Q.1.

1 Fig. 1.1 shows drawings of a cell at various stages in the mitotic cell cycle.

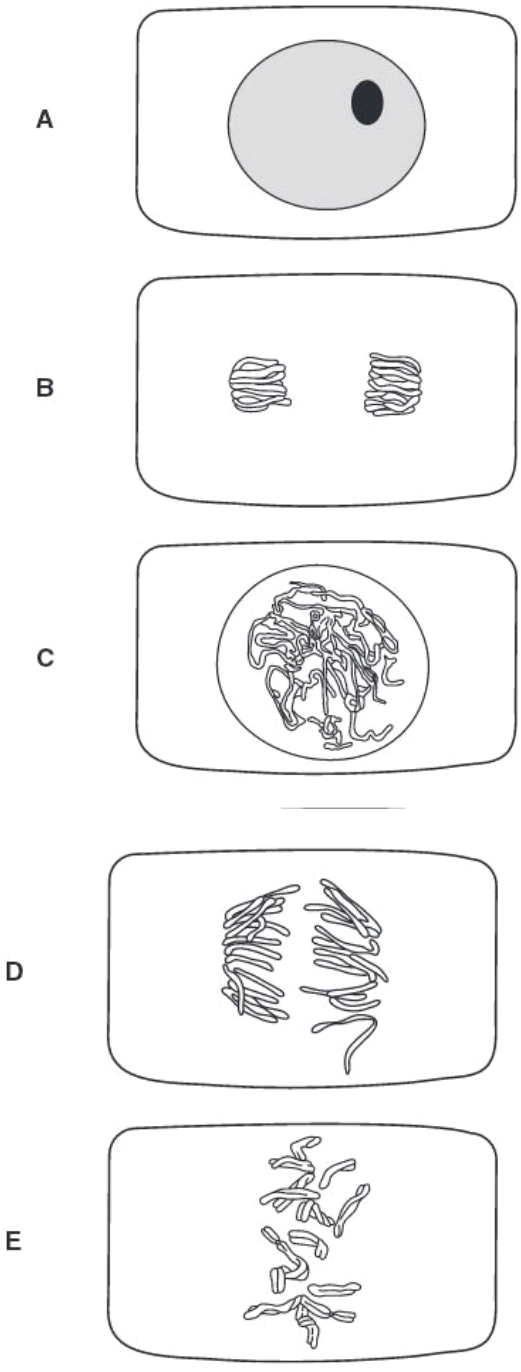


Fig. 1.1

(a) List the letters shown in Fig. 1.1 in the order in which these stages occur during a mitotic cell cycle. The first stage has been entered for you.

A .... [1]

(b) Explain what is happening in stage **D** in Fig. 1.1.

.....

.....

.....

.....[2]

(c) Describe in outline what happens to the DNA in the nucleus during stage **A** in Fig. 1.1.

.....

.....

.....

.....

.....

.....[3]

(d) State the importance of mitosis in the growth of a multicellular organism, such as a flowering plant or a mammal.

.....[1]

[Total : 7]

Q.2.

3 Muntjac are small deer found throughout Asia. Cells at the base of the epidermis in the skin continually divide by mitosis. Fig. 3.1 shows the chromosomes from a skin cell of a female Indian muntjac deer at metaphase of mitosis.

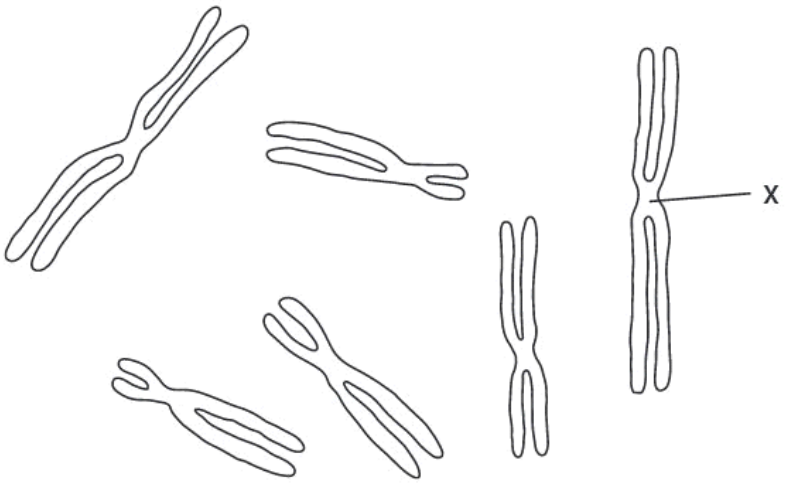


Fig. 3.1

(a) (i) State the diploid chromosome number of the female Indian muntjac deer.

.....[1]

(ii) Name X and state its role in mitosis.

name .....

role .....

.....[2]

(iii) On Fig. 3.1, **shade in** a pair of homologous chromosomes. [1]

(iv) In the space below, draw one of the chromosomes shown in Fig. 3.1 as it would appear during **anaphase** of mitosis.

[2]

(b) Outline what happens to **a chromosome** between the end of anaphase and the start of the next mitosis.

.....

.....

.....

.....

.....

.....[3]

(c) During the formation of eggs in the ovary of the female Indian muntjac deer, the chromosome number changes.

State what happens to the chromosome number and explain why this change is necessary.

.....

.....

.....

.....[2]

[Total: 11]

Q.3.

(b) Describe the roles of centrioles in animal cells.

.....

.....

.....

.....

.....

..... [3]

Q.4.

6 Fig. 6.1 is an electron micrograph of a cancer cell in the process of dividing by mitosis.

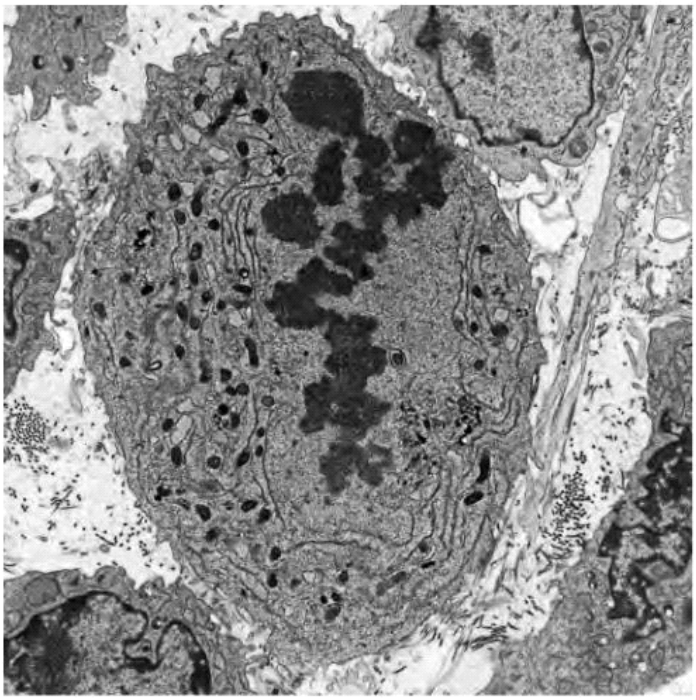


Fig. 6.1

(a) The stage of mitosis visible in Fig. 6.1 is metaphase.

State which features of the cell shown in Fig. 6.1 indicate that it is at metaphase and not at anaphase.

.....

.....

.....

.....[2]

(b) People who have smoked cigarettes for many years are at risk of developing lung cancer.

Describe how cigarette smoke is responsible for the development of lung cancer.

.....

.....

.....

.....

.....

.....

.....

.....[4]

(c) Fig. 6.2 shows the change in the percentage of smokers in the male population of the UK between 1950 and 2005.

Fig. 6.3 shows the change in mortality rate in the UK in men aged 75 to 84 between 1950 and 2005.

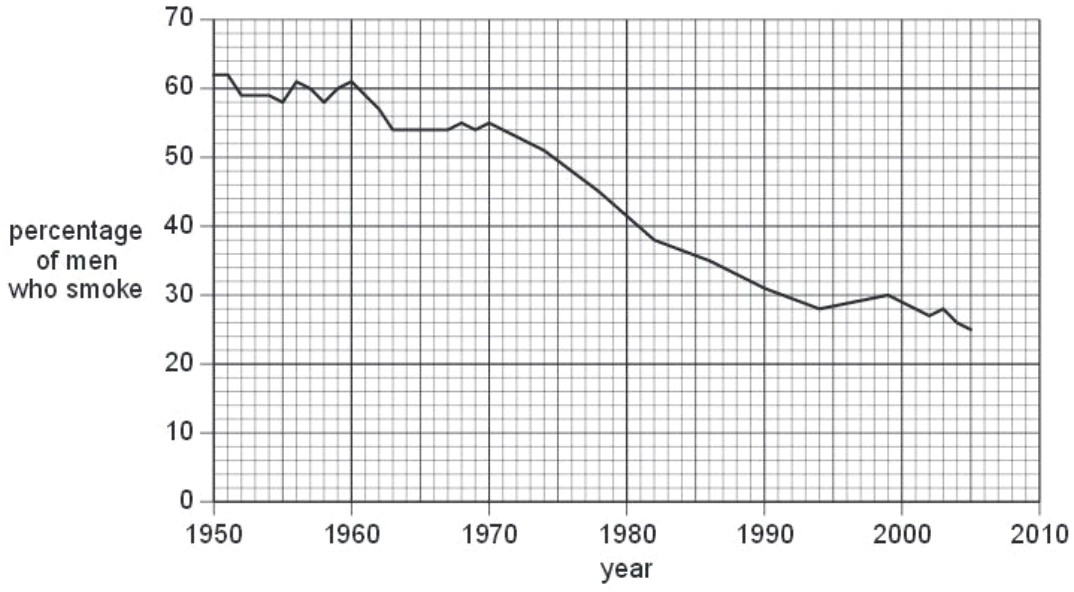


Fig. 6.2

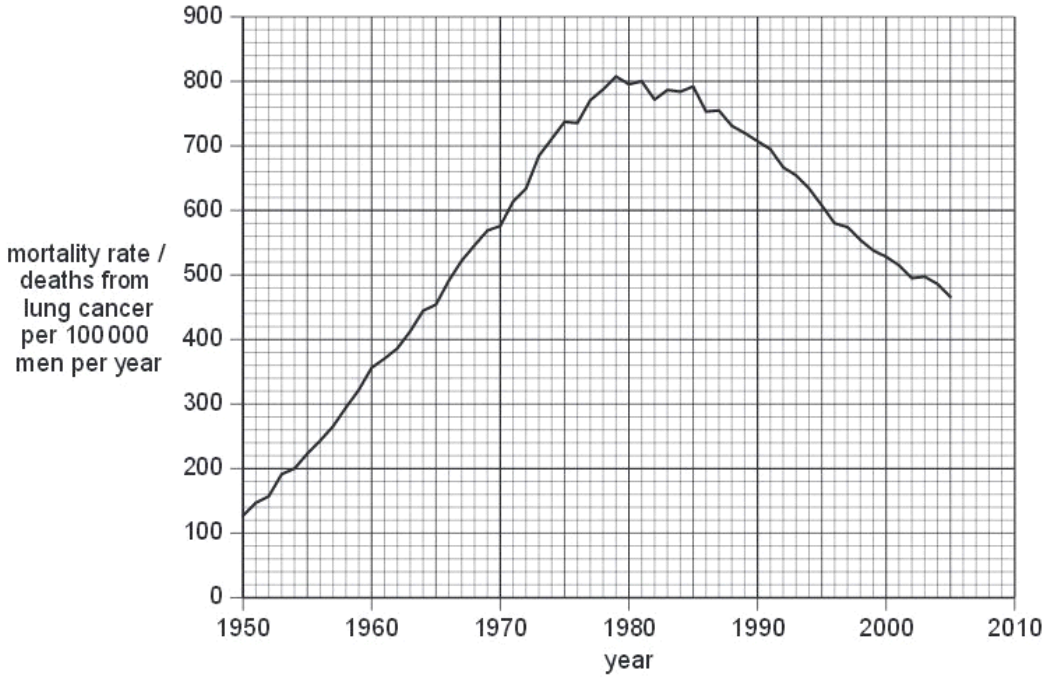


Fig. 6.3

Fig. 6.2 and Fig. 6.3 appear to show that there is no link between the percentage of the population that smoke and the death rate from lung cancer.

Explain why the mortality rate from lung cancer among men increased and then decreased over the period shown in Fig. 6.3, even though the percentage of smokers decreased over the same period of time.

.....

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 9]

Q.5.

1 Fig. 1.1 is a photomicrograph of a root tip of onion, *Allium cepa*, showing cells in interphase and in stages of mitosis.

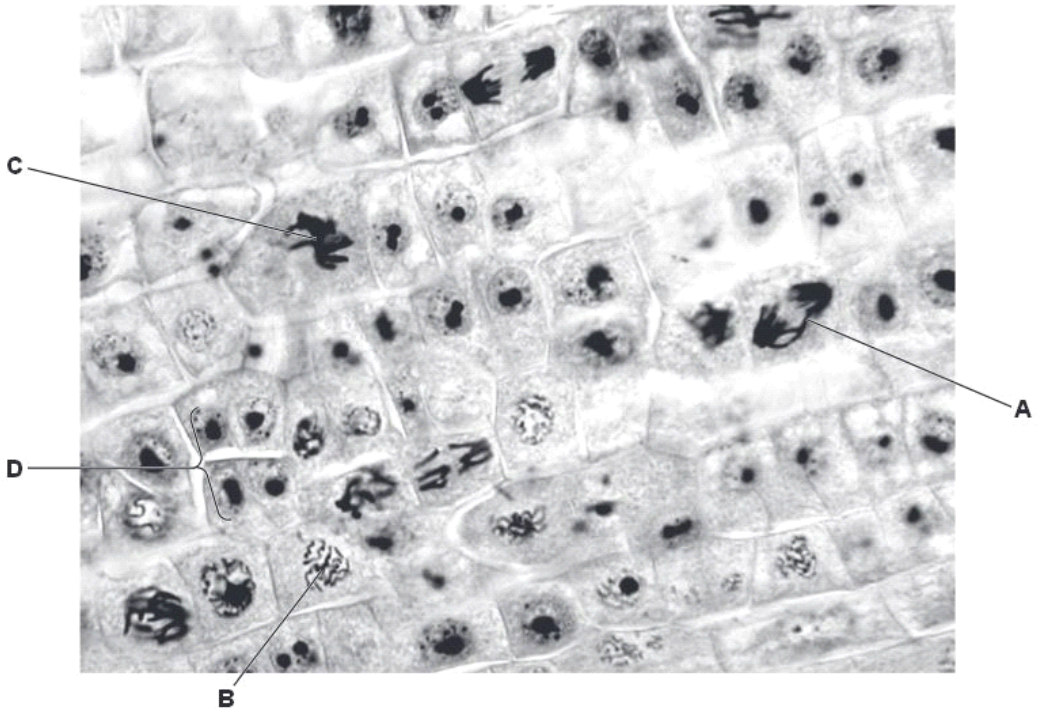


Fig. 1.1

(a) Name the stages of mitosis shown in cells **A**, **B** and **C**.

A .....

B .....

C .....[3]

(b) Suggest why the cells labelled **D** are smaller than most of the other cells in Fig. 1.1.

.....

.....

.....[1]

(c) Interphase is often described as a 'resting stage'.

Explain why the term 'resting stage' is not an appropriate description for cells in interphase.

.....

.....

.....[2]

[Total: 6]

Q.6.

1 Fig. 1.1 shows a stage in the mitotic cell cycle in an animal cell.

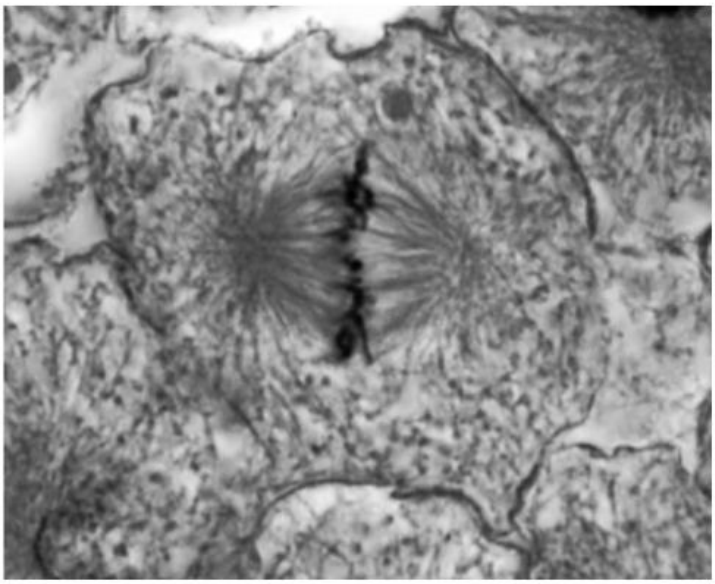


Fig. 1.1

(a) (i) Name the stage of mitosis shown in Fig. 1.1.

..... [1]

(ii) State three features which are characteristic of the stage of mitosis shown in Fig. 1.1.

1. .....

.....

2. .....

.....

3. .....

..... [3]

(b) Explain the importance of mitosis in organisms.

.....

.....

.....

.....

.....

..... [3]

(c) In many multicellular organisms, such as mammals, the time taken for the mitotic cell cycle varies considerably between different tissues, but is very carefully controlled in each cell.

Suggest the importance of this control in mammals.

.....

.....

.....

.....

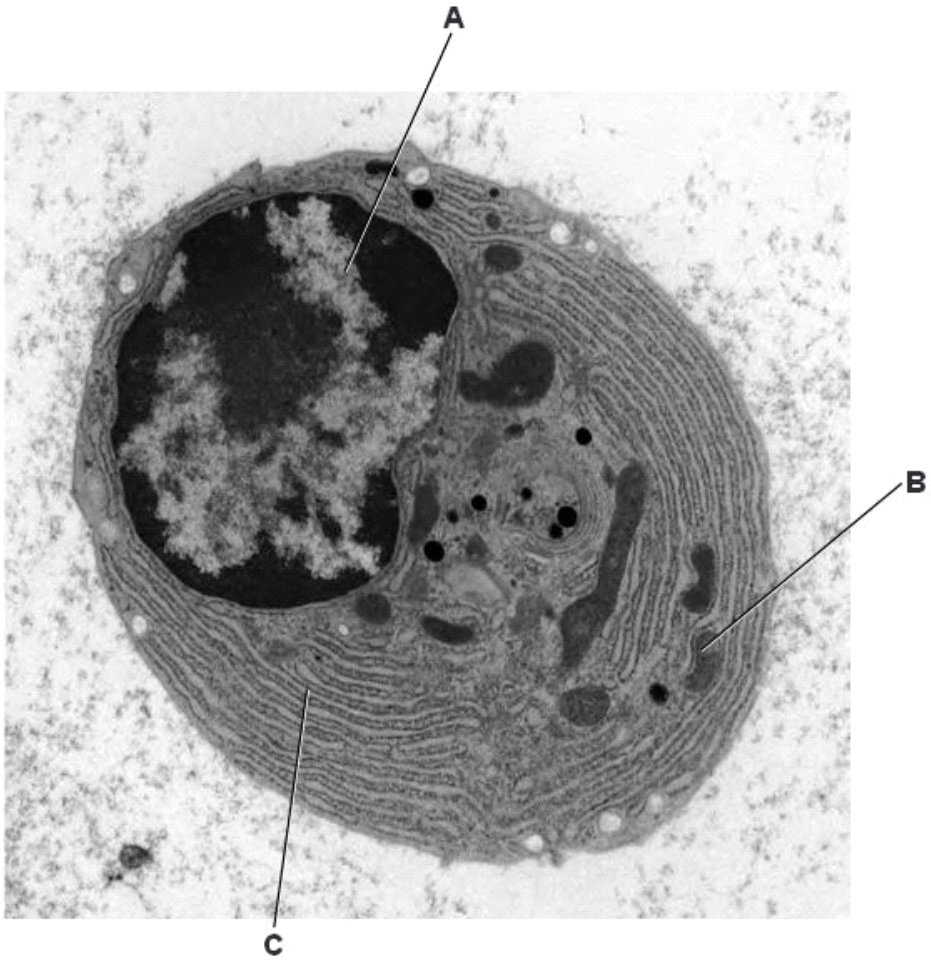
.....

..... [2]

[Total: 9]

Q.7.

2 Fig. 2.1 is a transmission electron micrograph of a plasma cell. Plasma cells are antibody-secreting cells that are formed from B-lymphocytes.



(b) An activated B-lymphocyte divides repeatedly by mitosis to produce many identical plasma cells.

(i) Explain why it is important that many identical plasma cells are produced.

.....

.....

.....

.....

.....

..... [3]

(ii) B-lymphocytes have centrioles and a spindle that can be observed during mitosis.

Describe and explain how the behaviour of the centrioles and spindle of a cell dividing by mitosis is associated with the behaviour of the chromosomes.

You may use the space below for labelled diagrams.

.....

.....

.....

.....

.....

..... **[4]**

[Total: 13]

Q.8.

6 **(a)** Explain how uncontrolled cell division can result in cancer.

.....

.....

.....

.....

.....

.....

..... [3]

(b) Describe the experimental evidence that shows that smoking causes lung cancer.

.....

.....

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.....

.....

.....

..... [3]

(c) Fig. 6.1 shows the changes in mortality rates for lung cancer in five countries between 1950 and 2006 for males.

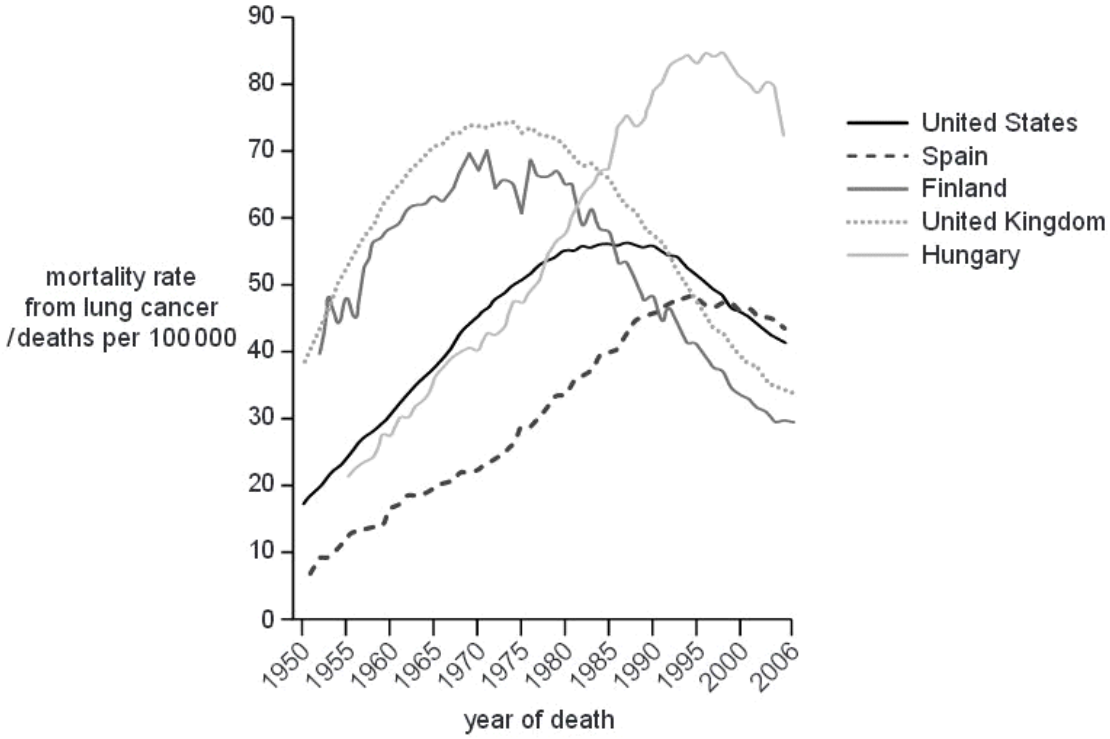


Fig. 6.1

With reference to Fig. 6.1, describe the similarities **and** differences in the trends in mortality rates in the countries shown.

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 9]

Q.9.

1 **(a)** The cells in Fig. 1.1 are from the same organism and look the same. The cells in Fig. 1.1(a) have been produced by mitosis and the cells in Fig. 1.1(b) have been produced by meiosis.

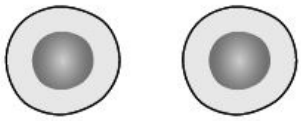


Fig. 1.1(a)

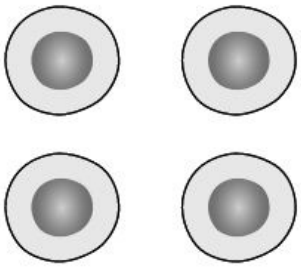


Fig. 1.1(b)

(i) Complete the table to show two differences between cells that have been produced by mitosis compared to cells that have been produced by meiosis.

mitosis	meiosis

[2]

(ii) Explain why the organism produces cells by meiosis.

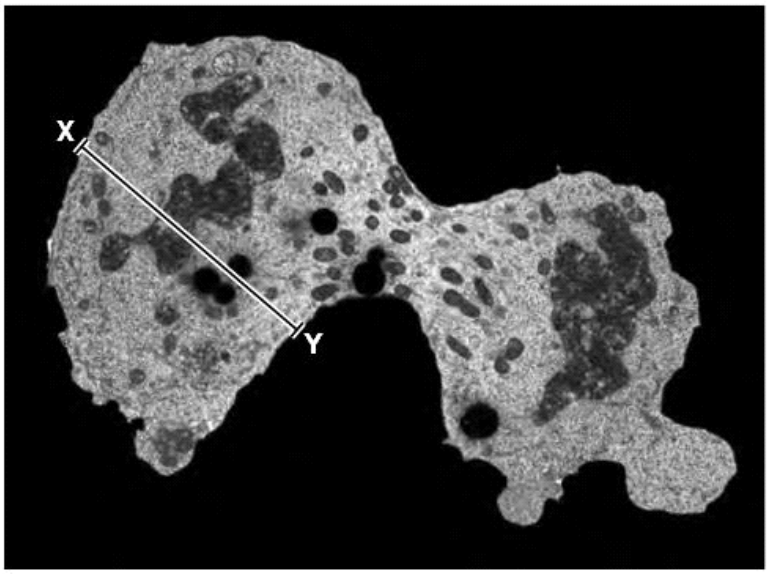
.....

.....

.....

..... [2]

(b) Fig. 1.2 is a transmission electron micrograph of a dividing cancer cell.



magnification x 3000

Fig. 1.2

(i) Calculate the actual width of the cell shown in Fig. 1.2 at **X-Y**.

Show your working and give your answer to the nearest micrometre (μm).

answer ..... μm [2]

(ii) The cancer cell shown in Fig. 1.2 has more mitochondria and rough endoplasmic reticula (RER) compared to the non-cancerous cell from which it originated.

Suggest why this is so.

.....

.....

.....

..... [2]

[Total: 8]

Q.10.

5 **(a)** Explain the importance of mitosis in multicellular organisms.

.....

.....

.....

.....

.....

..... [3]

A protein, mitosis-promoting factor (MPF), has been identified in cells. MPF is a globular protein made from two polypeptide chains.

(b) Place a tick (✓) in the box next to the type, or types, of protein structure shown by MPF.

primary	☐
secondary	☐
tertiary	☐
quaternary	☐

[1]

The presence of MPF is known to cause prophase to start.

(c) Describe the changes that occur during prophase in an animal cell.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(d) MPF normally begins to break down and stops functioning during anaphase.

Suggest the possible consequences of MPF **not** breaking down.

.....

.....

.....

.....

.....

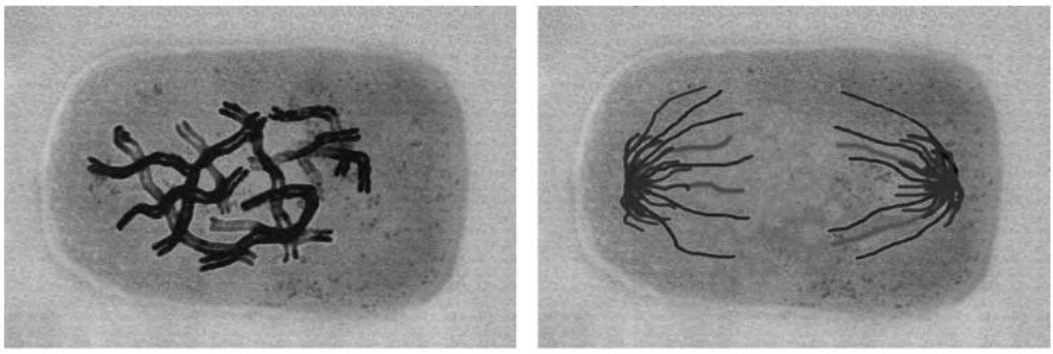
.....

..... [3]

[Total: 11]

Q.11.

4 Fig. 4.1 shows two stages of mitosis in a cell from a root tip of *Allium cepa*.



D **E**

Fig. 4.1

(a) Describe what happens to the chromosomes during mitosis between the stage shown in **D** and the stage shown in **E**.

.....

.....

.....

.....

.....

.....

.....

.....[4]

(b) Describe the events that occur within a cell after the stage shown in Fig. 4.1 **E** to allow the formation of two cells.

.....

.....

.....

.....

.....

.....[3]

(c) A root was cut into ten transverse sections at different distances from the tip. The sections were stained and viewed under the microscope. The number of cells in mitosis were counted in each section and the results were used to determine the mitotic index. This is calculated as follows:

$$\text{mitotic index} = \frac{\text{number of cells in mitosis}}{\text{total number of cells}}$$

Fig. 4.2 shows the mitotic index for the ten sections.

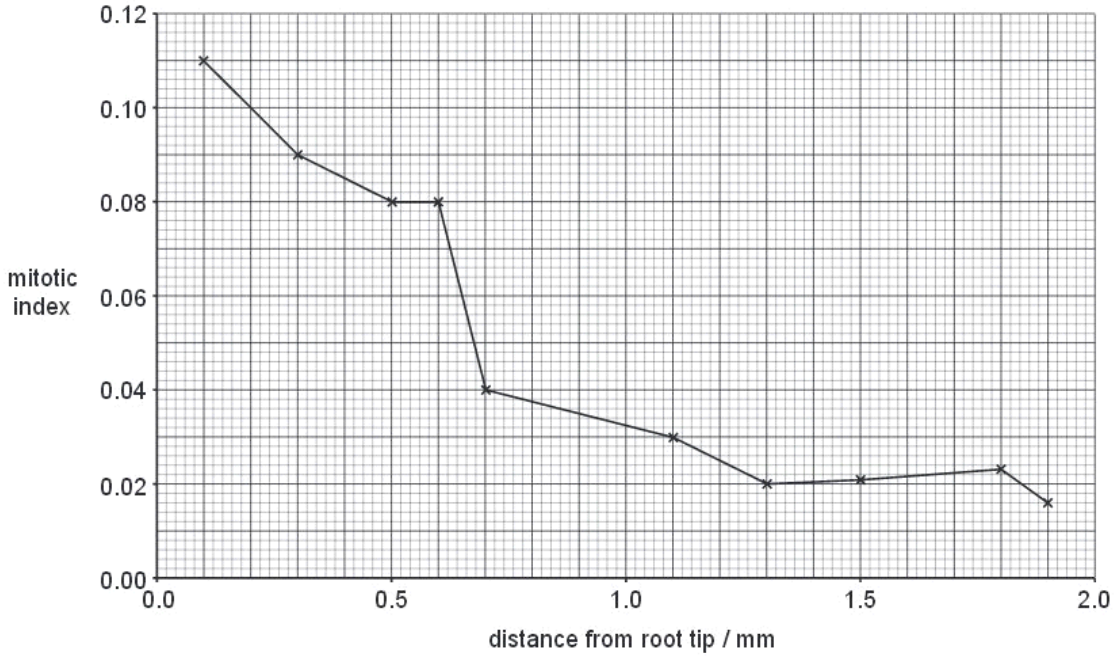


Fig. 4.2

Using the information in Fig. 4.2, describe how the mitotic index changes along the length of the root.

.....

.....

.....

.....

.....

.....[3]

(d) Explain how the events in the mitotic cell cycle ensure that all the cells in the root are genetically identical.

.....

.....

.....

.....

.....

.....

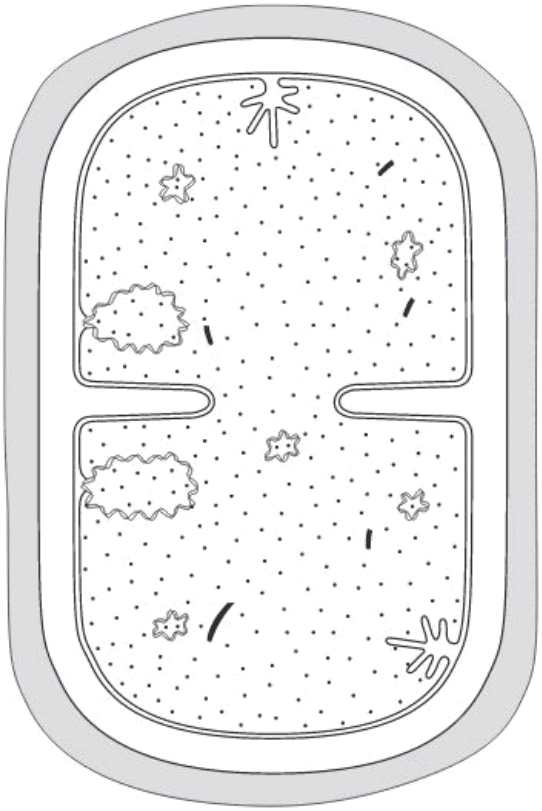
.....

.....[3]

[Total: 13]

Q.12.

1 Fig. 1.1 shows a bacterial cell dividing by binary fission.



magnification = x 37 500

(a) With reference to Fig. 1.1, state three structural features of prokaryotic cells that are **not** shown by eukaryotic cells.

1 .....

2 .....

3 .....[3]

(b) Plant cells divide by mitosis, not by binary fission.

(i) State three roles of mitosis in plants.

1 .....

2 .....

3 .....[3]

(ii) Explain why cells that are produced as a result of mitosis are genetically identical.

.....

.....

.....

.....

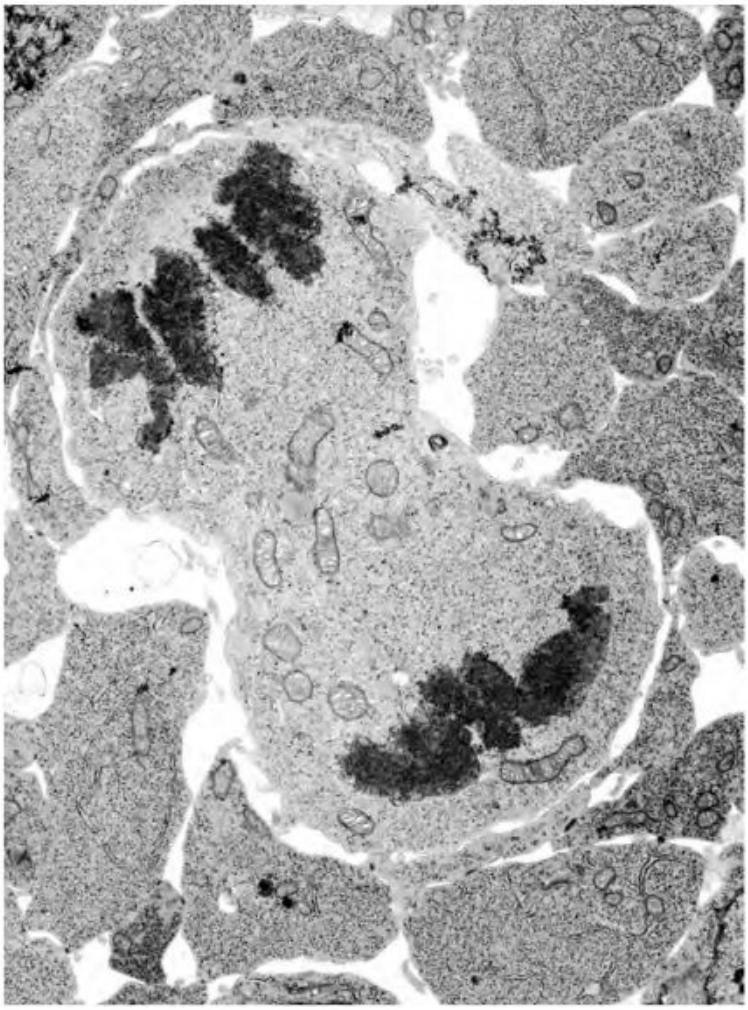
.....

.....[3]

[Total: 9]

Q.13.

3 Fig. 3.1 is an electron micrograph of a lymphocyte in the process of cell division during an immune response.



(a) With reference to Fig. 3.1,

(i) name the stage of mitosis shown;

.....[1]

(ii) describe what is happening during this stage of mitosis;

.....

.....

.....

.....

.....[2]

(iii) suggest the **disadvantages** of using an electron microscope to study mitosis.

.....

.....

.....

.....

.....[2]

(b) Tumours may form inside the lungs of long-term smokers.

(i) Describe how a tumour develops in the lungs.

.....

.....

.....

.....

.....

.....

.....[3]

(ii) Describe two signs or symptoms of lung cancer.

1 .....

.....

2 .....

.....[2]

[Total: 10]

Q.14.

3 **(a)** Explain why it is important that the daughter cells produced during a mitotic cell cycle in humans are genetically identical.

.....

.....

.....

.....[2]

(b) Name two factors that increase the chance that a cancer cell will develop.

1 .....

2 .....[2]

(c) Fig. 3.1 shows a cancer cell in the process of cell division.

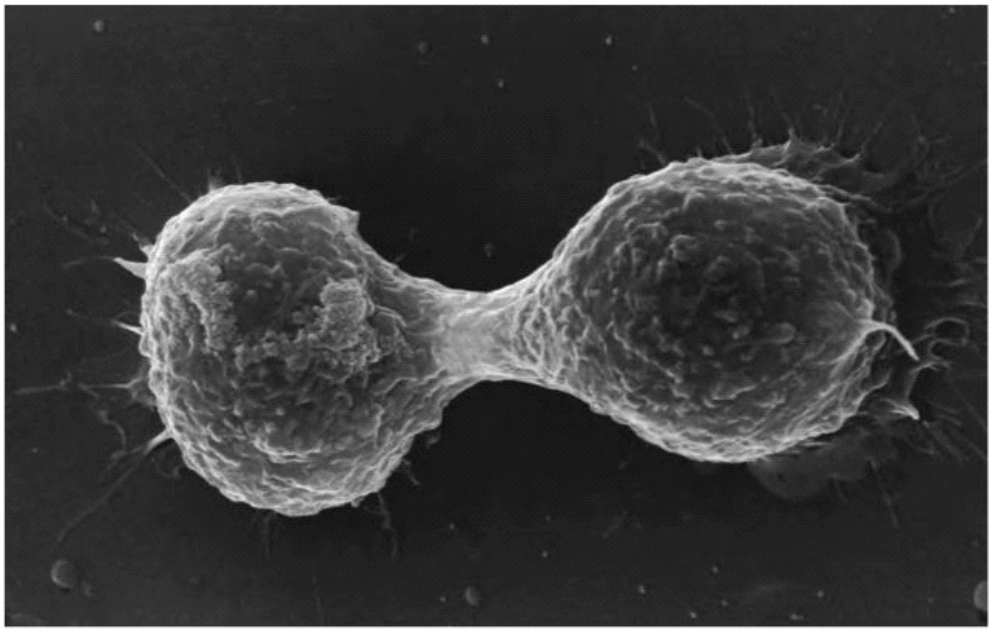


Fig. 3.1

With reference to Fig. 3.1,

(i) state the stage of cell division;

.....[1]

(ii) describe what is happening to the cell during this stage of cell division;

.....

.....

.....

.....

.....

.....

.....[3]

(iii) describe how these cells develop into a tumour.

.....

.....

.....

.....

.....[2]

[Total: 10]

Q.15.

4 (a) (i) Name two factors that increase the chances that cancer will develop.

1. .....

2. .....[2]

(ii) State why lung cancer is categorised as a non-infectious disease.

.....

.....[1]

The effectiveness of anti-cancer drugs may be determined by growing different tumours in culture.

The effectiveness of two drugs on two human tumours (**A** and **B**) from different tissues was assessed. The two drugs, T138067 and vinblastine, were added to the tumours in culture on days 5, 12 and 19. The volumes of the tumours were compared with the volumes of tumours that were not treated with any drugs.

The results are shown in Fig. 4.1.

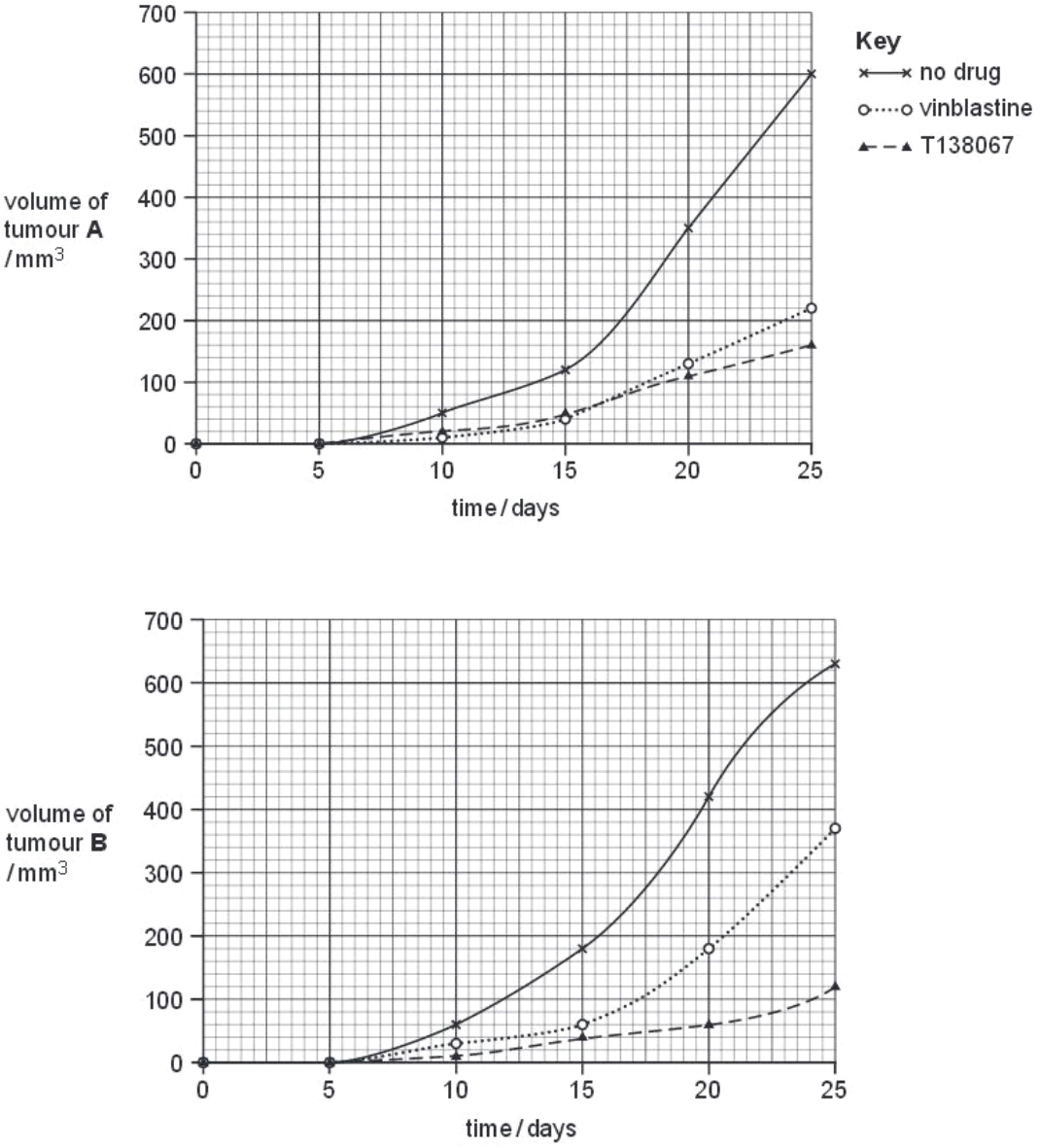


Fig. 4.1

(b) Use the data in Fig. 4.1 to compare the effectiveness of the two drugs used to treat the tumours.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

(c) Vinblastine disrupts the formation of the spindle apparatus during mitosis.

Explain how vinblastine has its effect as an anti-cancer drug.

.....

.....

.....

.....

.....

.....[3]

[Total: 10]

Q.16.

3 Bone marrow contains stem cells that divide by mitosis to form blood cells. Each time a stem cell divides it forms a replacement stem cell and a cell that develops into a blood cell.

Fig. 3.1 shows changes in the mass of DNA in a human stem cell from the bone marrow during three cell cycles.

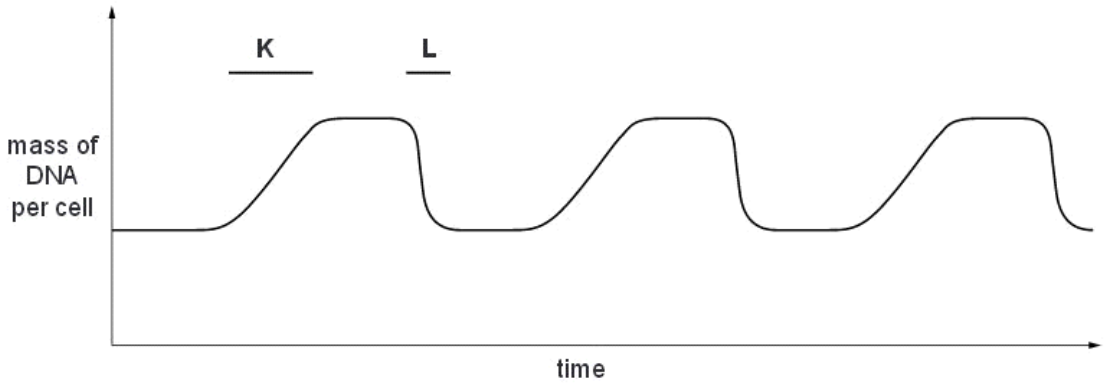


Fig. 3.1

(a) With reference to Fig. 3.1, state:

(i) what happens to bring about the changes in the mass of DNA per cell at **K** and at **L**

K .....

.....

L .....

.....[2]

(ii) how many blood cells are formed from the stem cell in the time shown

.....[1]

(iii) what happens to the number of chromosomes in the stem cell.

.....[1]

Stem cells in bone marrow give rise to phagocytes, B-lymphocytes and T-lymphocytes.

(b) Describe how a red blood cell develops from a stem cell.

.....

.....

.....

.....

.....

.....[3]

(c) During an immune response, cells divide by mitosis.

Describe how mitosis is involved in an immune response.

.....

.....

.....

.....

.....

.....[3]

Q.17.

1 Fig. 1.1 shows a cell of a female fruit fly, *Drosophila melanogaster*, during a stage of mitosis.

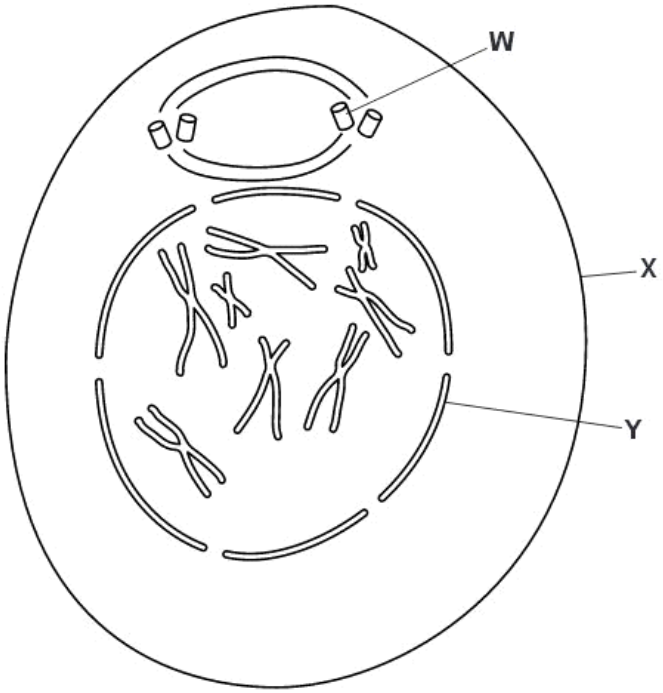


Fig. 1.1

(a) (i) Name the stage of mitosis shown in Fig. 1.1.

.....[1]

(ii) Shade a pair of homologous chromosomes. [1]

(iii) Name the structure labelled **W** and state its function.

.....

.....

.....[2]

(b) State what happens to structure **X** and to structure **Y** between the stage shown in Fig. 1.1 and the end of cell division.

.....

.....

.....

.....

.....

.....

.....

.....[3]

[Total: 7]

Q.18.

(d) The inner lining of arteries and veins is composed of a layer of epithelial cells supported by a layer of elastic and connective tissue. The epithelial cells are capable of cell division by mitosis.

(i) State the role of mitosis in cell division of epithelial cells.

.....

.....

.....

.....[2]

(ii) Explain why the epithelial cells undergo mitosis and **not** meiosis.

.....

.....

.....

.....[2]

(e) Fig. 1.2 is a diagram of a cell in late prophase of mitosis.

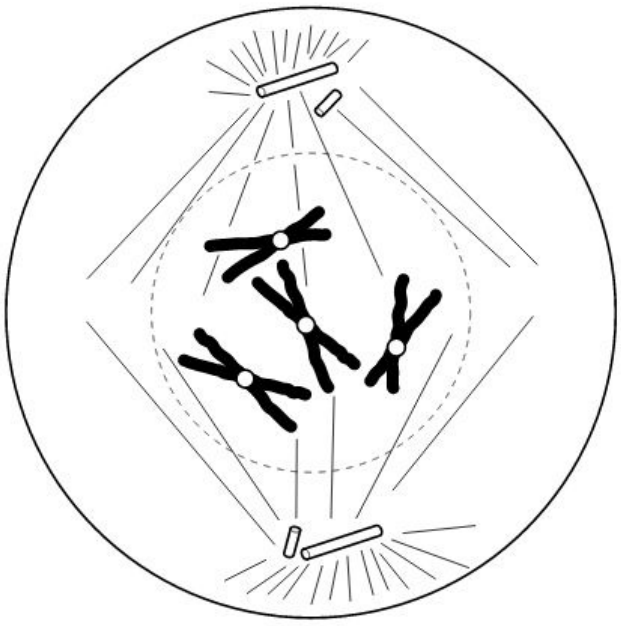


Fig. 1.2

Complete Fig. 1.3 to show the **same cell** in the **anaphase** stage of mitosis.

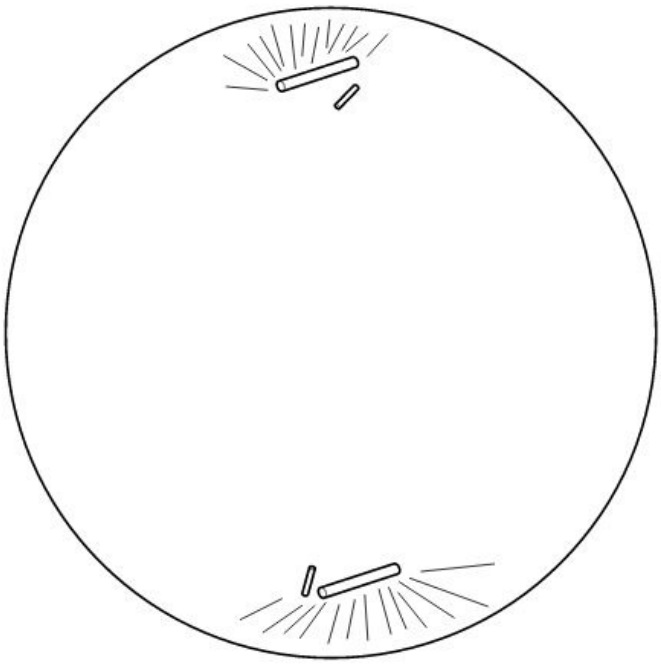


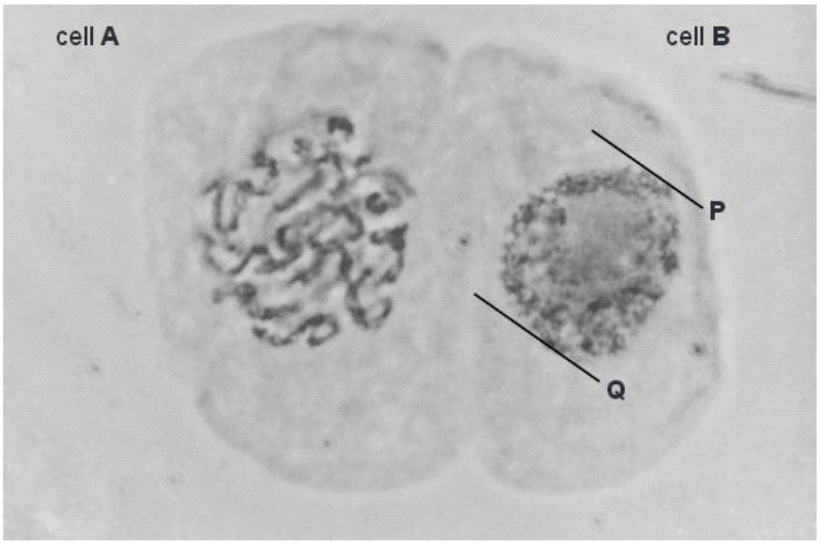
Fig. 1.3

[2]

[Total: 13]

Q.19

3 Fig. 3.1 is a photomicrograph of two animal cells, **A** and **B**, at different stages of the mitotic cell cycle.



magnification × 5000

Fig. 3.1

(a) **(i)** For each cell, state the name of the stage of the cell cycle shown in Fig. 3.1.

cell **A** .....

cell **B** .....
[2]

(ii) Describe the events that occur during the stage of the cell cycle named for cell **A** in **(a)(i)**.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) The magnification of Fig. 3.1 is × 5000.

Calculate the diameter of the nucleus of cell **B** between lines **P** and **Q**.

Show your working and give your answer to the nearest micrometre (μm).

answer ..... μm [2]

(c) State the advantages of light microscopy, rather than electron microscopy, for studies of the cell cycle.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 11]

Q.20.

(c) Cells, such as **C**, at the base of the epithelium of the trachea divide by mitosis.

Describe the changes that occur within the cell between the beginning of prophase and the end of metaphase.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[5]