

4 Fig. 4.1 is a photomicrograph of a copepod. These animals are found living in sea water and in fresh water environments.

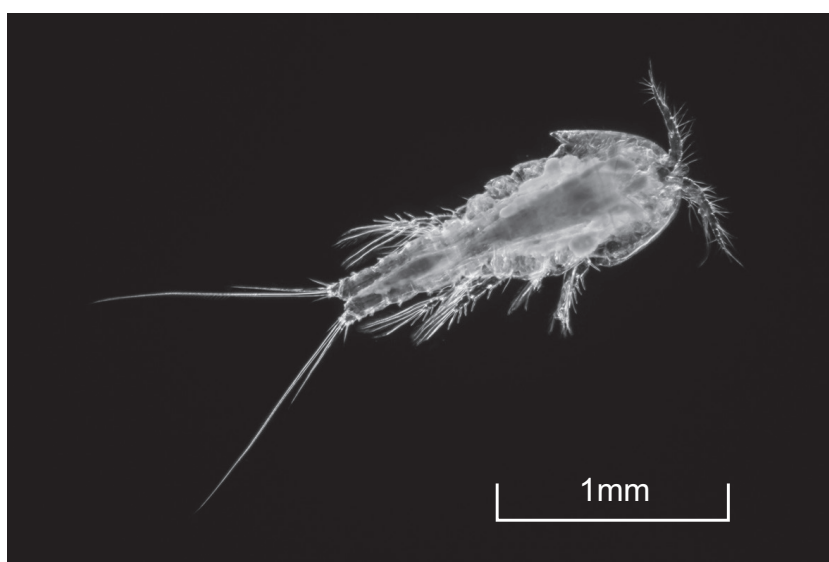


Fig. 4.1

(a) The outer surface of a copepod is covered in a layer of the polysaccharide chitin.

Fig. 4.2 shows part of a chitin molecule.

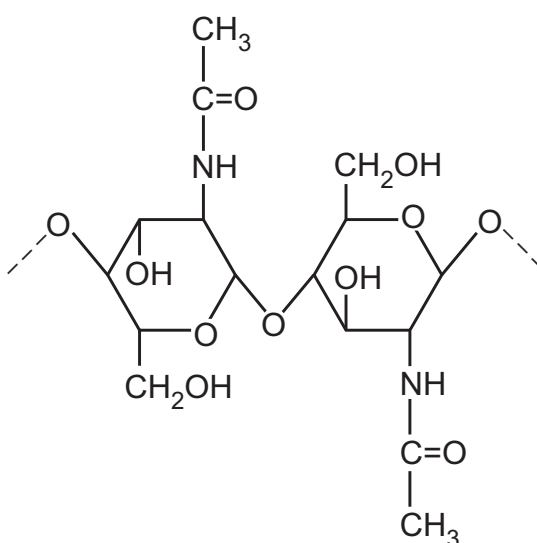


Fig. 4.2

- (i) Draw a circle around a glycosidic bond in Fig. 4.2. [1]
- (ii) In aquatic environments, *Vibrio cholerae* can live on the surface of copepods. *V. cholerae* secretes enzymes to hydrolyse chitin to its N-acetylglucosamine monomers. These can be broken down to provide carbon, nitrogen and a source of energy.

Draw the monomer that is formed when chitin is hydrolysed by *V. cholerae*.

[2]

(b) *V. cholerae* is a pathogen that causes cholera.

Scientists studied the transmission of *V. cholerae* in groups of people living in an area where there is a high number of cases of cholera.

Some families living in this area filtered their water through several layers of folded fabric from old clothing. The folded fabric traps particles and organisms larger than 20 μm.

The scientists recorded the number of cases of cholera in families that filtered their water through folded fabric and compared this to the number of cases of cholera recorded in families that did **not** filter their water through the folded fabric.

The results are shown in Fig. 4.3.

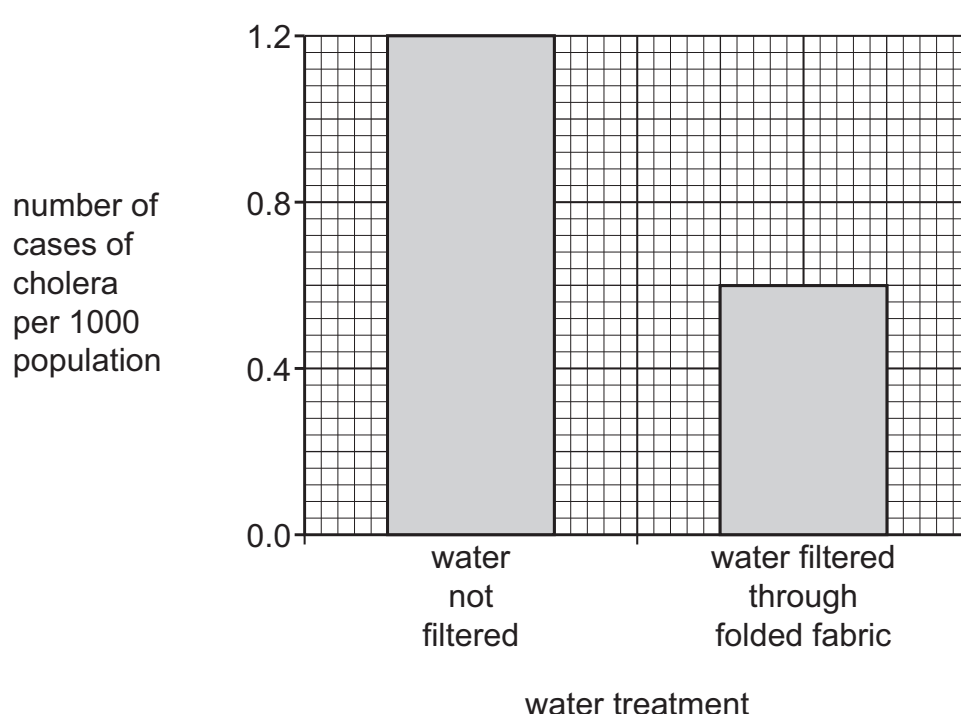


Fig. 4.3

Suggest possible explanations for the results shown in Fig. 4.3.

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[4]

(c) The World Health Organization (WHO) recommends the use of an oral cholera vaccine (OCV) to protect people living in an area where a cholera outbreak has occurred.

People who receive an OCV and make changes in their behaviour are less likely to have a serious case of cholera.

(i) Describe **one** change in behaviour that a person can make, **other** than purifying water, to help prevent a serious case of cholera.

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[1]

(ii) The antibiotic tetracycline is used to treat cholera. However, some bacteria that cause cholera have evolved resistance to this antibiotic.

Scientists have reported that resistant bacteria have an extra protein in their cell surface membrane. This protein has been found to use ATP.

Suggest how the presence of this protein in the cell surface membrane gives *V. cholerae* resistance to tetracycline.

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[2]

(iii) For some vaccines, there may not be an effective secondary immune response when a person is infected by the specific pathogen. The antibodies that are produced do **not** act on the pathogen. This is known as immune evasion.

Evolution of resistance of bacteria to antibiotics occurs more frequently than immune evasion.

Suggest why bacteria evolve resistance to antibiotics more frequently than vaccines that lose their effectiveness in protecting against bacterial pathogens.

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