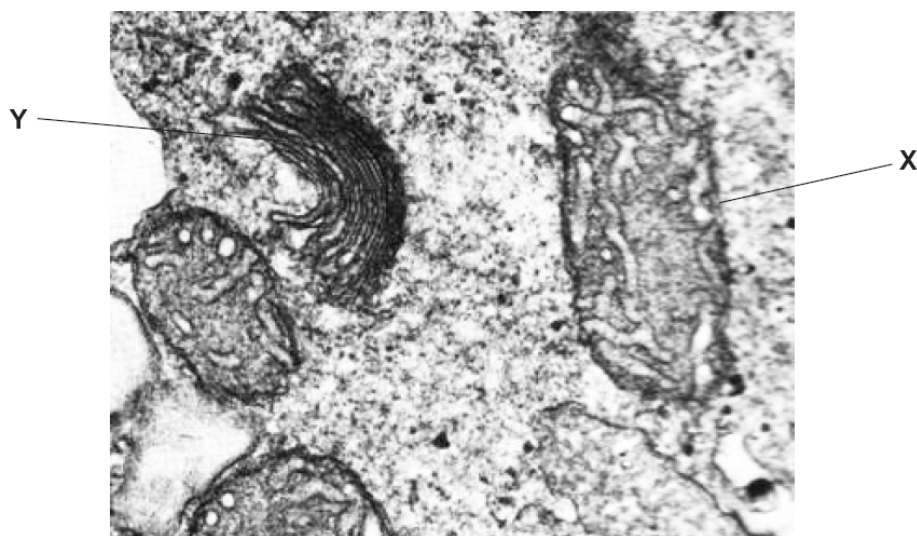


1)

The photograph shows part of the cytoplasm of a cell.



(a) (i) Organelle **X** is a mitochondrion.

What is the function of this organelle?

.....

 (1 mark)

(a) (ii) Name organelle **Y**.

.....
 (1 mark)

(b) This photograph was taken using a transmission electron microscope. The structure of the organelles visible in the photograph could not have been seen using an optical (light) microscope. Explain why.

.....
 (2 marks)

2)

(a) Name the monosaccharides of which the following disaccharides are composed.

(a) (i) Sucrose

monosaccharides and
 (1 mark)

(a) (ii) Lactose

monosaccharides and
 (1 mark)

- (b) Amylase and maltase are involved in the digestion of starch in the small intestine.

Complete the table by identifying where these enzymes are produced and the product of the reaction they catalyse.

Name of enzyme	Where the enzyme is produced	Product of the reaction catalysed by the enzyme
Amylase		
Maltase		

(2 marks)

3)

- (a) Cholera bacteria produce toxins which increase secretion of chloride ions into the lumen of the intestine.

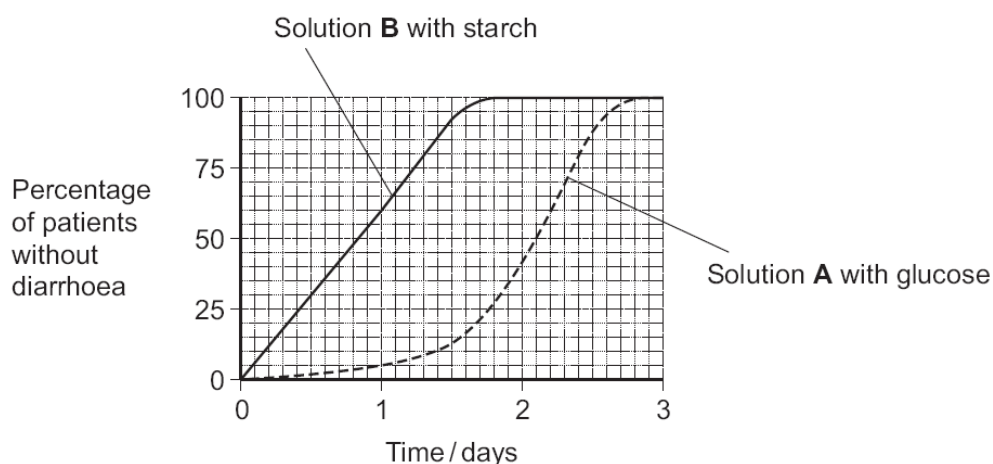
Explain why this results in severe diarrhoea (watery faeces).

.....
(3 marks)

- (b) Scientists investigated how effective two oral rehydration solutions, **A** and **B**, were in treating patients with diarrhoea caused by cholera.

- Solution **A** contained glucose.
- Solution **B** was identical to **A**, except that glucose was replaced by starch.

The graph shows their results.



- (b) (i) The water potential of solution **B** was higher (less negative) than the water potential of solution **A**.

Explain why.

.....

.....

.....

(1 mark)

- (b) (ii) 100 patients were treated with solution **A** and 100 patients were treated with solution **B**.

Calculate the difference in the number of patients without diarrhoea after 1 day's treatment with solution **A** and those without diarrhoea after 1 day's treatment with solution **B**.

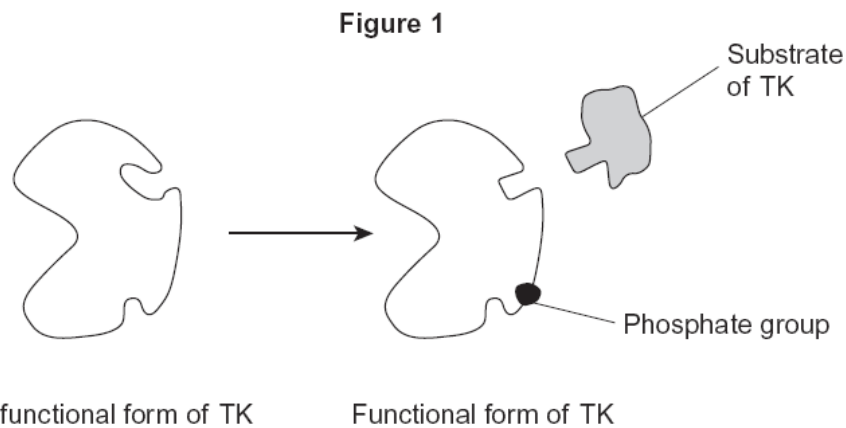
Show your working.

Difference in number of patients
(2 marks)

4)

The enzyme tyrosine kinase (TK) is found in human cells. TK can exist in a non-functional and a functional form. The functional form of TK is only produced when a phosphate group is added to TK.

This is shown in **Figure 1**.



- (a) Addition of a phosphate group to the non-functional form of TK leads to production of the functional form of TK.

Explain how.

.....
(2 marks)

- (b) The binding of the functional form of TK to its substrate leads to cell division. Chronic myeloid leukaemia is a cancer caused by a faulty form of TK. Cancer involves uncontrolled cell division.

Figure 2 shows the faulty form of TK.

Figure 2



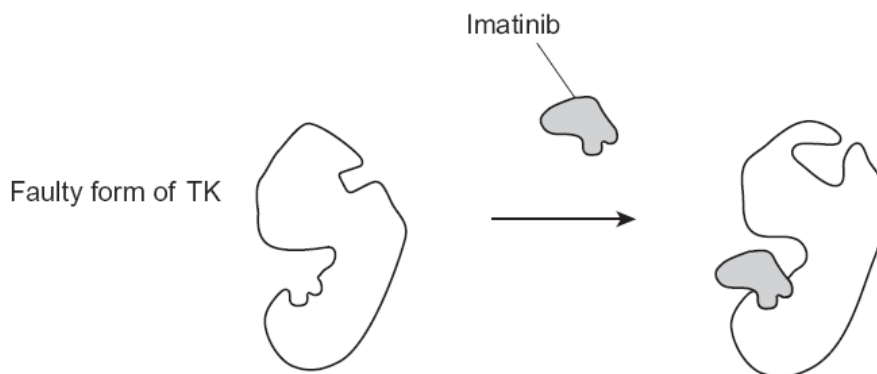
Faulty form of TK

Suggest how faulty TK leads to chronic myeloid leukaemia.

(2 marks)

- (c) Imatinib is a drug used to treat chronic myeloid leukaemia. **Figure 3** shows how imatinib inhibits faulty TK.

Figure 3



Using all of the information, describe how imatinib stops the development of chronic myeloid leukaemia.

(2 marks)

5)

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.

.....
(3 marks)

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

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

.....
(2 marks)

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

.....
(2 marks)

- (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.

.....
(3 marks)

6)

Some substances can cross the cell-surface membrane of a cell by simple diffusion through the phospholipid bilayer.

Describe other ways by which substances cross this membrane.

.....
(5 marks)

7)

- (a) The table shows some statements about three carbohydrates. Complete the table with a tick in each box if the statement is true.

Statement	Starch	Cellulose	Glycogen
Found in plant cells			
Contains glycosidic bonds			
Contains β -glucose			

(3 marks)

- (b) Name the type of reaction that would break down these carbohydrates into their monomers.

.....
(1 mark)

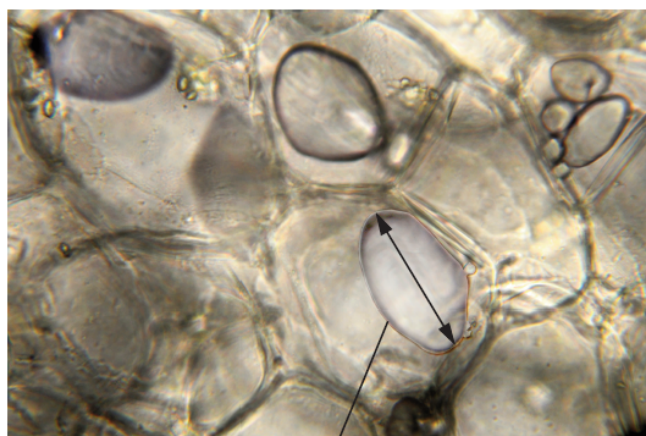
- (c) Give **one** feature of starch and explain how this feature enables it to act as a storage substance.

Feature

Explanation

.....
(2 marks)

- (d) The picture shows starch grains as seen with an optical microscope. The actual length of starch grain **A** is 48 μm . Use this information and the arrow line to calculate the magnification of the picture. Show your working.

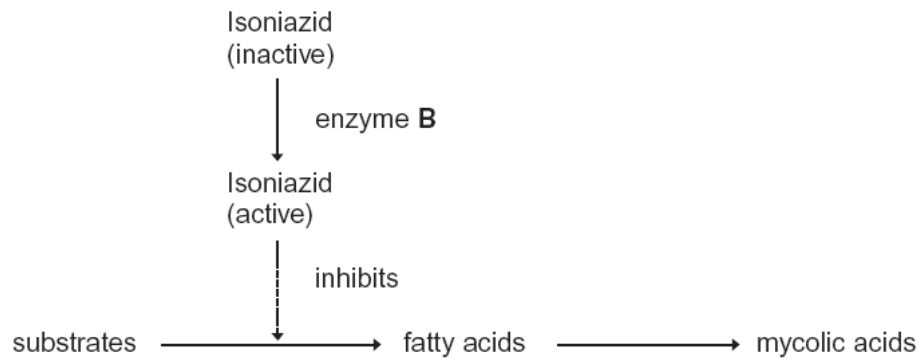


Starch grain A

Magnification times
(2 marks)

8)

Mycolic acids are substances that form part of the cell wall of the bacterium that causes tuberculosis. Mycolic acids are made from fatty acids. Isoniazid is an antibiotic that is used to treat tuberculosis. The diagram shows how this antibiotic inhibits the production of mycolic acids in this bacterium.



- (a) Treatment with isoniazid leads to the osmotic lysis of this bacterium. Use information in the diagram to suggest how.

.....
(2 marks)

- (b) Human cells also produce fatty acids. Isoniazid does not affect the production of these fatty acids.

Use information in the diagram to suggest **one** reason why isoniazid does **not** affect the production of fatty acids in human cells.

.....
(1 mark)

9)

- (a) Describe how DNA is replicated.

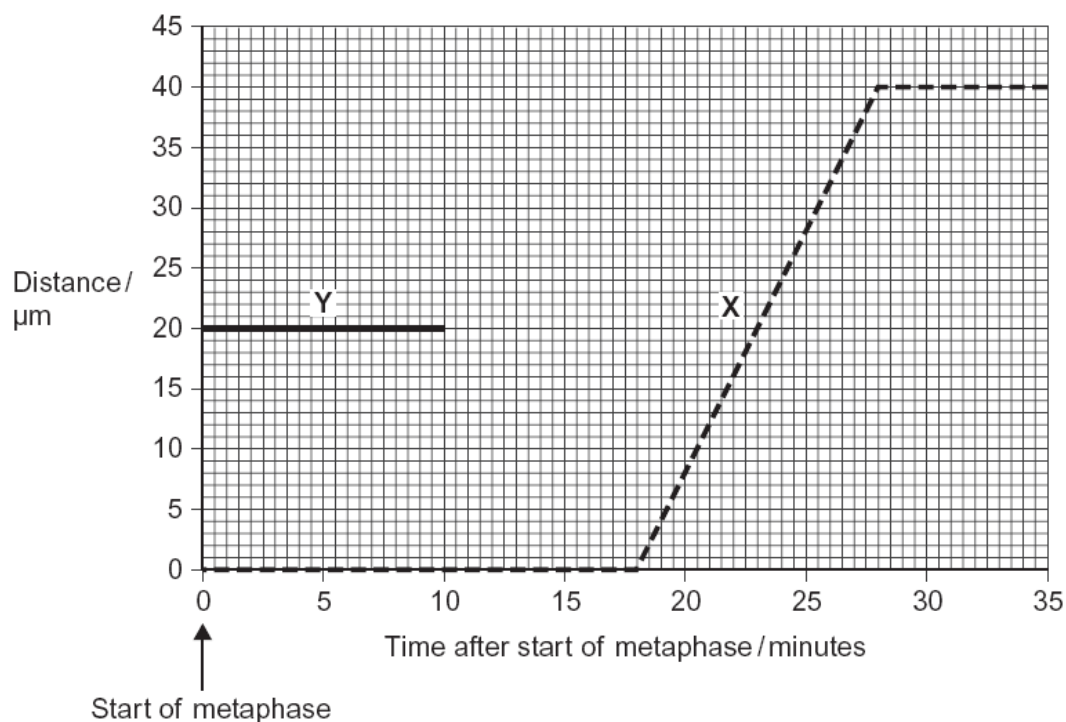
.....
(6 marks)

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

Key

----- = distance between chromatids

———— = distance between each chromatid and the pole to which it is moving



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

minutes

(1 mark)

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

minutes

(1 mark)

(b) (iii) Complete line Y on the graph.

(2 marks)

(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 C	Tissue sample D
Interphase	82	45
Prophase	4	16
Metaphase	5	18
Anaphase	5	12
Telophase	4	9

- (c) (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 marks)

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

(1 mark)

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

.....
(2 marks)