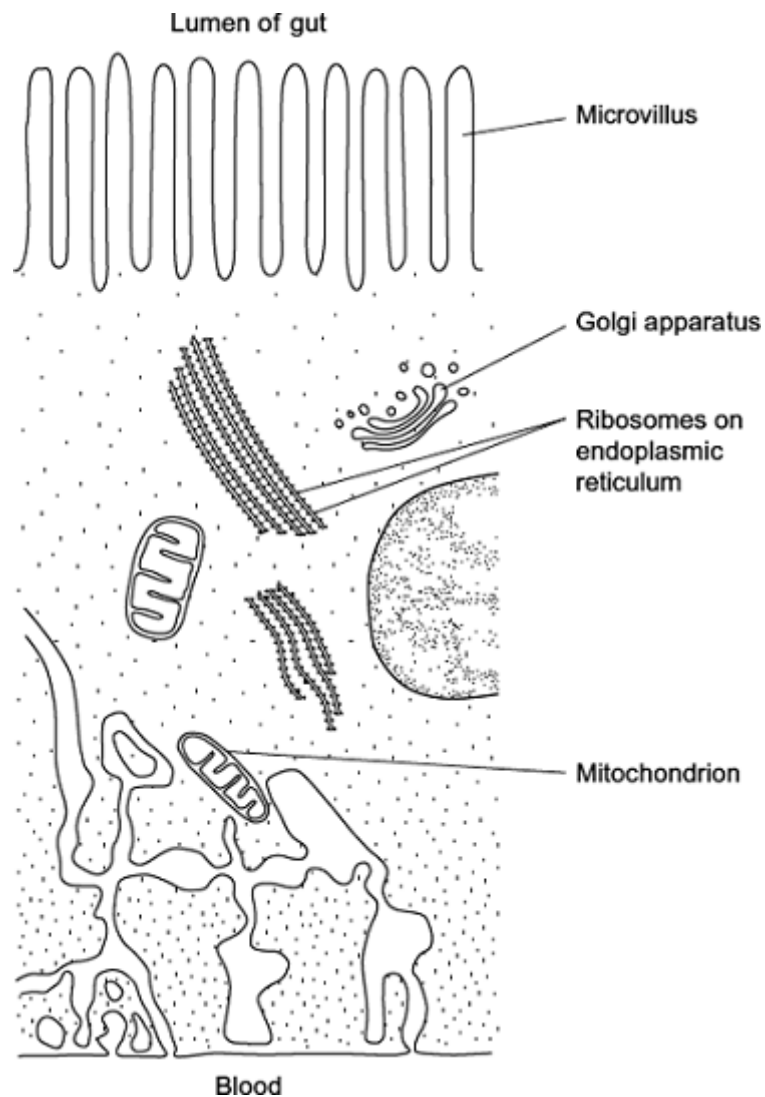
- (d) Describe how the control group should have been treated.

(2)

(Total 7 marks)

**Q3.**

The diagram shows part of an epithelial cell from an insect's gut.



This cell is adapted for the three functions listed below. Use the diagram to explain how

this cell is adapted for each of these functions.

Use a **different** feature in the diagram for each of your answers.

- (a) the active transport of substances from the cell into the blood

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(2)

- (b) the synthesis of enzymes

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(2)

- (c) rapid diffusion of substances from the lumen of the gut into the cytoplasm

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(1)

(Total 5 marks)

#### Q4.

A stomach ulcer is caused by damage to the cells of the stomach lining. People with stomach ulcers often have the bacterium *Helicobacter pylori* in their stomachs.

A group of scientists was interested in trying to determine how infection by *H. pylori* results in the formation of stomach ulcers.

The scientists grew different strains of *H. pylori* in liquid culture.

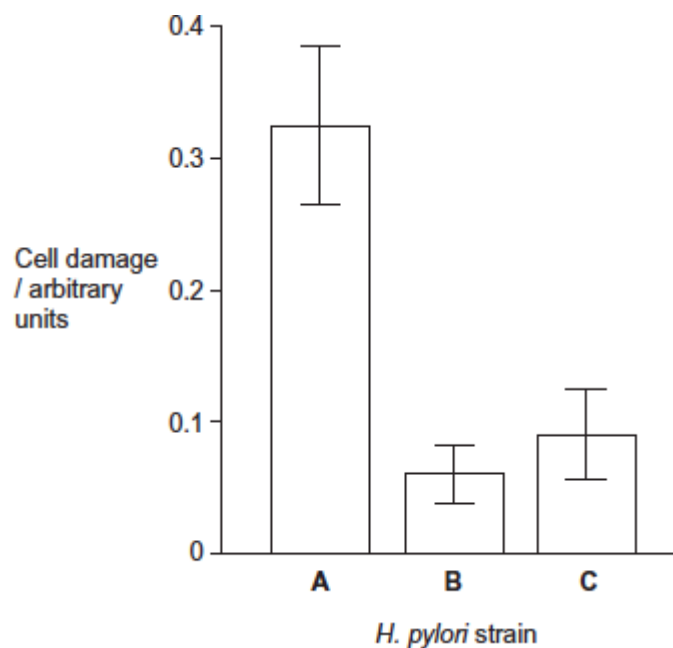
The table below shows the substances released by each of these strains.

<i>H. pylori</i> strain	Substances released by the <i>H. pylori</i> cells
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	Toxin	Enzyme that neutralises acid
A	✓	✓
B	x	✓
C	✓	x

The scientists centrifuged the cultures of each strain to obtain cell-free liquids. They added each liquid to a culture of human cells. They then recorded the amount of damage to the human cells.

Their results are shown below. The error bars show  $\pm 1$  standard deviation.



- (a) Describe and explain how centrifuging the culture allowed the scientists to obtain a cell-free liquid.

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(3)

- (b) The scientists measured cell damage by measuring the activity of lysosomes. Give **one** function of lysosomes.

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(1)

- (c) *H. pylori* cells produce an enzyme that neutralises acid.  
Suggest **one** advantage to the *H. pylori* of producing this enzyme.

(2)

- (d) What do these data suggest about the damage caused to human cells by the toxin and by the enzyme that neutralises acid?  
Explain your answer.

(3)

- (e) The scientists carried out a further investigation. They treated the liquid from **strain A** with a protein-digesting enzyme before adding it to a culture of human cells. No cell damage was recorded.  
Suggest why there was no damage to the cells.

(3)

(Total 12 marks)

**Q5.**

- (a) Describe and explain how cell fractionation and ultracentrifugation can be used to isolate mitochondria from a suspension of animal cells.

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(5)

(b) Describe the principles and the limitations of using a transmission electron microscope to investigate cell structure.

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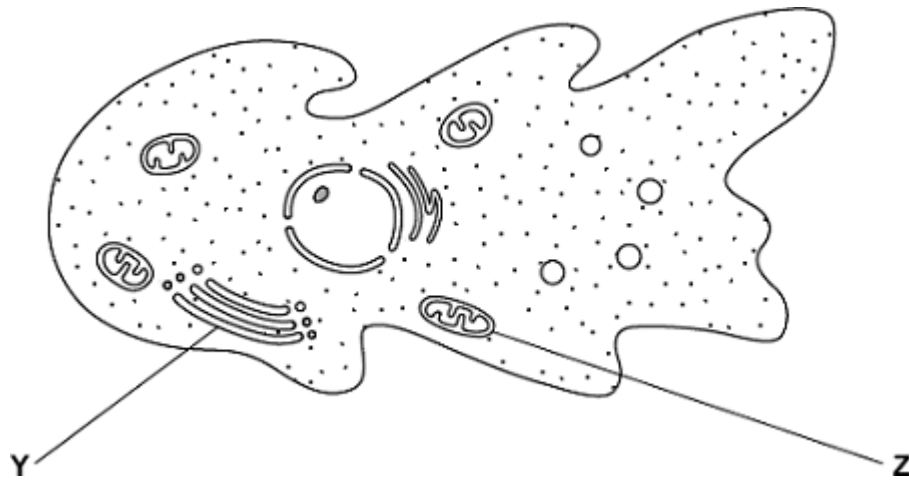
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(5)

(Total 10 marks)

**Q6.**

An amoeba is a single-celled, eukaryotic organism. Scientists used a transmission electron microscope to study an amoeba. The diagram shows its structure.



- (a) (i) Name organelle **Y**.

\_\_\_\_\_ (1)

- (ii) Name **two** other structures in the diagram which show that the amoeba is a eukaryotic cell.

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

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

(2)

- (b) What is the function of organelle **Z**?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(1)

- (c) The scientists used a transmission electron microscope to study the structure of the amoeba. Explain why.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2)

(Total 6 marks)

## Q7.

- (a) Describe how phospholipids are arranged in a plasma membrane.

\_\_\_\_\_  
\_\_\_\_\_



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(2)

- (b) Cells that secrete enzymes contain a lot of rough endoplasmic reticulum (RER) and a large Golgi apparatus.

- (i) Describe how the RER is involved in the production of enzymes.

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(2)

- (ii) Describe how the Golgi apparatus is involved in the secretion of enzymes.

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(1)

(Total 5 marks)

**Q8.**

In many parts of the world, crops have to be watered to grow enough food but fresh water is often in short supply.

Barley is a plant that grows a leafy shoot and then produces seed that is harvested for food.

Scientists investigated whether barley could be grown successfully using fresh water mixed with seawater. This would reduce the use of fresh water. However, seawater contains dissolved sodium chloride (salt).

The scientists grew barley in plots of equal size in the same large field. Each plot received one of four treatments.

- A** No watering.
- B** Watering with fresh water during growth and seed production.
- C** Watering with a 1:1 mix of fresh water and seawater during growth and seed production.
- D** Watering with fresh water during growth and with a 1:1 mix of fresh water and seawater during seed production.

At the end of the investigation, the scientists measured the concentration of salt in the soil in each plot and the yield of barley seed harvested from each plot.

The scientists' results are shown in the table below.

Watering treatment	Mean concentration of salt in soil / arbitrary units	Mean yield of barley seed / g
A	10.1	346
B	9.7	804
C	13.5	538
D	11.6	695

- (a) Watering treatment was the independent variable in this investigation. Explain what is meant by the **independent** variable.

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(1)

- (b) The same variety of barley was used in all the plots. Why was this important?

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(2)

- (c) When barley plants are growing, the number of cells increases. Name the process that increases the number of cells.

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(1)

- (d) What do the data in the table above show about the effect of watering barley with a mixture of fresh water and seawater?

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(2)

- (e) The scientists suggested that watering barley with diluted seawater might not be sustainable if repeated every year.

Do these data support this suggestion?

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(3)

(Total 9 marks)

**Q9.**

- (a) Give **two** ways in which pathogens can cause disease.

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

\_\_\_\_\_

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

\_\_\_\_\_

(2)

- (b) Putting bee honey on a cut kills bacteria. Honey contains a high concentration of sugar.

Use your knowledge of water potential to suggest how putting honey on a cut kills bacteria.

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(3)

(Total 5 marks)

**Q10.**

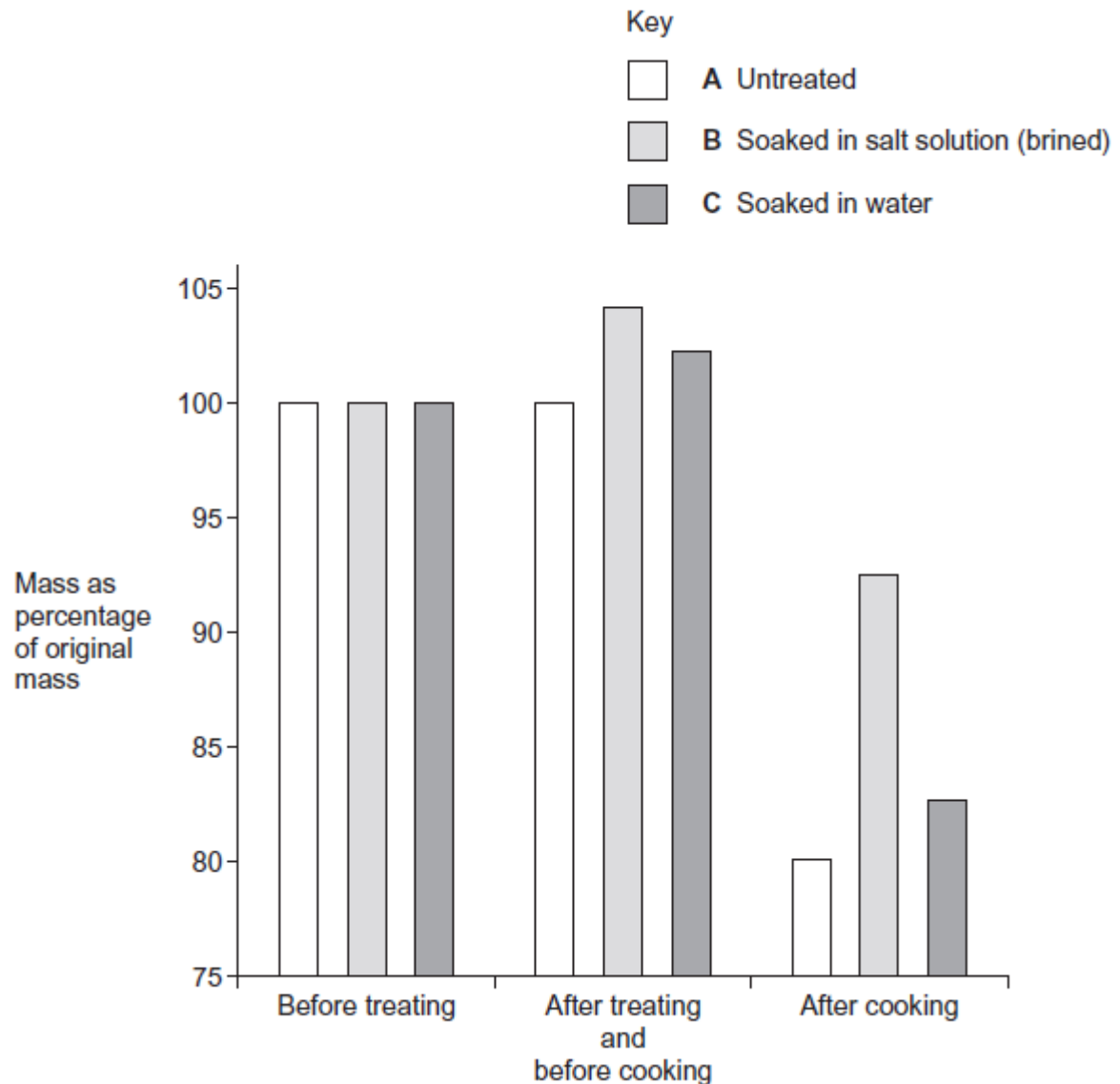
Turkey meat can dry out when it is cooked in an oven. One way to overcome this is to soak the meat in a salt solution before cooking it. This is called brining.

A food writer organised a demonstration. He treated three similar pieces of turkey in

different ways.

- Piece **A** was untreated.
- Piece **B** was soaked overnight in a 6% solution of salt. A 6% solution of salt has a greater solute concentration than the cells in turkey meat.
- Piece **C** was soaked overnight in water.

He put all three pieces in an oven at 150 °C. He left each piece until it was cooked and the temperature in its centre was 65 °C. The writer weighed each piece at different stages in the demonstration. The graph shows his results.



- (a) (i) Explain the advantage of using percentage change in mass in this investigation.

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(2)

- (ii) The pieces of turkey meat were cooked. Explain the advantage of leaving them in the oven until the temperature in the centre of each piece was 65 °C.

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(2)

- (iii) Recording mass is a valid way to measure the dependent variable in this investigation.  
Evaluate this statement.

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(2)

- (b) Students suggested that osmosis resulted in cooked brined turkey meat containing more water than cooked untreated meat.

Use your knowledge of water potential and the data in the graph to explain why this suggestion could not be correct.

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(2)

(Total 8 marks)

**Q11.**

Imatinib is a drug used to treat a type of cancer that affects white blood cells. Scientists investigated the rate of uptake of imatinib by white blood cells. They measured the rate of uptake at 4°C and at 37°C.

Their results are shown in the table.

Concentration of imatinib outside cells / $\mu\text{mol dm}^{-3}$	Mean rate of uptake of imatinib into cells / $\mu\text{g}$ per million cells per hour	
	4°C	37°C
0.5	4.0	10.5
1.0	10.7	32.5
5.0	40.4	420.5
10.0	51.9	794.6
50.0	249.9	3156.1
100.0	606.9	3173.0

- (a) The scientists measured the rate of uptake of imatinib in  $\mu\text{g}$  per million cells per hour. Explain the advantage of using this unit of rate in this investigation.

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(2)

- (b) Calculate the percentage increase in the mean rate of uptake of imatinib when the temperature is increased from 4°C to 37°C at a concentration of imatinib outside the cells of  $1.0 \mu\text{mol dm}^{-3}$ .

Give your answer to one decimal place.

Answer \_\_\_\_\_

(2)

- (c) Imatinib is taken up by blood cells by active transport.

- (i) Explain how the data for the two different temperatures support this statement.

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(2)

- (ii) Explain how the data for concentrations of imatinib outside the blood cells at 50 and 100  $\mu\text{mol dm}^{-3}$  at 37°C support the statement that imatinib is taken up by active transport.

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(2)

(Total 8 marks)

### Q12.

Nicotine is the addictive substance in tobacco. When nicotine reaches the brain, it binds to a specific protein. This causes the release of chemicals that give a feeling of reward to the smoker. This reward is part of the reason why people find it difficult to stop smoking.

Scientists have developed a vaccine against nicotine to help people stop smoking. They set up an investigation, which involved a large number of volunteers. Once a month for 5 months, one group of volunteers was given the vaccine and the other group was given a placebo.

At regular intervals, the scientists measured the concentration of antibodies to nicotine in the blood of each group of volunteers. They also calculated the percentage of volunteers who had stopped smoking from months 2 to 6 of the investigation.

- (a) (i) In this investigation, neither the volunteers nor the scientists knew if a particular volunteer was receiving the vaccine or a placebo.

Suggest **two** reasons why this made the scientists' results more reliable.

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

\_\_\_\_\_

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

\_\_\_\_\_

(2)

- (ii) The scientists measured the concentration of nicotine in the blood of two volunteers who smoked the same number of cigarettes per day.

Suggest **two** reasons why the concentration of nicotine in the blood of these smokers might be different.

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

\_\_\_\_\_

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

\_\_\_\_\_

(2)

(b) (i) Suggest how this vaccine could help people to stop smoking.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(3)

(ii) Some people have suggested that this vaccine should **not** be given free to smokers on the National Health Service (NHS). Evaluate this suggestion.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(3)

The scientists measured the concentration of antibodies to nicotine in the blood of the volunteers for 12 months after the first vaccination. As a result of these measurements, they divided the volunteers who received the nicotine vaccine into three groups:

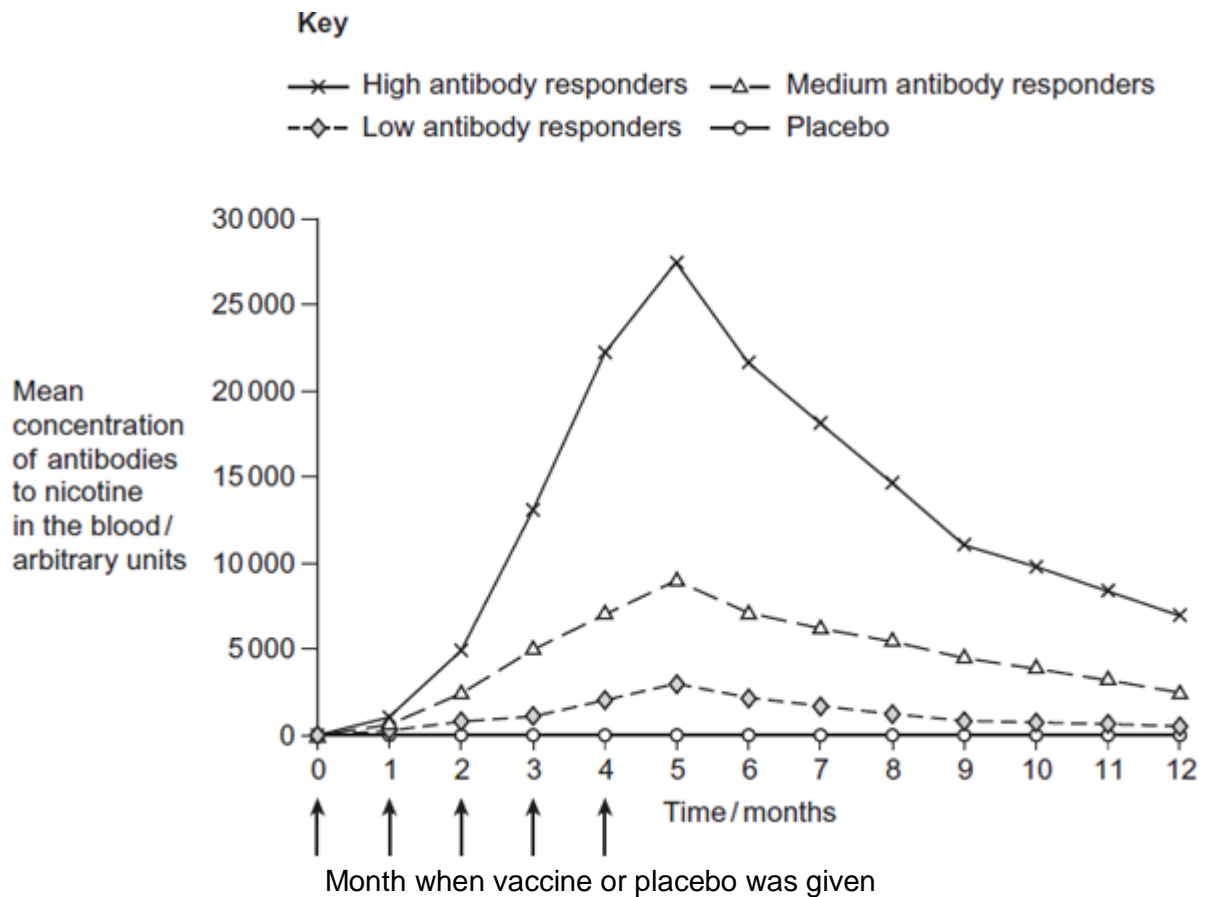
- high antibody responders
- medium antibody responders
- low antibody responders.

The figure below shows their results.

The scientists also recorded the number of volunteers who had stopped smoking from months 2 to 6 of the investigation.

The table below shows these results.





Group	Percentage of volunteers who had stopped smoking from months 2 to 6 of the investigation
High antibody responders	56.6
Low antibody responders	38.1
Medium antibody responders	32.1
Placebo	31.3

- (c) A journalist reported that this vaccine is a major breakthrough in helping people to stop smoking. Do these data support this statement? Explain your answer.

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(5)  
(Total 15 marks)

**Q13.**

Read the following passage.

Microfold cells are found in the epithelium of the small intestine. Unlike other epithelial cells in the small intestine, microfold cells do not have adaptations for the absorption of food.

Microfold cells help to protect against pathogens that enter the intestine. They have receptor proteins on their cell-surface membranes that bind to antigens on the surface of pathogens. The microfold cells take up the antigens and transport them to cells of the immune system. Antibodies are then produced which give protection against the pathogen.

5

Scientists believe that it may be possible to develop vaccines that make use of microfold cells. These vaccines could be swallowed in tablet form.

10

Use information from the passage and your own knowledge to answer the following questions.

- (a) (i) Microfold cells have receptor proteins on their cell-surface membranes that bind to antigens (line 5). What is an antigen?

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(1)

- (ii) Microfold cells take up the antigens and transport them to cells of the immune system (lines 6-7). Antigens are not able to pass through the cell-surface membranes of other epithelial cells. Suggest **two** reasons why.

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(2)

- (b) Scientists believe that it may be possible to develop vaccines that make use of

microfold cells (lines 9-10). Explain how this sort of vaccine would lead to a person developing immunity to a pathogen.

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(5)

(Total 8 marks)

#### Q14.

Researchers investigated whether the blood supply to slow and fast muscle fibres in a muscle changes with age. They used diaphragms taken from hamsters (*Mesocricetus auratus*). The diaphragm is in constant use for breathing. They took diaphragms from groups of young, adult and old hamsters.

They removed the diaphragm from each animal and took a sample of muscle tissue. They examined it under an optical (light) microscope. For each sample they selected several fields of view at random. In each field of view, they then counted the number of capillaries associated with each type of muscle fibre.

This allowed the researchers to calculate the mean number of capillaries for each type of muscle fibre, for each age group.

The table below shows the researchers' results which include standard deviation (SD).

Hamster age group	Number of hamsters in group	Mean number of capillaries associated with each type of muscle fibre	
		Slow fibres ( $\pm$ SD)	Fast fibres ( $\pm$ SD)
Young	9	3.4 ( $\pm 0.8$ )	4.0 ( $\pm 0.8$ )
Adult	10	4.7 ( $\pm 0.2$ )	6.3 ( $\pm 0.4$ )
Old	8	4.6 ( $\pm 0.9$ )	6.8 ( $\pm 0.6$ )

- (a) Give **four** precautions that the researchers took to make their calculations of mean number of capillaries per fibre reliable.

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

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

3. \_\_\_\_\_

4. \_\_\_\_\_

(4)

- (b) The researchers examined the muscle of an animal in the **old** age group. They found one field of view containing only slow muscle fibres. They counted 69 capillaries in this field of view.

- (i) Use a calculation to estimate how many slow muscle fibres were visible in this field of view. Show your working.

Number of slow muscle fibres = \_\_\_\_\_

(2)

- (ii) The actual number of slow muscle fibres in the field of view was **not** the same as the number you calculated in question (i).

Give **one** reason why.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(1)

- (c) A student read the report of the researchers' investigation. She thought that the investigation was unethical but that a conclusion could still be made.

- (i) Suggest why she thought the investigation was unethical.

\_\_\_\_\_

\_\_\_\_\_

(1)

- (ii) She concluded that age had a significant effect on the mean number of capillaries per fibre.

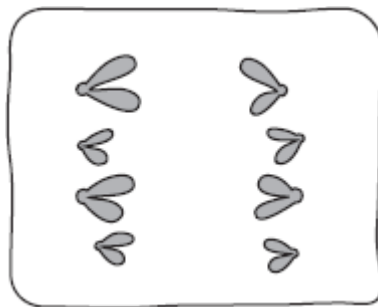
Evaluate this conclusion.

(4)

(Total 12 marks)

**Q15.**

- (a) The diagram shows a stage of mitosis in an animal cell.



- (i) Name this stage.

(1)

- (ii) Describe what happens during this stage that results in the production of two genetically identical cells.

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(2)

- (b) A sample of epithelial tissue from the small intestine of an animal was analysed. Some of the cells had 8.4 units of DNA, others had only 4.2 units.

- (i) Use your knowledge of the cell cycle to explain why some cells had 8.4 units of DNA and others had only 4.2 units.

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(2)

- (ii) How many units of DNA would you expect to be present in a gamete formed in this animal as a result of meiosis?

(1)

(Total 6 marks)

### Q16.

- (a) Mitosis is important in the life of an organism. Give **two** reasons why.

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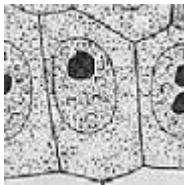


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(2)

A biologist used a microscope to investigate plant tissue where some of the cells were dividing by mitosis. She examined 200 cells and counted the number of cells in interphase and in each stage of mitosis.

The table shows some of the cells she saw, and the percentage of cells in interphase and in two stages of mitosis, **A** and **B**.

Stage of cell cycle	Percentage of cells
---------------------	---------------------

Interphase		90
Stage A		3
Stage B		1

Images by Edmund Beecher Wilson [Public domain], via Wikimedia Commons

- (b) (i) Explain why the biologist chose to examine 200 cells.

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(1)

- (ii) Name Stage A and Stage B. Give the evidence from the photograph that you used to identify the stage.

Name of Stage A \_\_\_\_\_

Evidence \_\_\_\_\_

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Name of Stage B \_\_\_\_\_

Evidence \_\_\_\_\_

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(4)

- (c) In this tissue one complete cell cycle took 20 hours.  
Using information from the table, calculate the mean time for these cells to complete mitosis. Show your working.

Answer \_\_\_\_\_

(2)

(Total 9 marks)

**Q17.**

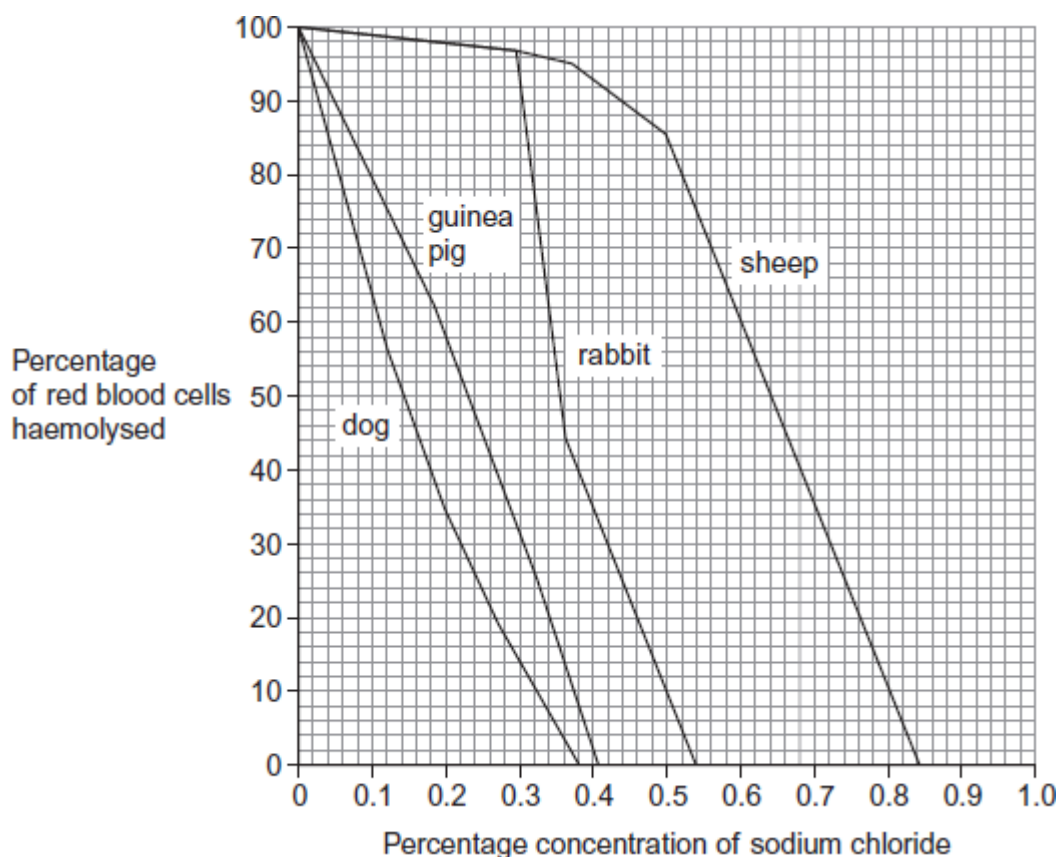
If red blood cells are placed in pure water, water enters the cells by osmosis and they burst. This is called haemolysis. As red blood cells burst they release pigment.

Scientists placed samples of red blood cells in different concentrations of sodium chloride solution for the same period of time. They used red blood cells from four different mammals: dog, guinea pig, rabbit and sheep.

If haemolysis had taken place, the solution turned red. The scientists measured the intensity of the red colour using a colorimeter. The more intense the red colour, the greater the amount of haemolysis.

The scientists calculated the percentage of red blood cells that were haemolysed in each sodium chloride solution.

The following figure shows the scientists' results.



- (a) Use the figure to give **two** differences between the results for dog and sheep.

Difference 1 \_\_\_\_\_

Difference 2 \_\_\_\_\_

(2)

- (b) Calculate the difference in the percentage of haemolysed cells between sheep and rabbit at a sodium chloride concentration of 0.5%.



(1)

- (c) Explain the relationship between the depth of the red colour of the solution and how much haemolysis has taken place.

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(2)

- (d) During treatment in a veterinary surgery, any of the mammals in the figure above may be given an infusion of sodium chloride solution directly into a vein. The concentration of sodium chloride solution used is 0.9%, rather than 0.5%, regardless of the species of mammal.

Explain the advantage to the vet of using this concentration.

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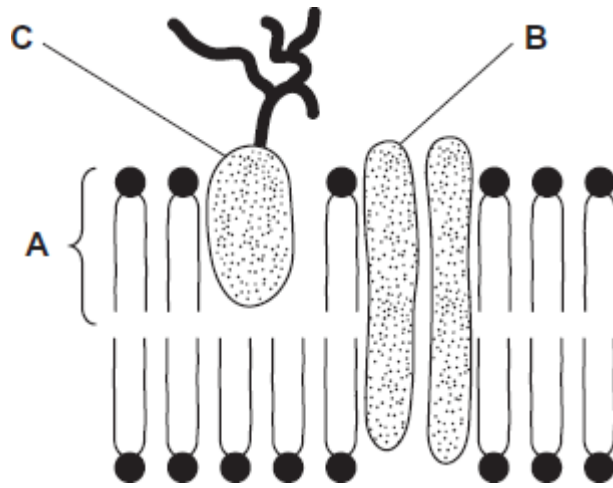
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(2)

(Total 7 marks)

**Q18.**

The diagram shows the structure of the cell-surface membrane of a cell.



- (a) Name **A** and **B**.

**A** \_\_\_\_\_

**B** \_\_\_\_\_

(2)

- (b) (i) **C** is a protein with a carbohydrate attached to it. This carbohydrate is formed by joining monosaccharides together. Name the type of reaction that joins monosaccharides together.

Name the type of reaction that joins monosaccharides together.

\_\_\_\_\_

(1)

- (ii) Some cells lining the bronchi of the lungs secrete large amounts of mucus. Mucus contains protein.

Name **one** organelle that you would expect to find in large numbers in a mucus-secreting cell and describe its role in the production of mucus.

Organelle \_\_\_\_\_

Description of role \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2)

(Total 5 marks)

## Mark schemes

### Q1.

(a)

Protein synthesis	<b>L;</b>
Modifies protein	<b>H;</b>
Aerobic respiration	<b>N;</b>

3

(b) 1800–2200;

*1.8, 2.0 or 2.2 in working or answer = 1 mark.*

*Ignore units in answer.*

1 mark for an incorrect answer in which student clearly divides measured length by actual length (of scale).

*Accept I / A or I / O for 1 mark but ignore triangle.*

*Accept approx 60mm divided by 30µm for 1 mark*

2

[5]

### Q2.

(a) Regulator protein.

*Accept regulator protein antigen*

*Reject regulator protein receptor*

*Ignore regular protein*

1

- (b) 1. Lipid soluble / hydrophobic  
2. Enters through (phospholipid) bilayer

**OR**

3. (Protein part of) LDL attaches to receptor  
4. Goes through carrier / channel protein.

*4. Accept by facilitated diffusion or active transport*

*4. Reject active transport through channel protein*

2

(c) Any **two** from:

1. (Monoclonal antibody) has a specific tertiary structure / variable region / is complementary to regulator protein

*Do not award MP1 if reference to active site.*

2. Binds to / forms complex with (regulator protein)

*"It" refers to monoclonal antibody in MP1 and MP2*

3. (So regulator protein) would not fit / bind to the receptor / is not complementary to receptor

*3. Reject receptor on LDL*

- (d) 1. Injection with salt solution  
       1. *Accept inject placebo in salt solution*
2. Otherwise treated the same.

2

[7]

**Q3.**

- (a) 1. Mitochondria respire to release energy / produce ATP;  
       1. *Do not credit make energy*
2. Transport against gradient;  
       2. *Do not credit active transport as this is given in question.*  
       2. *Do not accept diffusion against.*

**OR**

3. Infolding of membrane increases area;  
       3. *Reject microvilli but if mentioned can still accept point 4.*
4. More proteins for active transport;

2 max

- (b) 1. Ribosomes make proteins / enzymes;  
       *Ignore references to Golgi or rough ER.*
2. Enzymes are proteins;

**OR**

3. Mitochondria respire;
4. Release energy / produce ATP;
5. (Energy / ATP) for protein / enzyme synthesis;

2

- (c) Microvilli increase area / have large area;  
       *Ignore references to other properties of microvilli.*

1

[5]

**Q4.**

- (a) 1. Large / dense / heavy cells;  
       2. Form pellet / move to bottom of tube (when centrifuged);  
       3. Liquid / supernatant can be removed.  
       *Must refer to whole cells.*

3

- (b) Break down cells / cell parts / toxins.  
       *Idea of 'break down / digestion' needed, not just damage*

1

- (c) 1. To stop / reduce them being damaged / destroyed / killed;  
*Reject (to stop) bacteria being denatured.*

2. By stomach acid.  
*Must be in context of stomach.*

2

- (d) 1. More cell damage when both present / A;  
2. Some cell damage when either there on their own / some cell damage in B and C;

*MP1 and MP2 – figures given from the graph are insufficient.*

3. Standard deviation does not overlap for A with B and C so difference is real;

*MP3 and MP4 **both** aspects needed to gain mark.*

4. Standard deviations do overlap between B and C so no real difference.

*MP3 and MP4 accept reference to significance / chance for 'real difference'*

3 max

- (e) 1. Enzyme (a protein) is broken down (so no enzyme activity);  
*Accept hydrolyse / digested for 'broken down'.*

2. No toxin (as a result of protein-digesting enzyme activity);  
*Must be in the correct context.*

3. (So) toxin is protein.  
*This must be stated, not inferred from use of 'protein-digesting enzyme'.*

3

[12]

## Q5.

- (a) Any **five** from:

1. Cell homogenisation to break open cells;  
*1. Accept suitable method of breaking open cells.*
2. Filter to remove (large) debris / whole cells;  
*2. Reject removes cell walls.*
3. Use isotonic solution to prevent damage to mitochondria / organelles;  
*3. Ignore to prevent damage to cells.*
4. Keep cold to prevent / reduce damage by enzymes / use buffer to prevent protein / enzyme denaturation;
5. Centrifuge (at lower speed / 1000 g) to separate nuclei / cell fragments / heavy organelles;  
*5. Ignore incorrect numerical values.*
6. Re-spin (supernatant / after nuclei / pellet removed) at higher speed to

get mitochondria in pellet / at bottom.

6. *Must have location*

*Reject ref to plant cell organelles only once*

5 max

(b) Principles:

1. Electrons pass through / enter (thin) specimen;
2. Denser parts absorb more electrons;
3. (So) denser parts appear darker;
4. Electrons have short wavelength so give high resolution;

*Principles:*

*Allow maximum of 3 marks*

Limitations:

5. Cannot look at living material / Must be in a vacuum;
6. Specimen must be (very) thin;
7. Artefacts present;
8. Complex staining method / complex / long preparation time;
9. Image not in 3D / only 2D images produced.

Limitations:

*Context of limitation must be clear, not simply explaining how TEM works*

*E.g "allows you to see organelles as a thin section is used" is not a limitation*

*Allow maximum of 3 marks*

*Ignore ref to colour*

5 max

[10]

## Q6.

(a) (i) Golgi (apparatus / body);

1

(ii) 1. Nucleus;

*Accept: nucleolus / nuclear envelope / nuclear membranes*

2. Mitochondrion;

*Accept cristae / mitochondrial membranes*

3. Endoplasmic reticulum / ER;

*Ignore reference to rough / smooth*

4. Lysosome;

*Reject lysozyme*

2 max

(b) (Aerobic) respiration / ATP production / provide energy;

*Accept Krebs cycle / electron transport.*

*Ignore 'produces energy'*

*Reject anaerobic respiration*

*Ignore what energy is used for*

1

- (c) 1. High / better resolution;  
 2. Shorter wavelength;  
 3. To see internal structures / organelles / named organelles;  
*Accept ultrastructure*

2 max

[6]

**Q7.**

- (a) 1. Bilayer;  
*Accept double layer*  
*Accept drawing which shows bilayer*  
 2. Hydrophobic / fatty acid / lipid (tails) to inside;  
 3. Polar / phosphate group / hydrophilic (head) to outside;  
 2. & 3. *need labels*  
 2. & 3. *accept water loving or hating*

2 max

- (b) (i) 1. (Rough endoplasmic reticulum has) ribosomes;  
*accept "contains / stores"*  
 2. To make protein (which an enzyme is);  
*Accept amino acids joined together / (poly)peptide*  
*Reject makes amino acids*  
*Ignore glycoprotein*

2

- (ii) (Golgi apparatus) modifies (protein)

**OR**

packages / put into (Golgi) vesicles

**OR**

transport to cell surface / vacuole;  
*Accept protein has sugar added*  
*Reject protein synthesis*  
*Accept lysosome formation*

1

[5]

**Q8.**

- (a) Variable that is changed;  
*Reject 'the variable that changes'.*

1

- (b) 1. Idea of a confounding variable;  
 2. (So) genetically similar;

2. Do not accept 'genetically identical / same DNA'.

3. (So) have similar salt tolerance / response to salt water / response to watering treatment;

4. (So) have similar yield / mass of seeds;

Do not accept 'amount / number of seeds' or 'growth rate'.

2 max

(c) Mitosis;

Ignore cell division

1

(d) 1. Irrigation with sea water / **C** / **D** increased yield compared with no irrigation / **A**;

For 'yield' accept 'mass of seed' throughout.

2. Yield was lower when irrigated with sea water / **C** / **D** compared with fresh water / **B**;

Only penalise once for use of 'amount / number of seeds'.

3. Yield was lower when watered with sea water throughout growth and seed formation / **C** than when watered with sea water just at seed formation / **D**;

Accept use of figures from table.

'It' refers to watering with seawater / mixture.

2 max

(e) 1. Irrigation with sea water / **C** / **D** increases concentration of salt in soil;

Ignore reference to standard deviation / quality of the data.

2. Lower water potential in the soil linked to reduced uptake of water;

3. Salt concentration in the soil might / might not increase in the future;

Mark point 3 includes the principle for mark point 1 so mp3 gains 2 marks (for mp1 and mp3)

4. Might decrease plant growth / yield in the future;

5. Less food / fewer seeds for future planting;

Mp 3 and 4. Allow 'further' for the idea of 'in the future'.

3 max

[9]

## Q9.

(a) 1. (Releases) toxins;

2. Kills cells / tissues.

2. Accept any reference to cell / tissue damage

Ignore infecting / invading cells

2

(b) 1. Water potential in (bacterial) cells higher (than in honey) / water potential in honey lower (than in bacterial cells);

Q candidates must express themselves clearly



1. *Must be comparative e.g. high WP in cell and low WP in honey*

2. Water leaves bacteria / cells by osmosis;
3. (Loss of water) stops (metabolic) reactions.
3. *Needs a reason why lack of water kills the cell*

3

[5]

### Q10.

- (a) (i) 1. Allows results to be compared;
2. Because initial masses may have been different;
- (ii) 1. Quantitative measure (of cooking);
2. Ensures all cooked to same extent as not all turkey pieces same shape / thickness;
- 2 Emphasis here must be on being cooked to the same extent. Do not accept reference to all being cooked.*
- (iii) 1. (Yes) Loss of water results in loss in mass;
2. (No) Loss of other substances / other substances being burnt;
- No marks should be given for "Yes" or "No"*
- (b) 1. Water potential in brine lower than in cells / meat;
- Accept water potential more negative or converse answers*
2. Water would move out of the meat / water does not move out of the meat;

2

2

2

2

[8]

### Q11.

- (a) 1. To allow comparison;
2. Because different number of cells in samples / different times for incubation / numbers become easier to manipulate;
- (b) 203.7(%);;
- Allow 1 mark for 21.8 / 10.7*
- Allow 1 mark for correct answer (203.74) but not correctly to 1 dp*
- 204 = 1 mark*
- (c) (i) 1. (At every concentration) uptake is faster at 37°C / at higher temperature;
2. Due to faster respiration / ATP production;

2

2

- (ii) 1. Uptake at 37°C only small increase / levelling off / almost constant as carrier proteins full;  
*Accept 'no (significant) change'*  
*Ignore use of numbers*
2. Concentration of imatinib is not the limiting factor;

2

[8]

**Q12.**

- (a) (i) 1. (Scientists) can't show bias / influence / may have a vested interest / work for the company developing the vaccine;  
*Relates to the scientists*
2. (Volunteers) can't show psychological / mental effects / 'placebo effect' / expectations;  
*Relates to the volunteers*  
*Accept: reduces the 'Hawthorne effect' / demand characteristics*  
*Neutral: so they have no idea what they are taking*

2

- (ii) Any **two** suitable suggestions, eg  
*Neutral: refs. to age and health*
1. Amount of nicotine in cigarettes;  
*Neutral: different types of cigarette / different ways / frequency of smoking*
2. Amount inhaled / absorbed / time since last cigarette;  
*Neutral: absorption by gut / digestion*  
*Accept: absorption by mouth*
3. (Different) amounts excreted / metabolism / rate of binding (of nicotine) to protein;  
*Accept: broken down (differently)*
4. (Different) blood volumes;  
*Neutral: different body masses*
5. Nicotine from passive smoking / other smokers / other sources;
6. Some volunteers received the vaccine / placebo;  
*Accept: some volunteers would have / would not have the antibodies*

2 max

- (b) (i) 1. Antibodies to nicotine produced / antibodies bind to nicotine;  
**Q Reject:** vaccine contains / produces antibodies  
**Q Neutral:** antibodies digest / kill / fight nicotine

2. (So) nicotine does not bind to protein / does not reach the brain;  
**Q Reject:** any reference to 'active site'  
*Neutral:* idea that the antibodies bind to the protein
3. (So) cigarettes / smoking does not satisfy addiction / reward smokers / release (reward) chemicals;

3

(ii) **(Agree):**

1. People choose to smoke / know the risks;
2. Should spend this money on education / preventing people from starting to smoke / treating other health problems / vaccines are expensive;

**(Disagree):**

3. Unethical not to treat;
4. Less money needed to treat the effects of smoking / cancer / smokers pay taxes so are entitled to treatment;

3 max

- (c)
1. High antibody responders have a high % to stop smoking / are more likely to stop smoking;  
*'People producing a high concentration of antibodies' is equivalent to 'high antibody responders'*  
*Accept:* reference to values from the table
  2. Only a few may be high antibody responders / no numbers on how many are high / medium / low antibody responders;  
*Neutral:* not all people are high antibody responders
  3. Percentage who stopped smoking is similar for placebo group and low / medium responders / some / % of placebo group (still) stopped smoking / placebo has the lowest value / % to stop smoking;  
*Accept:* reference to values from the table
  4. Large sample size / double blind **so** reliable / representative;
  5. Antibody levels peak at / drop after 5 months / boosters may be needed at / after 5 months;
  6. May start smoking again after 5 / 6 months / do not know the percentage who stopped smoking after 5 / 6 months;
  7. Nicotine is not the only factor responsible for making people smoke;  
*Must mention nicotine*  
*Do not accept: correlation does not mean causation / could be due to other factors*

5 max

[15]

**Q13.**

- (a) (i) Substance that causes an immune response / production of antibodies;  
*Ignore foreign / non-self*

1

- (ii) 1. Not lipid soluble;  
2. Too large (to diffuse through the membrane);  
3. Antigens do not have the complementary shape / cannot bind to receptor / channel / carrier proteins (in membranes of other epithelial cells);

2 max

- (b) 1. (Vaccine contains) antigen / attenuated / dead pathogen;  
*1. Reject if in context of injection of vaccine*  
2. T-cells activate B-cells;  
3. B-cells divide / form clone / undergo mitosis;  
4. Plasma cells produce antibodies;  
5. Memory cells produced meaning more antibodies / antibodies produced faster in secondary response / on reinfection;

5

[8]

#### Q14.

- (a) 1. Fields of view randomly chosen;  
2. Several fields of view;  
3. All same species (of animal / hamster);  
*Reject general statements related to sample size. All mark points relate directly to information provided in Resource A.  
Accept 'all (Mesocricetus) auratus'.*  
4. Same muscle / organ used / only diaphragm used;  
5. Used at least 8 (animals) in each (age) group.

4 max

- (b) (i) 15

*Correct answer = 2 marks.*

*Allow 1 mark for showing*

$$69 \div 4.6$$

*OR*

*answer of 10 / 10.1 (correct calculation using fast in error.)*

2

- (ii) 1. (Calculation) used mean (number of capillaries);  
2. Variation in number of capillaries per fibre.  
*Note: maximum of 1 mark for this question.  
Ignore reference to an anomaly or calculation errors.*

1 max

- (c) (i) (Removing diaphragm means) animals / hamsters are killed.

1

- (ii) 1. (Suggests) significant (difference) between young and adult;  
*MP1, MP2, MP4 and MP5 can include use of figures but check figures are used correctly.*
2. (Suggests) not significant (difference) between adult and old;  
*Statements related to 'results being significant / not significant' do not meet the marking points. It is the difference that is significant or not. However, only penalise this error once.*
3. For slow **and** fast fibres;  
*This MP can be given in the context of either MP1 or MP2 but only allow once. As well as this context there must be a reference to 'both' types of fibre.*
4. (Suggests) significant (difference) between young and old for fast (fibres)  
OR  
(Suggests) not significant (difference) between young and old for slow (fibres);  
*All aspects of either approach required to gain credit.*
5. (Suggests) significant (difference) where means  $\pm$  SD do not overlap  
OR  
(Suggests) not significant (difference) where means  $\pm$  SD overlap;  
*All aspects of either approach required to gain credit.*
6. Stats test is required (to establish whether significant or not).

4 max

[12]

### Q15.

- (a) (i) Anaphase

1

- (ii) 1. Sister / identical chromatids / identical chromosomes;  
*Reject: Homologous chromosomes separate.*  
*Allow any reference to chromatids / chromosomes being identical e.g. same DNA*

2. To (opposite) poles / ends / sides;

2

- (b) (i) 1. 8.4 / cells with twice DNA content = replicated DNA / late interphase / prophase / metaphase / anaphase;  
*Any reference to interphase must suggest towards end of interphase.*  
*'Chromosomes replicate' is not enough for DNA replicates.*

2. 4.2 = DNA not replicated / (early) interphase / telophase / cell just divided / finished mitosis;

2

- (ii) 2.1;

**Q16.**

- (a)
1. Growth / increase in cell number;  
*Ignore growth of cells*
  2. Replace cells / repair tissue / organs / body;  
*Ignore repair cells*  
*Reject bacteria*
  3. Genetically identical cells;  
*'Produces 2 genetically identical cells' does not reach MP1 as well as MP3*
  4. Asexual reproduction / cloning;  
*Allow example or description*

2 max

- (b) (i) (Ensures) representative (sample);  
*Accept find some cells in mitosis / not in interphase.*  
*Accept 'more reliable' only if linked to percentage (of cells). 'Improves reliability' on its own does not gain this mark*  
*Neutral: Large sample*

1

- (ii)
1. A = metaphase;
  2. Chromosome / chromatids lie on equator;  
*Reject homologous chromosomes Allow centre / middle*
  3. B = anaphase;
  4. Chromatids / chromosomes separating / moving apart / moving to poles;  
*Reject homologous chromosomes*

4

- (c) 2 hours / 120 minutes;  
*Allow 1 mark if working shows candidate understood that mitosis would take 10%*

2

[9]

**Q17.**

- (a)
1. (Curve for) dog falls rapidly at the start but (curve for) sheep falls slowly at first;  
*Do **not** allow curve for dog falls more steeply (since from 0.5% NaCl fall in sheep is just as steep as fall in dog)*
  2. Sheep doesn't fall rapidly until 0.5 (but dog falls rapidly from 0);
  3. (Trend shows that) for any concentration of sodium chloride haemolysis

is lower in the dog;

*The idea of a trend is required. Statement of individual values alone is insufficient, eg 'at 0.2, 34% in dog and 98% in sheep' is insufficient*

*Accept dog reaches 0 at lower concentration of sodium chloride than for sheep / dog reaches 0 at 0.38% compared to 0.84 % in sheep;*

2 max

(b) 74 to 76;

*Accept a value within this range*

1

(c) 1. (Red) colour is due to haemoglobin;

*Note: a correct response to marking point 2 also scores marking point 1*

2. The more haemoglobin released the more red the solution;

*Need idea of haemoglobin release before giving credit*

2

(d) 1. (Use of 0.9%) will not cause haemolysis in any (of the mammals);

*Full credit requires statement of marking point 1 and any approach from marking point 2*

2. (So) will not kill any of the animals;

or

Only need to use / store / buy one concentration of sodium chloride solution / cheaper to have one concentration of sodium chloride solution / can buy in bulk;

or

Anyone can give it / no need to find out what concentration any animal requires;

*Different approaches available for this marking point*

2 max

[7]

### Q18.

(a) 1. **A:** phospholipid (layer);

*1. Reject hydrophobic / hydrophilic phospholipid*

2. **B:** pore / channel / pump / carrier / transmembrane / intrinsic / transport protein;

*2. Ignore unqualified reference to protein*

2

(b) (i) Condensation (reaction);

1

(ii) Organelle named; Function in protein production / secretion;

*Function must be for organelle named*

*Incorrect organelle = 0*

eg

1. Golgi (apparatus);  
*1. Accept smooth endoplasmic reticulum*
2. Package / process proteins;

**OR**

3. Rough endoplasmic reticulum / ribosomes;  
*3. Accept alternative correct functions of rough endoplasmic reticulum. ER / RER is insufficient*  
*3. Accept folding polypeptide / protein*
4. Make polypeptide / protein / forming peptide bonds;

**OR**

5. Mitochondria;
6. Release of energy / make ATP;  
*6. Reject produce / make energy*  
*6. Accept produce energy in the form of ATP*

**OR**

7. Vesicles;
8. Secretion / transport of protein;

2

**[5]**