Replication and division of nuclei and cells

Question Paper 1

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 1

Time Allowed : **66 minutes**

Score : **/ 55**

Percentage : **/100**

Grade Boundaries:

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

1 A student investigated growth in the roots of broad bean, *Vicia faba*. The student cut sections of the root tip of this plant and viewed them with a light microscope.

Fig. 1.1 is a photomicrograph of one of the sections. The cell labelled **D** is in interphase.

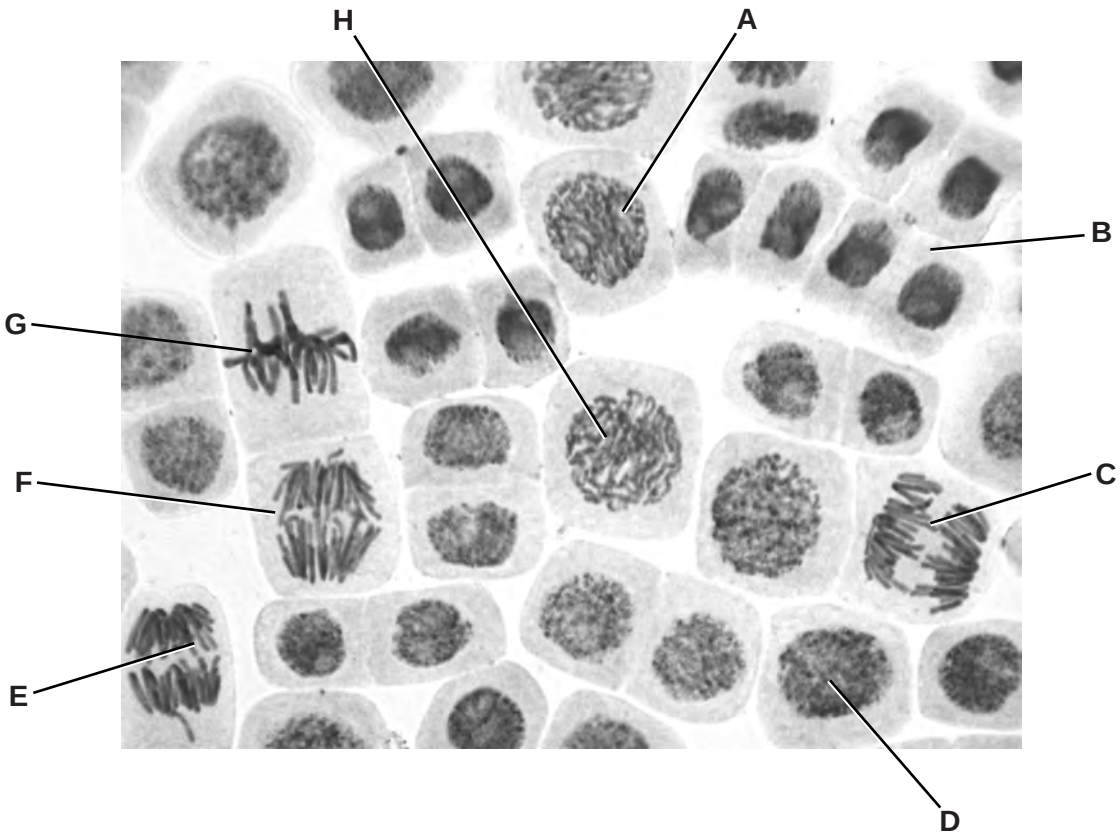

Fig. 1.1

(a) Complete the table below by:

- naming the stages of mitosis in the correct sequence following interphase
- identifying **one** example from the cells labelled **A** to **H** that is in each stage of mitosis that you have named.

stage of mitosis	label from Fig. 1.1

[5]

(b) In animal cells, centrioles are responsible for assembling microtubules to make the spindle at the beginning of mitosis.

Describe the role of the spindle during mitosis.

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(c) State two roles of mitosis in plants and animals **other than growth**.

1 .....

2 .....[2]

(d) *V. faba* is a legume. Roots of legumes often have swellings at intervals known as nodules. Cells within the nodules contain nitrogen-fixing bacteria.

(i) Explain the role of nitrogen fixation in the nitrogen cycle.

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(ii) Farmers in some parts of the world grow legume crops together with cereal crops in the same field. This is known as intercropping.

Explain how intercropping results in an increase in the yield of the cereals when the legumes die.

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[Total: 14]

2 Russian scientists have discovered the fruits of a flowering plant, *Silene stenophylla*, in the food store in a burrow of a ground squirrel in frozen sediments in Siberia.

Dating techniques suggest that the fruits were stored by the ground squirrel about 32 000 years ago, shortly before the ground became permanently frozen.

Tissue samples were taken from the fruits and grown in a nutrient culture medium. After treatment with plant hormones to stimulate the growth of roots and shoots, 36 complete plants were produced.

These 'regenerated' plants, which looked identical to one another, flowered and after cross-pollination, produced seeds that were able to germinate.

(a) Explain why cross-pollination produces more genetic variation among the offspring than self-pollination.

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(b) The flowers of modern-day *S. stenophylla* look similar, but not identical, to the flowers of the 'regenerated' plants.

Outline how DNA sequencing could be used to compare the DNA of modern-day and 'regenerated' *S. stenophylla*.

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(c) Suggest a simple experiment, using plants of modern-day and 'regenerated' *S. stenophylla* to find out whether, after 32 000 years, they are still the same species.

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[Total: 9]

3 **(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**.**

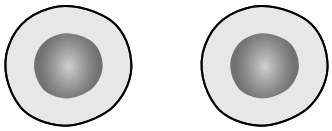

Fig. 1.1(a)

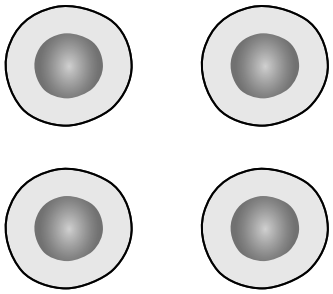

Fig. 1.1(b)

(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.

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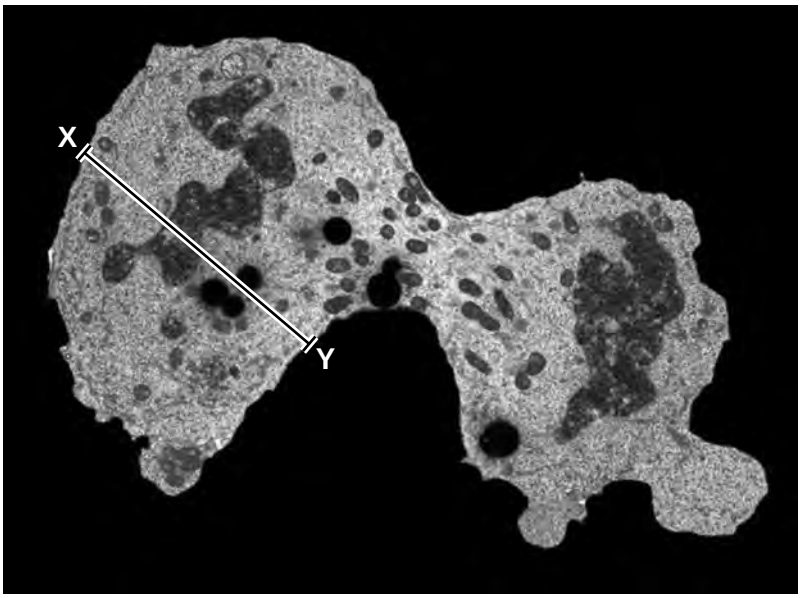
(b) Fig. 1.2 is a transmission electron micrograph of a dividing cancer cell.



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.

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[Total: 8]

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

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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.

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

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

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[Total: 11]

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

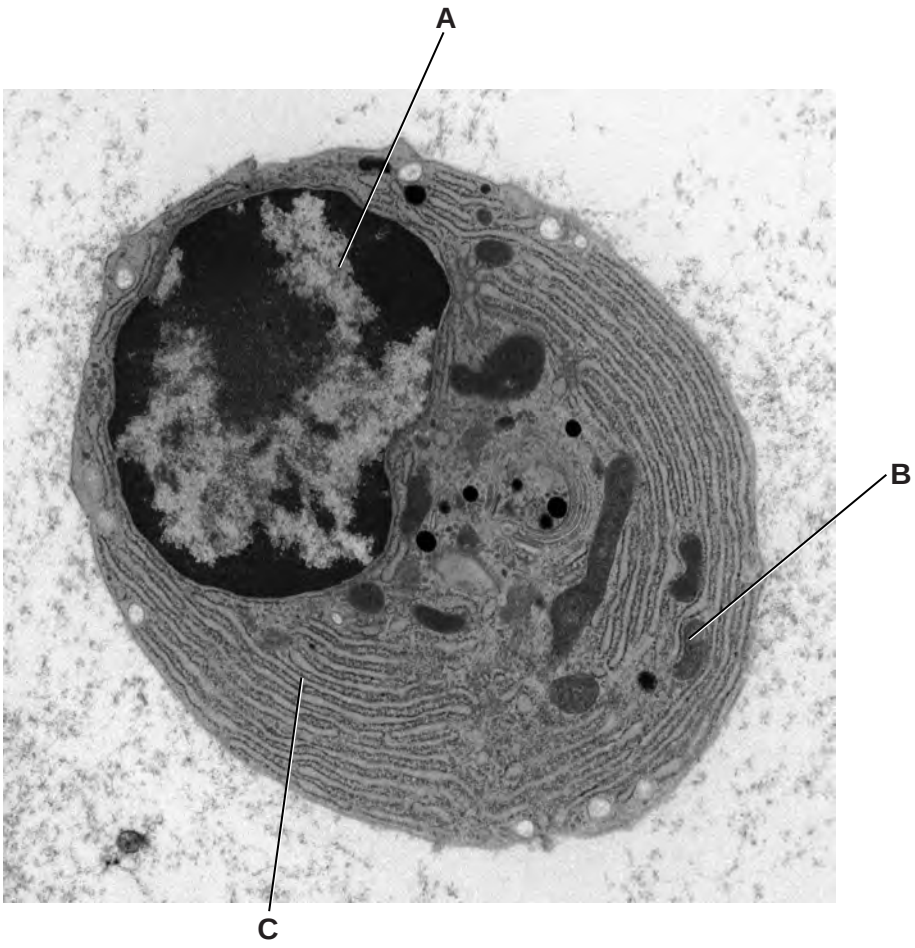

Fig. 2.1

(a) Complete Table 2.1 to:

- name in full, structures **A**, **B** and **C**
- outline how each structure functions to contribute to the **specific role of the plasma cell**.

Table 2.1

structure	name of structure	function of structure within plasma cell
A		
B		
C		

[6]

(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.

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(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.

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[Total: 13]