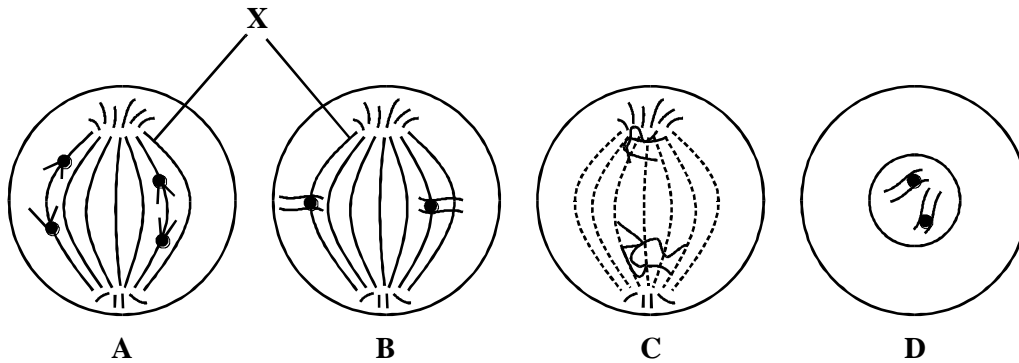


1. The diagram shows four stages in mitosis. Only one pair of homologous chromosomes is shown.



- (a) Place stages **A**, **B**, **C** and **D** in the correct order.

.....

(1)

- (b) (i) Name the structures labelled **X**.

.....

(1)

- (ii) Describe the part played by the structures labelled **X** in this type of cell division.

.....

.....

(2)

- (c) Each of the cells shown in the diagram contains 100 units of DNA. How many units of DNA would there be in each of the daughter cells immediately after they were formed?

.....

(1)

(Total 5 marks)

2. (a) A garlic root tip was examined for stages of mitosis. The root tip was cut off, stained and put on a microscope slide. A cover slip was placed on top. The root tip was squashed and then viewed through a microscope.

Give **one** reason for each of the following:

- (i) staining the root tip;

.....  
 .....

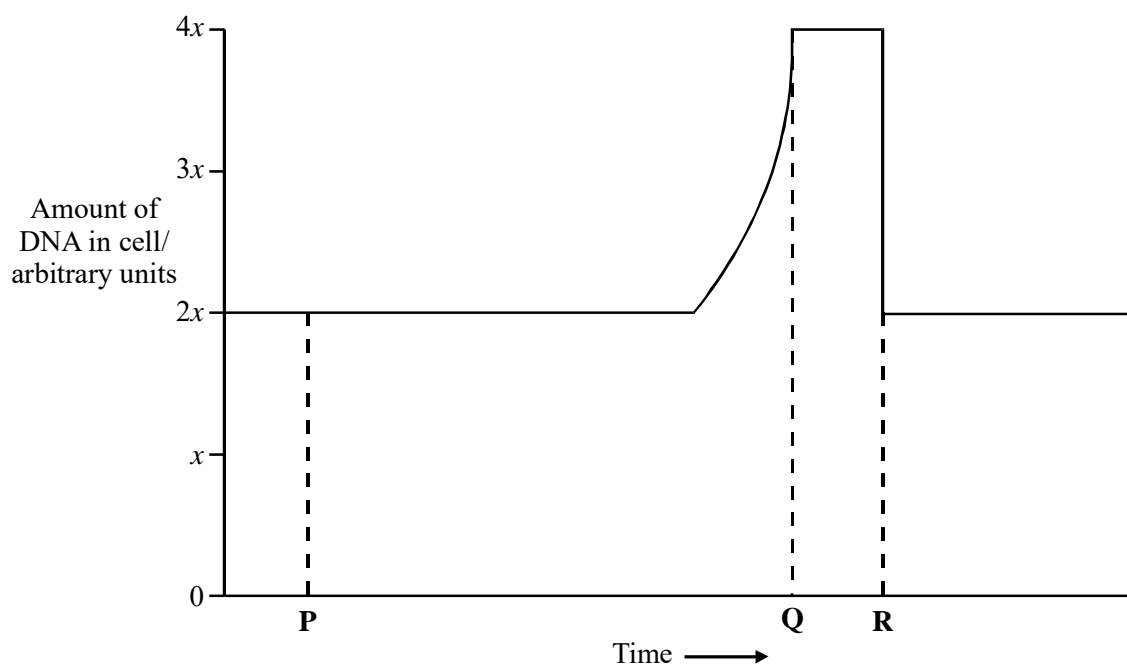
(1)

- (ii) squashing the root tip.

.....  
 .....

(1)

- (b) The graph shows the amount of DNA in a cell during a cell cycle.



- (i) Name the stage occurring between time **P** and time **Q**. Give the reason for your answer.

Stage .....

Reason .....

.....

(2)

- (ii) Explain the decrease in the amount of DNA present at time **R**.

.....

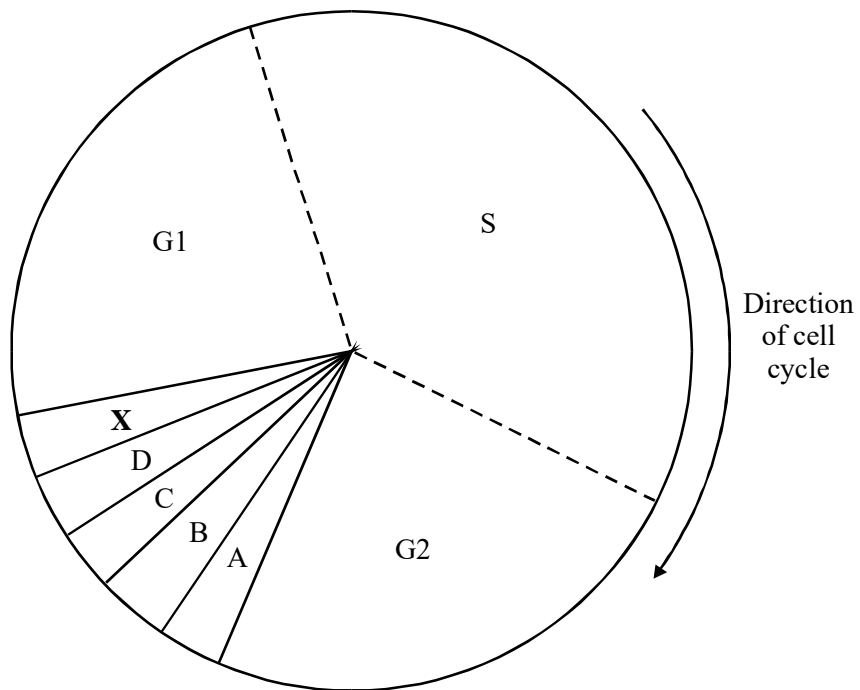
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(1)

(Total 5 marks)

3. The diagram shows the main stages of the cell cycle. The letters A to D represent the four stages of mitosis.



(a) Identify the stage when each of the following events is taking place.

(i) DNA replication

.....

(ii) Individual chromatids from a chromatid pair move to opposite poles of the cell.

.....

(2)

(b) What is happening during Stage X?

.....

.....

(1)

(c) *Vinblastine* is an anti-cancer drug that prevents the formation of a spindle.

(i) What is the function of the spindle?

.....

.....

(1)

(ii) How would a drug like vinblastine help prevent the growth of a tumour?

.....

.....

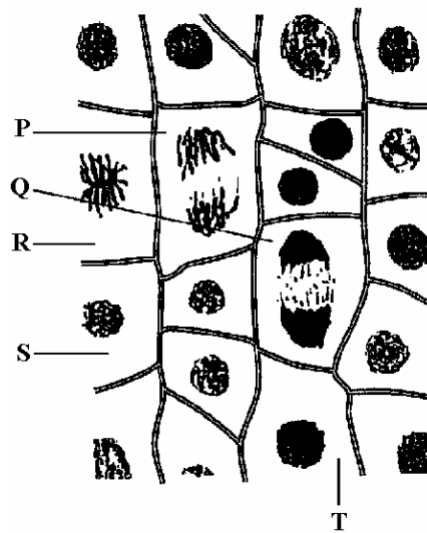
.....

.....

(2)

**(Total 6 marks)**

4. The diagram shows some plant cells in different stages of the cell cycle.



(a) Cell **T** is in interphase. Describe **two** events which occur during interphase.

1 .....

.....

2 .....

.....

(2)

(b) Cells **P, Q, R** and **S** have reached different stages of mitosis. Arrange them in the correct sequence beginning with the cell representing the earliest stage

Sequence .....

(1)

- (c) The tips of onion roots are often used to prepare slides showing cells in different stages of mitosis. As part of the procedure, the root tips are squashed and then stained.

Explain why:

- (i) the tips of the roots are used;

.....  
.....

- (ii) the root tips are squashed;

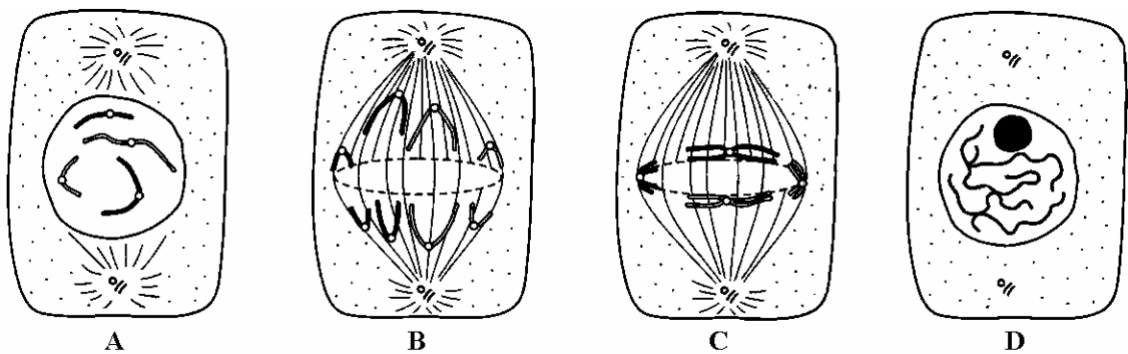
.....  
.....

- (iii) the cells are stained.

.....  
.....

(3)  
(Total 6 marks)

- 5. (a) (i) The diagrams show some of the stages of mitosis. Arrange the letters A - D to give the correct sequence of stages.



Sequence .....

(1)

- (ii) Describe the role of the spindle in mitosis.

.....

.....

.....

.....

(2)

- (b) Sexual reproduction involves the fusion of gametes. Explain the importance of meiosis in the life cycle of a sexually reproducing organism.

.....

.....

.....

.....

(2)

- (c) The table shows the mean mass of DNA in the nuclei of different cells in cattle.

<b>Cell</b>	<b>Mean mass of DNA/ arbitrary units</b>
Sperm cell	3.42
Red Blood cell	0.00
Liver cell	7.05

- (i) Explain the difference in DNA content between sperm and liver cells.

.....

.....

(1)

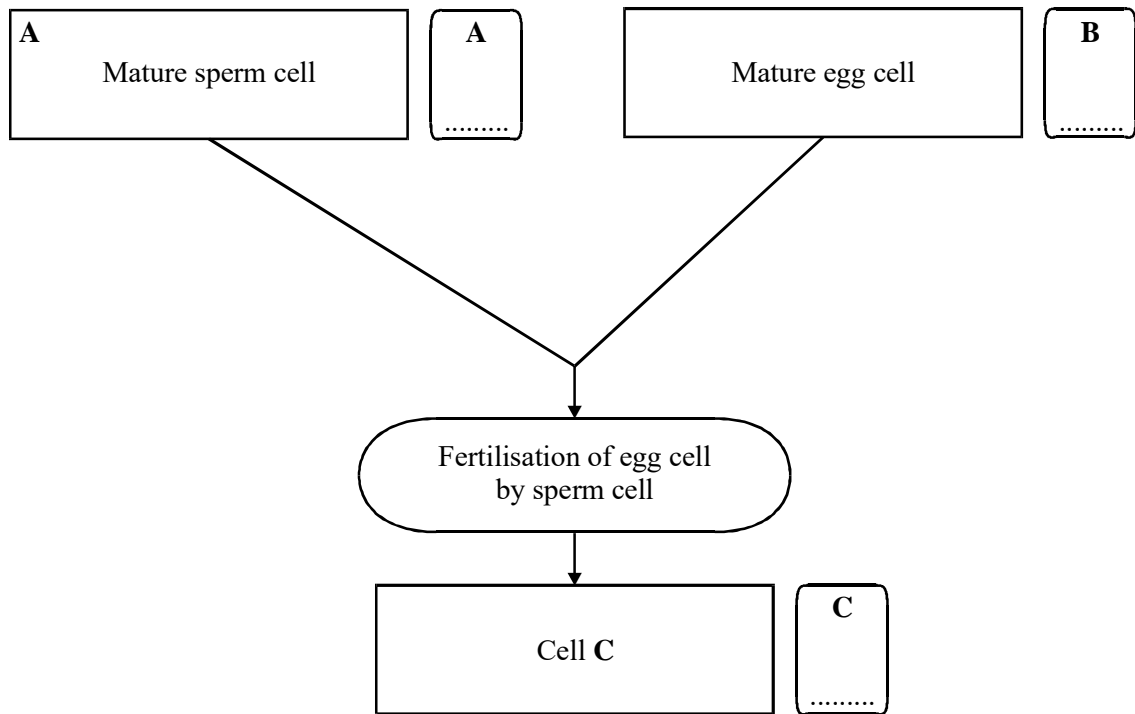
(ii) There is no DNA in the red blood cell. Explain why.

.....

.....

(1)  
(Total 7 marks)

6. A human body cell contains 23 pairs of chromosomes. The diagram shows the events of fertilisation.



(a) Complete boxes **A** to **C** to show the number of chromosomes present in the relevant cells.

(2)

(b) Name **Cell C**.

.....

(1)

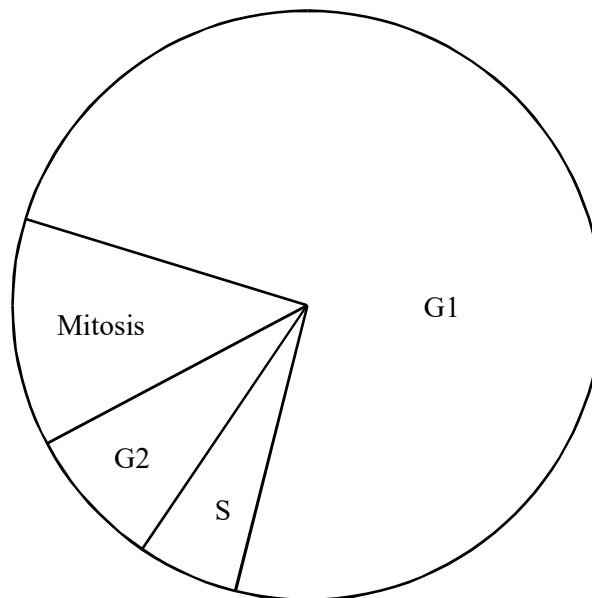


- (c) Complete the table, which describes events that take place at various stages in the cell cycle.

Stage	Description of events
Anaphase	
	DNA replication occurs
Prophase	
	Division of cytoplasm

(4)  
(Total 7 marks)

7. The diagram shows some of the different stages in the cell cycle.



- (a) There are 20 units of DNA in a cell during stage G2. Give the number of units of DNA you would expect to find in this cell
- (i) at prophase of mitosis; .....
- (ii) in one of the daughter cells produced at the end of mitosis; .....

(iii) during stage G1. ....

(3)

(b) Vincristine is a drug used in the treatment of cancer. It prevents spindle formation during mitosis.

(i) Explain how treatment with vincristine will affect the behaviour of chromosomes during mitosis.

.....

.....

.....

.....

(2)

(ii) People who are given vincristine to treat cancer have a reduced number of red blood cells. Suggest a reason for this.

.....

.....

(1)

(Total 6 marks)

8. (a) The table shows the mass of DNA in various cells from the body of a man.

Cell	Mass of DNA / arbitrary units	Number of chromosomes
A	7	
B	14	46
C	28	

(i) Which cell is a mature sperm cell? Explain your answer.

.....

.....

.....

(1)

(ii) What would be the mass of DNA in a zygote resulting from the fertilisation of an egg cell by this sperm cell? Explain your answer.

.....  
.....  
.....  
.....

(2)

(b) What is the role of the spindle during the process of mitosis?

.....  
.....

(1)

(Total 4 marks)

9. (a) (i) List the following phases of the cell cycle in the correct sequence.

**anaphase                  interphase                  metaphase                  prophase                  telophase**

- 1    interphase
- 2    .....
- 3    .....
- 4    .....
- 5    .....

(1)

(ii) During which phase does the replication of DNA occur?

.....

(1)

- (b) Draw a single chromosome attached to a spindle fibre as it would appear during metaphase of mitosis. Label the following on your drawing:

**centromere**

**chromatid**

**spindle fibre**

(3)

- (c) The diploid chromosome number of the fruit fly is 8. How many chromosomes would be present in the nucleus of

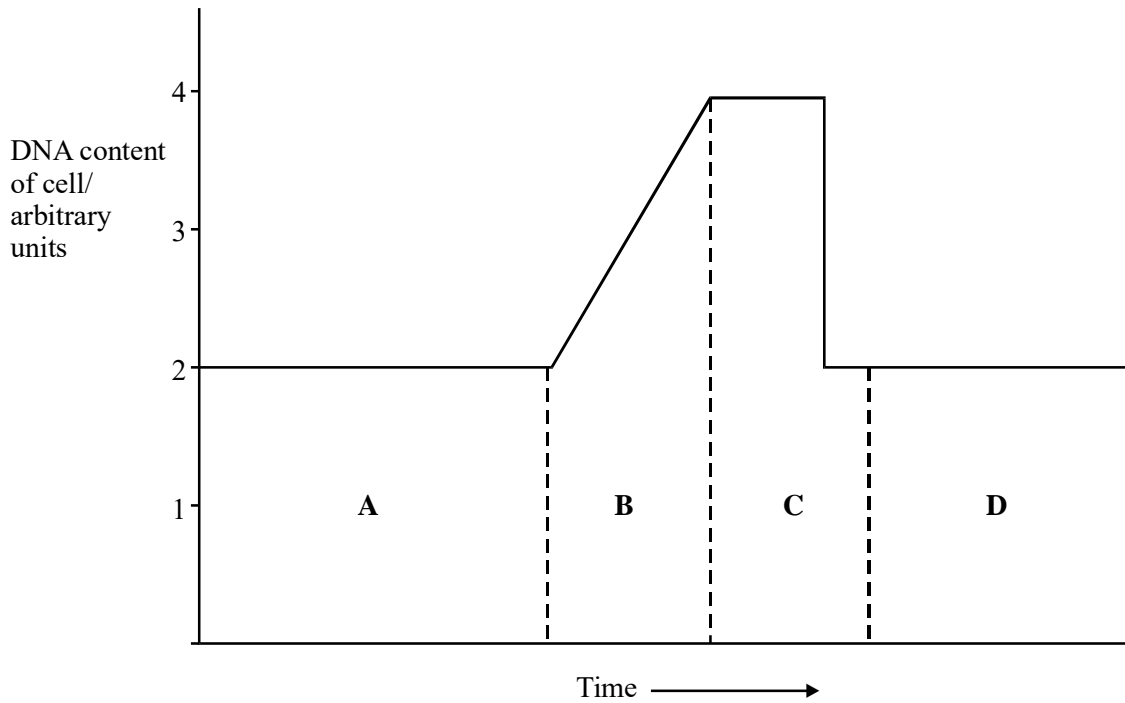
(i) a cell from the gut lining; .....

(ii) a sperm cell? .....

(1)

**(Total 6 marks)**

10. The graph shows the changes in the DNA content of cells during the cell cycle.



(a) In which of the stages, **A** to **D**, does each of the following take place?

(i) DNA replicates .....

(ii) The chromosomes become visible. ....

(2)

(b) Describe and explain how the amount of DNA in the cell changes during stage **C**.

.....

.....

.....

.....

.....

.....

.....

(3)

- (c) (i) Cytarabine is a drug used to treat cancer. It inhibits an enzyme needed to synthesise new DNA. Suggest how the graph would be different if cytarabine was present during the cell cycle.

.....  
 .....

(1)

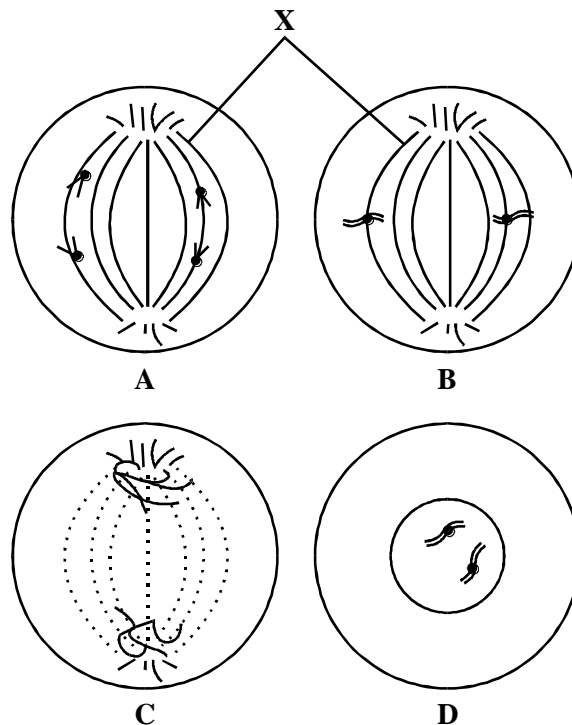
- (ii) Explain why cytarabine is effective in treating cancer.

.....  
 .....

(2)

(Total 8 marks)

11. (a) The diagram shows four stages of mitosis in an animal cell. The stages are not in the correct sequence.



- (i) List the stages **A**, **B**, **C** and **D** in the correct sequence.

.....

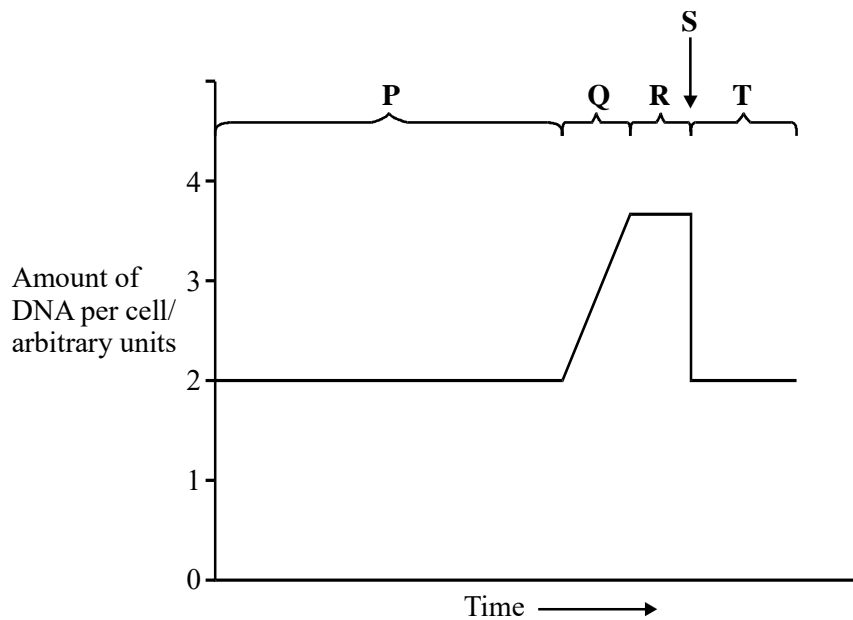
(1)

- (ii) What is the function of structure **X**?

.....

(1)

- (b) The graph shows how the amount of DNA in a cell varies during the cell cycle.



Radioactive thymine was supplied to the cells of some growing tissue. The radioactivity of the cells' nuclei increased during period **Q** shown in the graph.

(i) Explain why the radioactivity of the nuclei increased during period Q.

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.....

(3)

(ii) Explain why an increase in the amount of DNA is important in the cell cycle.

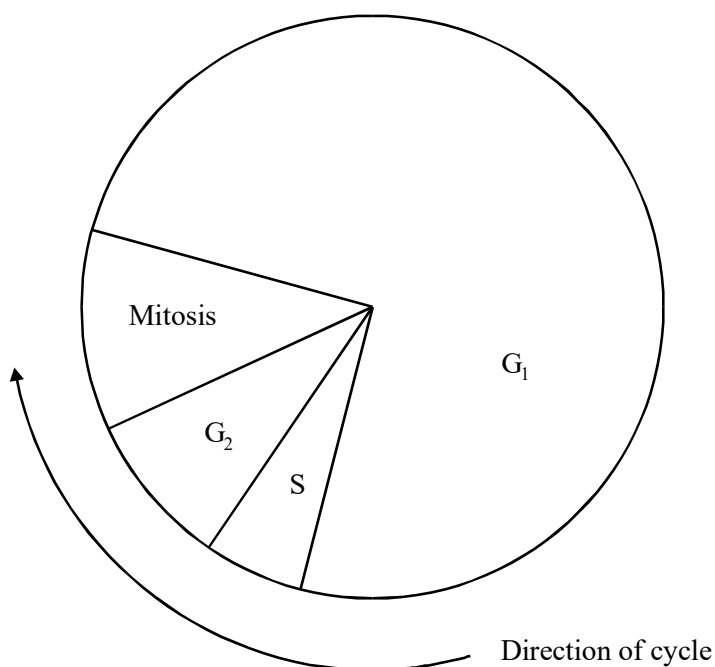
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(1)

(Total 6 marks)

12. The diagram shows the stages in the cell cycle.





(a) There are 40 units of DNA in a cell during stage  $G_2$ . How many units of DNA would you expect to find in this cell

(i) during stage  $G_1$ ;

.....

(ii) at prophase of mitosis?

.....

(2)

(b) Cytarabine is a drug which is used to treat cancer. The shape of a cytarabine molecule is very similar to that of a cytosine nucleotide but there are some differences.

(i) Cytarabine is incorporated into DNA. At what stage in the cell cycle would you expect cytarabine to be incorporated into DNA? Give a reason for your answer.

.....

.....

.....

.....

(2)

(ii) Explain why DNA which contains cytarabine instead of cytosine cannot produce mRNA.

.....

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.....

.....

(2)

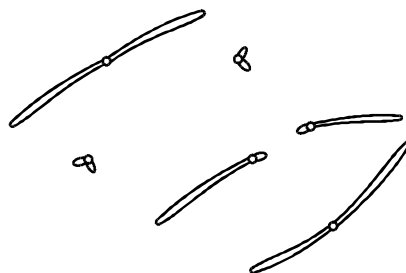
(Total 6 marks)

13. (a) Give **one** process which occurs in the nucleus of a cell during interphase which is necessary before cell division can take place.

.....

(1)

- (b) The diagram shows the chromosomes from a cell with a diploid chromosome number of six.



Draw a diagram to show the chromosomes from one of the resulting cells if

- (i) the cell divides by **mitosis**;

(2)

- (ii) the cell divides by **meiosis**.

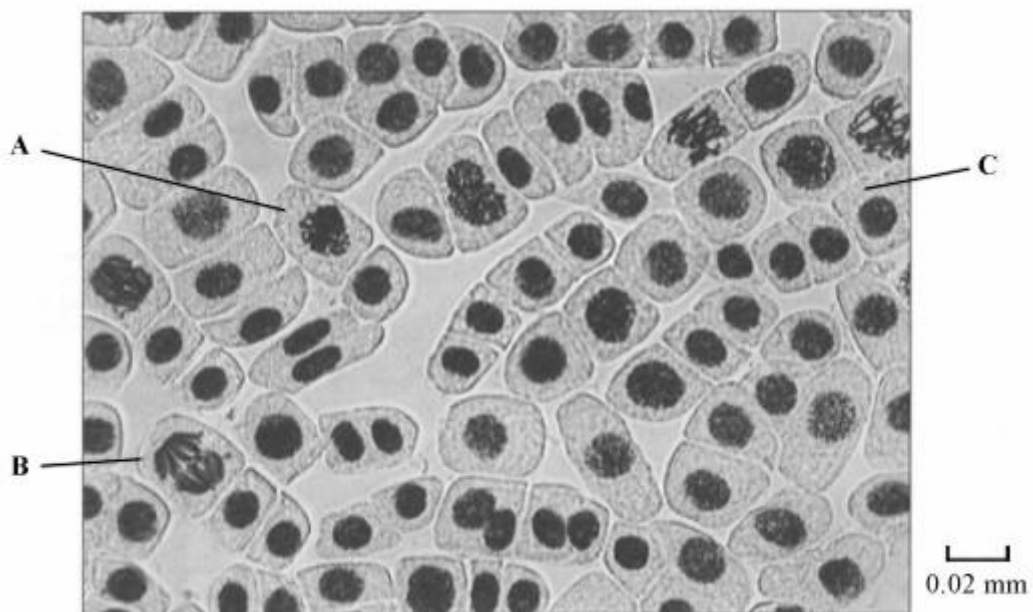
(2)

- (c) Explain **one** advantage of cells lining the human gut dividing very frequently.

.....  
 .....

(1)  
 (Total 6 marks)

14. The photograph shows cells from an onion root tip. The root tip has been squashed and stained to show the stages of mitosis.



- (a) (i) At what stage of mitosis is cell **A**?

.....

(1)

- (ii) What is the evidence that cell **B** is in anaphase?

.....  
 .....

(1)

- (iii) Cell C is in interphase. Give **two** processes which occur during interphase that enable cell division to occur.

1 .....

.....

2 .....

.....

(2)

- (b) Explain how you would calculate the magnification of the photograph.

.....

.....

(1)

- (c) The number of cells at each stage of mitosis was counted. The results are shown in the table.

Stage of mitosis	Number of cells
Interphase	123
Prophase	32
Metaphase	12
Anaphase	6
Telophase	27

One complete cell cycle takes 24 hours. The number of cells at each stage is proportional to the time spent at that stage. Calculate the length of time spent in metaphase. Show your working.

Answer ..... hours

(2)

(Total 7 marks)

**15.** A student investigated the stages of mitosis in a garlic root. The root tip was placed on a microscope slide with a stain. A cover slip was placed on top and the root tip was firmly squashed.

(a) Explain why

(i) a root tip was used;

.....  
 .....

(1)

(ii) a stain was used;

.....  
 .....

(1)

(iii) the root tip was firmly squashed.

.....  
 .....

(1)

- (b) The student examined the cells in the garlic root tip under the microscope, and obtained the following data.

Stage	Number of cells
Interphase	872
Prophase	74
Metaphase	18
Anaphase	10
Telophase	8

- (i) Calculate the percentage of these cells in which the chromosomes are visible and would consist of a pair of chromatids joined together. Show your working.

Answer .....

(2)

- (ii) A different set of results was obtained when the count was repeated on another occasion with a different garlic root tip. Give **two** reasons for the difference in results.

1 .....

.....

2 .....

.....

(2)

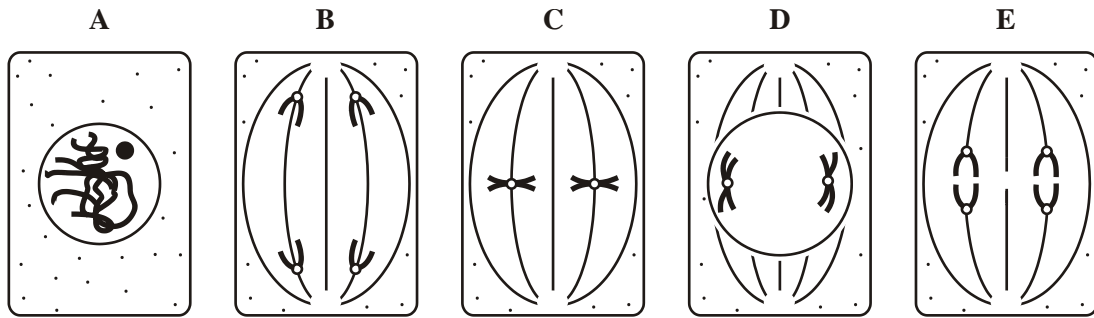
(Total 7 marks)

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

.....

(1)

(b) The diagrams show five stages of mitosis.



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

.....

(1)

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

.....  
 .....  
 .....  
 .....

(2)

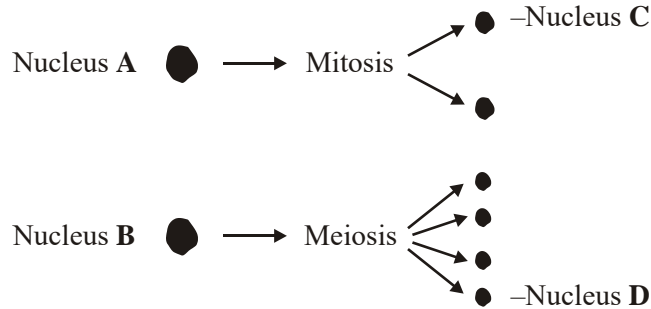
(d) Meiosis also occurs during the life cycle of organisms. What is the importance of meiosis?

.....  
 .....  
 .....  
 .....

(2)

**(Total 6 marks)**

17. (a) Nucleus **A** and nucleus **B** come from the same organism. The diagram shows these nuclei immediately before division and the nuclei formed immediately after their division. The table gives information about some of the nuclei shown in the diagram.



Nucleus	Number of chromosomes	Mass of DNA / arbitrary units
<b>A</b>	8	600
<b>B</b>	8	600
<b>C</b>		
<b>D</b>		

Complete the table for nuclei **C** and **D**.

(2)

- (b) A student investigated the process of meiosis by observing cells on a microscope slide. The cells on the slide had been stained.

- (i) Name an organ from which the cells may have been obtained.

.....

(1)

- (ii) Explain why a stain was used.

.....

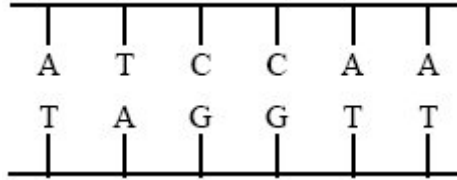
.....

(1)

(Total 4 marks)



18. (a) The diagram shows part of a DNA molecule. In the space below, draw a similar diagram to show this part of the molecule after it has replicated. Label the original strands and the new strands.



(2)

- (b) Biologists found the mean mass of DNA in three different types of cells from different animals. Their results are shown in the table.

Animal	Mass of DNA in nucleus/picograms		
	Liver cell	Blood cell	Sperm cell
Chicken	2.53	2.51	1.26
Goldfish	3.29	3.28	1.64
Trout	5.79	5.78	2.89
Toad	7.33	7.31	3.68

- (i) What would you expect to be the mean mass of DNA in a skin cell from a toad? Explain your answer.

.....

.....

.....

.....

(2)

(ii) A zygote is formed when a sperm cell fertilises an egg cell. How much DNA would you expect to find in a trout zygote that had just been formed? Explain your answer.

.....  
.....  
.....  
.....

(2)  
(Total 6 marks)

19. (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.

.....

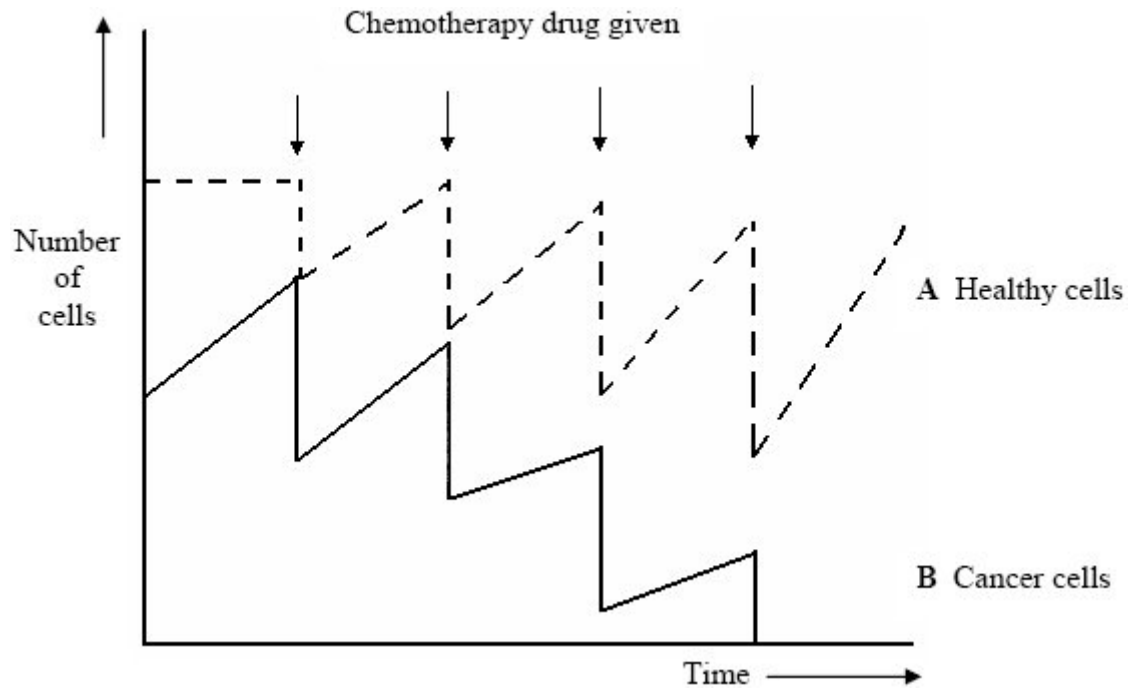
(1)

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

.....

(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.

.....  
 .....  
 .....  
 .....

(2)

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

.....

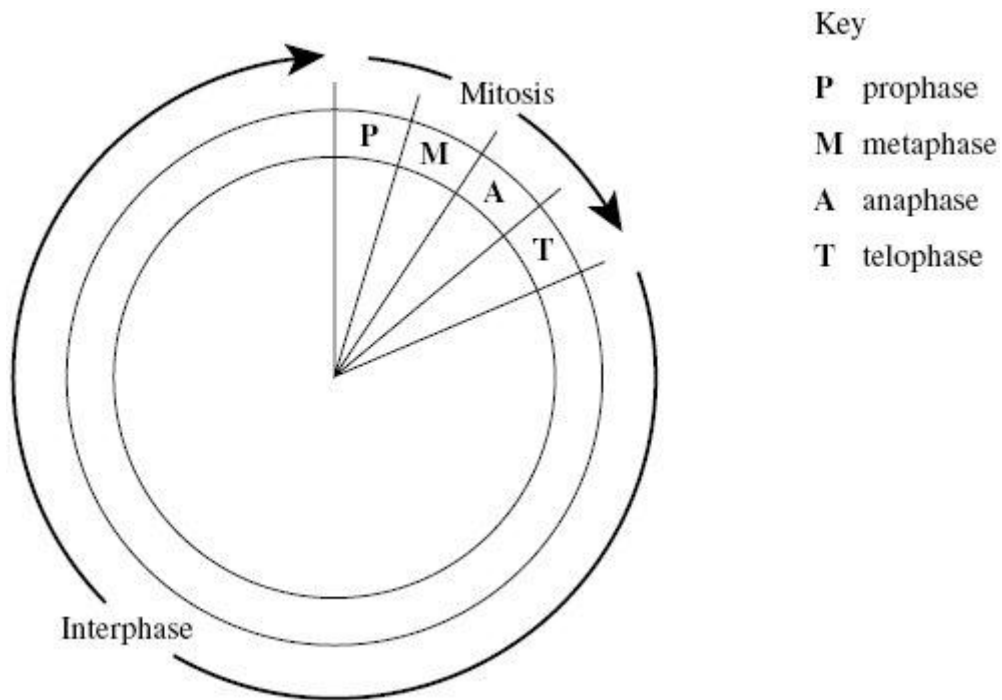
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(2)  
(Total 7 marks)

20. 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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.....

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.....

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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

.....

(1)

(ii) A drug that prevents spindle fibres shortening

.....

(1)

**(Total 9 marks)**