

**AQA, OCR, Edexcel**

**A Level**

# **A Level Biology**

Cells, Microscopes, Cell Cycle  
and Immunity Questions

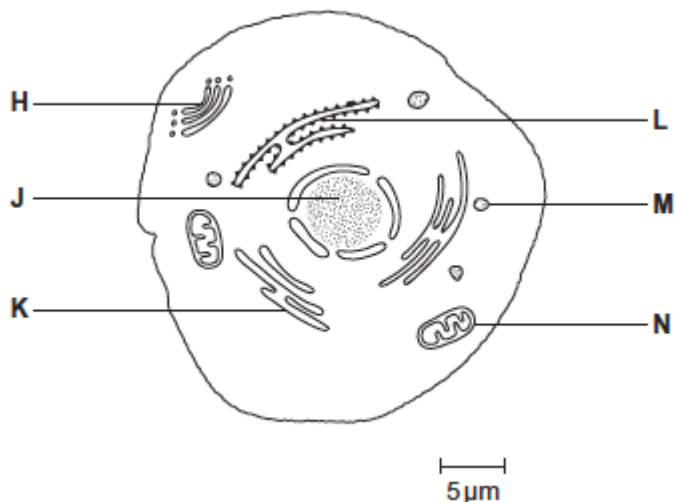
Name:

**M M E**

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Total 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.(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.

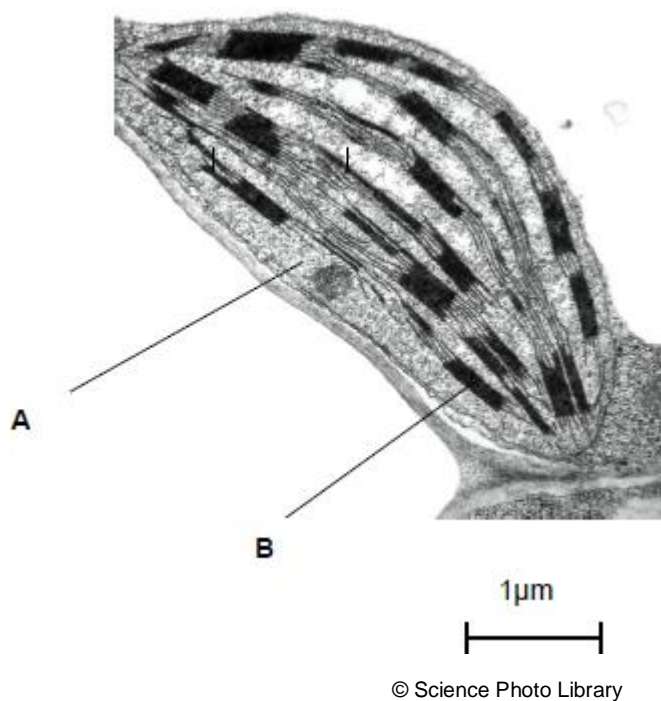
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**(Total 10 marks)**

**Q3.(a)** Describe how you could use cell fractionation to isolate chloroplasts from leaf tissue.

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.....(3)

The figure below shows a photograph of a chloroplast taken with an electron microscope.



(b) Name the parts of the chloroplast labelled **A** and **B**.

Name of **A** .....

Name of **B** .....(2)

(c) Calculate the length of the chloroplast shown in the figure above.

Answer .....(1)

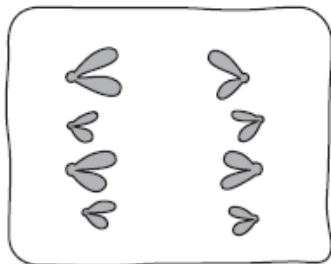
(d) Name **two** structures in a eukaryotic cell that **cannot** be identified using an optical microscope.

1 .....

2 .....(1)

(Total 7 marks)

**Q4.(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)

**Q5.** (a) Mitosis is important in the life of an organism. Give **two** reasons why.

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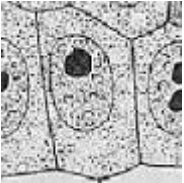


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.....(2)

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 <b>A</b> 	3
Stage <b>B</b> 	1

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

.....  
.....  
.....(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 .....

.....

Name of Stage **B** .....

Evidence .....

.....(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.

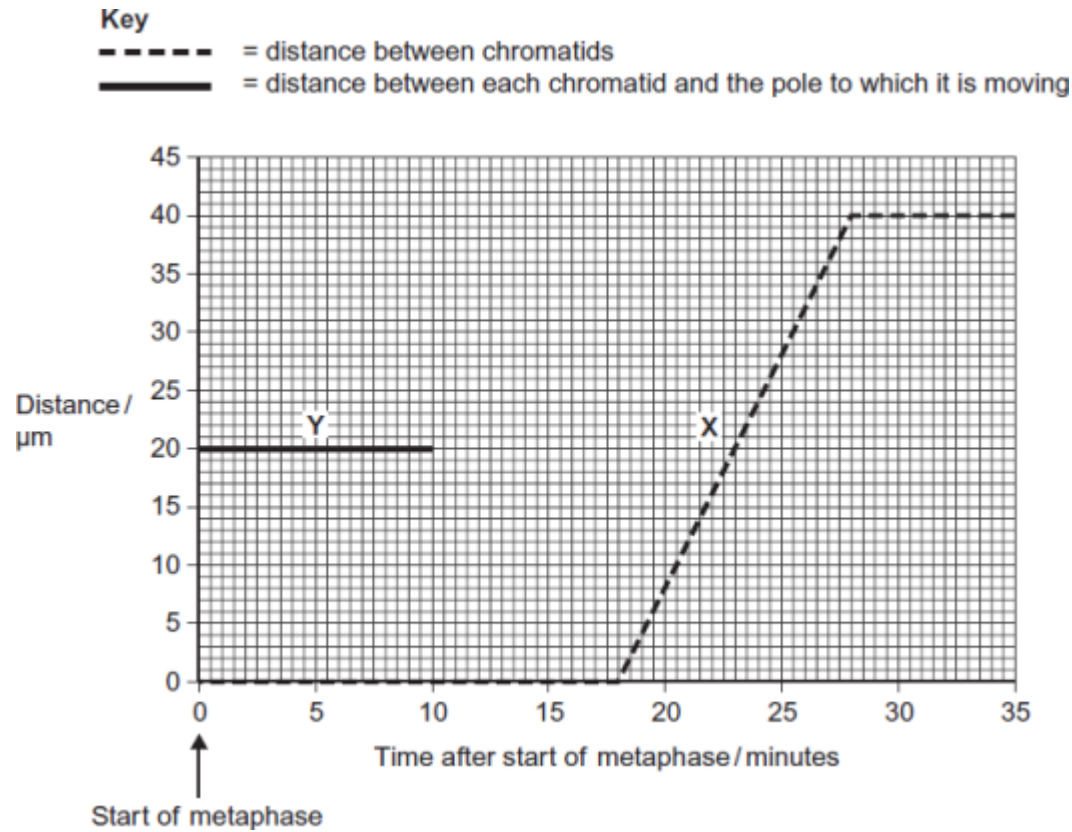
Answer .....

(2)  
(Total 9 marks)

**Q6.(a)** Describe how DNA is replicated.

**(6)**

(b) The graph shows information about the movement of chromatids in a cell that has just started metaphase of mitosis.



(i) What was the duration of metaphase in this cell?

minutes **(1)**

(ii) Use line X to calculate the duration of anaphase in this cell.

minutes **(1)**

(iii) Complete line Y on the graph. **(2)**



- (c) A doctor investigated the number of cells in different stages of the cell cycle in two tissue samples, **C** and **D**. One tissue sample was taken from a cancerous tumour. The other was taken from non-cancerous tissue. The table shows his results.

Stage of the cell cycle	Percentage of cells in each stage of the cell cycle	
	Tissue sample <b>C</b>	Tissue sample <b>D</b>
Interphase	82	45
Prophase	4	16
Metaphase	5	18
Anaphase	5	12
Telophase	4	9

- (i) In tissue sample **C**, one cell cycle took 24 hours. Use the data in the table to calculate the time in which these cells were in interphase during one cell cycle. Show your working.

Time cells in interphase ..... hours **(2)**

- (ii) Explain how the doctor could have recognised which cells were in interphase when looking at the tissue samples.

.....  
 .....  
 .....**(1)**

- (iii) Which tissue sample, **C** or **D**, was taken from a cancerous tumour? Use information in the table to explain your answer.

.....  
 .....  
 .....  
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**(2)**  
**(Total 15 marks)**

**Q7.** A group of students carried out an investigation to find the water potential of potato tissue.

The students were each given a potato and 50 cm<sup>3</sup> of a 1.0 mol dm<sup>-3</sup> solution of sucrose.

- They used the 1.0 mol dm<sup>-3</sup> solution of sucrose to make a series of different concentrations.
- They cut and weighed discs of potato tissue and left them in the sucrose solutions for a set time.
- They then removed the discs of potato tissue and reweighed them.

The table below shows how one student presented his processed results.

Concentration of sucrose solution / mol dm <sup>-3</sup>	Percentage change in mass of potato tissue
0.15	+4.7
0.20	+4.1
0.25	+3.0
0.30	+1.9
0.35	-0.9
0.40	-3.8

(a) Explain why the data in the table above are described as **processed** results.

.....  
.....(1)

(b) Describe how you would use a 1.0 mol dm<sup>-3</sup> solution of sucrose to produce 30 cm<sup>3</sup> of a 0.15 mol dm<sup>-3</sup> solution of sucrose.

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.....(2)

(c) Explain the change in mass of potato tissue in the 0.40 mol dm<sup>-3</sup> solution of sucrose.

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.....(2)

- (d) Describe how you would use the student's results in the table above to find the water potential of the potato tissue.

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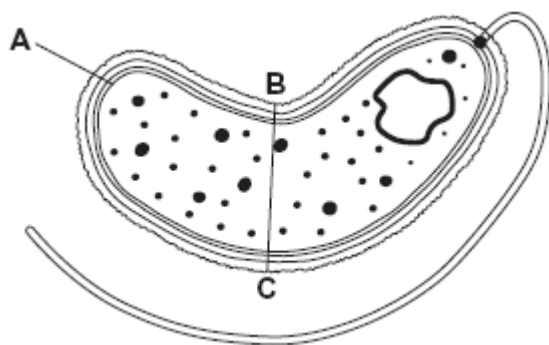
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..... (3)

(Total 8 marks)

**Q8.** The diagram shows a cholera bacterium. It has been magnified 50 000 times.



- (a) Name **A**.

.....(1)

- (b) Name **two** structures present in an epithelial cell from the small intestine that are **not** present in a cholera bacterium.

1 .....

2 .....(2)

- (c) Cholera bacteria can be viewed using a transmission electron microscope (TEM) or a scanning electron microscope (SEM).

- (i) Give **one** advantage of using a TEM rather than a SEM.

.....

.....(1)

- (ii) Give **one** advantage of using a SEM rather than a TEM.

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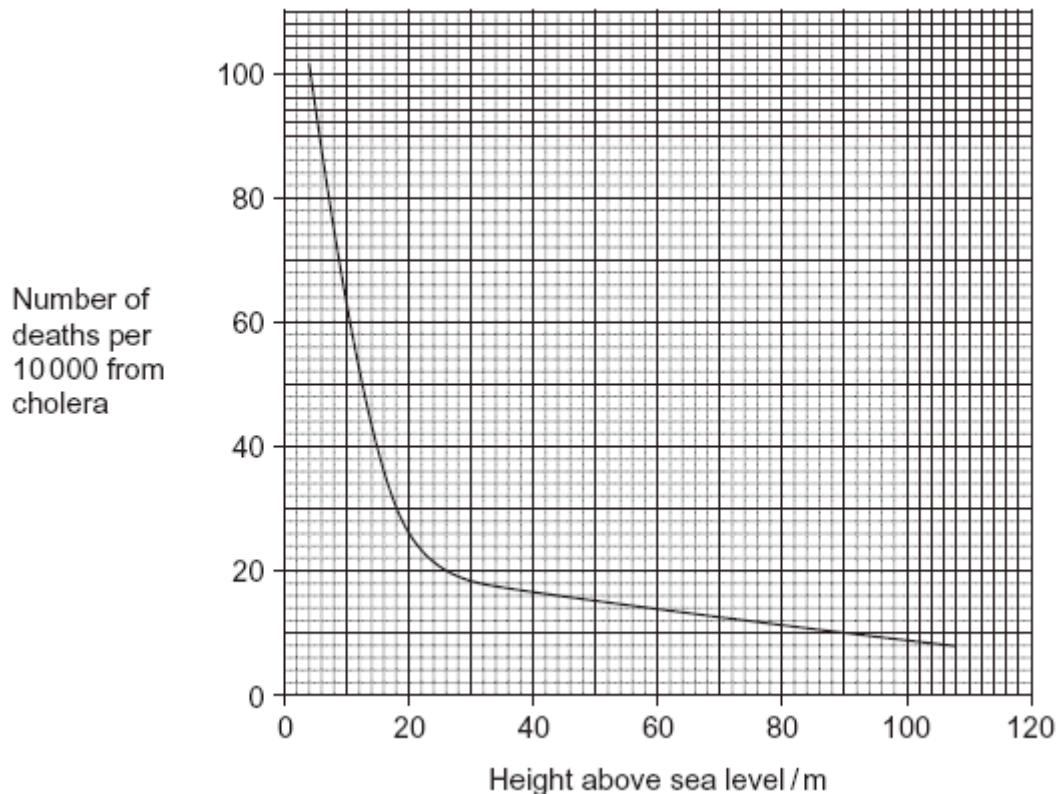
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.....(1)

- (d) Calculate the actual width of the cholera bacterium between points **B** and **C**.  
Give your answer in micrometres and show your working.

.....  $\mu\text{m}$  (2)

- (e) An outbreak of cholera occurred in London in 1849. The graph shows the relationship between the number of deaths from cholera and the height at which people lived above sea level.



Describe the relationship between the number of deaths from cholera and the height at which people lived above sea level.

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(2)

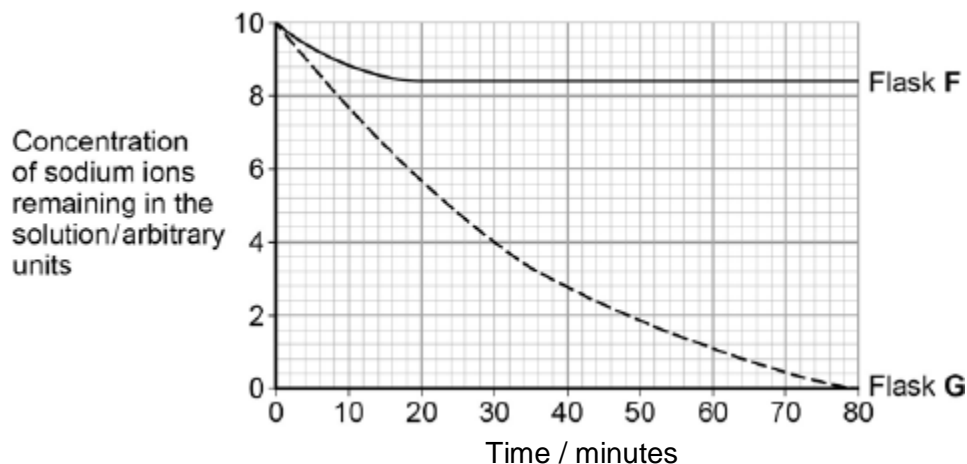
(Total 9 marks)

**Q9.**A scientist investigated the uptake of sodium ions by animal tissue.

To do this, he:

- used two flasks, **F** and **G**
- put equal masses of animal tissue into each flask
- added equal volumes of a solution containing sodium ions to each flask
- added to flask **F** a solution of a substance that prevents the formation of ATP by cells
- measured the concentration of sodium ions **remaining** in the solution in each flask.

The graph below shows his results.



(a) Calculate the rate of uptake of sodium ions by the tissue in flask **G** during the first 20 minutes of this investigation.

Answer = ..... arbitrary units per minute (1)

(b) The scientist concluded that the cells in flask **G** took up sodium ions by active transport. Explain how the information given supports this conclusion.

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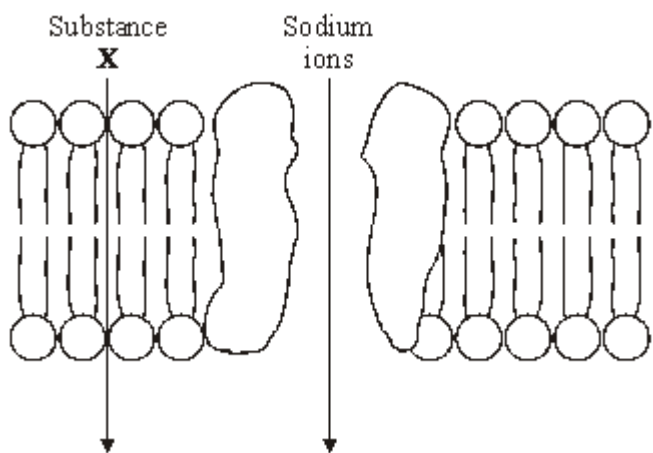
(4)

(c) The curve for flask **F** levelled off after 20 minutes. Explain why.

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.....(2)

(Total 7 marks)

**Q10.** The diagram shows part of a plasma membrane. The arrows show the path taken by sodium ions and by substance **X** when they diffuse through the membrane into a cell.



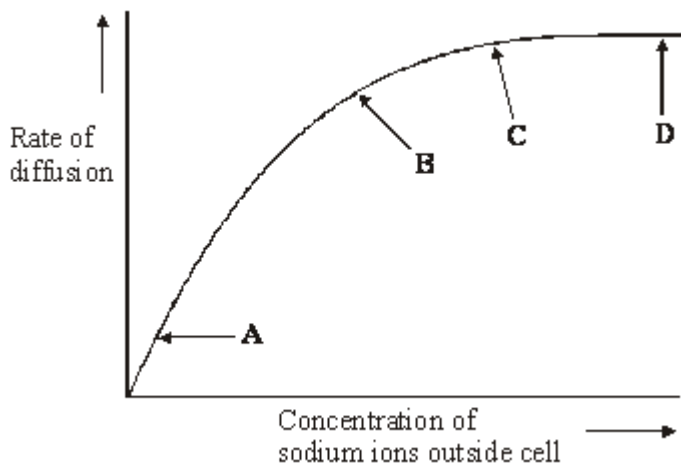
(a) An optical microscope cannot be used to see a plasma membrane. Explain why.

.....  
.....  
.....  
.....(2)

(b) Give **one** property of the molecules of substance **X** which allows them to diffuse through the membrane at the position shown.

.....  
.....(1)

- (c) The effect of the concentration of sodium ions in the surrounding solution on their rate of diffusion across the membrane was investigated. The graph shows the results.



- (i) What limits the diffusion of sodium ions across the membrane between **A** and **B** on the graph? Give the evidence for your answer.

Limiting factor .....

Evidence .....

.....(2)

- (ii) Explain the shape of the curve between **C** and **D**.

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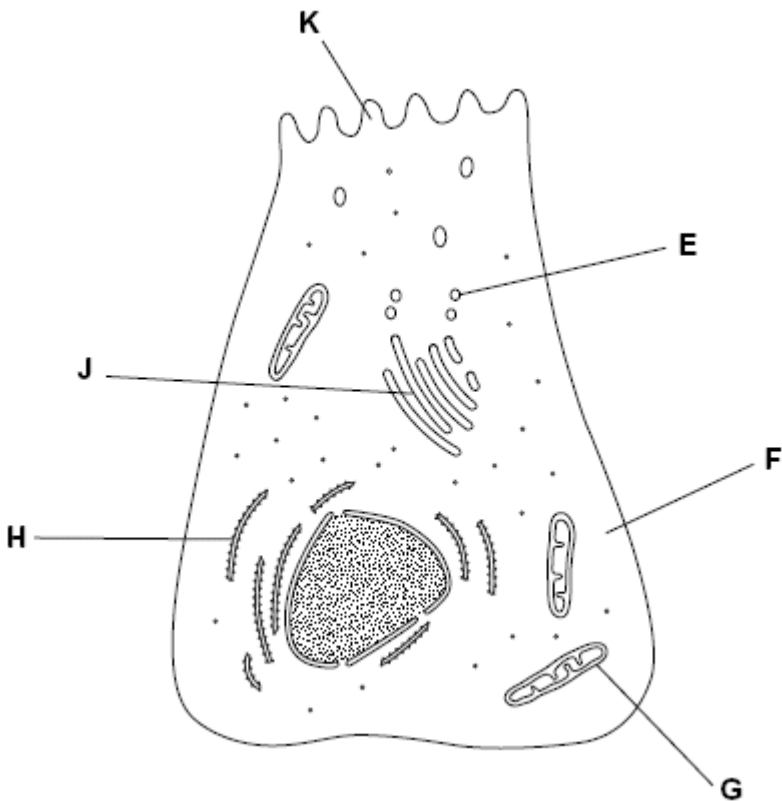
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.....(2)

(Total 7 marks)

**Q11.** (a) Name the type of bond that joins amino acids together in a polypeptide.  
 .....(1)

The diagram shows a cell from the pancreas.



(b) The cytoplasm at **F** contains amino acids. These amino acids are used to make proteins which are secreted from the cell.

Place the appropriate letters in the correct order to show the passage of an amino acid from the cytoplasm at **F** until it is secreted from the cell as a protein at **K**.

<b>F</b>				<b>K</b>
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(2)

(c) There are lots of organelle **G** in this cell. Explain why.

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(2)



- (d) A group of scientists homogenised pancreatic tissue before carrying out cell fractionation to isolate organelle **G**.

Explain why the scientists

- (i) homogenised the tissue

.....  
.....(1)

- (ii) filtered the resulting suspension

.....  
.....(1)

- (iii) kept the suspension ice cold during the process

.....  
.....(1)

- (iv) used isotonic solution during the process.

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.....(2)

**(Total 10 marks)**

**Q12.** 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
<b>A</b>	10.1	346
<b>B</b>	9.7	804
<b>C</b>	13.5	538
<b>D</b>	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.

.....(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)**

**Q13.(a)** Contrast the processes of facilitated diffusion and active transport.

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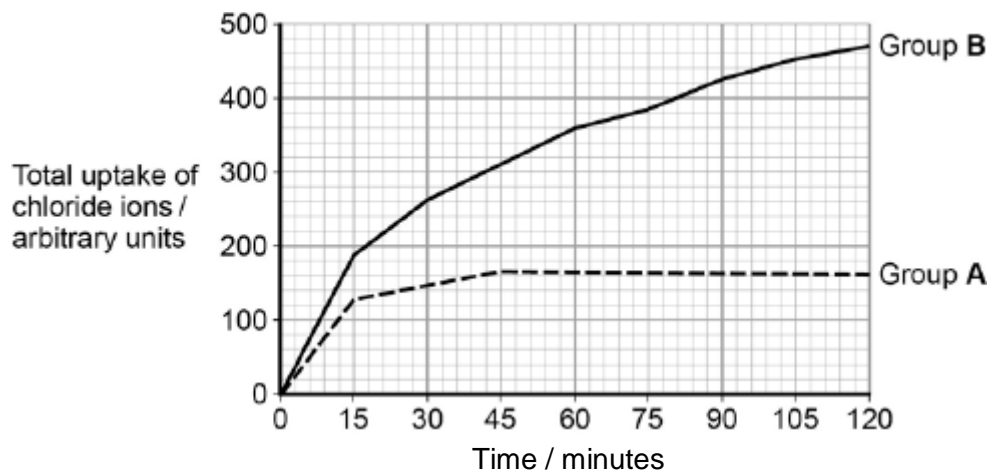
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..... **(3)**

Students investigated the uptake of chloride ions in barley plants. They divided the plants into two groups and placed their roots in solutions containing radioactive chloride ions.

- Group **A** plants had a substance that inhibited respiration added to the solution.
- Group **B** plants did not have the substance added to the solution.

The students calculated the total amount of chloride ions absorbed by the plants every 15 minutes. Their results are shown in the figure below.



(b) Calculate the ratio of the mean **rate** of uptake of chloride ions in the first hour to the **rate** of uptake of chloride ions in the second hour for group **B** plants.

Ratio = ..... :1 **(2)**

(c) Explain the results shown in the figure above.

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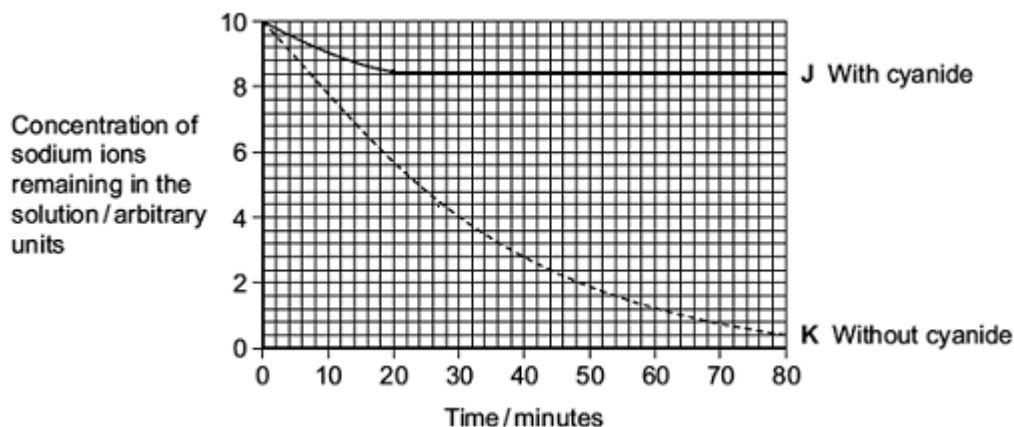
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(Total 9 marks)

**Q14.** A scientist investigated the effect of cyanide on the uptake of sodium ions by animal tissue. He set up two beakers, **J** and **K**. He put equal volumes of a solution containing sodium ions and equal masses of an animal tissue in each beaker.

- He added cyanide to beaker **J**.
- He did not add cyanide to beaker **K**.

He measured the concentration of sodium ions remaining in the solution in each beaker, for 80 minutes. The graph shows his results.



(a) Calculate the rate of uptake of sodium ions by the tissue in beaker **K** for the first 30 minutes. Show your working.

Answer ..... arbitrary units per minute (2)

(b) Adding cyanide affects the uptake of sodium ions by the tissue. Use the graph to describe how.

.....  
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 .....  
 .....  
 ..... (2)

- (c) Cyanide is a substance which affects respiration.  
Use information in the question to explain the effect of cyanide on the uptake of sodium ions by the tissue.

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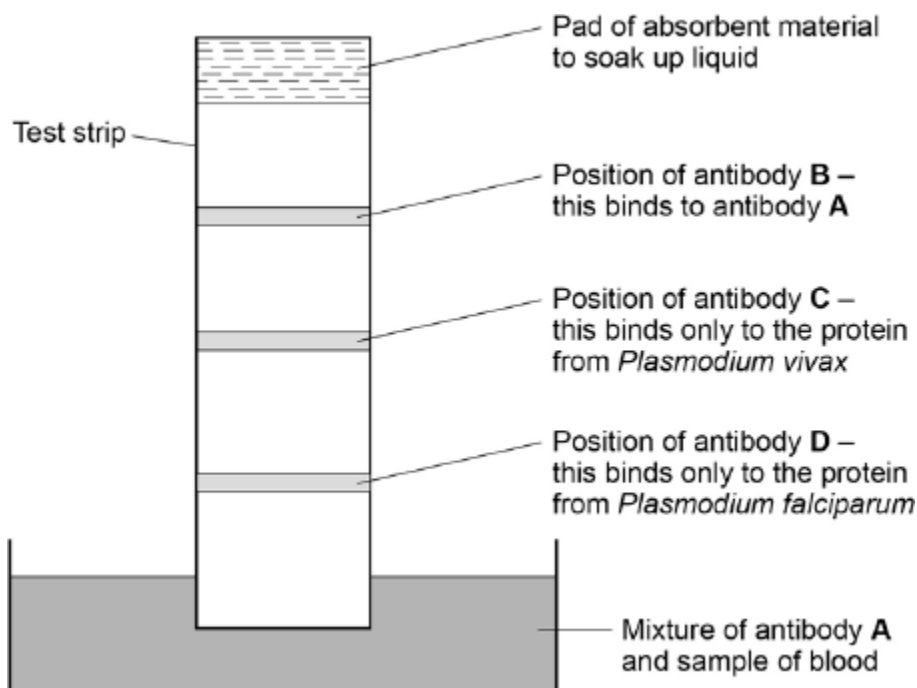
(3) (Total 7 marks)

**Q15.** Malaria is a disease caused by parasites belonging to the genus *Plasmodium*. Two species that cause malaria are *Plasmodium falciparum* and *Plasmodium vivax*.

A test strip that uses monoclonal antibodies can be used to determine whether a person is infected by *Plasmodium*. It can also be used to find which species of *Plasmodium* they are infected by.

- A sample of a person's blood is mixed with a solution containing an antibody, **A**, that binds to a protein found in both species of *Plasmodium*. This antibody has a coloured dye attached.
- A test strip is then put into the mixture. The mixture moves up the test strip by capillary action to an absorbent pad.
- Three other antibodies, **B**, **C** and **D** are attached to the test strip. The position of these antibodies and what they bind to is shown in **Figure 1**.

**Figure 1**



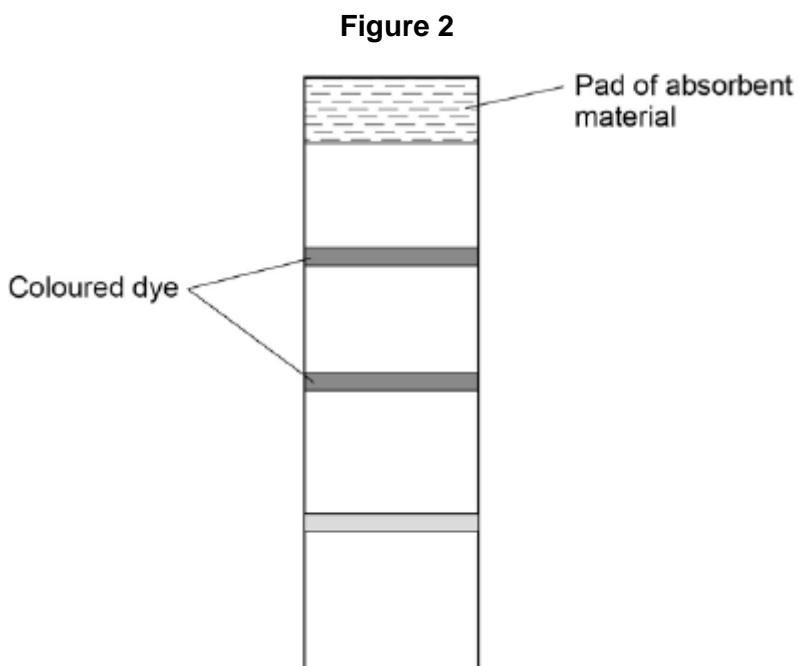
(a) Explain why antibody **A** attaches only to the protein found in species of *Plasmodium*.

.....  
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.....  
.....(2)

(b) Antibody **B** is important if this test shows a person is not infected with *Plasmodium*.  
Explain why antibody **B** is important.

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.....  
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.....(2)

(c) One of these test strips was used to test a sample from a person thought to be infected with *Plasmodium*. **Figure 2** shows the result.



What can you conclude from this result?  
Explain how you reached your conclusion.

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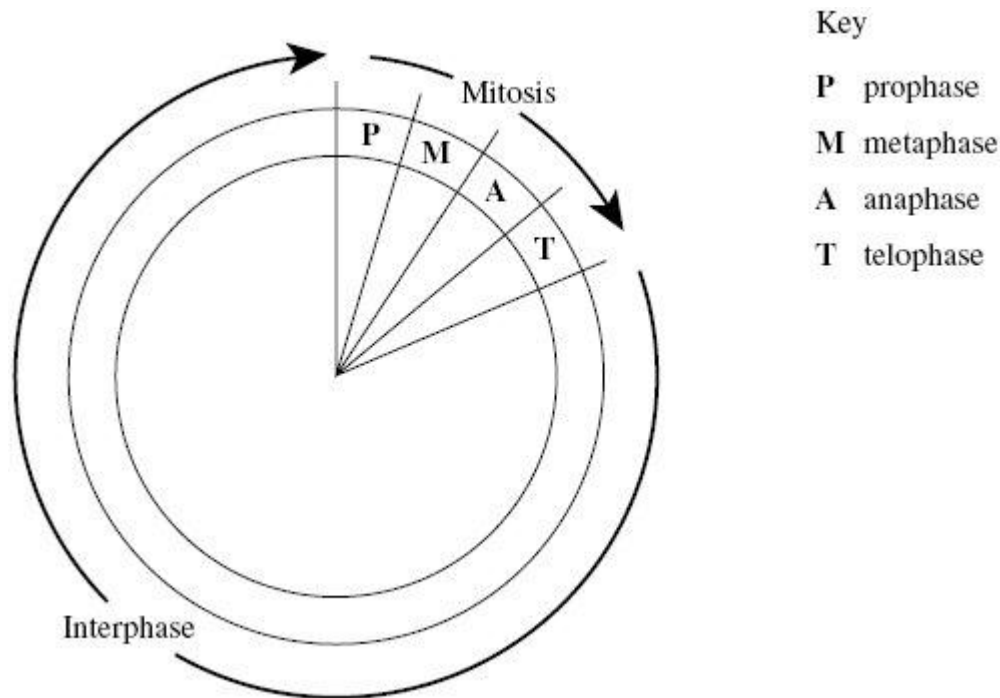
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(4)  
(Total 8 marks)

**Q16.** The diagram shows a cell cycle.



(a) The table shows the number of chromosomes and the mass of DNA in different nuclei.  
All the nuclei come from the same animal. Complete this table.

Nucleus	Number of chromosomes	Mass of DNA / arbitrary units
At prophase of mitosis	26	60
At telophase of mitosis		
From a sperm cell		

(4)





- (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?

.....(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.

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**(2)**  
**(Total 7 marks)**

**Q18.(a)** (i) A mutation of a tumour suppressor gene can result in the formation of a tumour.

Explain how.

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.....(2)

(ii) Not all mutations result in a change to the amino acid sequence of the encoded polypeptide.

Explain why.

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(1)

(b) Some cancer cells have a receptor protein in their cell-surface membrane that binds to a hormone called **growth factor**. This stimulates the cancer cells to divide.

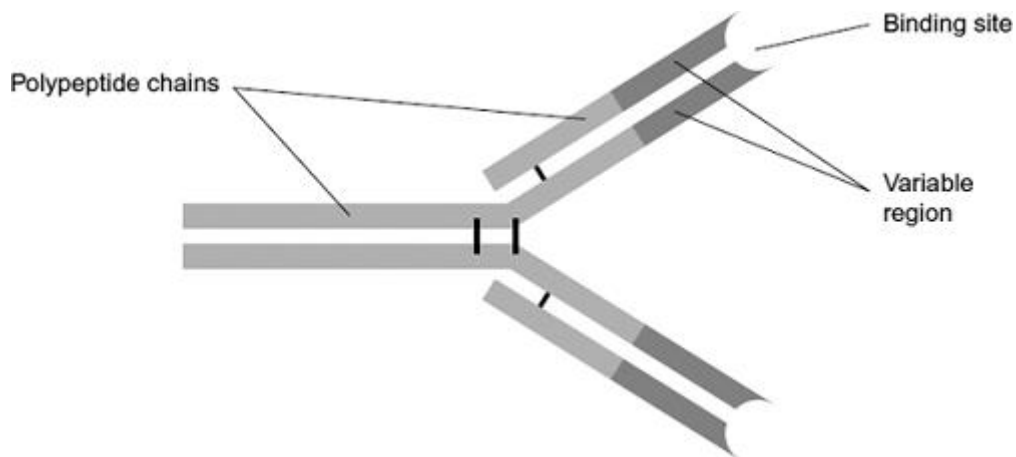
Scientists have produced a monoclonal antibody that stops this stimulation.

Use your knowledge of monoclonal antibodies to suggest how this antibody stops the growth of a tumour.

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.....(3)

(Total 6 marks)

**Q19.**The diagram shows an antibody molecule.



(a) What is the evidence from the diagram that this antibody has a quaternary structure?

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.....(1)

(b) Scientists use this antibody to detect an antigen on the bacterium that causes stomach ulcers. Explain why the antibody will only detect this antigen.

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.....(3)

**(Total 4 marks)**

**Q20.**

The human immunodeficiency virus (HIV) leads to the development of acquired immunodeficiency syndrome (AIDS). Eventually, people with AIDS die because they are unable to produce an immune response to pathogens.

Scientists are trying to develop an effective vaccine to protect people against HIV. There are three main problems. HIV rapidly enters host cells. HIV causes the death of T cells that activate B cells. HIV shows a lot of antigenic variability. 5

Scientists have experimented with different types of vaccine for HIV. One type contains HIV in an inactivated form. A second type contains attenuated HIV which replicates in the body but does not kill host cells. A third type uses a different, non-pathogenic virus to carry genetic information from HIV into the person's cells. This makes the person's cells produce HIV proteins. So far, these types of vaccine have not been considered safe to use in a mass vaccination programme. 10  
15

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

- (a) People with AIDS die because they are unable to produce an immune response to pathogens (lines 2-4).

Explain why this leads to death.

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**(3)**

- (b) Explain why each of the following means that a vaccine might **not** be effective against HIV.

- (i) HIV rapidly enters host cells (lines 6-7).

.....  
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.....  
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**(2)**

(ii) HIV shows a lot of antigenic variability (lines 7-8).

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.....(2)

(c) So far, these types of vaccine have not been considered safe to use in a mass vaccination programme (lines 14-15).

Suggest why they have **not** been considered safe.

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.....(3)

**(Total 10 marks)**

**Q21.** (a) What is an antigen?

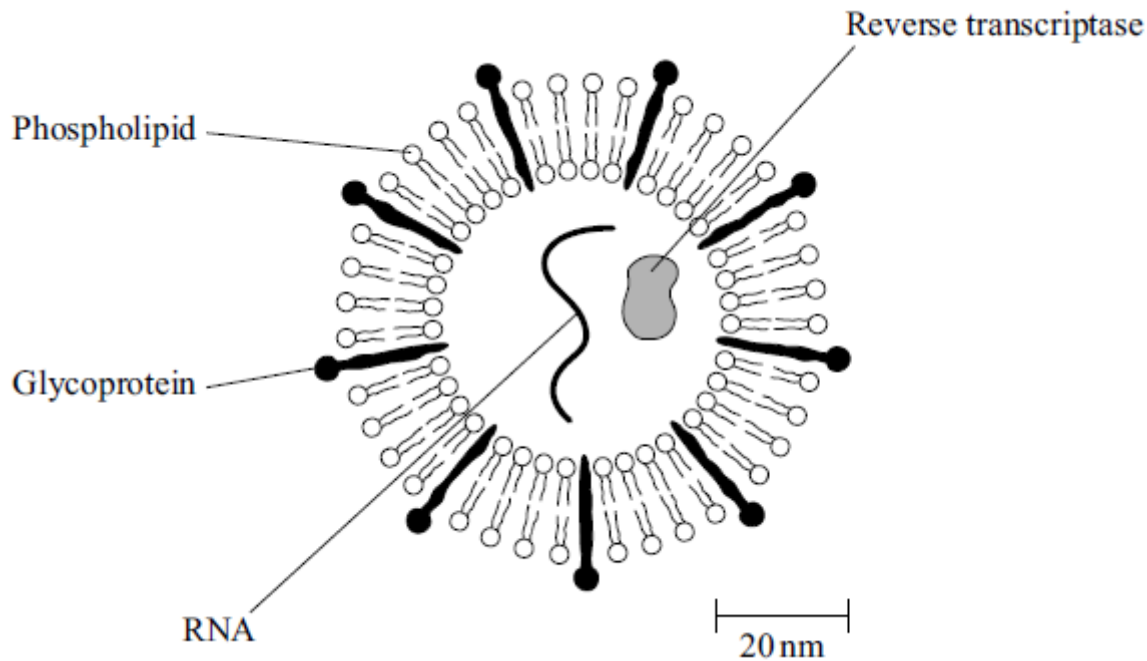
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(b) Describe how B-lymphocytes respond when they are stimulated by antigens.

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.....(4)

**(4)**

(c) The diagram shows some components of a human immunodeficiency virus (HIV).



(i) Suggest which labelled component of the virus is most likely to act as an antigen. Give a reason for your answer.

Component .....

Reason .....

.....(1)

(ii) A cell that HIV infects is 15  $\mu\text{m}$  in diameter. Calculate how many times larger in diameter this cell is than an HIV particle. Show your working.

Answer ..... times larger (2)

(Total 9 marks)

**Q22.** (a) Describe how B-lymphocytes respond when they are stimulated by antigens.

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..... (4)

(b) The table gives information about some components of a red blood cell.

<b>Component</b>	Glycoprotein	Phospholipid	Haemoglobin
<b>Location in cell</b>	on outer surface of plasma membrane	within plasma membrane	in cytoplasm

Suggest which component of an intact red blood cell is most likely to act as an antigen during a blood transfusion. Explain your answer.

Component .....

Explanation .....

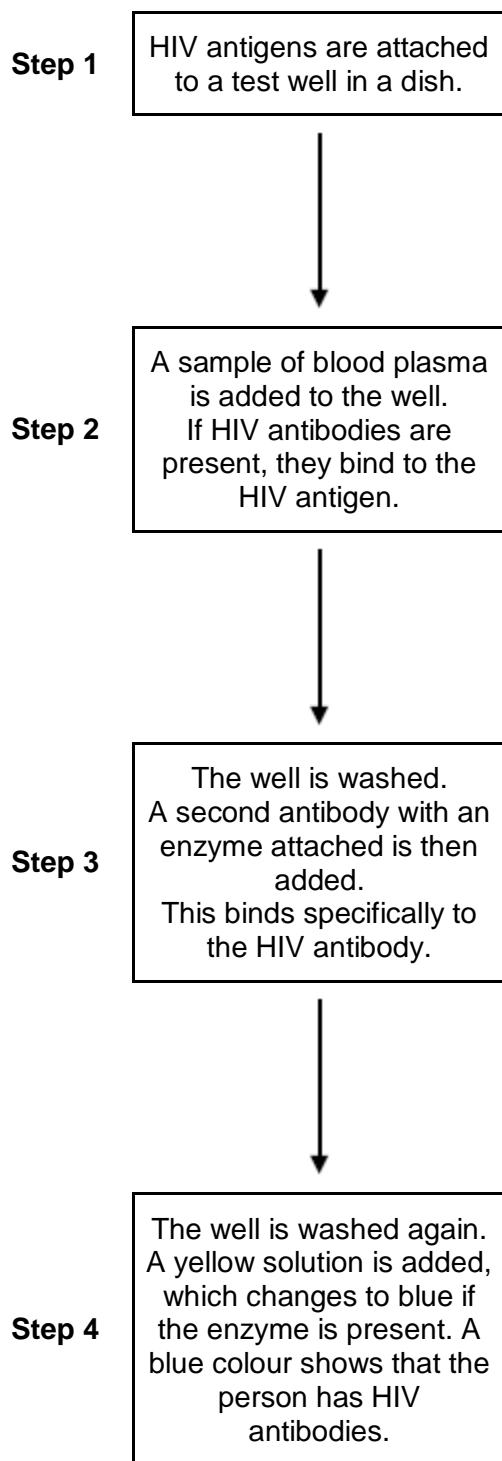
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.....(2)

**(Total 6 marks)**



**Q23.** The figure below shows a test that has been developed to find out if a person has antibodies to the human immunodeficiency virus (HIV) antigen.



(a) This test only detects the presence of HIV antibodies. Give **two** reasons why it cannot be used to find out if a person has AIDS.

- 1 .....
- .....
- 2 .....
- .....

(2)

(b) The solution will remain yellow if a person is **not** infected with HIV. Explain why.

.....  
.....  
.....  
.....(2)

(c) A mother who was infected with HIV gave birth to a baby. The baby tested positive using this test. This does not prove the baby is infected with HIV. Explain why.

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.....  
.....(2)

(d) A control well is set up every time this test is used. This is treated in exactly the same way as the test wells, except that blood plasma is replaced by a salt solution.

Use information from the figure above to suggest **two** purposes of the control well.

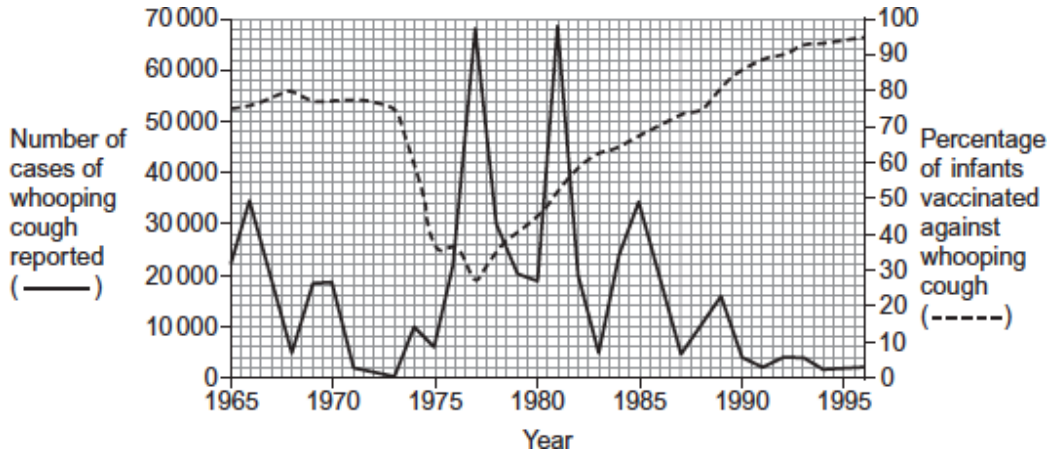
1 .....  
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.....(2)

**(Total 8 marks)**

**Q24.** Whooping cough is a disease that affects some infants. Doctors collected data relating to whooping cough between 1965 and 1996. They collected data for:

- the number of cases of whooping cough reported
- the percentage of infants vaccinated against whooping cough.

The graph shows the data collected by the doctors.



(a) Suggest **two** reasons why the percentage of infants vaccinated decreased between 1973 and 1975.

1 .....

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2 .....

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.....(2)

(b) Between 1980 and 1990, there were three peaks in the number of reported cases of whooping cough. After 1981, the number of cases of whooping cough in each peak decreased. Use the information from the graph to suggest why.

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..... (2)

Visit <http://www.mathsmadeeasy.co.uk/> for more fantastic resources.

- (c) The percentage of the population vaccinated does **not** need to be 100% to be effective in preventing the spread of whooping cough.

Suggest why.

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(2)  
(Total 6 marks)