Replication and division of nuclei and cells

Question Paper 5

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	The Mitotic Cell Cycle
Sub Topic	Replication and division of nuclei and cells
Booklet	Theory
Paper Type	Question Paper 5

Time Allowed : **58 minutes**

Score : **/ 48**

Percentage : **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

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

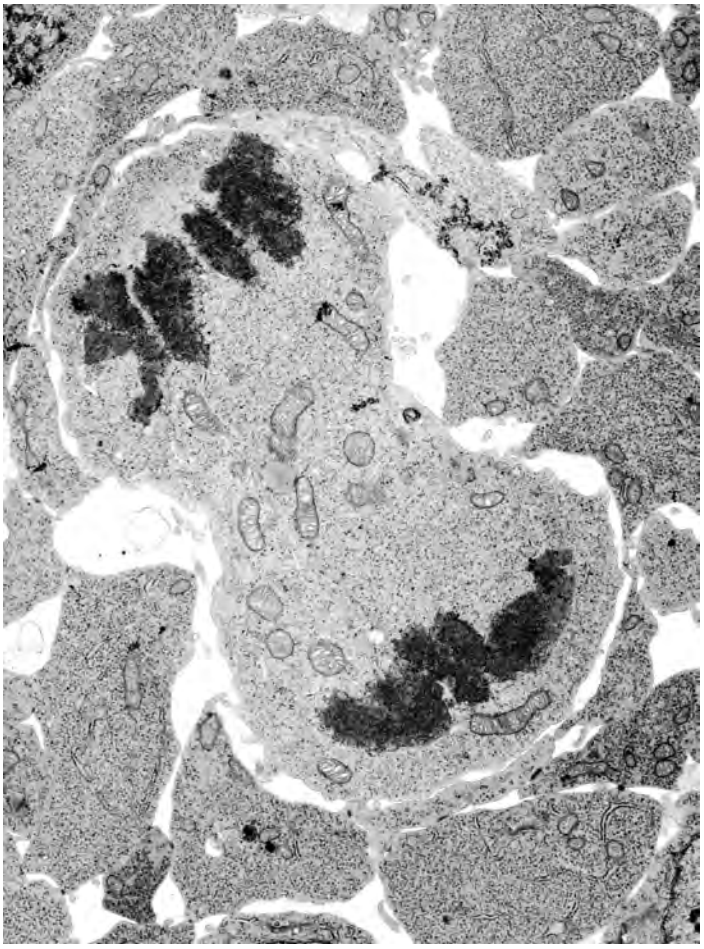


Fig. 3.1

(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]

2 **(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.

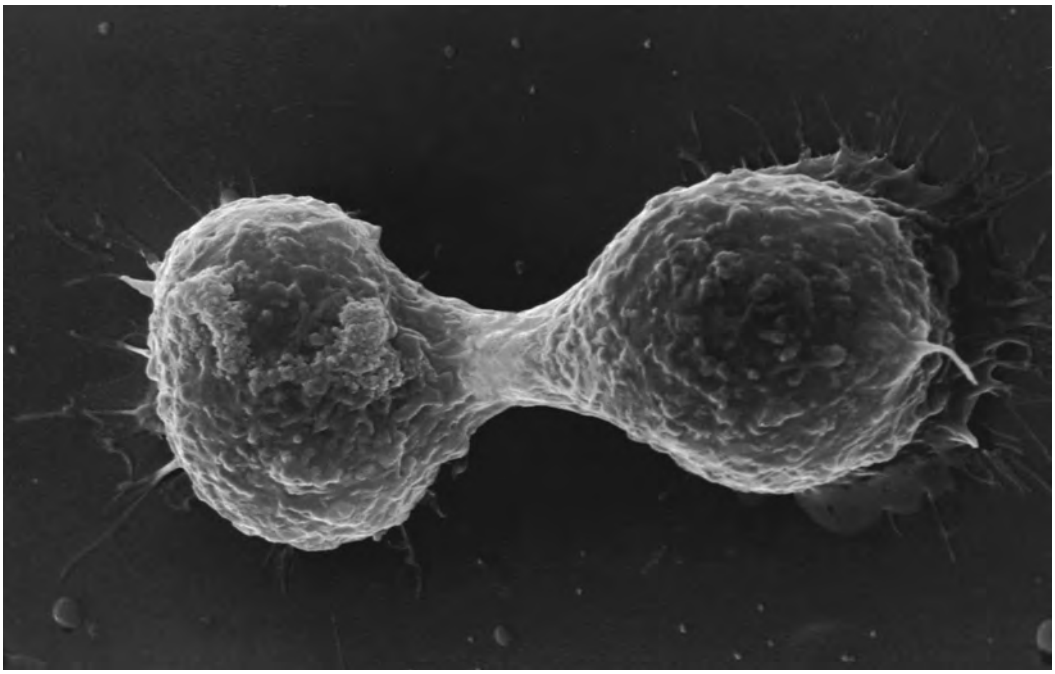


Fig. 3.1

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]

3 Proteases that work in alkaline conditions are made in large quantities for use in the detergent industry. The microorganism that is generally used for this is the bacterium *Bacillus subtilis*.

An investigation was carried out to compare three potential production methods:

- using free cells of *B. subtilis*
- using *B. subtilis* cells immobilised in cubes of agar
- using *B. subtilis* cells immobilised in beads of sodium alginate.

To immobilise the cells in agar, the agar was dissolved and cooled. A suspension of *B. subtilis* was then added. The agar-bacterium mixture was poured into sterile dishes and allowed to solidify. It was then cut into cubes with sides of 2 mm.

(a) (i) Explain why the agar was cooled before the suspension of *B. subtilis* was added.

.....

..... [1]

(ii) Describe how cells of *B. subtilis* could be immobilised in beads of alginate.

.....

.....

.....

.....

.....

..... [3]

(b) A liquid medium containing glucose, a nitrogen source and various mineral ions was made up, and 50 cm^3 placed into each of three flasks.

Samples of a culture of free cells of *B. subtilis*, agar cubes containing immobilised *B. subtilis* and alginate beads containing *B. subtilis* were placed in the three flasks. Each flask contained the same number of bacteria. All the flasks were incubated at 37 °C for 48 hours.

Samples of the liquid medium in each flask were taken at six hourly intervals and the concentration of protease measured.

The results are shown in Fig. 3.1.

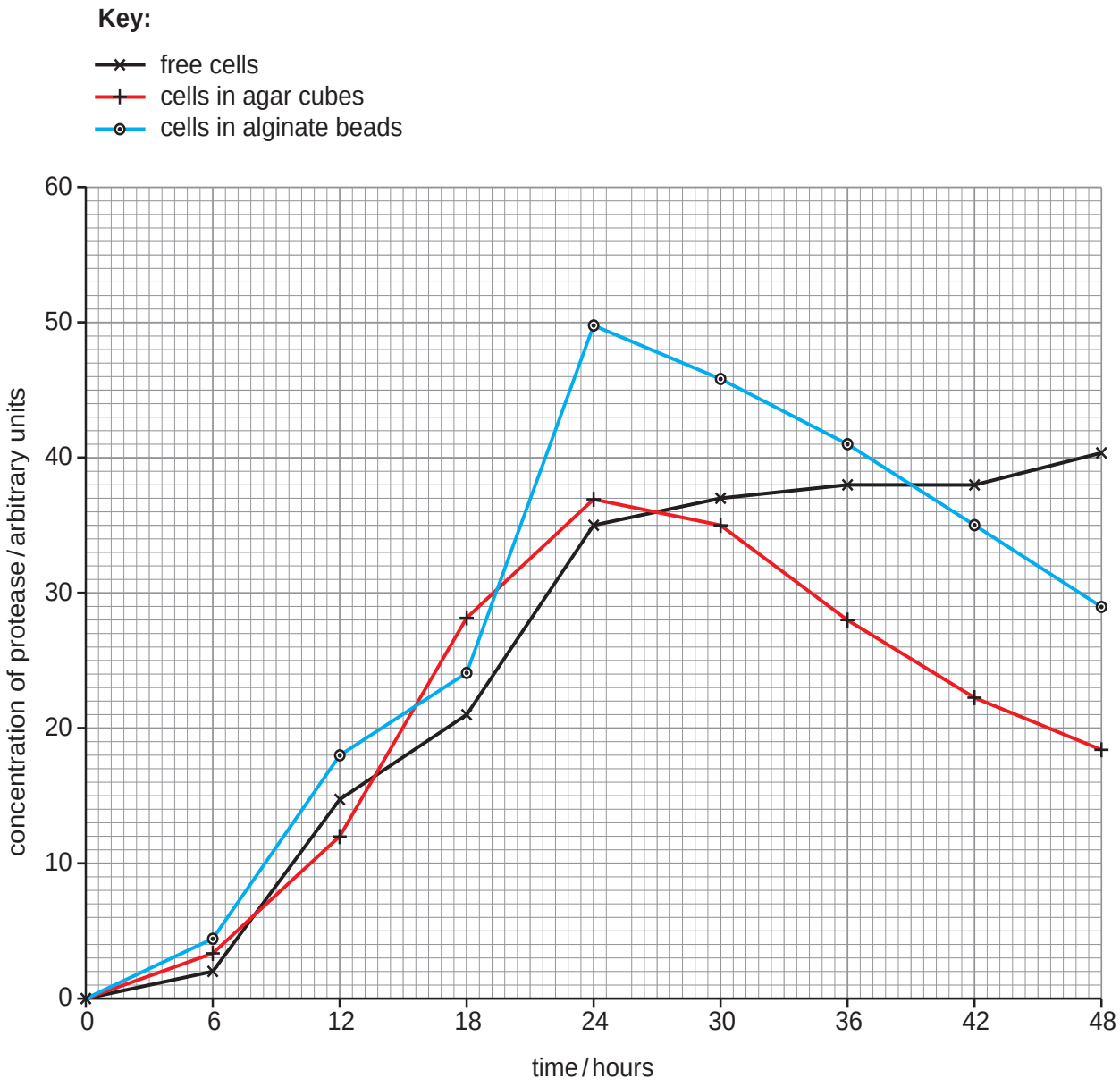


Fig. 3.1

(i) With reference to Fig. 3.1, compare the results for the free cells of *B. subtilis* and cells immobilised in alginate beads.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(ii) Suggest why lower concentrations of protease were produced by *B. subtilis* immobilised in agar cubes than *B. subtilis* immobilised in alginate beads.

.....

.....

.....

..... [2]

(c) Two new cultures of immobilised *B. subtilis* were set up as described in **(b)**.
However, this time a repeat batch fermentation method was used, in which the liquid medium was replaced every 24 hours. This was continued until the cubes or beads had begun to disintegrate.

The results are shown in Table 3.1.

Table 3.1

	number of batches before cubes or beads disintegrated	total fermentation time / hours	total protease produced / arbitrary units	mean productivity of protease / arbitrary units per hour
agar cubes	6	144	1792	12.44
alginate beads	9	216	3264	15.11

With reference to Table 3.1

(i) calculate the percentage increase in the total protease produced when the bacteria were immobilised in alginate rather than agar.

Show your working.

..... [2]

(ii) explain why using bacteria immobilised in alginate rather than agar would be a more cost-effective production of protease.

.....

.....

.....

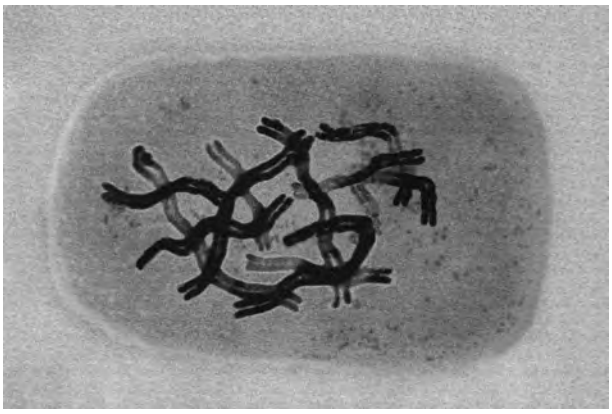
.....

.....

..... [3]

[Total: 15]

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



D

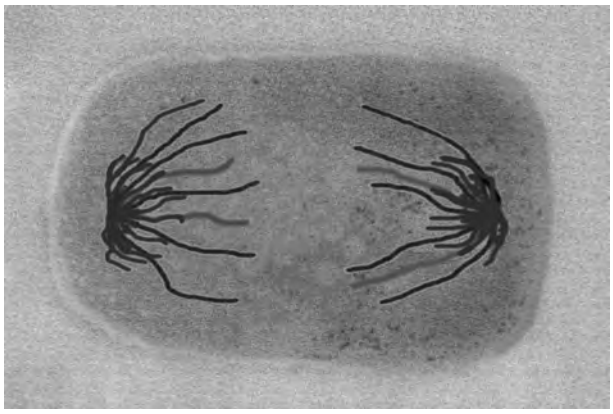


Fig. 4.1

(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.

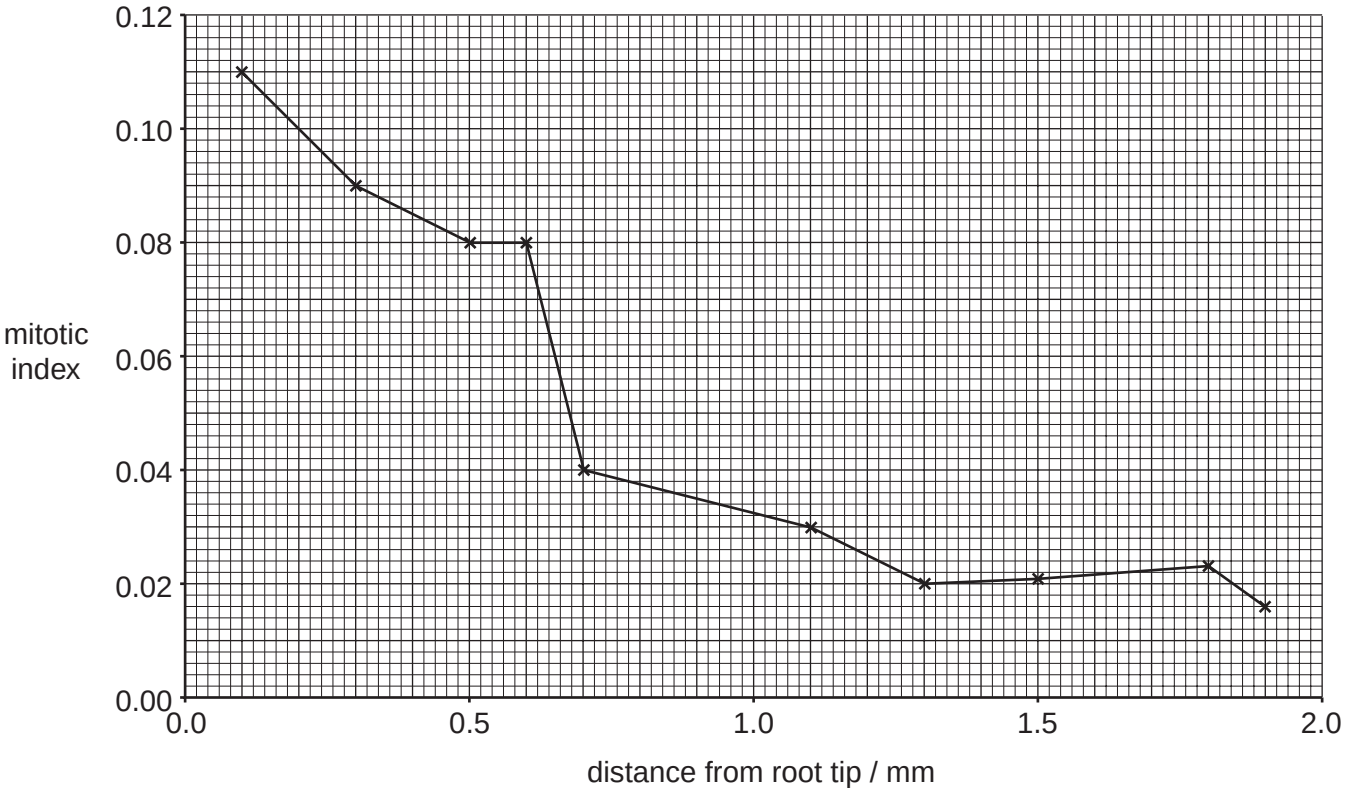


Fig. 4.2

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]