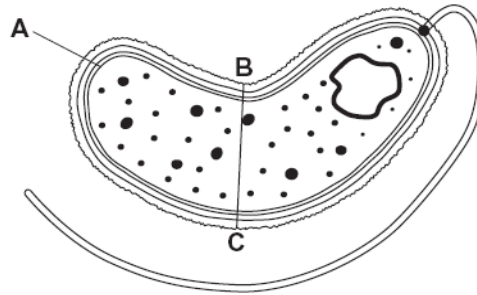


1)

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



(a) Name **A**.

.....
(1 mark)

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

1

2

(2 marks)

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

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

.....
(1 mark)

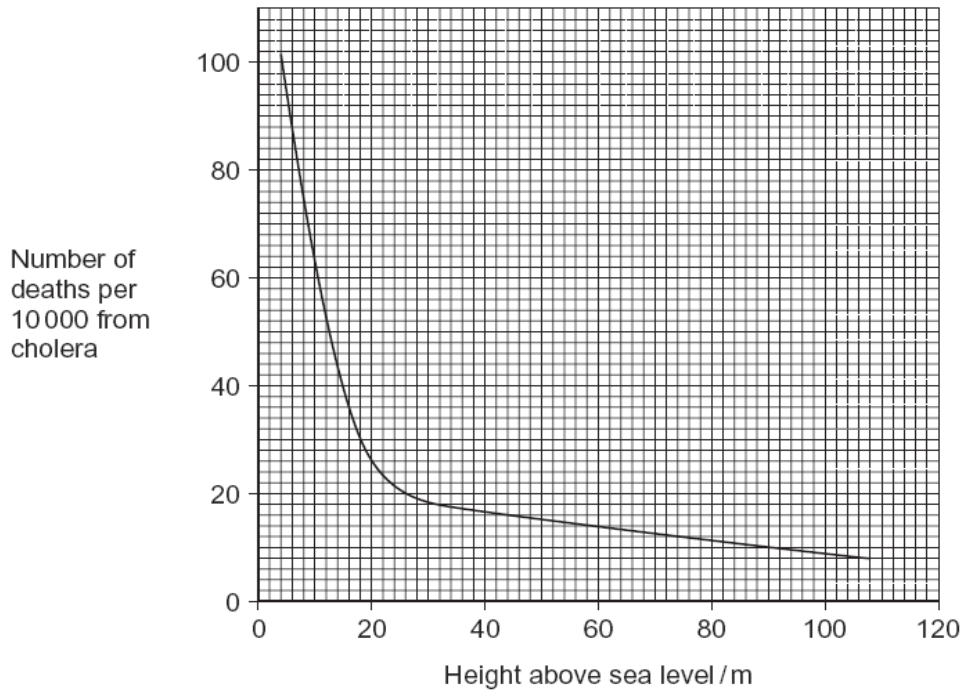
(c) (ii) Give **one** advantage of using a SEM rather than a TEM.

(1 mark)

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

.....µm
(2 marks)

(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.

.....
(2 marks)

2)

(a) *Induced fit* and *lock and key* are two models used to explain the action of enzymes.

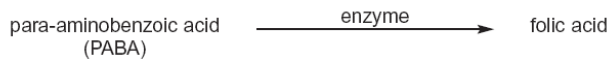
(a) (i) Describe the *induced fit* model of enzyme action.

.....
(2 marks)

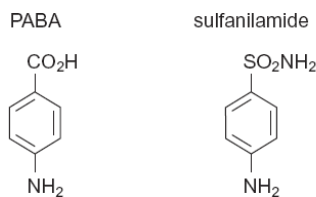
(a) (ii) Describe **one** way that the *lock and key* model is different from the *induced fit* model.

(1 mark)

(b) Folic acid is a substance required by bacteria for cell growth. Bacteria produce folic acid by the following reaction.



The diagram shows the structure of a molecule of PABA. It also shows the structure of a molecule of a drug called sulfanilamide, which can be used to treat bacterial infections. Sulfanilamide prevents bacteria producing folic acid.

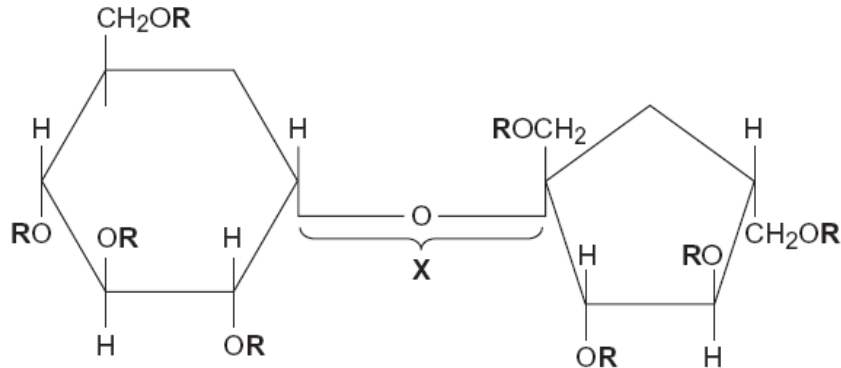


Use the diagram and your knowledge of enzymes to explain how sulfanilamide prevents bacteria producing folic acid.

.....
(3 marks)

3)

Olestra is an artificial lipid. It is made by attaching fatty acids, by condensation, to a sucrose molecule. The diagram shows the structure of olestra. The letter **R** shows where a fatty acid molecule has attached.



(i) Name bond X.

.....
(1 mark)

(ii) A triglyceride does **not** contain sucrose or bond X.

Give **one** other way in which the structure of a triglyceride is different to olestra.

.....
(1 mark)

.....
(1 mark)

iii) Starting with separate molecules of glucose, fructose and fatty acids, how many molecules of water would be produced when one molecule of olestra is formed?

(1 mark)

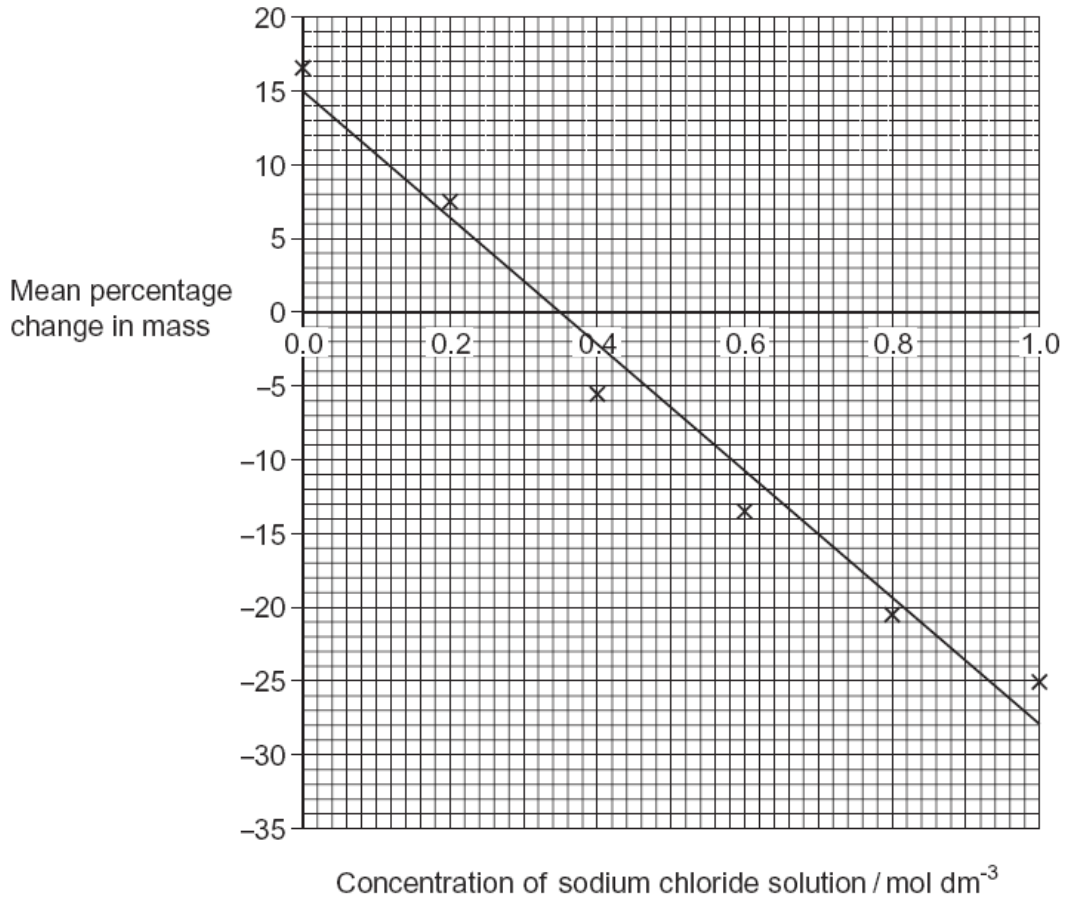
4)

A student investigated the effect of putting cylinders cut from a potato into sodium chloride solutions of different concentration. He cut cylinders from a potato and weighed each cylinder. He then placed each cylinder in a test tube. Each test tube contained a different concentration of sodium chloride solution. The tubes were left overnight. He then removed the cylinders from the solutions and reweighed them.

(a) Before reweighing, the student blotted dry the outside of each cylinder. Explain why.

.....
(2 marks)

The student repeated the experiment several times at each concentration of sodium chloride solution. His results are shown in the graph.



- (b) The student made up all the sodium chloride solutions using a 1.0 mol dm⁻³ sodium chloride solution and distilled water.

Complete the table to show how he made 20 cm³ of a 0.2 mol dm⁻³ sodium chloride solution.

Volume of 1.0 mol dm ⁻³ sodium chloride solution	Volume of distilled water

(1 mark)

- (c) The student calculated the *percentage* change in mass rather than the change in mass. Explain the advantage of this.

.....
(2 marks)

- (d) The student carried out several repeats at each concentration of sodium chloride solution. Explain why the repeats were important.

.....
(2 marks)

- (e) Use the graph to find the concentration of sodium chloride solution that has the same water potential as the potato cylinders.

.....mol dm⁻³
(1 mark)

5)

Read the passage below.

Most cases of cervical cancer are caused by infection with Human Papilloma Virus (HPV). This virus can be spread by sexual contact. There are many types of HPV, each identified by a number. Most of these types are harmless but types 16 and 18 are most likely to cause cervical cancer.

A vaccine made from HPV types 16 and 18 is offered to girls aged 12 to 13. Three 5 injections of the vaccine are given over six months. In clinical trials, the vaccine has proved very effective in protecting against HPV types 16 and 18. However, it will be many years before it can be shown that this vaccination programme has reduced cases of cervical cancer. Until then, smear tests will continue to be offered to women, even if they have been vaccinated. A smear test allows abnormal cells in 10 the cervix to be identified so that they can be removed before cervical cancer develops.

The Department of Health has estimated that 80% of girls aged 12 to 13 need to be vaccinated to achieve herd immunity to HPV types 16 and 18. Herd immunity is where enough people have been vaccinated to reduce significantly the spread of 15 HPV through the population.

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

- (a) HPV vaccine is offered to girls aged 12 to 13 (line 5). Suggest why it is offered to this age group.

.....
(1 mark)

- (b) The vaccine is made from HPV types 16 and 18 (line 5). Explain why this vaccine may **not** protect against other types of this virus.

.....
(2 marks)

- (c) Three injections of the vaccine are given (lines 5 to 6). Use your knowledge of immunity to suggest why.

- (d) It will be many years before it can be shown that this vaccination programme has reduced cases of cervical cancer (lines 7 to 9). Suggest **two** reasons why.

1

.....

2

.....

(2 marks)

- (e) Smear tests will continue to be offered to women, even if they have been vaccinated (lines 9 to 10). Suggest why women who have been vaccinated still need to be offered smear tests.

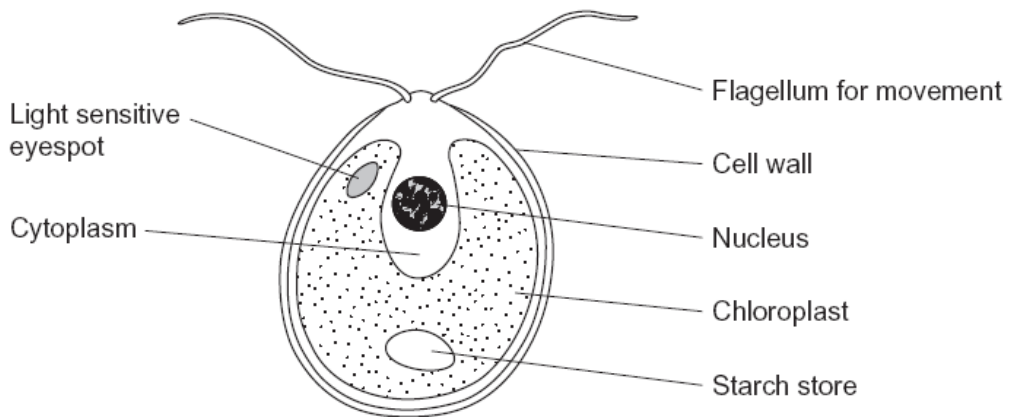
.....
(1 mark)

- (f) Suggest **one** reason why vaccinating a large number of people would reduce significantly the spread of HPV through the population (lines 14 to 16).

.....
(2 marks)

6)

The diagram shows an organism called *Chlamydomonas*.



- (a) Name **two** structures shown in the diagram that are present in plant cells but are **not** present in animal cells.

1

2

(2 marks)

- (b) *Chlamydomonas* lives in fresh water ponds. Use your knowledge of osmosis to suggest an advantage of using starch as a carbohydrate store.

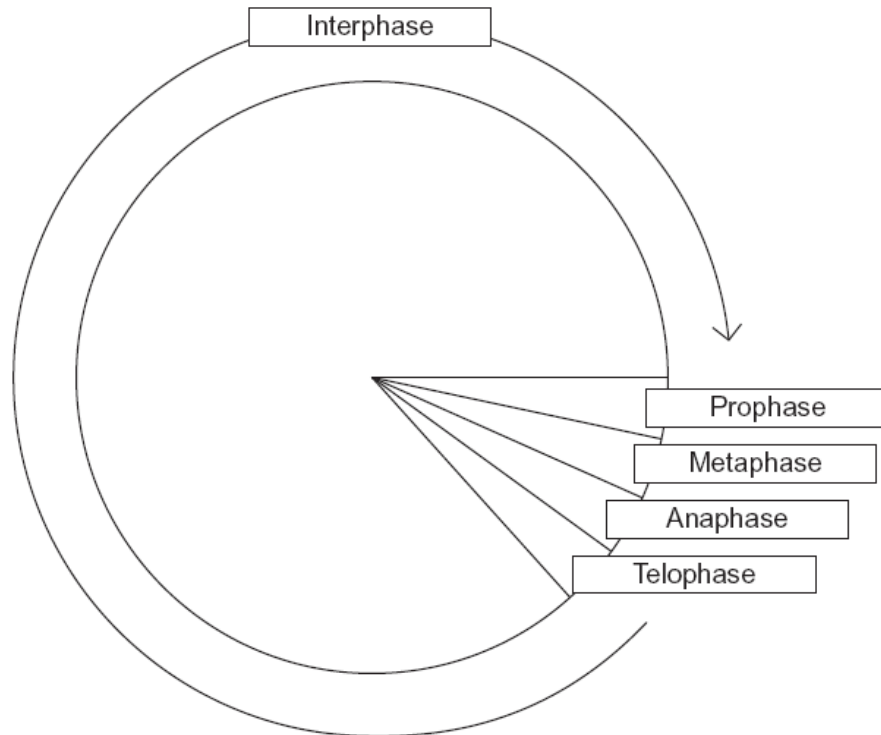
.....
(2 marks)

- (c) *Chlamydomonas* has adaptations that help it to maintain a high rate of photosynthesis. Use information in the diagram to explain what these adaptations are.

.....
(3 marks)

7)

The diagram shows a cell cycle.



(a) In prophase of mitosis, the chromosomes become visible. Describe what happens in

(a) (i) metaphase

.....
(2 marks)

(a) (ii) anaphase.

.....
(2 marks)

(b) (i) Cells lining the human intestine complete the cell cycle in a short time. Explain the advantage of these cells completing the cell cycle in a short time.

.....
(1 mark)

(b) (ii) The time required for a cell to complete the cell cycle was 4 hours 18 minutes. Calculate the time required in minutes for this cell to multiply to produce eight cells. Show your working.

Answer
(2 marks)

(c) Mikanolide is a drug that inhibits the enzyme DNA polymerase. Explain why this drug may be effective against some types of cancer.

.....
(2 marks)

8)

(a) *Clostridium difficile* is a bacterium that is present in the gut of up to 3% of healthy adults and 66% of healthy infants.

(a) (i) *C. difficile* rarely causes problems, either in healthy adults or in infants. This is because its numbers are kept low by competition with harmless bacteria that normally live in the intestine.

Use this information to explain why some patients treated with antibiotics can be affected by *C. difficile*.

.....
(2 marks)

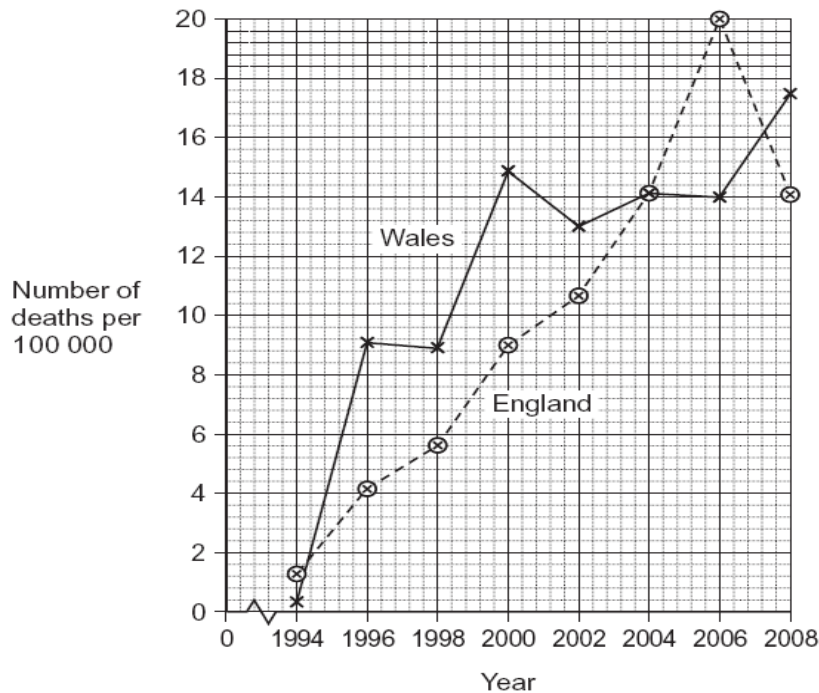
(a) (ii) Suggest why older people are more likely to be affected by *C. difficile*.

.....
(1 mark)

(b) The antibiotic methicillin inhibits the enzyme transpeptidase. This enzyme is used by some bacteria to join monomers together during cell wall formation. Methicillin has a similar structure to these monomers. Use this information to explain how methicillin inhibits the enzyme transpeptidase.

.....
(2 marks)

(c) MRSA is a variety of *Staphylococcus aureus*. It is difficult to treat infections caused by this bacterium because it is resistant to methicillin and to some other antibiotics. As a result, some patients who are already very ill may die if they become infected with MRSA. The graph shows the number of deaths in England and Wales between 1994



(c) (i) It may be difficult to identify MRSA as the actual cause of death. Explain why.

.....
(1 mark)

- (c) (ii) Describe the change in the number of deaths caused by MRSA in England in the period shown in the graph.

.....
(1 mark)

- (c) (iii) Calculate the percentage increase in the number of deaths caused by MRSA in Wales from 1996 to 2006. Show your working.

Answer (2 marks)

- (d) Describe how gene transmission and selection have increased the difficulty of treating bacterial infections with antibiotics.

.....
(6 marks)