

**Q1.**A student investigated mitosis in the tissue from an onion root tip.

- (a) The student prepared a temporary mount of the onion tissue on a glass slide. She covered the tissue with a cover slip. She was then given the following instruction.

“Push down hard on the cover slip, but do not push the cover slip sideways.”

Explain why she was given this instruction.

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(2)

The image below shows one cell the student saw in the onion tissue.



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- (b) The student concluded that the cell in the image above was in the anaphase stage of mitosis.

Was she correct? Give **two** reasons for your answer.

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2 .....

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(2)

- (c) The student counted the number of cells she observed in each stage of mitosis. Of the 200 cells she counted, only six were in anaphase.

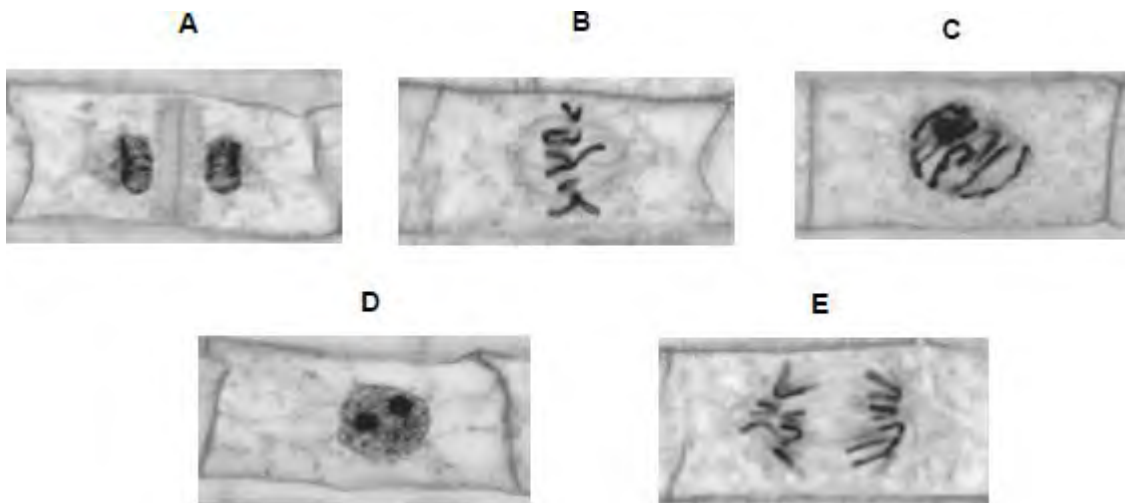
One cell cycle of onion root tissue takes 16 hours. Calculate how many minutes these cells spend in anaphase.

Show your working.

Answer = ..... minutes

(2)  
(Total 6 marks)

Q2. The figure below shows some cells from an onion root tip at different stages of the cell cycle.



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(a) Place stages **A** to **E** in the correct order. Start with stage **D**.

**D**

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(1)

To obtain these images, the onion root tip was cut off, stained and put on a microscope slide. A cover slip was placed on top. The root tip was then firmly squashed and viewed under an optical microscope.

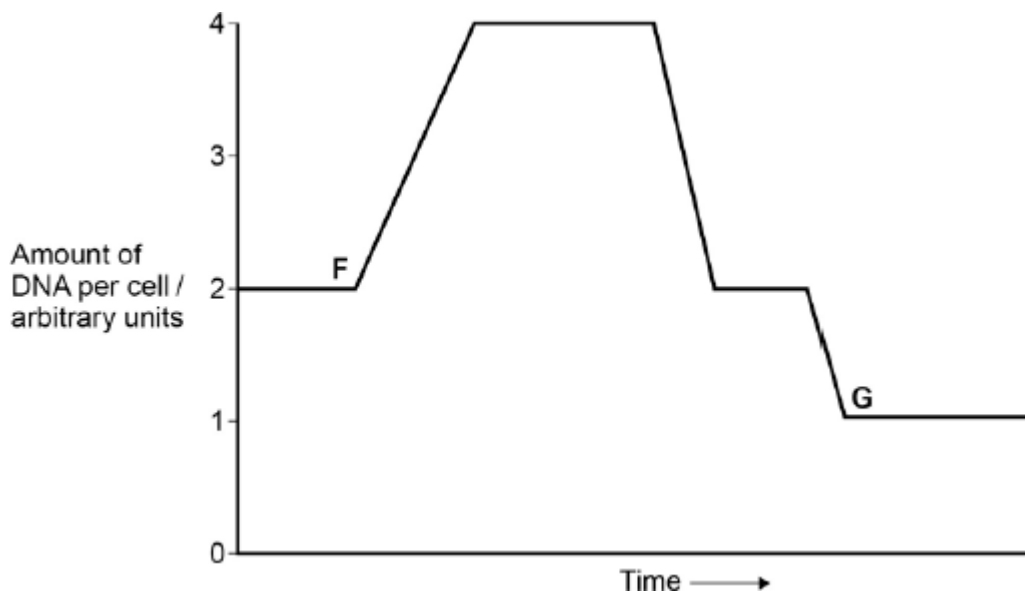
(b) Complete the table below to give **one** reason why each of these steps was necessary.

| Step                           | Reason |
|--------------------------------|--------|
| Taking cells from the root tip |        |

|                               |  |
|-------------------------------|--|
| Firmly squashing the root tip |  |
|-------------------------------|--|

(2)

The figure below shows how the amount of DNA per cell changed during interphase and meiosis in an animal.



(c) Explain how the behaviour of chromosomes causes these changes in the amount of DNA per cell between **F** and **G**.

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**(Extra space)** .....  
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(3)

(d) What would happen to the amount of DNA per cell at fertilisation of cell **G**?

(1)  
(Total 7 marks)

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**Q3.** Metastatic melanoma (MM) is a type of skin cancer. It is caused by a faulty receptor protein in cell-surface membranes. There have been no very effective treatments for this cancer.

Dacarbazine is a drug that has been used to treat MM because it appears to increase survival time for some people with MM.

Doctors investigated the use of a new drug, called ipilimumab, to treat MM. They compared the median survival time (ST) for two groups of patients treated for MM:

- a control group of patients who had been treated with dacarbazine
- a group of patients who had been treated with dacarbazine and ipilimumab.

The ST is how long a patient lives after diagnosis.

The doctors also recorded the percentage of patients showing a significant reduction in tumours with each treatment.

The total number of patients in the investigation was 502.

The table below shows the doctors' results.

| Treatment                  | Median survival time (ST) / months | Percentage of patients showing significant reduction in tumours |
|----------------------------|------------------------------------|---|
| Dacarbazine                | 9.1                                | 10.3  |
| Dacarbazine and ipilimumab | 11.2                               | 15.2  |

(a) The doctors compared median survival times for patients in each group.

How would you find the median survival time for a group of patients?

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(2)

- (b) In many trials of new drugs, a control group of patients is given a placebo that does not contain any drug.

The control group in this investigation had been treated with dacarbazine. Suggest why they had not been given a placebo.

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(1)

- (c) A journalist who read this investigation concluded that ipilimumab improved the treatment of MM.

Do the data in the table support this conclusion? Give reasons for your answer.

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(4)

- (d) MM is caused by a faulty receptor protein in cell-surface membranes. Cells in MM tumours can be destroyed by the immune system.

Suggest why they can be destroyed by the immune system.

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**(Extra space)** .....

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**(3)**  
**(Total 10 marks)**

**Q4.**In many parts of the world, crops have to be watered to grow enough food but fresh water is often in short supply.

Barley is a plant that grows a leafy shoot and then produces seed that is harvested for food.

Scientists investigated whether barley could be grown successfully using fresh water mixed with seawater. This would reduce the use of fresh water. However, seawater contains dissolved sodium chloride (salt).

The scientists grew barley in plots of equal size in the same large field. Each plot received one of four treatments.

- A** No watering.
- B** Watering with fresh water during growth and seed production.
- C** Watering with a 1:1 mix of fresh water and seawater during growth and seed production.
- D** Watering with fresh water during growth and with a 1:1 mix of fresh water and seawater during seed production.

At the end of the investigation, the scientists measured the concentration of salt in the soil in each plot and the yield of barley seed harvested from each plot.

The scientists' results are shown in the table below.

| Watering treatment | Mean concentration of salt in soil / arbitrary units | Mean yield of barley seed / g |
|--------------------|--|-------------------------------|
| <b>A</b>           | 10.1   | 346                           |

|          |      |     |
|----------|------|-----|
| <b>B</b> | 9.7  | 804 |
| <b>C</b> | 13.5 | 538 |
| <b>D</b> | 11.6 | 695 |

(a) Watering treatment was the independent variable in this investigation. Explain what is meant by the **independent** variable.

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(1)

(b) The same variety of barley was used in all the plots. Why was this important?

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(2)

(c) When barley plants are growing, the number of cells increases. Name the process that increases the number of cells.

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(1)

(d) What do the data in the table above show about the effect of watering barley with a mixture of fresh water and seawater?

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(2)

- (e) The scientists suggested that watering barley with diluted seawater might not be sustainable if repeated every year.  
Do these data support this suggestion?

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(Extra space) .....

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(3)

(Total 9 marks)