

Q1. (a) Boxes **A** to **E** show some of the events of the cell cycle.

A Chromatids separate

B Nuclear envelopes disappear

C Cytoplasm divides

D Chromosomes condense and become visible

E Chromosomes on the equator of the spindle

(i) List these events in the correct order, starting with **D**.

D (1)

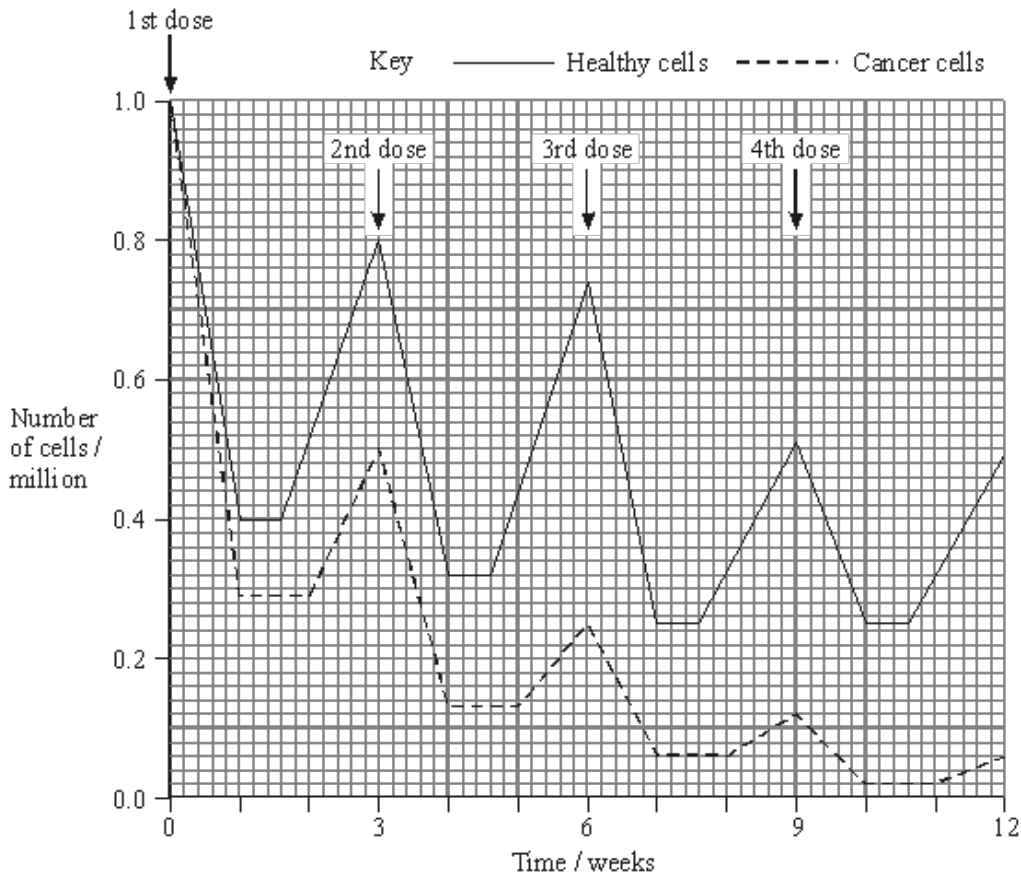
(ii) Name the stage described in box **E**.

..... (1)

(b) Name the phase during which DNA replication occurs.

..... (1)

- (c) Bone marrow cells divide rapidly. As a result of a mutation during DNA replication, a bone marrow cell may become a cancer cell and start to divide in an uncontrolled way. A chemotherapy drug that kills cells when they are dividing was given to a cancer patient. It was given once every three weeks, starting at time 0. The graph shows the changes in the number of healthy bone marrow cells and cancer cells during twelve weeks of treatment.



- (i) Using the graph calculate the number of cancer cells present at week 12 as a percentage of the original number of cancer cells. Show your working.

Answer%

(2)

- (ii) Suggest **one** reason for the lower number of cancer cells compared to healthy cells at the end of the first week.

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(1)

(iii) Describe **two** differences in the effect of the drug on the cancer cells, compared with healthy cells in the following weeks.

- 1
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- 2
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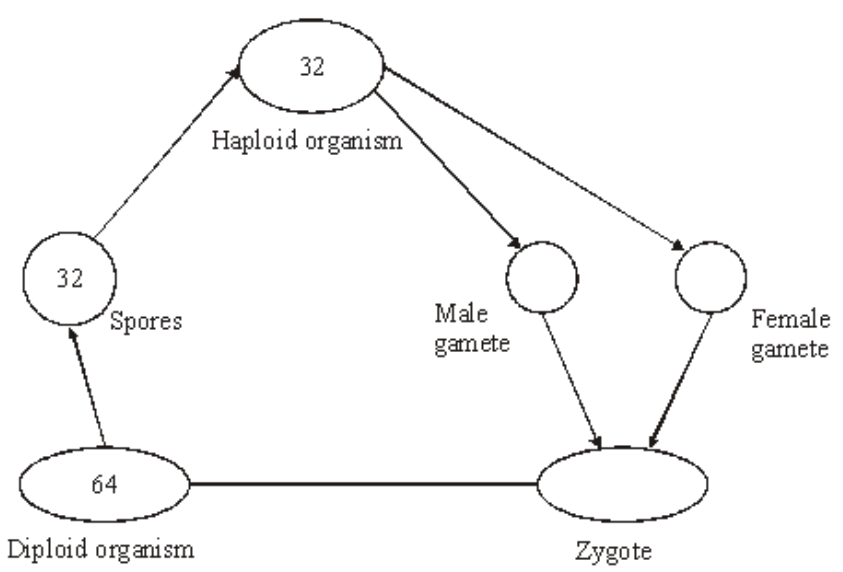
(2)
(Total 8 marks)

Q2. (a) Complete the table to describe some of the events during the cell cycle.

| Stage of cell cycle | Main event which takes place |
|---------------------|--|
| Metaphase | |
| | Chromosomes coil and shorten |
| | Daughter chromosomes move to poles of the cell |
| S-phase | |
| | Nuclear envelope re-forms |

(5)

(b) The diagram shows the life cycle of an organism. The numbers show how many chromosomes are present in one cell at each stage of the life cycle.



(i) Name the type of cell division that must be involved in producing the spores.

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(1)

(ii) How many chromosomes are there in a male gamete from this organism?

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(1)
(Total 7 marks)

Q3. (a) Boxes **A** to **E** show some of the events of the cell cycle.

A Chromatids separate.

B Nuclear envelope disappears

C Cytoplasm divides

D Chromosomes condense and become visible

E Chromosomes on the equator of the spindle

(i) List these events in the correct order starting with **D**.

.....**D**.....

(1)

(ii) Name the stage described in box **E**.

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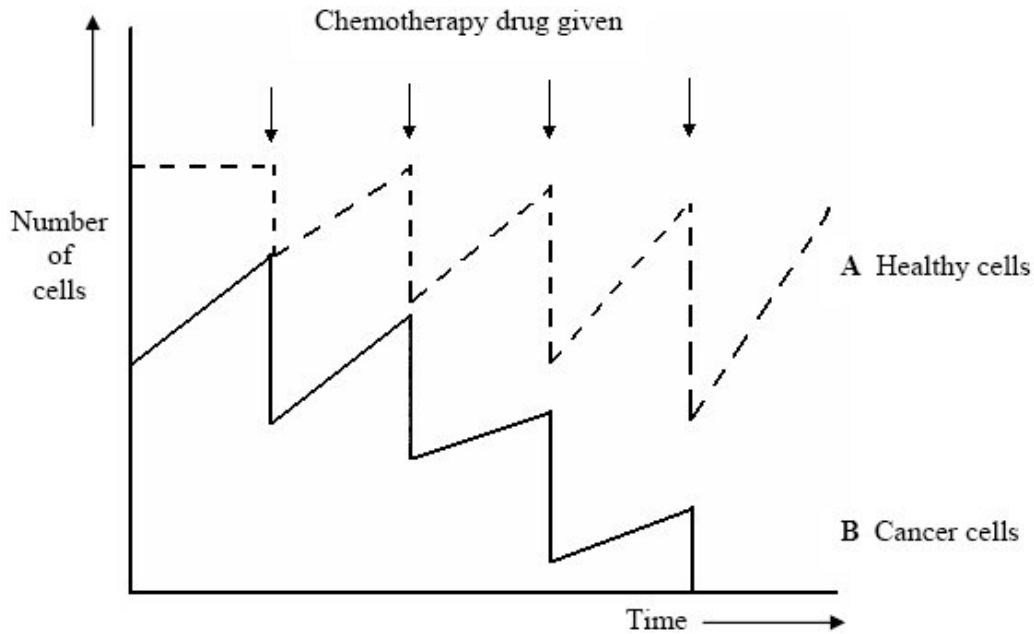
(1)

(b) Name the stage of the cell cycle during which DNA replication occurs.

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(1)

- (c) Scientists produced a model to show how chemotherapy works in the treatment of cancer. The model is shown in the diagram.



- (i) Explain the difference in curves A and B before chemotherapy starts.

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(2)

- (ii) Chemotherapy drugs must be given a number of times if the treatment is to be successful. Use the diagram to explain why.

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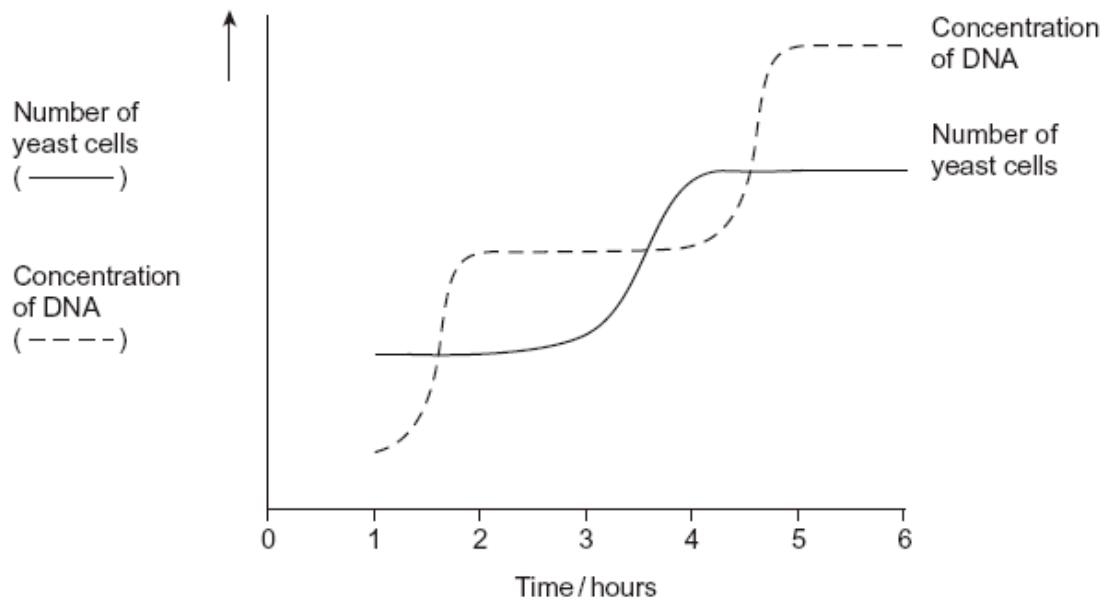
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(2)
(Total 7 marks)

Q4. Yeast is a single-celled eukaryotic organism. When yeast cells are grown, each cell forms a bud. This bud grows into a new cell. This allows yeast to multiply because the parent cell is still alive and the new cell has been formed.

Scientists grew yeast cells in a culture. They counted the number of cells present and measured the total concentration of DNA in the culture over a period of 6 hours. Their results are shown in the graph.



(a) Use your knowledge of the cell cycle to explain the shape of the curve for the number of yeast cells

(i) between 1 and 2 hours

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(1)

(ii) between 3 and 4 hours.

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(1)

- (b) Use the curve for the concentration of DNA to find the length of a cell cycle in these yeast cells. Explain how you arrived at your answer.

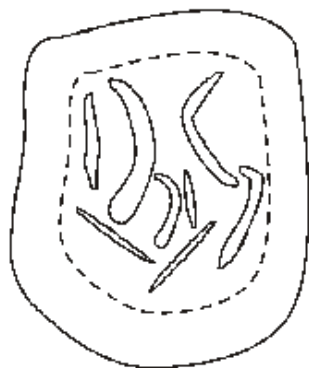
Length of cell cycle

Explanation

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(3)
 (Total 5 marks)

- Q5.** The diagram represents a cell from a fruit fly in which the diploid number is eight.



- (a) Draw a diagram to show
 (i) this cell during anaphase of mitosis;

(2)

- (ii) the chromosomes in a gamete produced from this cell by meiosis.

(2)

- (b) Explain why meiosis is important in sexual reproduction, apart from producing gametes that are genetically different.

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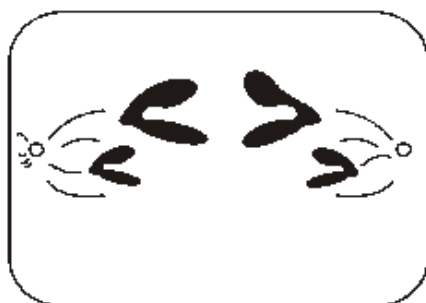
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(2)
(Total 6 marks)

- Q6. (a) The drawing shows a stage of mitosis in an animal cell.



- (i) Name this stage of mitosis.

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(1)

- (ii) Describe and explain what happens during this stage which ensures that two genetically identical cells are produced.

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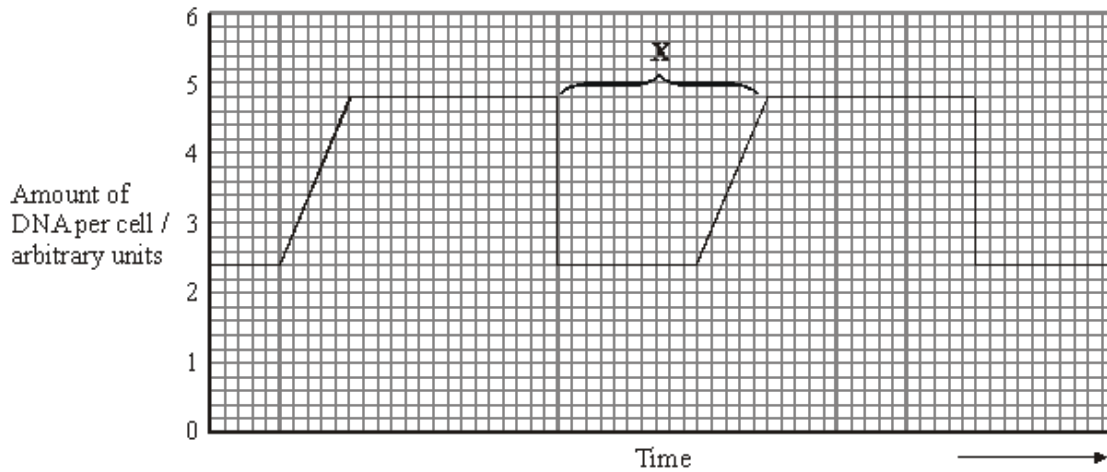
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(2)

(b) The graph shows the relative amounts of DNA per cell during two successive cell divisions in an animal.



(i) What stage of the cell cycle is shown by X?

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(1)

(ii) Apart from an increase in the amount of DNA, give **one** process which occurs during stage X which enables nuclear division to occur.

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(1)

(iii) How many units of DNA would you expect to be present in a gamete formed in this animal as a result of meiosis?

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(1)

- (c) The table shows the average duration of each stage of the cell cycle in the cells of a mammalian embryo.

| Stage | Mean duration/ minutes |
|------------|---------------------------|
| Interphase | 12 |
| Prophase | 50 |
| Metaphase | 15 |
| Anaphase | 10 |
| Telophase | 42 |

Give **one** piece of evidence from the table which indicates that these cells are multiplying rapidly.

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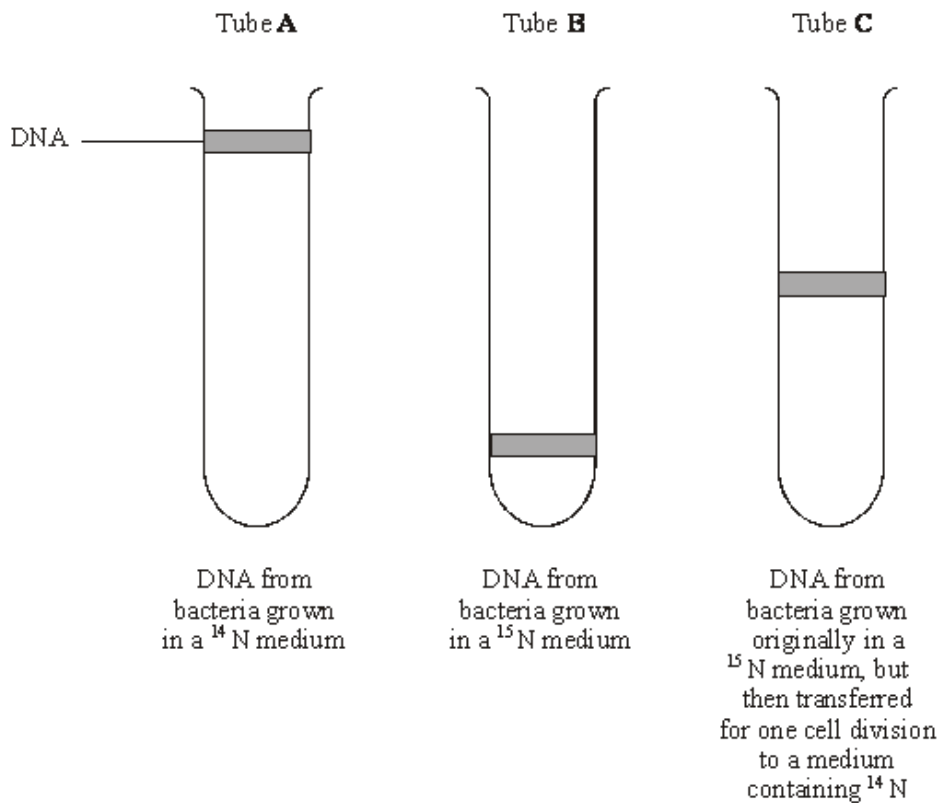
(1)
 (Total 7 marks)

- Q7.** (a) Explain why the replication of DNA is described as semi-conservative.

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(2)

- (b) Bacteria require a source of nitrogen to make the bases needed for DNA replication. In an investigation of DNA replication some bacteria were grown for many cell divisions in a medium containing ^{14}N , a light form of nitrogen. Others were grown in a medium containing ^{15}N , a heavy form of nitrogen. Some of the bacteria grown in a ^{15}N medium were then transferred to a ^{14}N medium and left to divide once. DNA was isolated from the bacteria and centrifuged. The DNA samples formed bands at different levels, as shown in the diagram.



- (i) What do tubes **A** and **B** show about the density of the DNA formed using the two different forms of nitrogen?

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(1)

- (ii) Explain the position of the band in tube **C**.

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(2)

- (c) In a further investigation, the DNA of the bacterium was isolated and separated into single strands. The percentage of each nitrogenous base in each strand was found. The table shows some of the results.

| DNA sample | Percentage of base present | | | |
|------------|----------------------------|----------|---------|---------|
| | Adenine | Cytosine | Guanine | Thymine |
| Strand 1 | 26 | | 28 | 14 |
| Strand 2 | 14 | | | |

Use your knowledge of base pairing to complete the table.

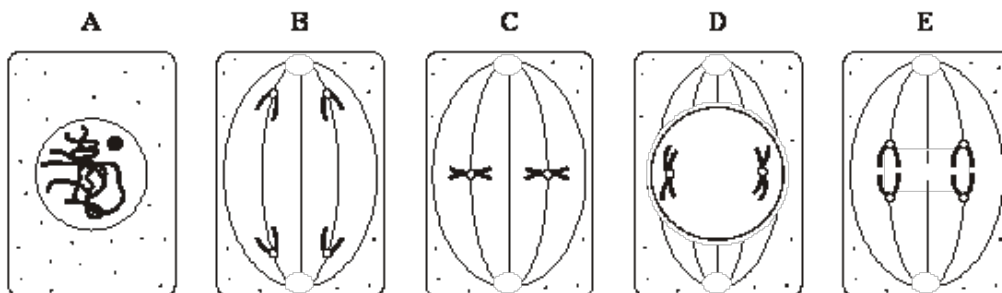
(2)
(Total 7 marks)

- Q8.** (a) In which phase of the cell cycle does DNA replication take place?

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(1)

- (b) The diagrams show five stages of mitosis.



List the stages **A** to **E** in the correct sequence, beginning with the earliest stage.

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(1)

- (c) Describe the role of the spindle during mitosis.

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(2)

(d) Meiosis also occurs during the life cycle of organisms. What is the importance of meiosis?

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(2)
(Total 6 marks)

Q9. (a) Describe and explain how the structure of DNA results in accurate replication.

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(4)

- (b) Describe the behaviour of chromosomes during mitosis and explain how this results in the production of two genetically identical cells.

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(7)

- (c) A cancerous tumour is formed by uncontrolled mitotic division. This results in a mass of cells with an inadequate blood supply. Drugs are being developed which only kill cells in a low oxygen environment. Suggest how these drugs could be useful in the treatment of cancer.

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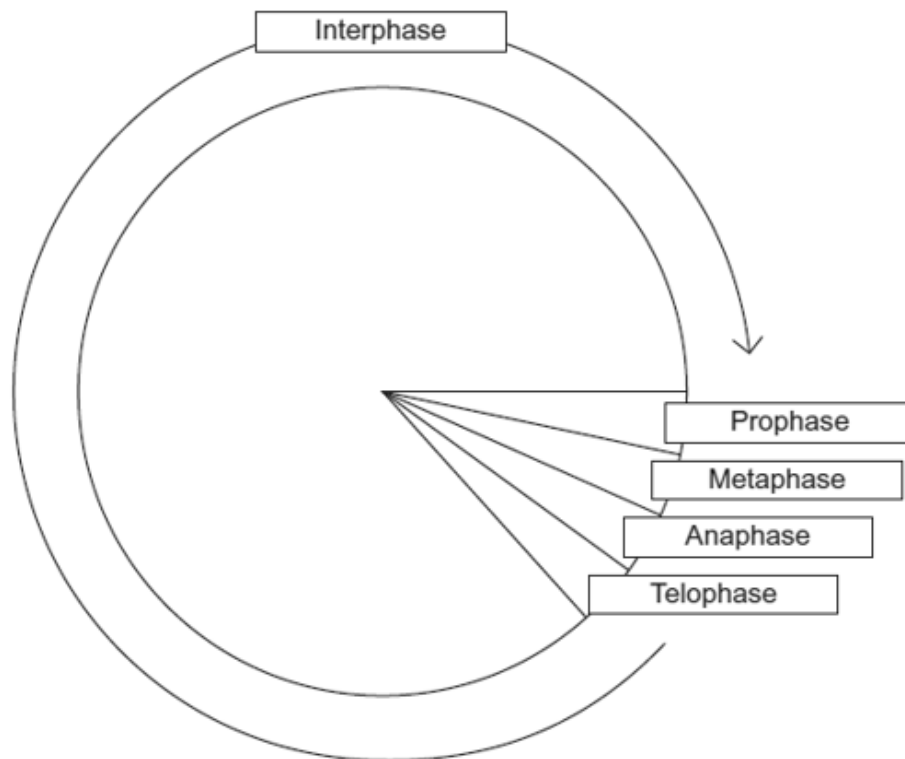
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(2)
(Total 13 marks)

Q10. The diagram shows a cell cycle.



(a) In prophase of mitosis, the chromosomes become visible. Describe what happens in

(i) metaphase

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(2)

(ii) anaphase.

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(2)

- (b) (i) Cells lining the human intestine complete the cell cycle in a short time. Explain the advantage of these cells completing the cell cycle in a short time.

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(1)

- (ii) The time required for a cell to complete the cell cycle was 4 hours 18 minutes.
Calculate the time required in minutes for this cell to multiply to produce eight cells.
Show your working.

Answer

(2)

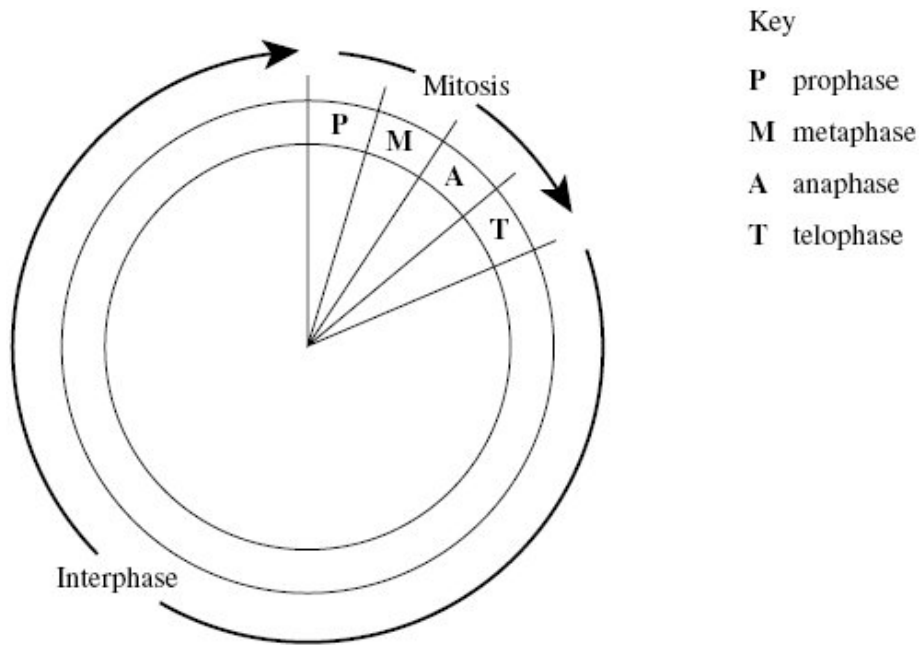
- (c) Mikanolide is a drug that inhibits the enzyme DNA polymerase. Explain why this drug may be effective against some types of cancer.

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(2)

(Total 9 marks)

Q11. The diagram shows a cell cycle.



(a) The table shows the number of chromosomes and the mass of DNA in different nuclei. All the nuclei come from the same animal. Complete this table.

| Nucleus | Number of chromosomes | Mass of DNA / arbitrary units |
|-------------------------|-----------------------|-------------------------------|
| At prophase of mitosis | 26 | 60 |
| At telophase of mitosis | | |
| From a sperm cell | | |

(4)

(b) If the DNA of the cell is damaged, a protein called p53 stops the cell cycle. Mutation in the gene for p53 could cause cancer to develop. Explain how.

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(3)

(c) Drugs are used to treat cancer. At what phase in the cell cycle would each of the following drugs act?

(i) A drug that prevents DNA replication

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(1)

(ii) A drug that prevents spindle fibres shortening

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(1)

(Total 9 marks)

