2018 Cancer STQ

2018 / H2 / AJC PRELIM / P2 Q5

1 Skin cancer cells may be grown in culture and examined using the technique of immunofluorescence in which antibodies are used to attach fluorescent dyes to specific molecules within the cells.

Fig. 5.1 is an immunofluorescent light micrograph of skin cancer cells. A particular type of protein is stained with the dye and appears as pale regions in the skin cancer cells.

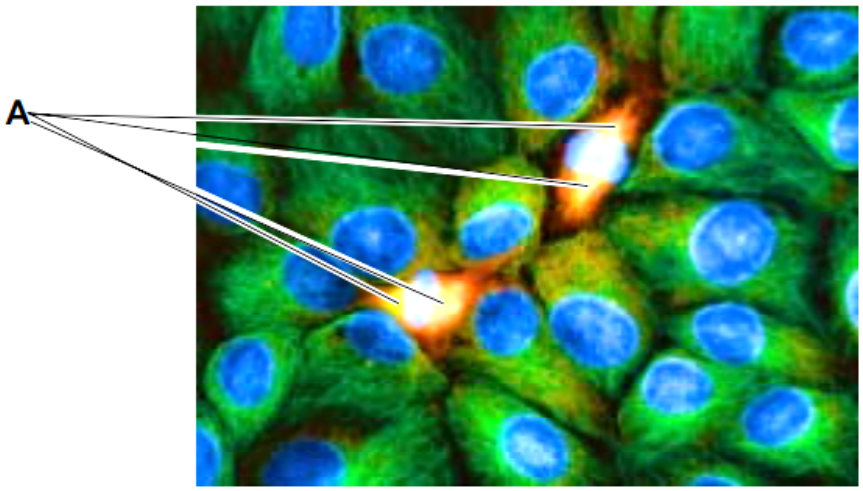

Fig. 5.1

(a) **(i)** Before the skin cancer cells could be stained with antibodies, the cells had to be fixed and treated with a mild detergent to increase the permeability of the cell surface membranes.

Explain the purpose of this step.

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…… [2]

(ii) There are two cells in the process of dividing. Each of these cells has two areas stained heavily, labelled **A** on Fig. 5.1.

Suggest the identity of these two areas and outline their functions in these cells.

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…… [3]

(iii) Suggest why the proteins stained in the cytoplasm of the non-dividing cells in Fig. 5.1 are not evenly distributed.

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…… [1]

(b) Explain **two** ways in which the behaviour of chromosomes in prophase of meiosis I differ from prophase of mitosis.

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…… [2]

(c) Some chemicals known to inhibit the cell cycle are used as drugs for the treatment of cancer.

A particular drug was found to be most effective when applied to cancer cells in the G2 phase of the cell cycle.

Suggest the possible mechanism of this drug.

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…… [3]

[Total: 11]

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QUESTION 2

Fig. 5.1 shows the stages involved in the synthesis of a p53 protein in a eukaryotic cell.

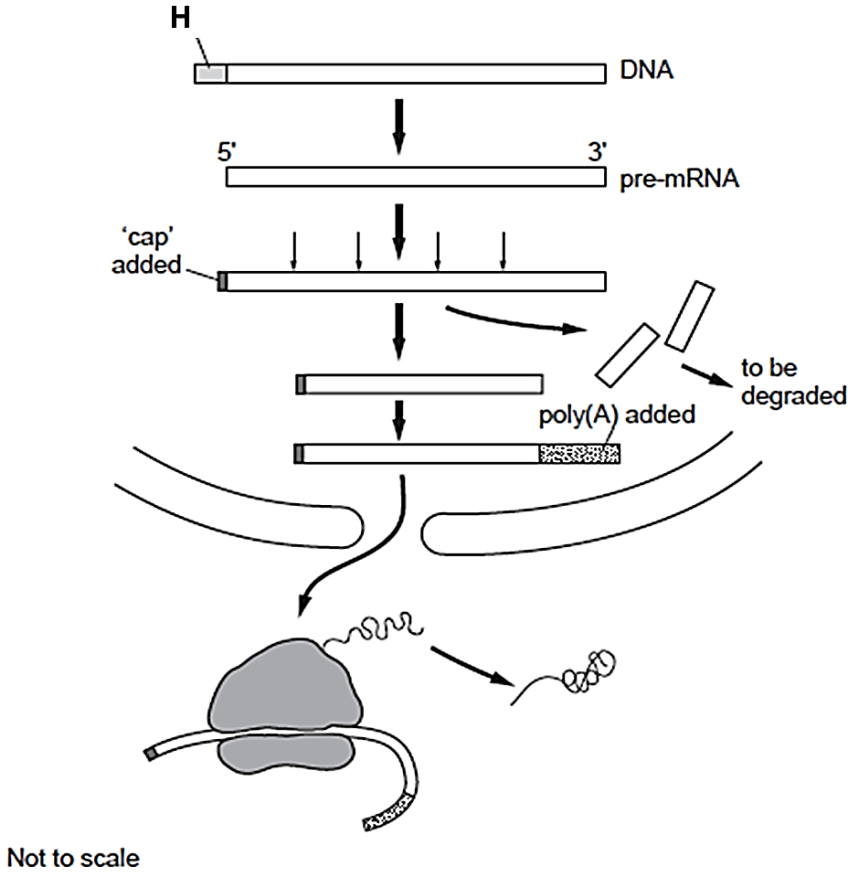

Fig. 5.1

(a) Name the structure **H**. [1]

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(b) Outline the events that occur in the nucleus of the cell to produce a functional molecule of mRNA encoding a p53 protein. [4]

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In a particular defective cell, all the pre-mRNA encoding the p53 protein were **not** cut.

(i) Explain how this would affect the function of the p53 protein. [4]

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(ii) Explain why this may not lead to cancer. [2]

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[Total: 11]

3 **Fig. 2.1** shows some *Allium sp.* plant cells in various stages of the mitotic cell cycle.

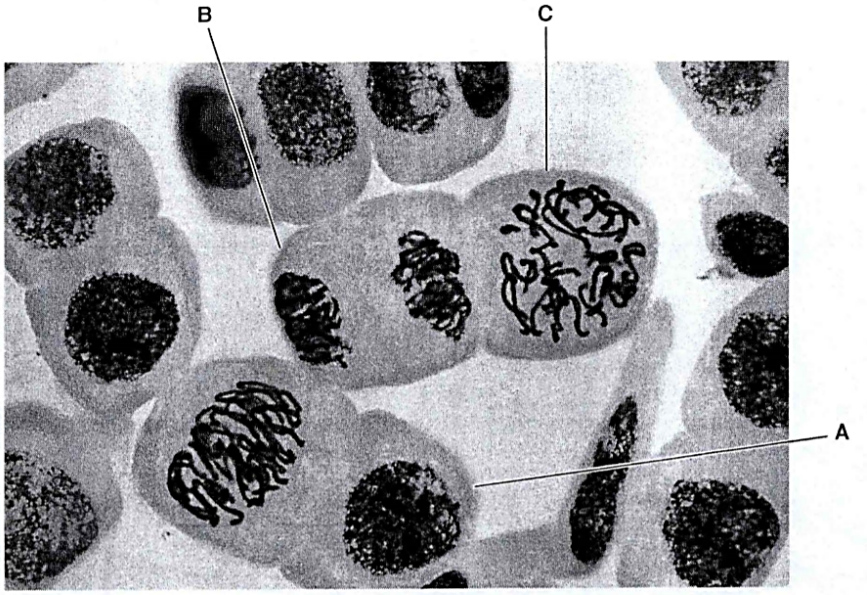

Fig. 2.1

(a) **(i)** Identify the three stages shown by the labelled cells.

A

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B

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C

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[3]

(ii) Identify the stage of mitosis that follows that shown in cell **C**.

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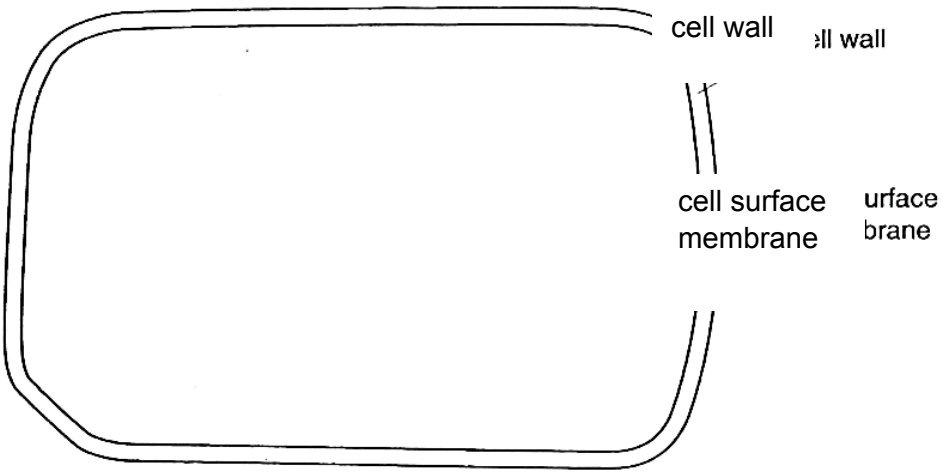
[1]

(iii) In the cell outline below, draw and label the structures visible in a cell that is in the stage you have named in **(ii)**. 2n for this plant is 6.



[3]

(b) Uncontrolled cell division can result in cancer. Some types of cancer can be treated by chemotherapy, which involves the injection of chemicals into the bloodstream.

One chemical used for chemotherapy is called Methotrexate. This is a reversible competitive inhibitors of one of the enzymes in the metabolic pathway that results in the formation of purines.

Explain how the use of Methotrexate will slow down the mitotic cell cycle.

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[2]

(c) Prokaryotic organisms such as *Escherichia coli* divide by simple cell splitting (binary fission), not mitosis.

Apart from ribosomes, prokaryotes have no organelles comparable to those found in eukaryotes and have a circular 'chromosome' with no centromere.

With reference to the information above and your knowledge of mitosis, suggest why mitosis does **not** occur in prokaryotes.

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[2]

[Total: 11]

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4 Cancer cells do not heed the normal signals that regulate cell cycle.

(a) Describe the development of cancer as a multi-step process.

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Fig. 5.1. shows a cell cycle-inhibiting pathway involving the p53 protein in a normal cell.

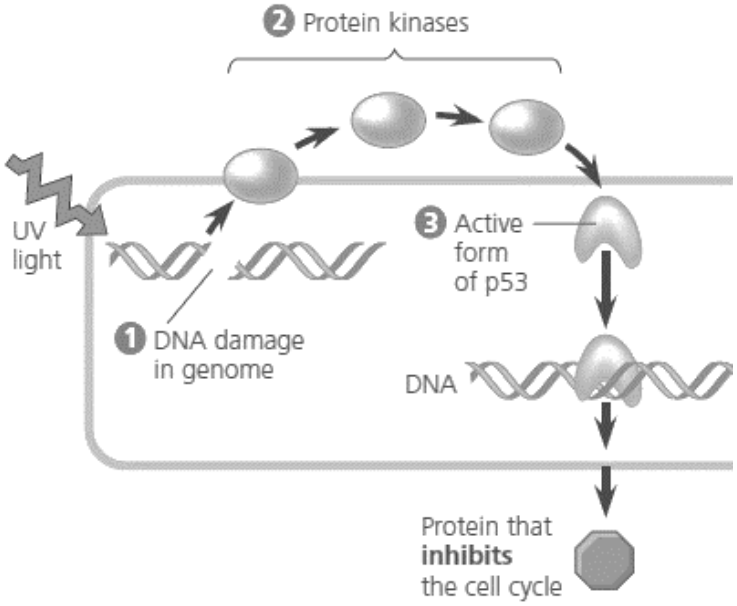

Fig. 5.1

(b) With reference to Fig. 5.1, explain how a missense mutation in p53 protein increases the likelihood of a cell becoming cancerous.

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…… [2]

(c) Explain why mutations in the p53 gene are considered to be recessive.

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…… [2]

When a particular retrovirus that does not carry oncogenes infects a particular organism, the amount of mRNA transcribed from a particular proto-oncogene became elevated approximately 20-fold compared with uninfected individuals.

(d) Suggest an explanation for the above observation.

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[Total: 9]

2018 / H2 / RVHS PRELIM / P2 Q6

5 A germline cell is undergoing meiosis to produce gametes. Fig. 6.1 shows a stage in this process.

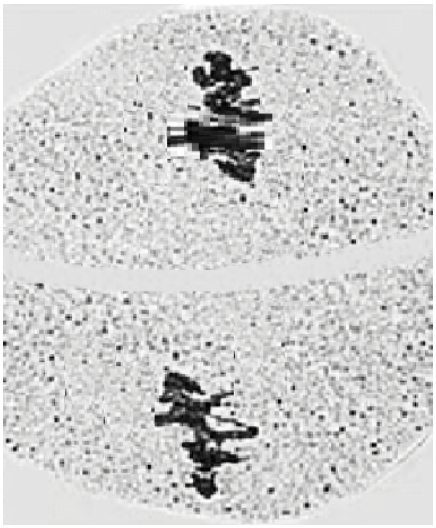

Fig. 6.1

(a) (i) Identify the stage of meiosis shown in Fig. 6.1 [1]

(ii) Explain you answer in **(a)(i)**. [2]

(b) Describe the role of centrioles in the next stage of meiosis. [3]

Fig. 6.2 shows an error in anaphase II.

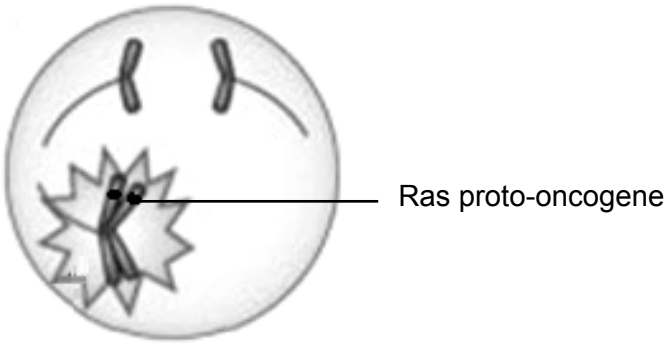

Fig. 6.2

(c) Explain why this error may increase the risk of cancer in a newborn. [3]

(d) Kinase inhibitors are often used to target such cancers associated with Ras proto-oncogenes by interrupting their downstream signalling.

Suggest how kinase inhibitors can interrupt Ras signalling pathway. [1]

[Total: 10]

2018 / H2 / VJC PRELIM / P2 Q4

7 **(a)** Explain why ATP is regarded as the universal energy currency in organisms.

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…… [2]

(b) Studies on cancer cells found that fast-growing cancer cells require much more energy than normal cells, which explains the much higher rate of glucose uptake into cancer cells. However, it is also found that, unlike normal cells, the higher glucose uptake reduces oxygen uptake into cancer cells. This respiratory inhibition is known the Crabtree effect. It is proposed that this is due to more mitochondrial damages in cancer cells.

(i) Besides the need for more energy for cell division, explain the process how cancer cells utilise glucose at a much higher rate than normal cells to produce energy.

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…… [3]

(ii) Compare the differences between respiration in cancer cells and yeast cells.

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…… [2]

[Total: 7]