EXAM PAPERS PRACTICE

All cells arise from other cells 1

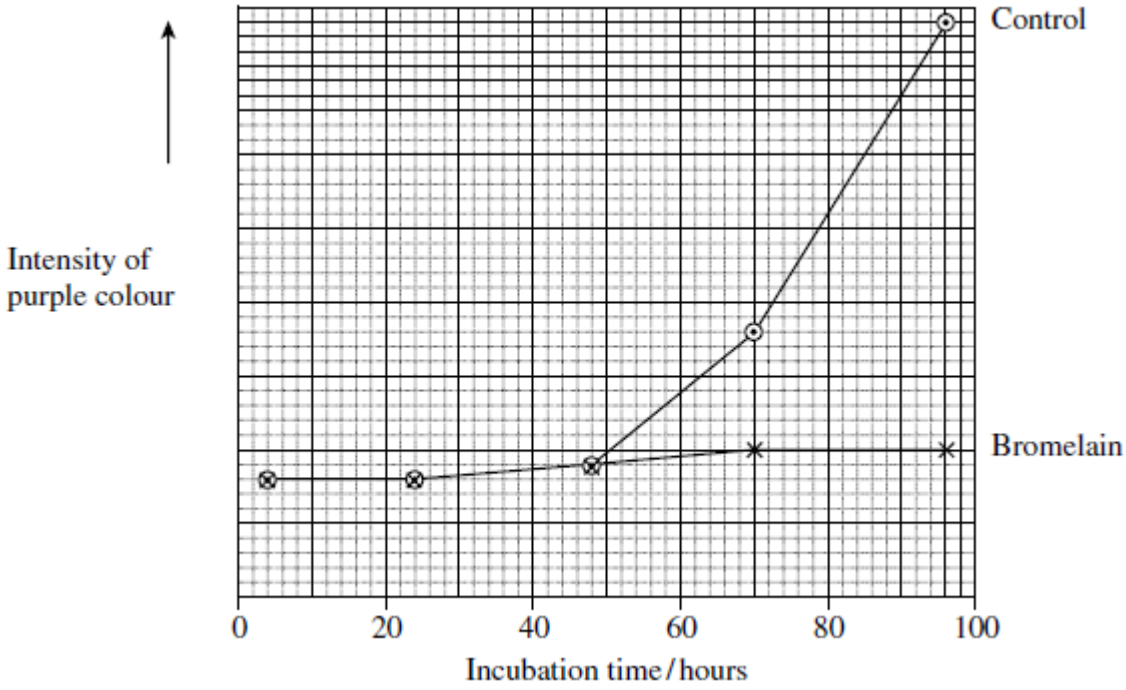
Level: OCR AS H020
Subject: Biology
Exam Board: Suitable for all boards
Topic: All cells arise from other cells 1
Type: Questionnaire

To be used by all students preparing for OCR AS Biology H020 foundation or higher tier but also suitable for students of other boards.

1 Scientists investigated the effect of bromelain on cancer cells. They took cells from skin cancers in mice and added them to a liquid growth medium in two dishes.

Four hours later they added a solution of bromelain to one of the dishes. They left the other dish as a control. They also added a substance to both dishes that is turned purple by respiring cells.

Both dishes were placed in an incubator. The scientists measured the intensity of the purple colour at intervals over a period of 100 hours.



(a) The scientists put the same number of skin tumour cells in each dish at the start of this investigation. Explain why it was important to put the same number of cells in each dish.

_____

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(1)

(b) The scientists concluded that bromelain did not kill cancer cells but stopped them dividing. Does the graph support this conclusion? Explain your answer.

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(2)

(c) An article in a newspaper claimed that these data show that bromelain can be used to treat cancer.

Give **three** reasons why we should be careful about accepting this claim.

1. _____

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2. _____

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3. _____

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(3)

(d) The rate of cell division is important in investigations into cancer. Suggest why.

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(2)

(e) Scientists have investigated the effects of bromelain on cancer growth in humans. Suggest why they gave bromelain in addition to, rather than instead of, the usual treatment.

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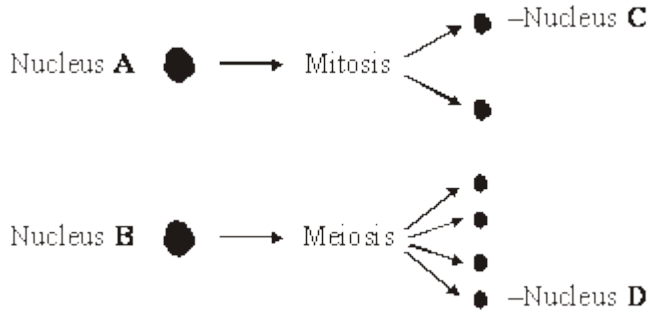
(2)

(Total 10 marks)

2 (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
A	8	600
B	8	600
C		
D		

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)

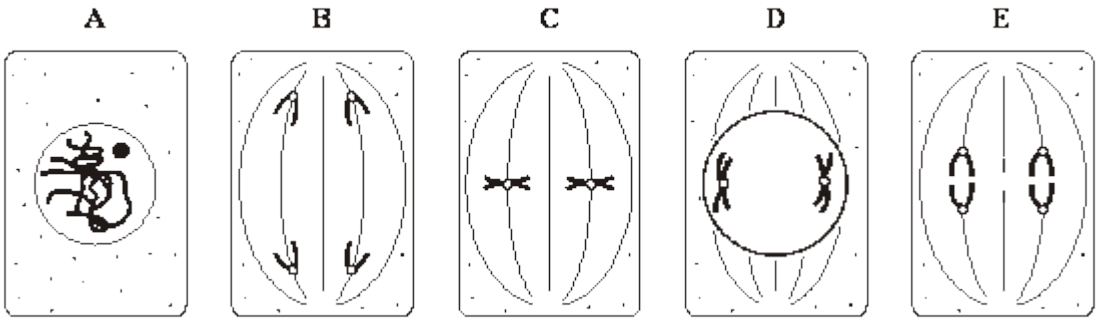
(Total 4 marks)

3 (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.

_____

_____

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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)

4 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.

© Ed Reschke/
Oxford Scientific/Getty Images

(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.

1. _____

_____

2. _____

_____

(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)

5 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?

_____

_____

_____

_____

(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.

_____

_____

(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.

(Extra space)

(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.

(Extra space)

(3)

(Total 10 marks)

6 (a) The letters **A**, **B**, **C**, **D** and **E** represent stages in mitosis.

- **A** – anaphase
- **B** – interphase
- **C** – metaphase
- **D** – prophase
- **E** – telophase

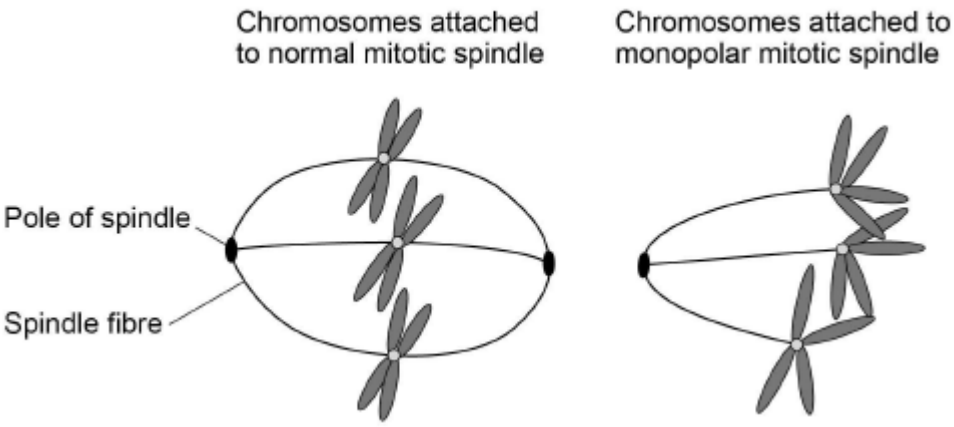
Write **one** of the letters, **A** to **E**, in the box to complete the following statement.

Chromosomes line up on the equator of the mitotic spindle in ☐

(1)

(b) Scientists looking for treatments for cancer are investigating the use of substances called kinesin inhibitors (KI). These inhibitors prevent successful mitosis. Some kinesin inhibitors cause the development of a monopolar spindle in mitosis.

The diagram below shows chromosomes attached to a normal mitotic spindle and to a monopolar mitotic spindle.



Suggest why the development of a monopolar mitotic spindle would prevent successful mitosis.

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(2)

(c) Scientists investigated the effect of different concentrations of a kinesin inhibitor (KI) on mitosis of human bone-cancer cells grown in a culture.

The following table shows the scientists' results.

Concentration of kinesin inhibitor / nmol dm^{-3}	**Percentage of dividing human bone-cancer cells showing a monopolar mitotic spindle**
0	0
1	0
10	8
100	93
1000	100
10 000	100

A student who saw these results concluded that in any future trials of this kinesin inhibitor with people, a concentration of 100 nmol dm^{-3} would be most appropriate to use.

Do these data support the student's conclusion? Give reasons for your answer.

(4)

(d) At the start of their investigation, the scientists made a solution of kinesin inhibitor (KI) with a concentration of 10 000 nmol dm^{-3}. They used this to make the other concentrations by a series of dilutions with water.

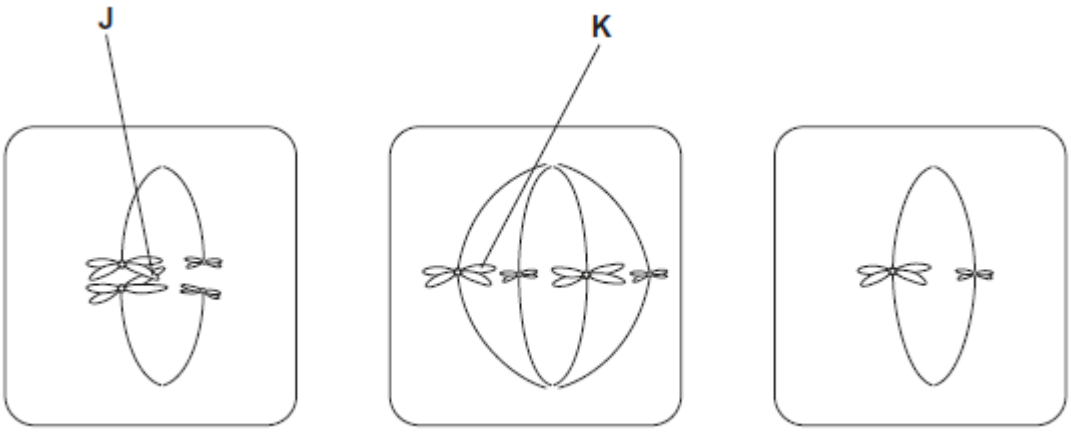
Describe how they made 100 cm^3 of 1000 nmol dm^{-3} solution of kinesin inhibitor.

(2)

(Total 9 marks)

7 **Figure 1** shows three cells, **B**, **C** and **D**, from tissues in the same organism. Each cell is in a stage of either mitosis or meiosis.

Figure 1



(a) Complete the table with a tick if the cell shows the feature.

	Cell B	Cell C	Cell D
homologous chromosomes are present			
a stage of mitosis			

(2)

(b) Describe and explain the appearance of chromosome **K** in cell **C**.

(2)

(c) Explain what is happening at point **J** in cell **B**.

(2)

(d) Use information from all three cells in **Figure 1** to explain how the number of chromosomes in cell **D** was produced.

_____

_____

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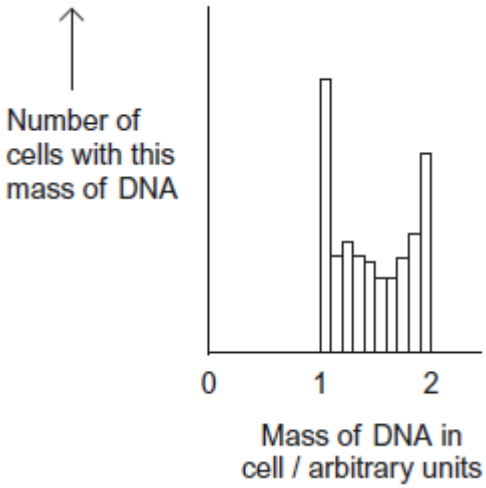
(1)

(e) **Figure 2** shows the mass of DNA present in cells of a population of healthy cells where mitosis is occurring.

Figure 2



Explain why some cells contain a mass of DNA between 1 and 2 arbitrary units.

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(1)

(Total 8 marks)

8 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
A	10.1	346
B	9.7	804
C	13.5	538
D	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.

_____

(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?

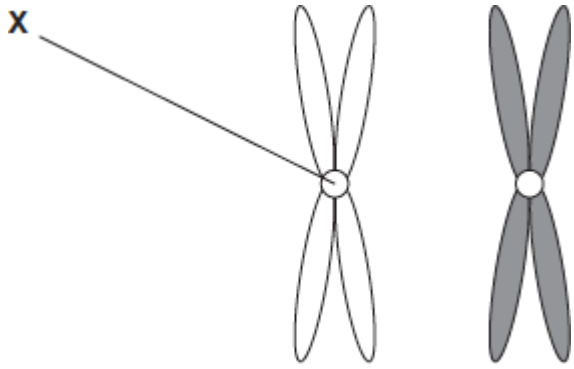
(Extra space)

(3)

(Total 9 marks)

9 (a) **Figure 1** shows one pair of homologous chromosomes.

Figure 1



(i) Name **X.**

(1)

(ii) Describe the role of **X** in mitosis.

_____

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(2)

(iii) Homologous chromosomes carry the same genes but they are **not** genetically identical.Explain why.

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_____

(1)

(b) **Figure 2** shows three pairs of homologous chromosomes in a cell at the end of cell division.

Figure 2

(i) The appearance of each chromosome in **Figure 2** is different from those shown in **Figure 1.** Explain why.

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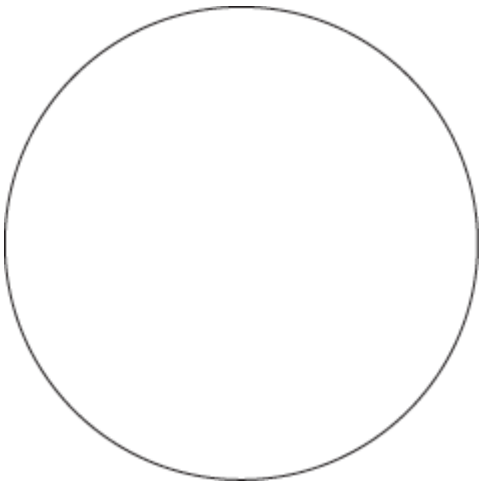
(1)

(ii) Complete the diagram to show the chromosomes in one cell that could be produced from the cell in **Figure 2** as a result of meiosis.



(2)

(iii) Other than independent segregation, give **one** way in which meiosis allows the production of genetically different cells.

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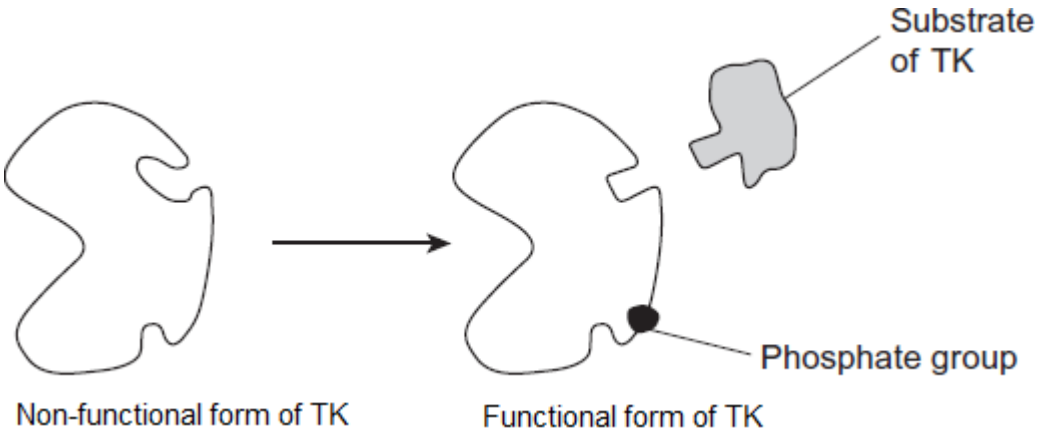
(1)

(Total 8 marks)

10 The enzyme tyrosine kinase (TK) is found in human cells. TK can exist in a non-functional and a functional form. The functional form of TK is only produced when a phosphate group is added to TK.

This is shown in **Figure 1.**

Figure 1



(a) Addition of a phosphate group to the non-functional form of TK leads to production of the functional form of TK.

Explain how.

_____

_____

_____

_____

_____

(2)

(b) The binding of the functional form of TK to its substrate leads to cell division. Chronic myeloid leukaemia is a cancer caused by a faulty form of TK. Cancer involves uncontrolled cell division.

Figure 2 shows the faulty form of TK.

Figure 2

Faulty form of TK

Suggest how faulty TK leads to chronic myeloid leukaemia.

_____

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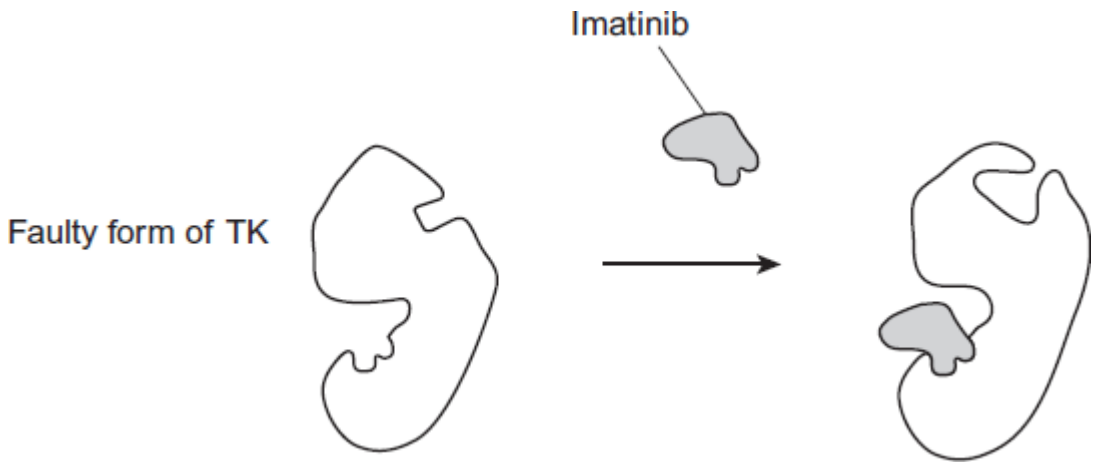
(2)

(c) Imatinib is a drug used to treat chronic myeloid leukaemia. **Figure 3** shows how imatinib inhibits faulty TK.

Figure 3



Using all of the information, describe how imatinib stops the development of chronic myeloid leukaemia.

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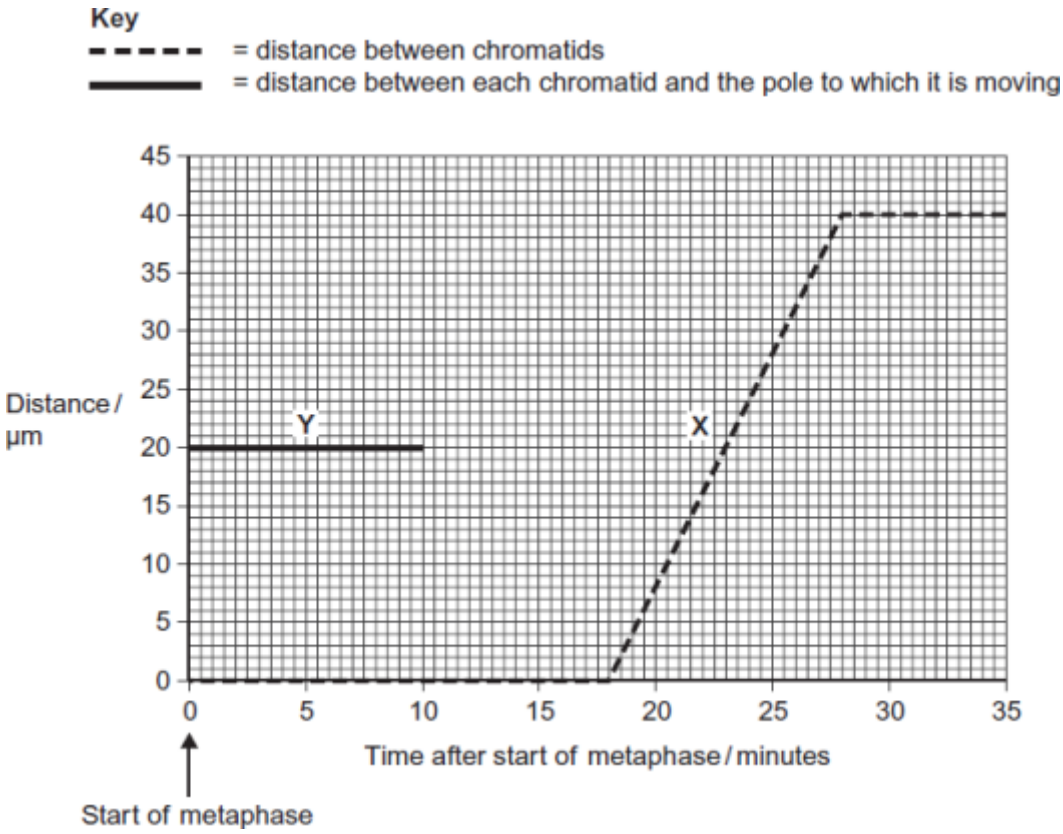
(2)

(Total 6 marks)

11 (a) Describe how DNA is replicated.

(6)

(b) The graph shows information about the movement of chromatids in a cell that has just started metaphase of mitosis.



(i) What was the duration of metaphase in this cell?

☐ minutes

(1)

(ii) Use line **X** to calculate the duration of anaphase in this cell.

☐ minutes

(1)

(iii) Complete line **Y** on the graph.

(2)

(c) A doctor investigated the number of cells in different stages of the cell cycle in two tissue samples, **C** and **D.** One tissue sample was taken from a cancerous tumour. The other was taken from non-cancerous tissue. The table shows his results.

	Percentage of cells in each stage of the cell cycle	
Stage of the cell cycle	Tissue sample **C**	Tissue sample **D**
Interphase	82	45
Prophase	4	16
Metaphase	5	18
Anaphase	5	12
Telophase	4	9

(i) In tissue sample **C**, one cell cycle took 24 hours. Use the data in the table to calculate the time in which these cells were in interphase during one cell cycle. Show your working.

Time cells in interphase _____ hours

(2)

(ii) Explain how the doctor could have recognised which cells were in interphase when looking at the tissue samples.

_____

_____

_____

(1)

(iii) Which tissue sample, **C** or **D**, was taken from a cancerous tumour?
Use information in the table to explain your answer.

_____

_____

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(2)

(Total 15 marks)

12 (a) Mitosis is important in the life of an organism. Give **two** reasons why.

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(2)

A biologist used a microscope to investigate plant tissue where some of the cells were dividing by mitosis. She examined 200 cells and counted the number of cells in interphase and in each stage of mitosis.

The table shows some of the cells she saw, and the percentage of cells in interphase and in two stages of mitosis, **A** and **B**.

Stage of cell cycle		Percentage of cells
Interphase		90
Stage **A**		3
Stage **B**		1

Images by Edmund Beecher Wilson [Public domain], via Wikimedia Commons

(b) (i) Explain why the biologist chose to examine 200 cells.

_____

_____

_____

(1)

(ii) Name Stage **A** and Stage **B**. Give the evidence from the photograph that you used to identify the stage.

Name of Stage **A** _____

Evidence _____

_____

Name of Stage **B** _____

Evidence _____

_____

(4)

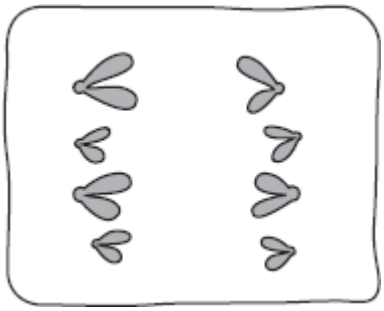
(c) In this tissue one complete cell cycle took 20 hours.
Using information from the table, calculate the mean time for these cells to complete mitosis. Show your working.

Answer _____

(2)

(Total 9 marks)

13 (a) The diagram shows a stage of mitosis in an animal cell.



(i) Name this stage.

_____

(1)

(ii) Describe what happens during this stage that results in the production of two genetically identical cells.

_____

_____

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(2)

(b) A sample of epithelial tissue from the small intestine of an animal was analysed. Some of the cells had 8.4 units of DNA, others had only 4.2 units.

(i) Use your knowledge of the cell cycle to explain why some cells had 8.4 units of DNA and others had only 4.2 units.

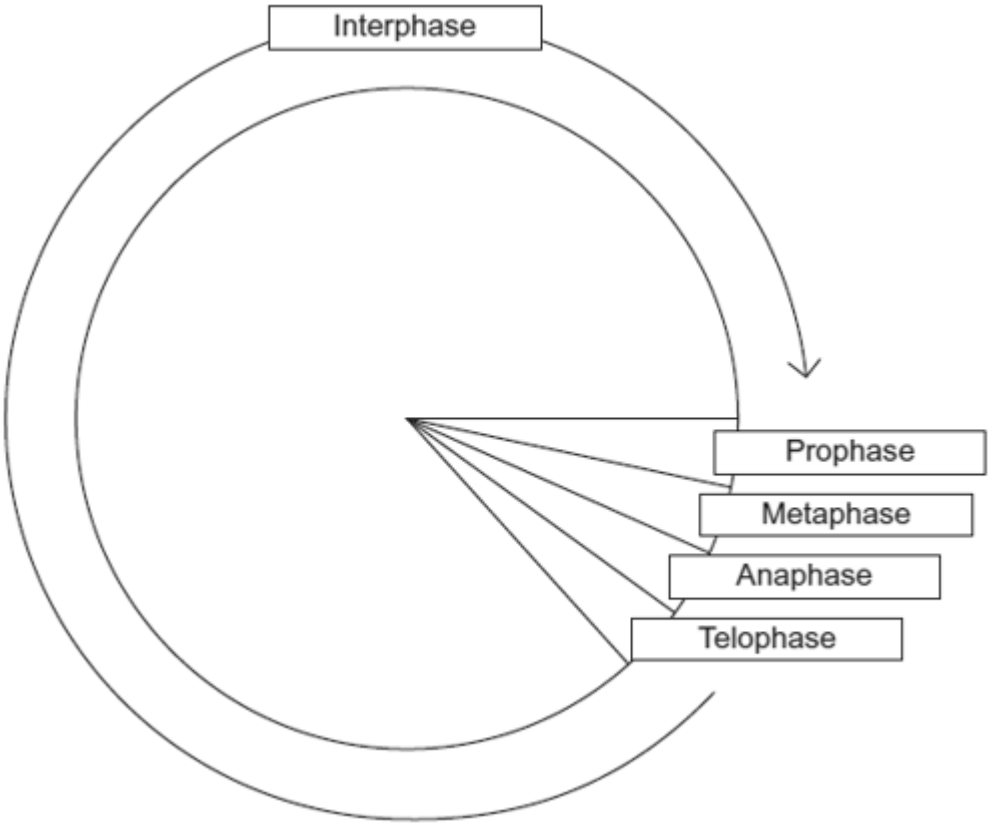
(2)

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

(1)

(Total 6 marks)

14 The diagram shows a cell cycle.



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

(i) metaphase

(2)

(ii) anaphase.

(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.

(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.

(2)

(Total 9 marks)

15 Plant physiologists attempted to produce papaya plants using tissue culture. They investigated the effects of different concentrations of two plant growth factors on small pieces of the stem tip from a papaya plant. Their results are shown in the table.

Concentration of auxin / μmol dm^{-3}	**Concentration of cytokinin / μmol dm^{-3}**		
	5	25	50
0	No effect	No effect	Leaves produced
1	No effect	Leaves produced	Leaves produced
5	No effect	Leaves produced	Leaves and some plantlets produced
10	Callus produced	Leaves and some plantlets produced	Plantlets produced
15	Callus produced	Callus and some leaves produced	Callus and some leaves produced

Callus is a mass of undifferentiated plant cells. Plantlets are small plants.

(a) Explain the evidence from the table that cells from the stem tip are totipotent.

(2)

(b) Calculate the ratio of cytokinin : auxin that you would recommend to grow papaya plants by this method.

Answer _____

(2)

(c) (i) Papaya plants reproduce sexually by means of seeds. Papaya plants grown from seeds are very variable in their yield. Explain why.

_____

_____

_____

_____

_____

(2)

(ii) Explain the advantage of growing papaya plants from tissue culture rather than from seeds.

_____

_____

_____

(1)

(Total 7 marks)

16 The table shows some differences between three varieties of banana plant.

	Variety **A**	Variety **B**	Variety **C**
Number of chromosomes in a leaf cell	22	33	44
Growth rate of fruit / cm^3 $week^{-1}$	2.9	6.9	7.2
Breaking strength of leaf / arbitrary units	10.8	9.4	7.8

(a) (i) How many chromosomes are there in a male gamete from variety **C**?

(1)

(ii) Variety **B** cannot produce fertile gametes. Use information in the table to explain why.

(2)

In some countries very strong winds may occur. Banana growers in these countries choose to grow variety **B**.

(b) (i) Use the data in the table to explain why banana growers in these countries choose to grow variety **B** rather than variety **A**.

(1)

(ii) Use the data in the table to explain why banana growers in these countries choose to grow variety **B** rather than variety **C**.

(1)

(c) Banana growers can only grow new variety **B** plants from suckers. Suckers grow from cells at the base of the stem of the parent plant.

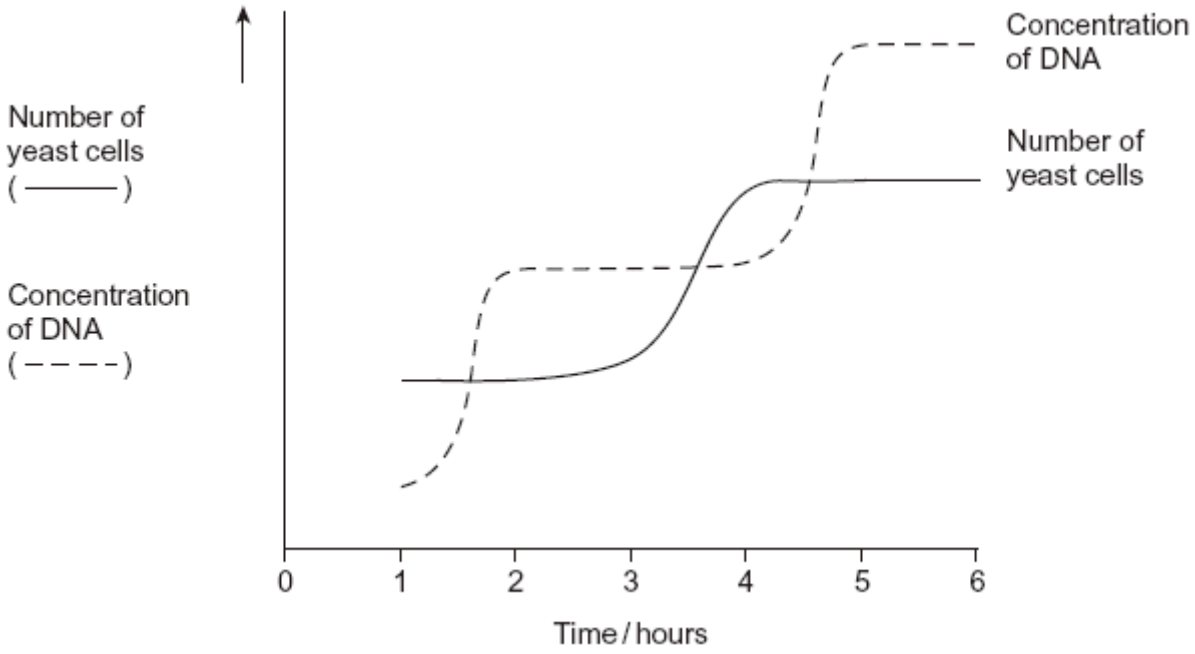
Use your knowledge of cell division to explain how growing variety **B** on a large scale will affect the genetic diversity of bananas.

(2)

(Total 7 marks)

17 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

_____

_____

(1)

(ii) between 3 and 4 hours.

_____

_____

(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 _____

_____

_____

_____

(3)

(Total 5 marks)

18 Taxol is a drug used to treat cancer. Research scientists investigated the effect of injecting taxol on the growth of tumours in mice. Some of the results are shown in **Figure 1**.

Figure 1

Number of days of treatment	Mean volume of tumour / mm^3	
	Control group	Group injected with taxol in saline
1	1	1
10	7	2
20	21	11
30	43	20
40	114	48
50	372	87

(a) Suggest how the scientists should have treated the control group.

_____

_____

_____

_____

(2)

(b) Suggest and explain **two** factors which should be considered when deciding the number of mice to be used in this investigation.

1. _____

_____

2. _____

_____

(2)

(c) The scientists measured the volume of the tumours. Explain the advantage of using volume rather than length to measure the growth of tumours.

_____

_____

(1)

(d) The scientists concluded that taxol was effective in reducing the growth rate of the tumours over the 50 days of treatment. Use suitable calculations to support this conclusion.

(2)

(e) In cells, taxol disrupts spindle activity. Use this information to explain the results in the group that has been treated with taxol.

_____

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_____

_____

(3)

(f) The research scientists then investigated the effect of a drug called OGF on the growth of tumours in mice. OGF and taxol were injected into different mice as separate treatments or as a combined treatment. **Figure 2** and **Figure 3** show the results from this second investigation.

Figure 2

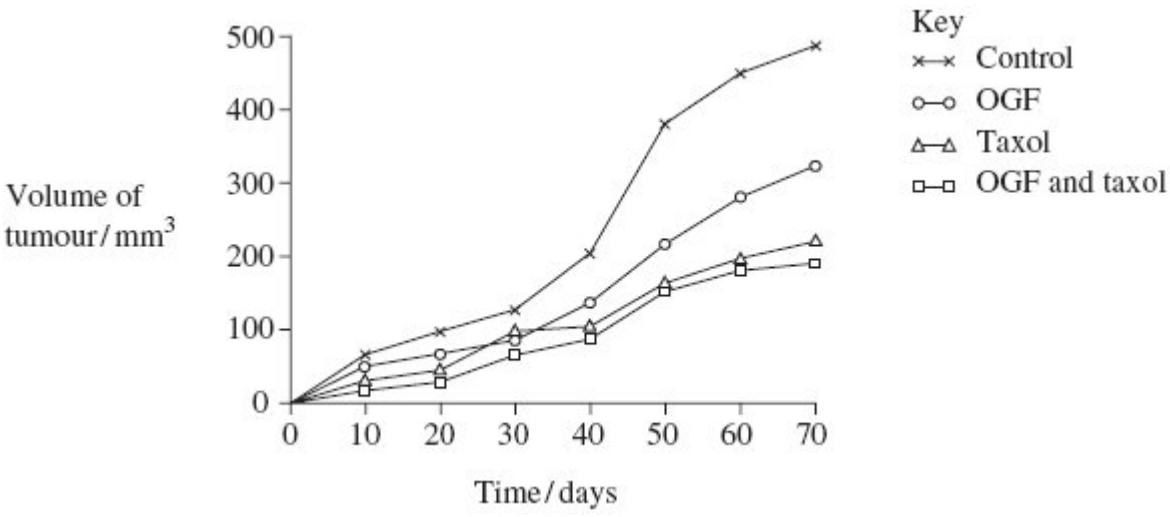

Figure 3

Treatment	Mean volume of tumour following 70 days treatment /mm^3 (± standard deviation)
OGF	322 (± 28.3)
Taxol	207 (± 22.5)
OGF and taxol	190 (± 25.7)
Control	488 (± 32.4)

(i) What information does standard deviation give about the volume of the tumours in this investigation?

_____

_____

(1)

(ii) Use **Figure 2** and **Figure 3** to evaluate the effectiveness of the two drugs when they are used separately and as a combined treatment.

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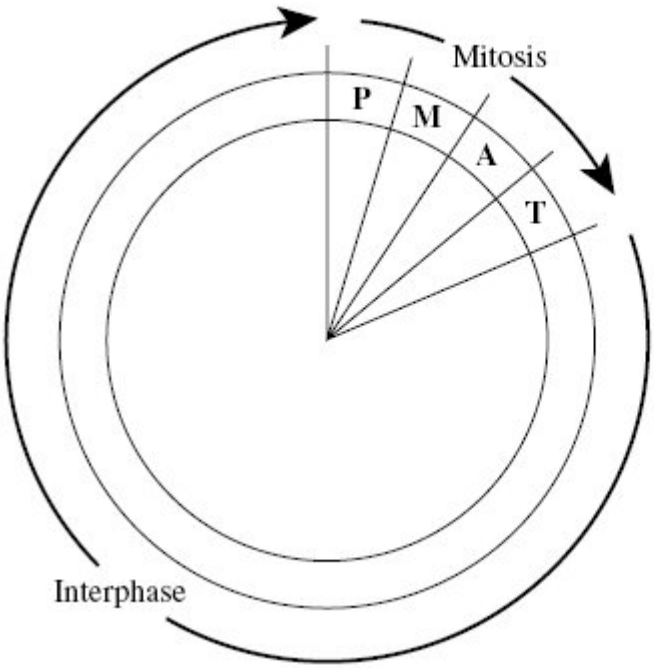
(4)

(Total 15 marks)

19 The diagram shows a cell cycle.



Key

P prophase

M metaphase

A anaphase

T telophase

(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

_____

(1)

(ii) A drug that prevents spindle fibres shortening

_____

(1)

(Total 9 marks)

20 (a) Name the process by which bacterial cells divide.

_____

(1)

A microbiologist investigated the ability of different plant oils to kill the bacterium *Listeria monocytogenes*. She cultured the bacteria on agar plates. She obtained the bacteria from a broth culture.

(b) Describe **two** aseptic techniques she would have used when transferring a sample of broth culture on to an agar plate.
Explain why each was important.

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(4)

The microbiologist tested five different plant oils at two different temperatures and determined the minimum concentration of plant oil that killed the *L. monocytogenes*.

The table below shows her results.

Plant oil	**Minimum concentration of plant oil that killed *Listeria monocytogenes* / percentage**	
	4 °C	**35 °C**
Bay	0.10	0.04
Cinnamon	0.08	0.08
Clove	0.05	0.05
Nutmeg	>1.00	0.05
Thyme	0.02	0.03

(c) Which plant oil is least effective at killing *L. monocytogenes* at 35 °C?

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(1)

L. monocytogenes is a pathogen of great concern to the food industry, especially in foods stored in refrigeration conditions (4 °C) where, unlike most food-borne pathogens, it is able to multiply. It has been suggested that plant oils, together with refrigeration may help to reduce the growth of *L. monocytogenes*.

(d) What conclusions can be drawn about the effectiveness of using plant oils with refrigeration to reduce food-borne infections caused by *L. monocytogenes*?

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(3)

(e) Plant oils are hydrophobic and can cross the cell-surface membrane of the bacterium. The low temperature of 4 °C can slow the rate of entry of plant oils into the cells.

Suggest how the low temperature slows the rate of entry.

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(1)

(Total 10 marks)

21 (a) Describe the appearance and behaviour of chromosomes during mitosis.

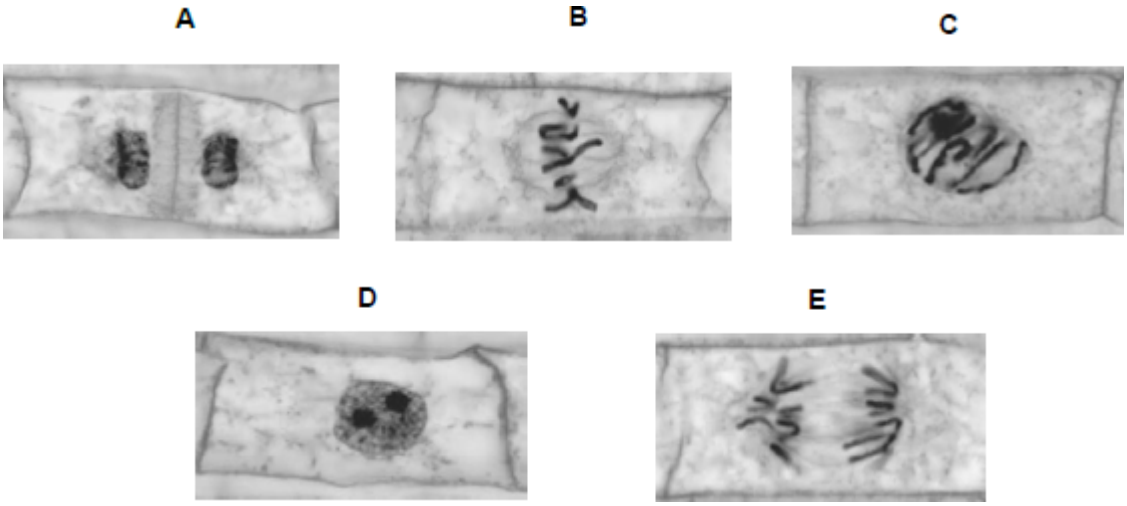
(5)

(b) Describe and explain the processes that occur during meiosis that increase genetic variation.

(5)

(Total 10 marks)

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



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

D

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(1)

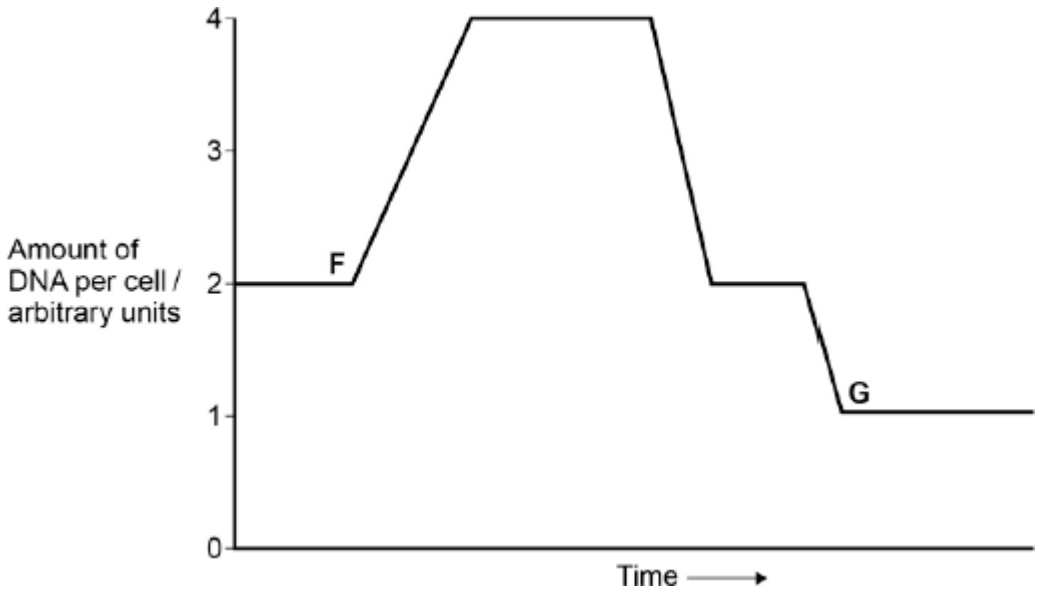
To obtain these images, the onion root tip was cut off, stained and put on a microscope slide. A cover slip was placed on top. The root tip was then firmly squashed and viewed under an optical microscope.

(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**.

(Extra space) _____

(3)

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

(1)

(Total 7 marks)