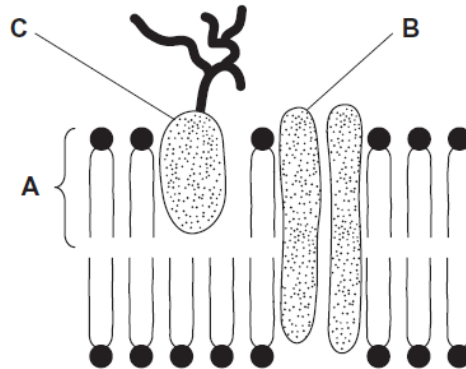


1)

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



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

**A** .....

**B** .....

(2 marks)

(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.

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(1 mark)

(b) (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 .....

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(2 marks)

2)

(a) An enzyme catalyses only one reaction. Explain why.

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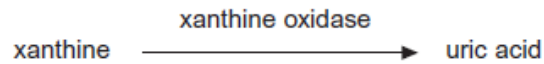
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(2 marks)

(b) Gout is a disease caused by the build-up of uric acid crystals in joints. Uric acid is produced from xanthine in a reaction catalysed by the enzyme xanthine oxidase.



Allopurinol is a drug used to treat gout. The diagram shows the structures of xanthine and allopurinol.



Use this information to suggest how allopurinol can be used to treat gout.

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(3 marks)

3)

(a) Infection by the cholera bacterium can cause acute diarrhoea. Explain how.

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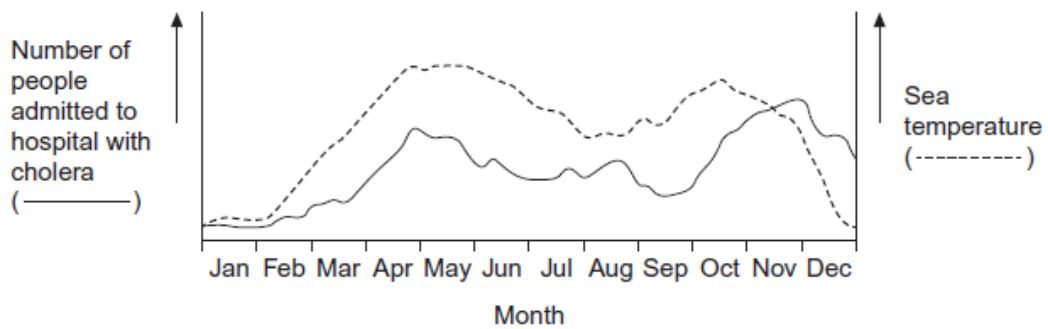
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(2 marks)

The bacteria that cause cholera can be found in seawater. Outbreaks of cholera often begin in populations living near the coast.

Scientists in Bangladesh investigated the relationship between outbreaks of cholera and the sea temperature. They used the number of people admitted to hospital with cholera as a measure of the number of cases of the disease. The graph shows their results.



(b) Describe the relationship between sea temperature and the number of people admitted to hospital with cholera between January and June.

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(2 marks)

- (c) Some scientists have suggested that a rise in sea temperatures could lead to an increase in outbreaks of cholera. Do these data support this suggestion? Give reasons for your answer.

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*(2 marks)*

- (d) In areas where there are repeated outbreaks of cholera, most people who become infected by cholera bacteria do not become ill. Suggest and explain **one** reason why.

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*(2 marks)*

4.

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 marks)

- (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 marks)

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

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

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*(2 marks)*

(c) (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 marks)*

5)

(a) Describe how you would test a sample of food for the presence of starch.

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(2 marks)

(b) The concentration of glucose in the blood rises after eating a meal containing carbohydrates.

The rise is slower if the carbohydrate is starch rather than sucrose. Explain why.

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(3 marks)

(Extra space) .....

6)

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) Microfold cells do not have adaptations for the absorption of food (lines 2 - 3). Give **two** adaptations that other epithelial cells have for the absorption of food.

1 .....

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2 .....

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*(2 marks)*

- (b) (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 mark)*

- (b) (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 marks)*



- (c) 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 marks)

(Extra space) .....

7)

- (a) DNA helicase is important in DNA replication. Explain why.

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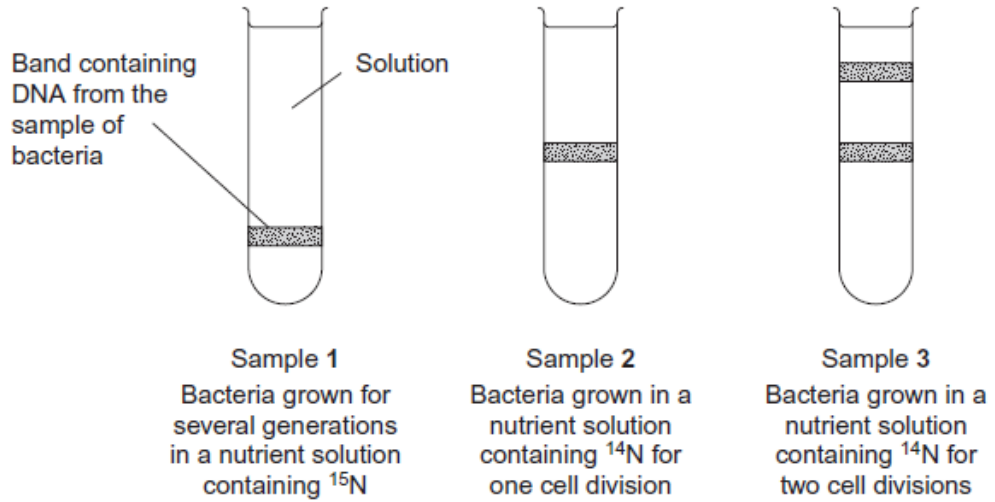
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(2 marks)

Scientists investigating DNA replication grew bacteria for several generations in a nutrient solution containing a heavy form of nitrogen ( $^{15}\text{N}$ ). They obtained DNA from a sample of these bacteria.

The scientists then transferred the bacteria to a nutrient solution containing a light form of nitrogen ( $^{14}\text{N}$ ). The bacteria were allowed to grow and divide twice. After each division, DNA was obtained from a sample of bacteria.

The DNA from each sample of bacteria was suspended in a solution in separate tubes. These were spun in a centrifuge at the same speed and for the same time. The diagram shows the scientists' results.

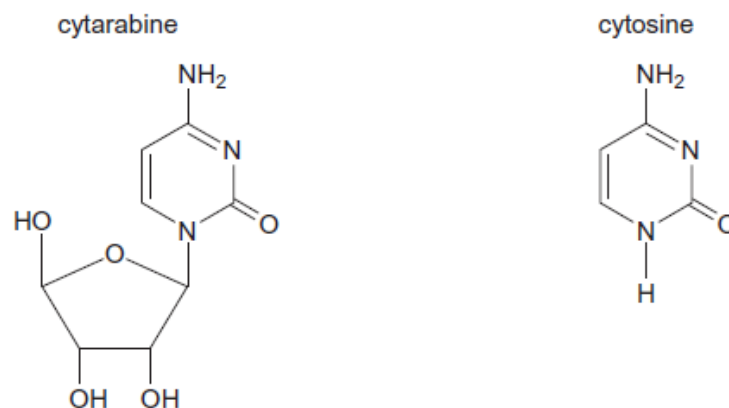


- (b) The table shows the types of DNA molecule that could be present in samples 1 to 3. Use your knowledge of semi-conservative replication to complete the table with a tick if the DNA molecule is present in the sample.

Sample	Type(s) of DNA molecule present in each sample		
	$^{15}\text{N} \ ^{15}\text{N}$ 	$^{15}\text{N} \ ^{14}\text{N}$ 	$^{14}\text{N} \ ^{14}\text{N}$ 
1			
2			
3			

(3 marks)

- (c) Cytarabine is a drug used to treat certain cancers. It prevents DNA replication. The diagram shows the structures of cytarabine and the DNA base cytosine.



(c) (i) Use information in the diagram to suggest how cytarabine prevents DNA replication.

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(2 marks)

(c) (ii) Cytarabine has a greater effect on cancer cells than on healthy cells. Explain why.

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(1 mark)

8)

(a) (i) Give one way in which antibiotics can prevent the growth of bacteria.

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(1 mark)

(a) (ii) Describe how bacteria can become resistant to antibiotics by *vertical* gene transmission.

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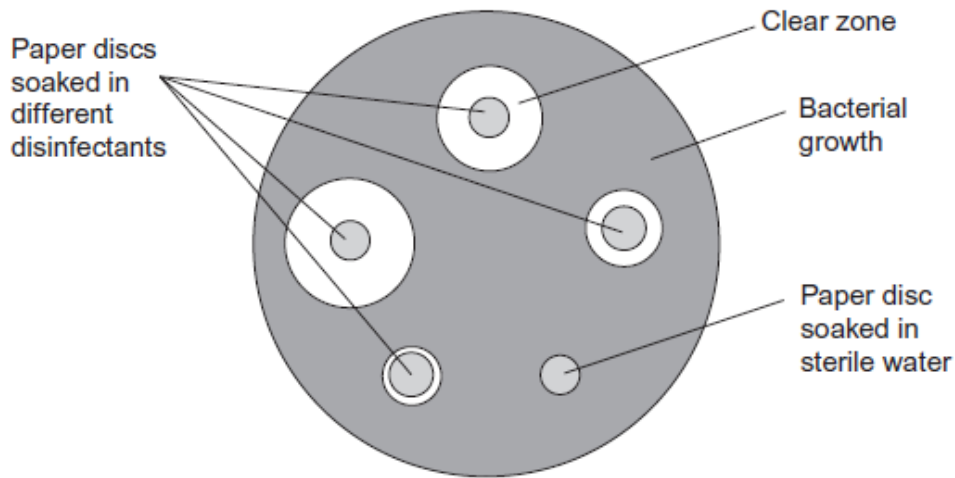
(1 mark)

*Pseudomonas aeruginosa* is a bacterium that can cause infections in hospital patients suffering from burns. Disinfectants are substances used to kill bacteria on non-living objects, such as medical equipment. Doctors in one hospital investigated how effective four disinfectants were at killing *P. aeruginosa*.

The doctors:

- took samples from many patients in the hospital
- isolated *P. aeruginosa* from those samples
- suspended the *P. aeruginosa* in a solution
- spread many samples of this solution on nutrient jelly in many Petri dishes.

The doctors then placed five small paper discs on the jelly in each dish. Each disc had been soaked in a different disinfectant or sterile water. The doctors left the plates for 24 hours to allow bacteria to grow and divide. The diagram shows a typical Petri dish after 24 hours.



- (b) The doctors used samples of this bacterium taken from many patients in the hospital. Explain why this was important.

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(1 mark)

After 24 hours, the doctors measured the diameter of any clear zones around each paper disc. They then calculated the mean diameter of the clear zone for each disinfectant. The table shows their results.

Disinfectant	Mean diameter of clear zone / mm ( $\pm$ standard deviation)
Chlorhexidine	22.8 $\pm$ 3.9
Cetrimide-C	9.1 $\pm$ 2.6
Hypochlorite	26.9 $\pm$ 5.2
Micro 10	6.6 $\pm$ 1.5

- (c) Do these data support the conclusion that hypochlorite was the most effective at killing this bacterium? Explain your answer.

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(3 marks)

(Extra space) .....

- (d) Doctors in a different hospital repeated this investigation. They found that hypochlorite had little effect on samples of *P aeruginosa* they obtained. Suggest how this different result may have arisen.

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(2 marks)