

Fig. 1.1 is a diagram of a plant cell.

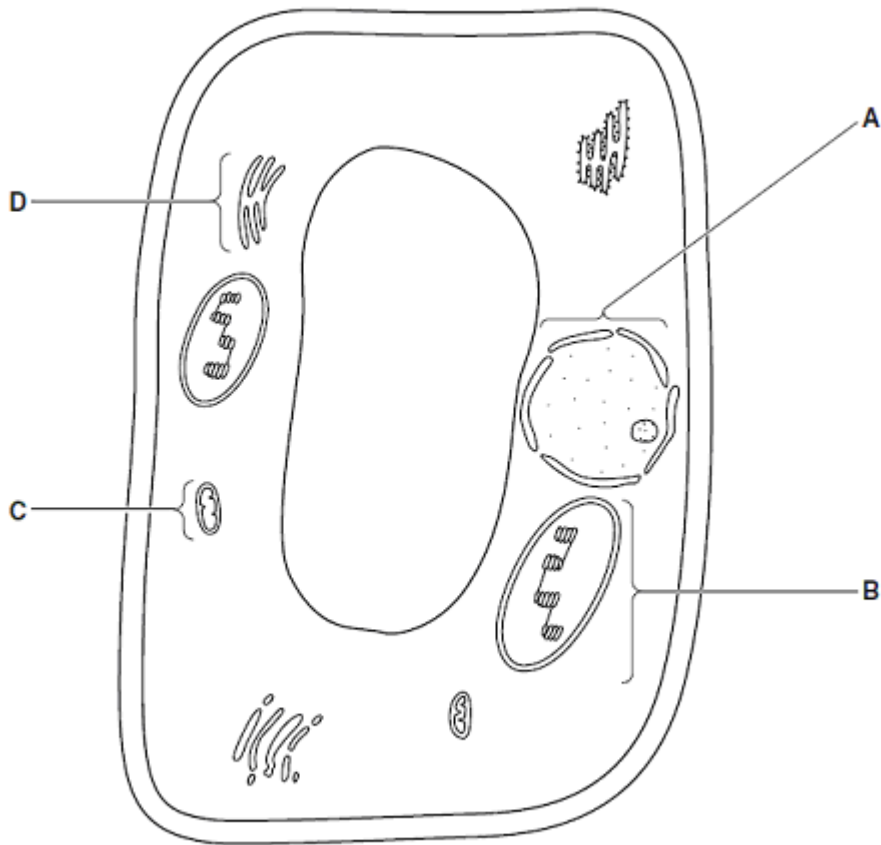


Fig. 1.1

(a) (i) Name the cell components labelled A and B.

A .....

B .....

[2]

(ii) State the functions of the components labelled C and D.

C .....

.....

D .....

.....

[2]

- (b) A student suggested that the details of component **C** could be seen clearly with a very good light microscope.

Explain why the student is **not** correct.

.....  
..... [2]

- (c) Staining is a process often used in microscopy.

Describe the **advantages** of staining specimens to be viewed under a microscope.

.....  
..... [2]

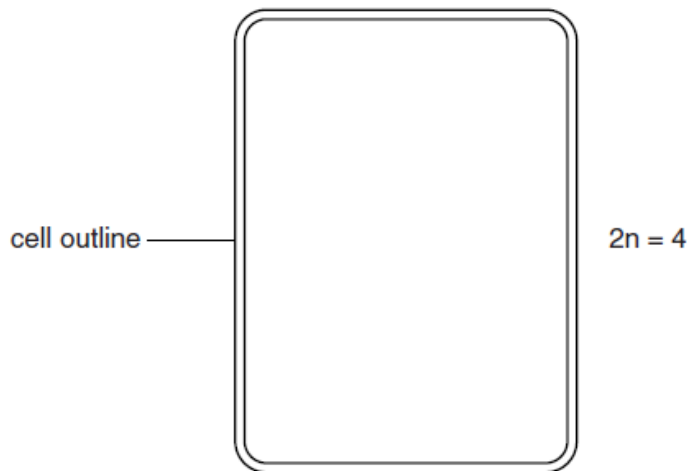
2)

- (a) (i) Name the type of nuclear division that occurs in plant growth.

..... [1]

- (ii) Draw the **chromosomes** within the cell outline below as they would appear during **metaphase** of nuclear division.

Assume the diploid number of chromosomes is **four**.

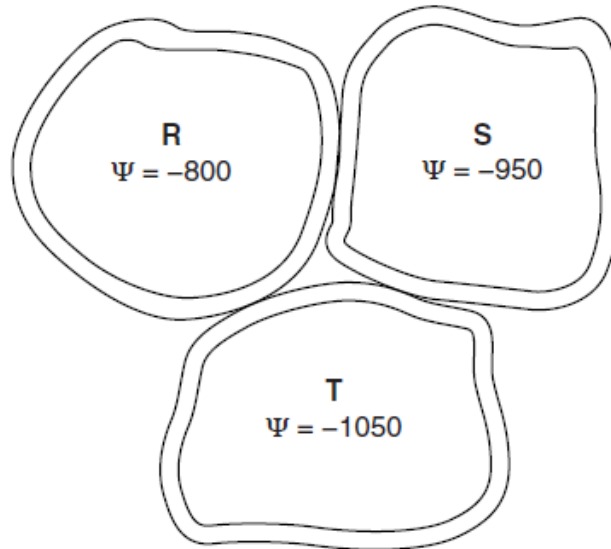


[2]

- (iii) Cytokinesis follows nuclear division. After cytokinesis, the cells elongate due to water uptake by osmosis.

Fig. 3.1 shows three plant cells. The value shown in each cell refers to the water potential,  $\Psi$ , in kPa.

Draw arrows on Fig. 3.1 below to show the movement of water between cells R, S and T.



[2]

- (b) Fig. 3.2, on the insert, shows the stump of a tree with new branches growing from the stump.

New growth in a stem or trunk comes from the **cambium**, which is situated between the xylem and phloem tissues.

Explain why the new branches in Fig. 3.2 are seen growing from a position just under the bark of the cut surface.

.....  
 ..... [2]

- (c) Name **one** other location where growth occurs in a plant.

..... [1]

- (d) Look at the areas labelled **L** on Fig. 3.2. These are areas of loosely packed cells in the bark called lenticels. Lenticels allow gases to diffuse into the living tissues of the trunk.

Suggest why lenticels are essential to the survival of large multicellular plants **and** explain why similar structures are not found in large multicellular animals.

.....  
 ..... [2]

3)

Membranes are found both at the surface of cells and within cells.

(a) State **two** functions of membranes **within** cells.

..... [2]

(b) Describe the arrangement and functions of **two** named components of a cell surface membrane.



*In your answer you should use appropriate technical terms, spelled correctly.*

..... [5]

(c) (i) Which component of a cell membrane becomes more fluid as temperature increases?

..... [1]

(ii) Which component of a cell membrane denatures as temperature increases?

..... [1]

(iii) Liver cells contain membrane-bound organelles called peroxisomes. These organelles contain catalase, an enzyme that breaks down hydrogen peroxide to release oxygen gas.

A student carried out an investigation on catalase using the following procedure:

- two identical sized cubes were cut from a piece of fresh liver
- one cube was frozen overnight and then defrosted
- the other cube was stored in the refrigerator
- both cubes were returned to room temperature and were placed in separate test tubes containing equal volumes of 2% hydrogen peroxide solution.

The student observed that the cube of liver that had been frozen and defrosted, bubbled significantly more than the cube that had been refrigerated.

Suggest an explanation for this result.

..... [2]

- 4)
- (a) Amino acids form part of the structure of proteins.
- (i) State the name given to the sequence of amino acids in a protein molecule.  
..... [1]
- (ii) Draw the **general structure** of an amino acid molecule in the space below.  
..... [3]
- (b) Collagen is an important fibrous protein which forms part of the wall of blood vessels.
- (i) State **one** property of collagen that makes it a useful component of blood vessel walls.  
..... [1]
- (ii) Describe the **structure** of the collagen molecule.  
.....  
..... [6]
- (c) Another protein that is important in mammals is haemoglobin.
- (i) State **one** function of haemoglobin.  
..... [1]
- (ii) Haemoglobin contains a prosthetic group known as haem.  
Collagen does not contain a prosthetic group.  
Describe **three** other ways in which the structure of haemoglobin differs from that of collagen.
- 1 .....  
2 .....  
3 ..... [3]

5)

- (a) Alcohol dehydrogenase is a protein molecule that is present in the liver. The molecule breaks down alcohols and other chemicals that would otherwise be toxic to the body.

Name the group of biological molecules to which alcohol dehydrogenase belongs.

..... [1]

- (b) In 1985, health concerns were raised when the compound diethylene glycol (DEG) was detected in samples of wine. The DEG had been added, illegally, to make the wine taste sweeter.

In the liver, DEG is broken down by alcohol dehydrogenase to form a toxic product. Alcohol dehydrogenase also breaks down ethanol, the key ingredient in alcoholic drinks such as wine, to form a non-toxic product.

Fig. 2.1 shows the structures of DEG and ethanol.

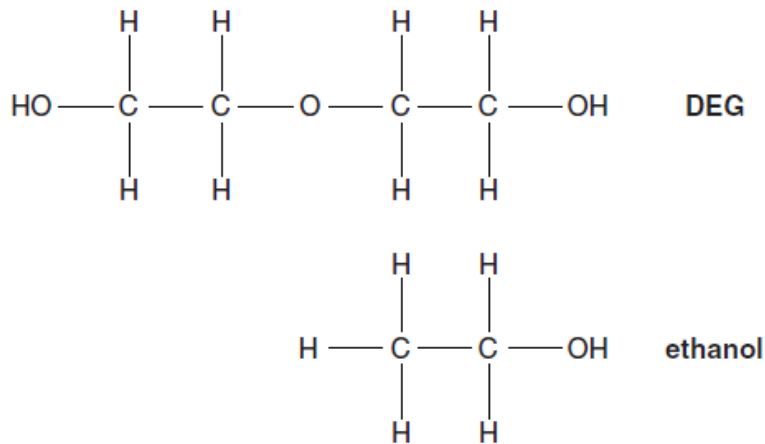


Fig. 2.1

- (i) Using the information in Fig. 2.1, explain why alcohol dehydrogenase is able to break down **both** ethanol and DEG.

..... [3]

- (ii) Suggest why DEG-contaminated wines with a high ethanol content may result in less DEG poisoning than contaminated wines with a low ethanol content.

.....

..... [3]

6)  
 (a) Fig. 5.1 shows part of a DNA molecule.

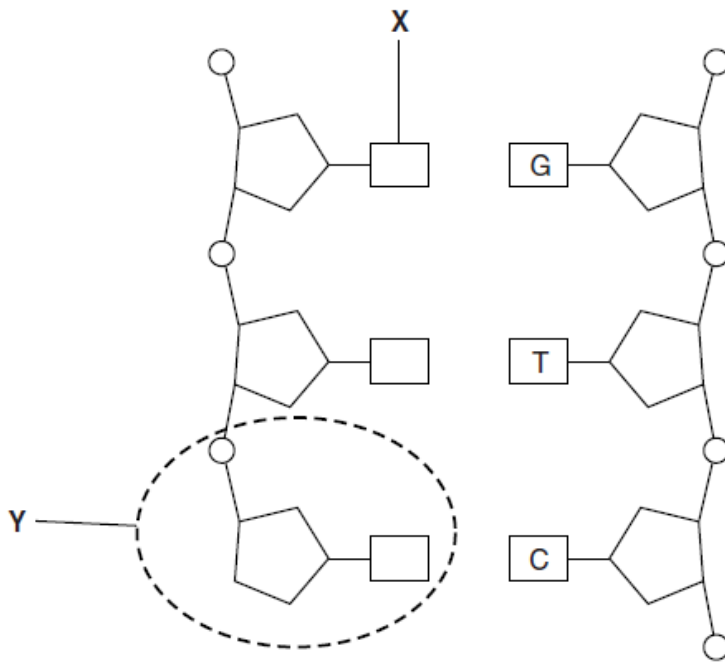


Fig. 5.1

(i) Name the parts of the molecule represented by the letters X and Y.

X .....

Y .....

[2]

(ii) Complete the diagram in Fig. 5.1 by drawing hydrogen bonds to connect the two strands.

*The hydrogen bonds should be drawn on Fig. 5.1.*

[2]

(iii) Complete the following paragraph by using the most appropriate term(s).

A gene is a section of DNA that codes for the production of a .....

The molecule that copies a gene and carries the information to a .....

is called RNA.

[2]

(iv) State two ways in which a diagram of part of an RNA molecule would appear different from the DNA molecule shown in Fig. 5.1.

1 .....

.....

2 .....

.....

[2]

(b) DNA replication takes place during interphase of the cell cycle. It occurs by a semi-conservative mechanism.

(i) Explain why DNA replication is considered to be semi-conservative.

..... [2]

(ii) Explain why complementary base-pairing is important in DNA replication.

.....

..... [2]

(c) In 1958, two scientists, Meselson and Stahl, conducted an investigation into DNA replication.

- Bacteria were grown in a food source that contained only the 'heavy' isotope of nitrogen,  $^{15}\text{N}$ . After many generations, the bacterial DNA contained only the 'heavy' form of nitrogen.
- Some of the bacteria were then transferred to another food source containing only the normal, 'lighter' form of nitrogen,  $^{14}\text{N}$ .
- DNA was extracted from the bacteria and centrifuged. (When a solution is centrifuged, the heavier, more dense molecules tend to settle nearer the bottom of the tube.)

Some of the results from the experiment are shown in Fig. 5.2.

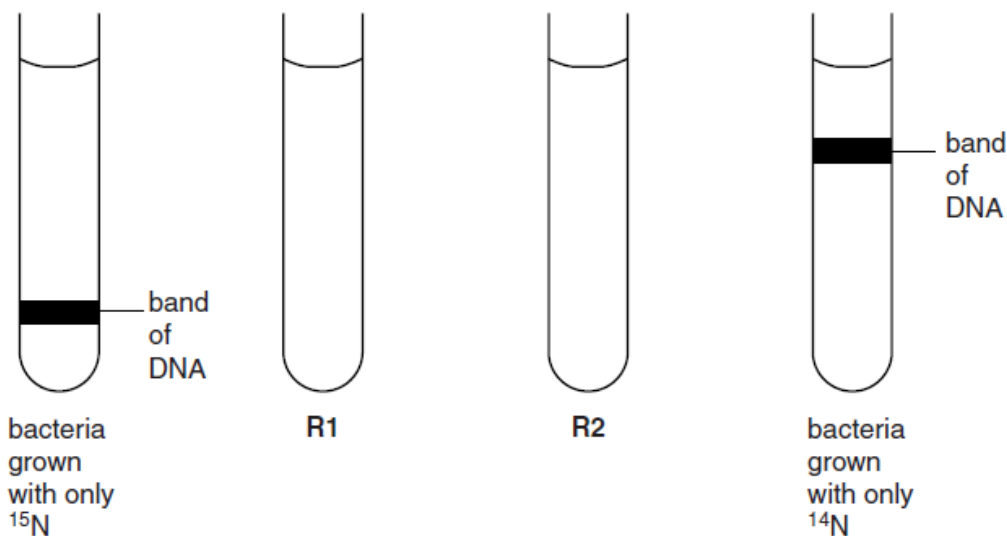


Fig. 5.2



- (i) In Fig. 5.2, the tube labelled **R1** represents the results for DNA extracted from bacteria that had been **transferred** from the  $^{15}\text{N}$  to the  $^{14}\text{N}$  food source and left long enough for their DNA to replicate **once** only.

Draw **one** band on tube **R1** in the position you would expect the DNA to appear **after** centrifuging.

*Draw the band on Fig. 5.2.* [1]

- (ii) In Fig. 5.2, the tube labelled **R2** represents the results for DNA obtained from bacteria that had been **transferred** from the  $^{15}\text{N}$  to the  $^{14}\text{N}$  food source and left long enough for their DNA to replicate **twice**.

Draw **two** bands on tube **R2** in the positions you would expect the DNA to appear **after** centrifuging.

*Draw the bands on Fig. 5.2.* [1]

- (d) The technique of centrifugation used by Meselson and Stahl involves:

- mixing the DNA sample with concentrated sugar solution
- placing the mixture of DNA and sugar solution in test-tubes
- spinning the test-tubes at a very high speed.

Suggest **three** precautions that Meselson and Stahl would have taken in order to ensure that the centrifugation part of their investigation produced valid results.

- 1 .....
- 2 .....
- 3 .....

[3]