

# All cells arise from other cells 2

Level: CIE A Level 9700

Subject: Biology

Exam Board: Suitable for all boards

Topic: All cells arise from other cells 2

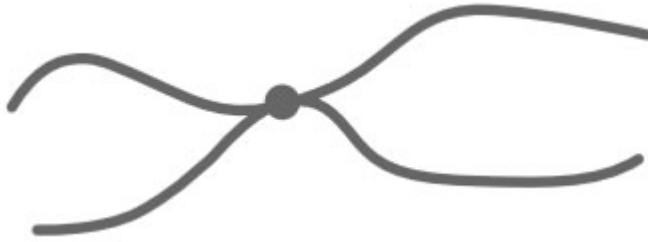
Type: Questionnaire

To be used by all students preparing for CIE Biology A Level 9700 foundation or higher tier but also suitable for students of other boards.



1

(a) The diagram shows a chromosome at the start of mitosis.



Describe and explain the appearance of the chromosome.

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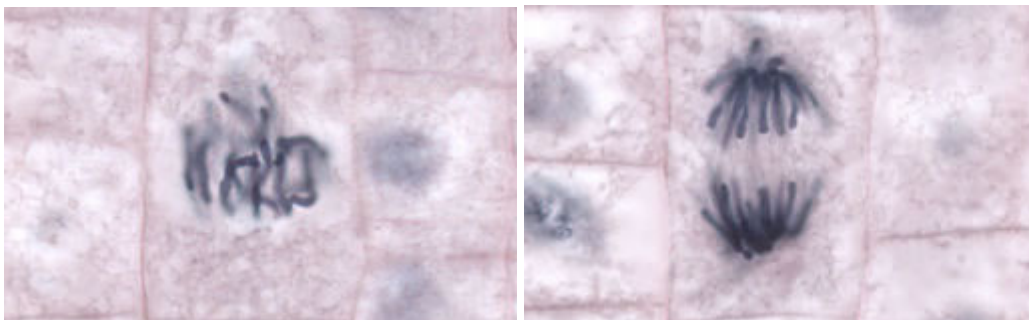
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(2)

(b) The photographs show two stages in mitosis.

Stage A

Stage B



By Dr. phil.nat Thomas Geier, Fachgebiet Botanik der Forschungsanstalt Geisenheim.  
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Name stages **A** and **B**. Describe what is happening to the chromosomes in each stage.

(i) Stage A \_\_\_\_\_

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(ii) Stage B \_\_\_\_\_

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(2)

(2)

(Total 6 marks)



(b) Explain why it is important to destroy all the cancer cells in a tumour.

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(2)

(c) Explain how the use of antibodies (lines 16-17) results in a drug only killing cancer cells.

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(3)

(d) Cancer drugs usually interfere with DNA replication. Use this information to explain why the cancer drugs are administered as prodrugs and not the active form.

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(4)

**(Total 15 marks)**



**2** 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;

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(1)

(ii) a stain was used;

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(1)

(iii) the root tip was firmly squashed.

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(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. \_\_\_\_\_

\_\_\_\_\_

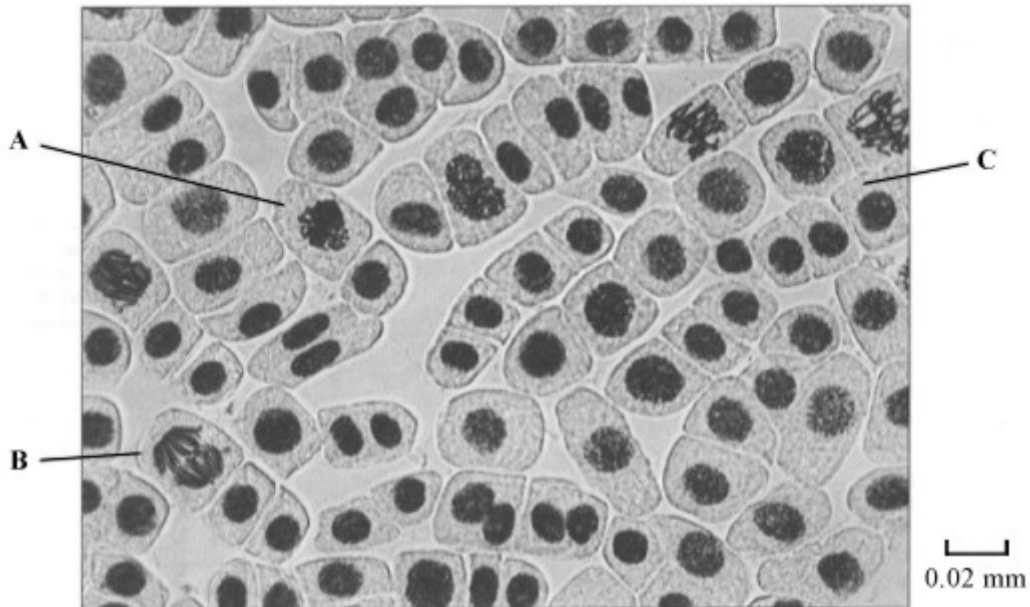
2. \_\_\_\_\_

\_\_\_\_\_

(2)

(Total 7 marks)

**3** 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)



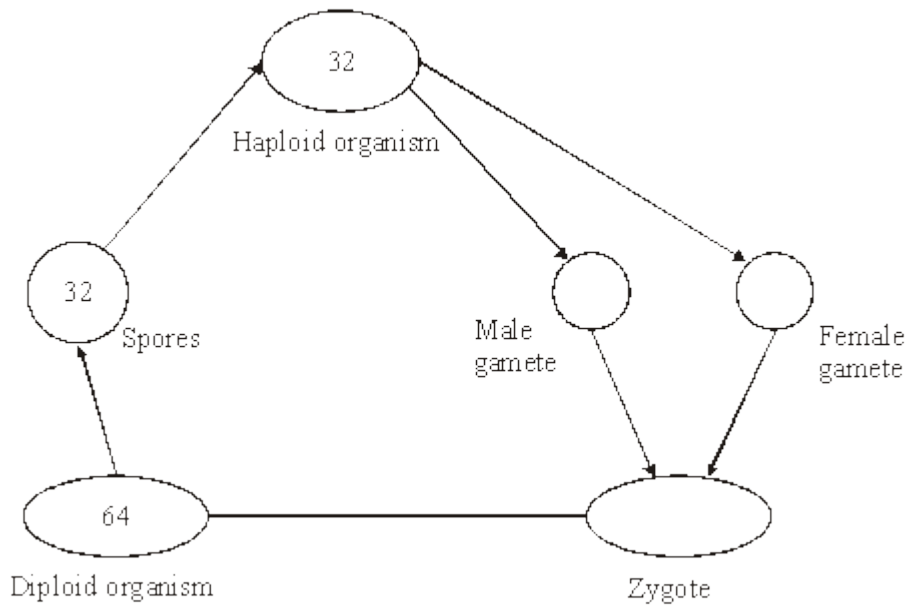
4

(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.

\_\_\_\_\_

(1)

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

\_\_\_\_\_

(1)

(Total 7 marks)



**5** Division of the nucleus by meiosis produces haploid cells from a diploid cell. Nuclei produced by mitosis have the same number of chromosomes as the parent nucleus.

(a) What is the biological importance of reducing the chromosome number when the cell divides by meiosis?

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(2)

(b) The table gives one difference between meiosis and mitosis. Complete the table by giving **three** further differences.

	Meiosis	Mitosis
1	Reduces the chromosome number	Maintains the same chromosome number as in the parent nucleus
2		
3		
4		

(3)

(Total 5 marks)

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

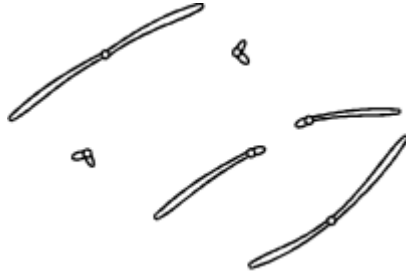
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(1)





- (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.

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(1)

(Total 6 marks)

7

- (a) Some tumours are benign and some are malignant.

- (i) Give **one** way in which a benign tumour differs from a malignant tumour.

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(1)



(ii) Describe **two** ways in which both types of tumour may cause harm to the body.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

(2)

(b) (i) Explain the link between sunbathing and skin cancer.

\_\_\_\_\_

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\_\_\_\_\_

\_\_\_\_\_

(2)

(ii) Suggest why fair-skinned people are at a greater risk of skin cancer than dark-skinned people when sunbathing.

\_\_\_\_\_

\_\_\_\_\_

(1)

(iii) Suggest why people with a family history of cancer are at a greater risk of cancer than those with no family history of cancer.

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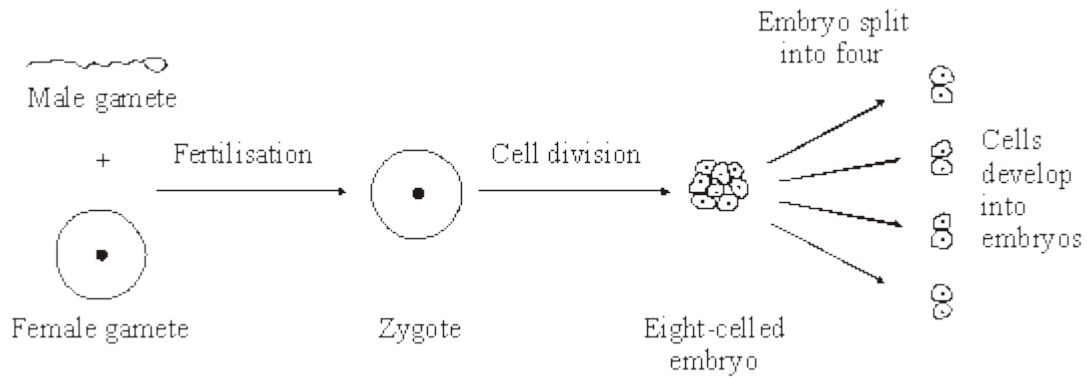
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(1)

(Total 7 marks)



**8** An egg cell from a cow was fertilised in a laboratory and allowed to develop into an eight-celled embryo. This was split into four parts, each of which developed into a new embryo. This is shown in the diagram. The new embryos were later transferred into different surrogate cows.



(a) Explain why the new embryos produced are a clone.

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(2)

(b) If embryos with more than eight cells are split up, the separated cells fail to develop into new embryos. Suggest why.

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(1)

(c) Give **two** advantages to a farmer of using embryos produced by this procedure.

Advantage 1 \_\_\_\_\_

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Advantage 2 \_\_\_\_\_

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(2)

(Total 5 marks)



9

(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)

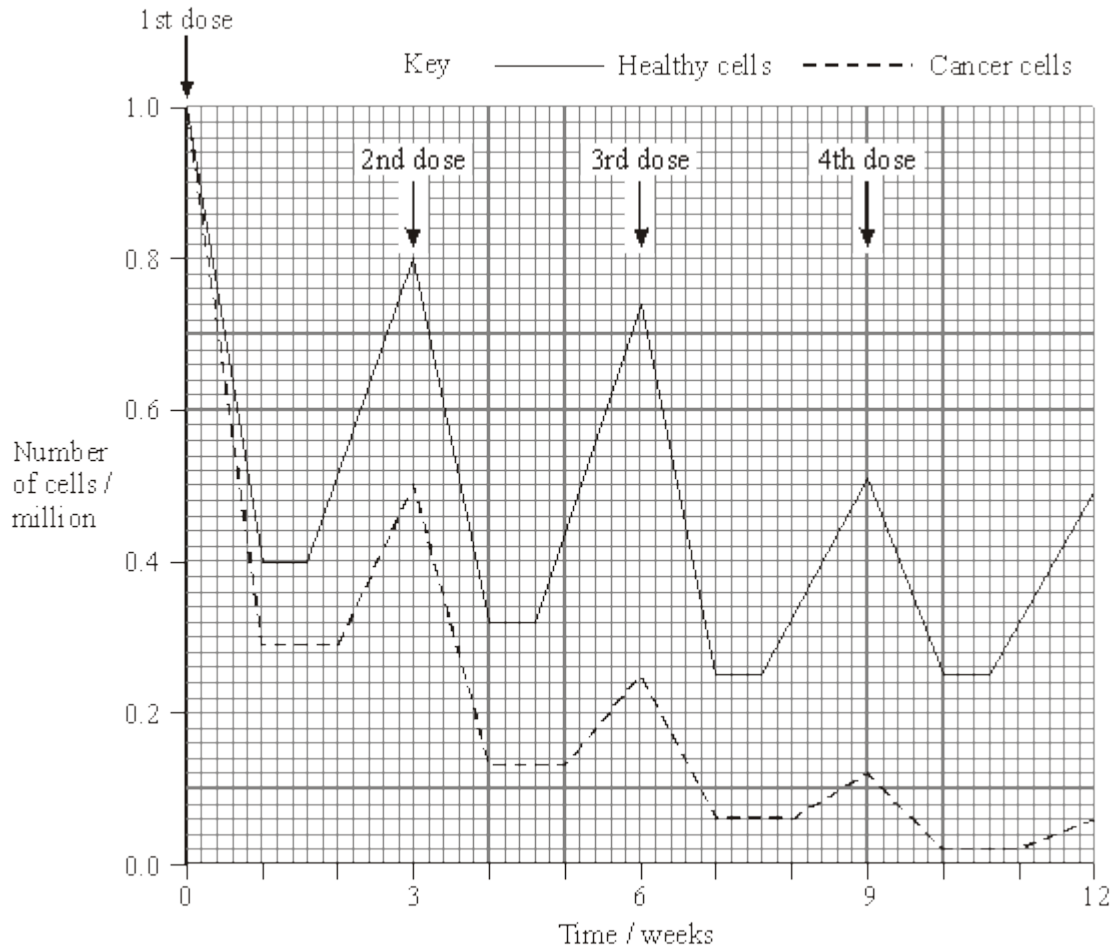
(b) Name the phase during which DNA replication occurs.

\_\_\_\_\_

(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.

\_\_\_\_\_

(1)



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

1. \_\_\_\_\_

\_\_\_\_\_

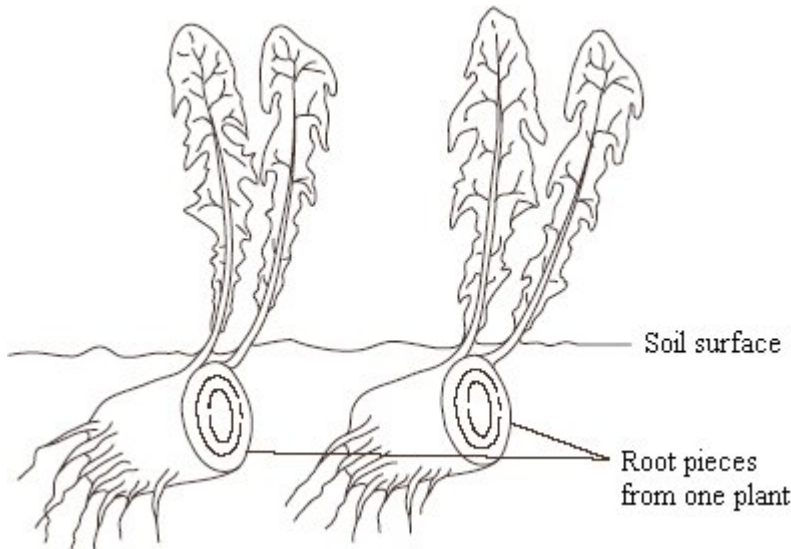
2. \_\_\_\_\_

\_\_\_\_\_

(2)

(Total 8 marks)

**10** It is difficult to get rid of dandelions from a garden because small pieces of the root are able to grow into new plants if left behind in the soil. This is shown in the drawing.



(a) Explain why the plants produced form a clone.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2)

(b) Suggest **one** reason why the plants in a clone may not be identical in appearance.

\_\_\_\_\_  
\_\_\_\_\_

(1)



- (c) Most plants produce seeds after fertilisation in sexual reproduction. However, dandelions produce small, windblown seeds without fertilisation taking place. Suggest **two** advantages to the dandelion of being able to reproduce from these seeds, as well as from pieces of root.

Advantage 1 \_\_\_\_\_

\_\_\_\_\_

Advantage 2 \_\_\_\_\_

\_\_\_\_\_

(2)

(Total 5 marks)

11

- (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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(2)

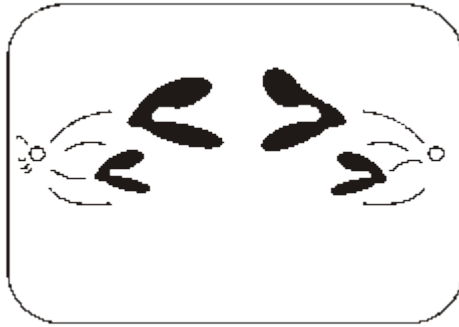
(Total 13 marks)





12

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



(i) Name this stage of mitosis.

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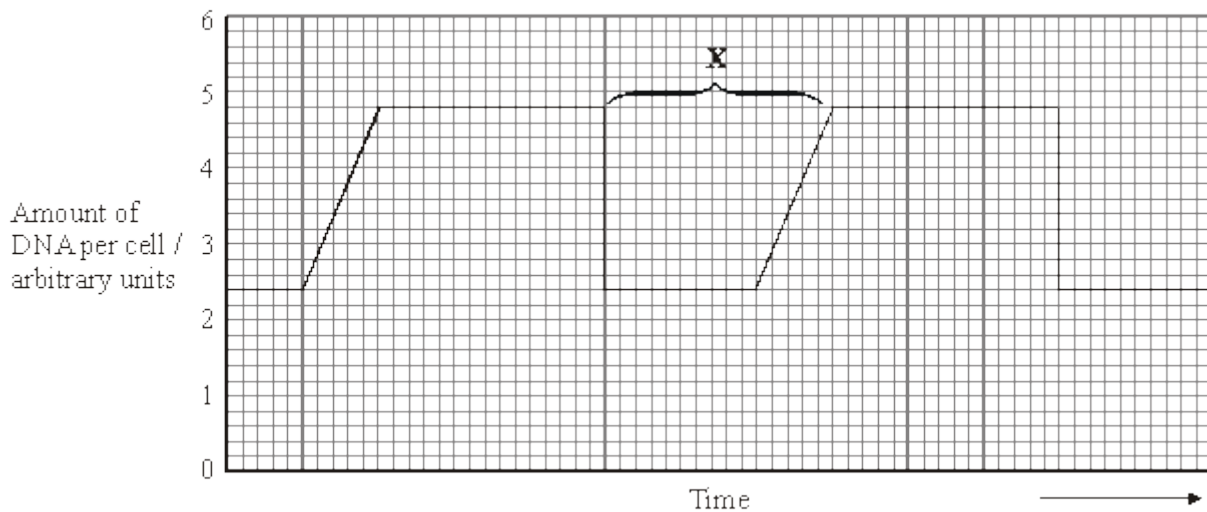
(1)

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

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(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?

\_\_\_\_\_  
\_\_\_\_\_

(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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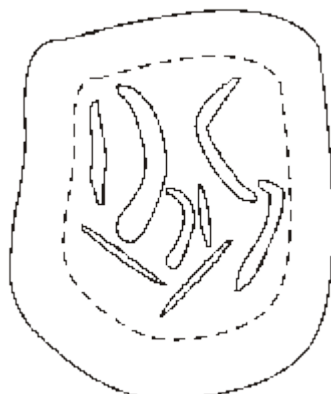
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(1)

(Total 7 marks)

13

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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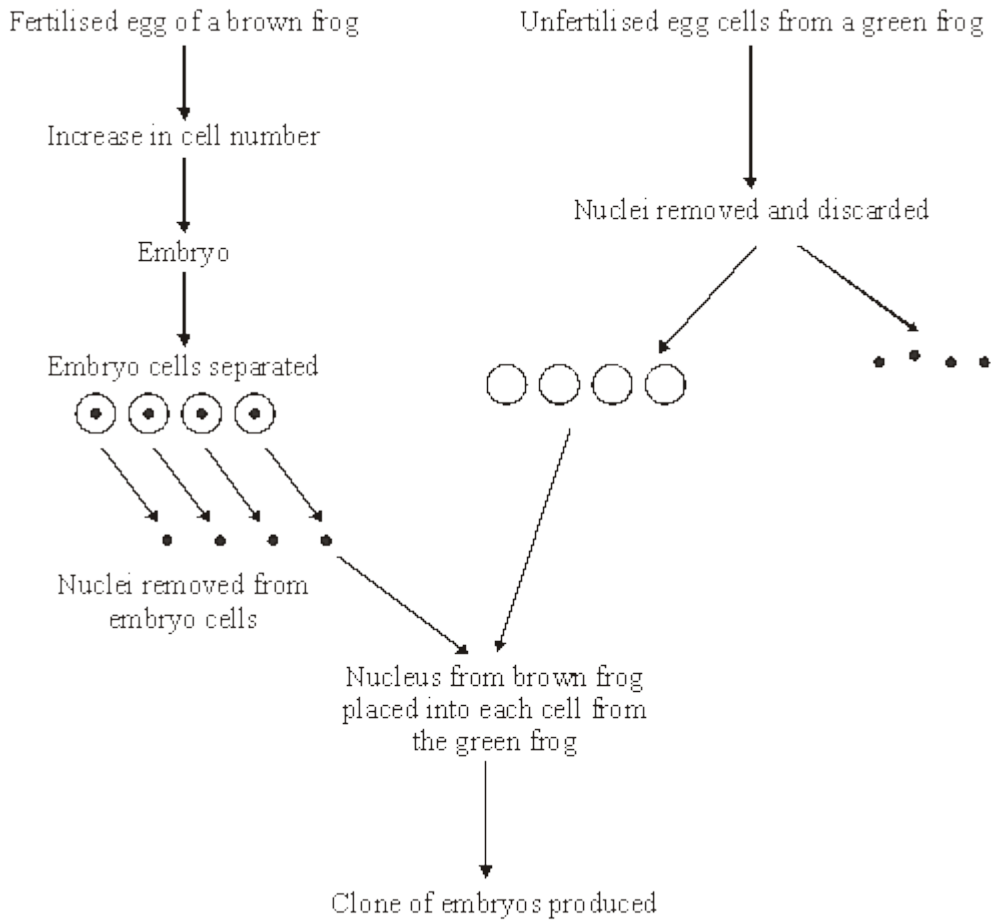
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(2)

**(Total 6 marks)**

14

A clone of frogs was produced by nuclear transfer. This procedure is summarised in the diagram.



(a) What is a clone?

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(1)

(b) Name the type of cell division occurring in a developing embryo.

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(1)

(c) The embryo cells used are from an early stage of development. Explain why.

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(1)

(d) What would be the colour of the cloned offspring? Explain your answer.

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(1)



(e) Give **two** differences between the nuclei removed from the embryo cells and the nuclei discarded from the unfertilised egg cells.

1. \_\_\_\_\_

2. \_\_\_\_\_

(2)

(f) Only 30% of the cloned cells successfully developed into embryos. Suggest a reason for this low success rate.

\_\_\_\_\_  
\_\_\_\_\_

(1)

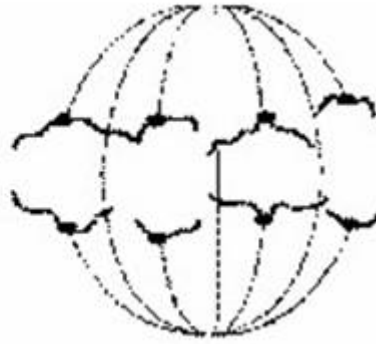
(Total 7 marks)

15

(a) The photographs show two stages in mitosis of a plant cell.



A



B

Name stages **A** and **B**. In each case describe what is happening to the chromosomes.

(i) Stage **A** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2)

(ii) Stage **B** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2)



(b) Describe **two** events during interphase which prepare a cell for mitosis.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

(2)

(Total 6 marks)

16

Research scientists can increase the nutritional value of potatoes by genetically engineering potato plants. A gene which results in increased protein production has been removed from cells of an amaranth plant and inserted into cells of a potato plant.

(a) Describe how a gene could be removed from cells of an amaranth plant and inserted into cells of a potato plant.

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(6)



(b) Whole potato plants can be produced from genetically identical potato cells grown in a tissue culture. Use your knowledge of genes to suggest how different cells, such as leaf and root cells, can develop from genetically identical cells.

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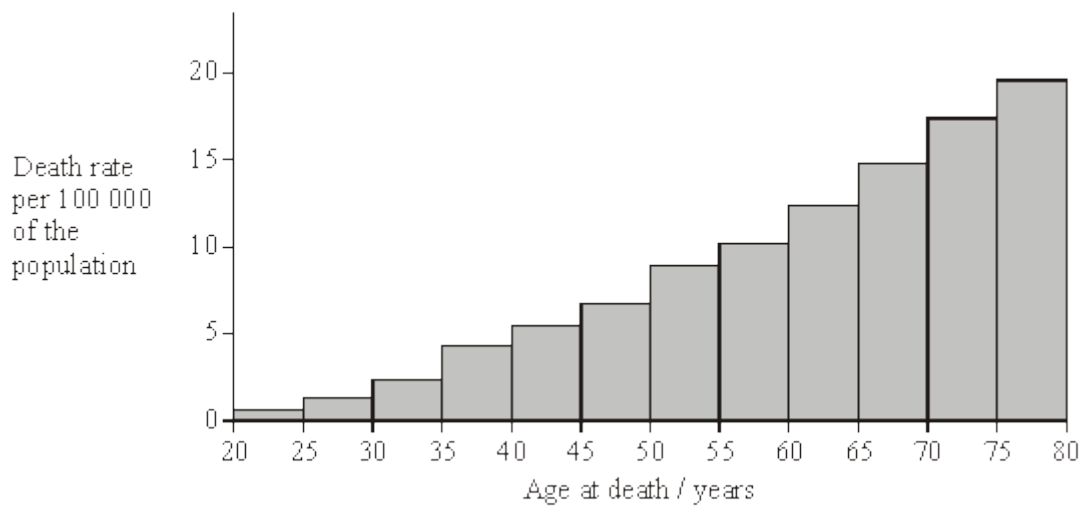
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(2)  
(Total 8 marks)

17

The death rate from malignant skin tumours was investigated in the USA. The graph shows the results for fair-skinned men in different age groups.



(a) Describe what is meant by a *malignant tumour*.

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(3)



- (b) Give **one** reason for the change in death rate from malignant skin tumours with increasing age.

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(1)

- (c) The data for fair-skinned and dark-skinned people were collected separately. Explain why skin colour was a factor likely to affect the death rate.

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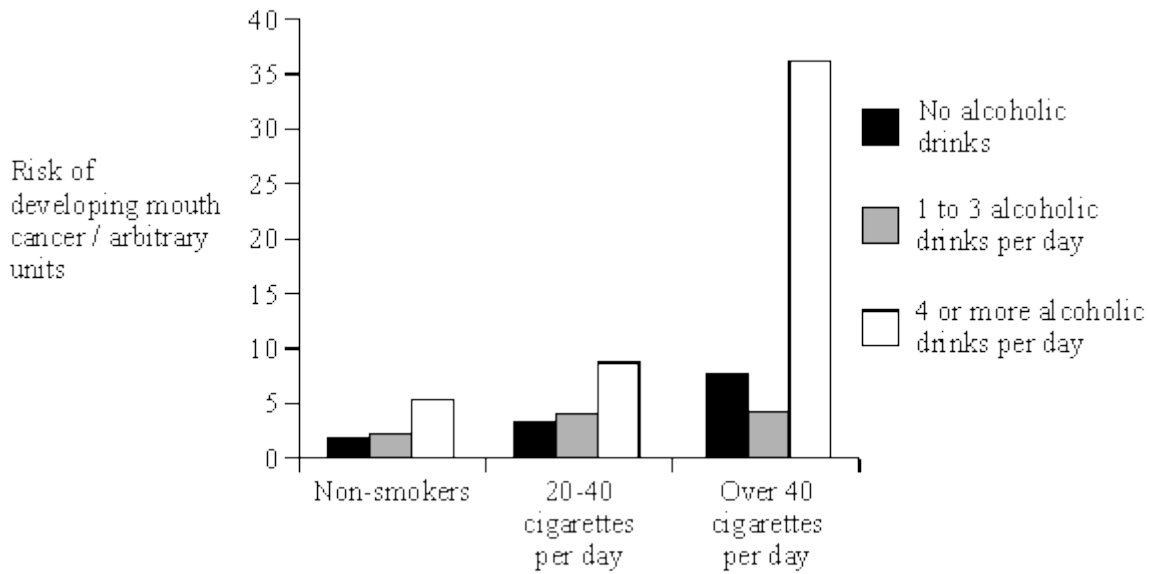
(2)

(Total 6 marks)





**18** The bar chart shows the effects of smoking and alcoholic drinks on the risk of developing mouth cancer.



(i) Describe the effects of smoking and drinking on the risk of developing mouth cancer.

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(3)

(ii) Suggest **one** reason why people who neither drink nor smoke sometimes develop mouth cancer.

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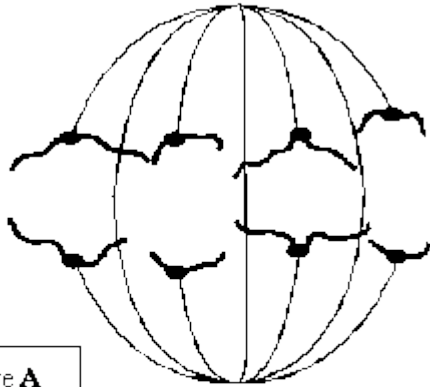
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(1)

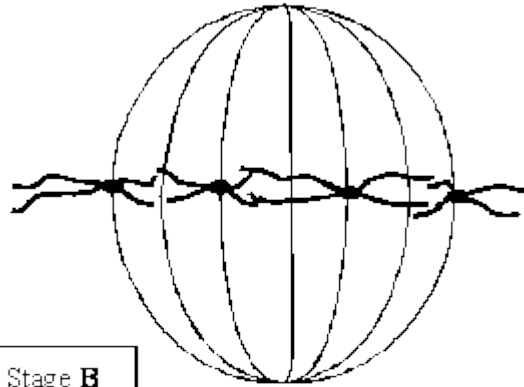
(Total 4 marks)

19

The diagrams show four stages of mitosis.



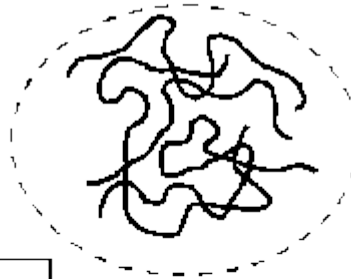
Stage **A**



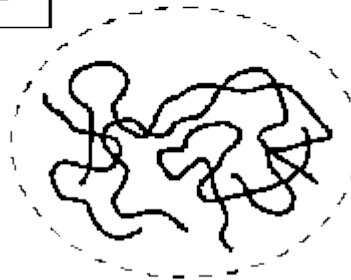
Stage **B**



Stage **C**



Stage **D**



(a) (i) Name stage **A**.

\_\_\_\_\_

(1)

(ii) Starting with stage **C**, give the stages **A** to **D** in the correct order.

**C** \_\_\_\_\_

(1)

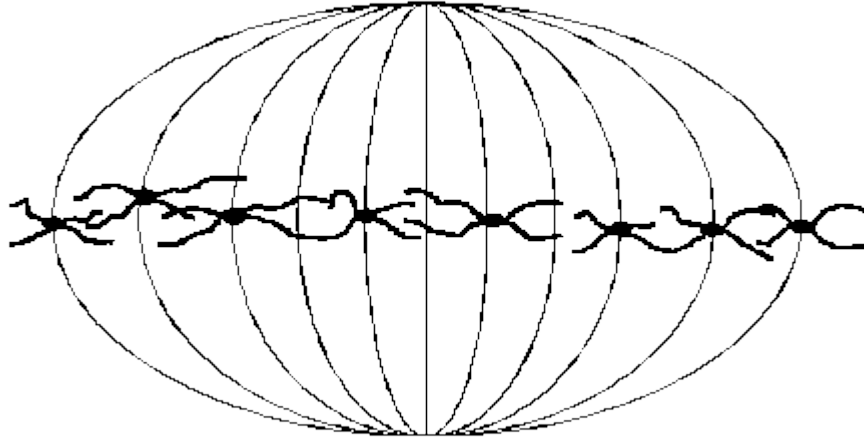
(iii) Describe and explain the appearance of one of the chromosomes in stage **B**.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

(2)



- (b) Colchicine is a substance that prevents the formation of the spindle in mitosis. Dividing cells were treated with colchicine. This stopped them dividing. After a few hours, the colchicine was removed and the cells began to divide again. The diagram shows the chromosomes from one of the treated cells at stage **B** after the cell began dividing again.



- (i) What has happened to the chromosome number?

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(1)

- (ii) Suggest an explanation for the change in the chromosome number.

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(1)

(Total 6 marks)

20

- (a) The following statements describe stages of mitosis.

- A chromosomes align at the centre of the cell attached to spindle fibres
- B chromatids are in groups at the poles
- C chromosomes become visible
- D chromatids move towards the poles

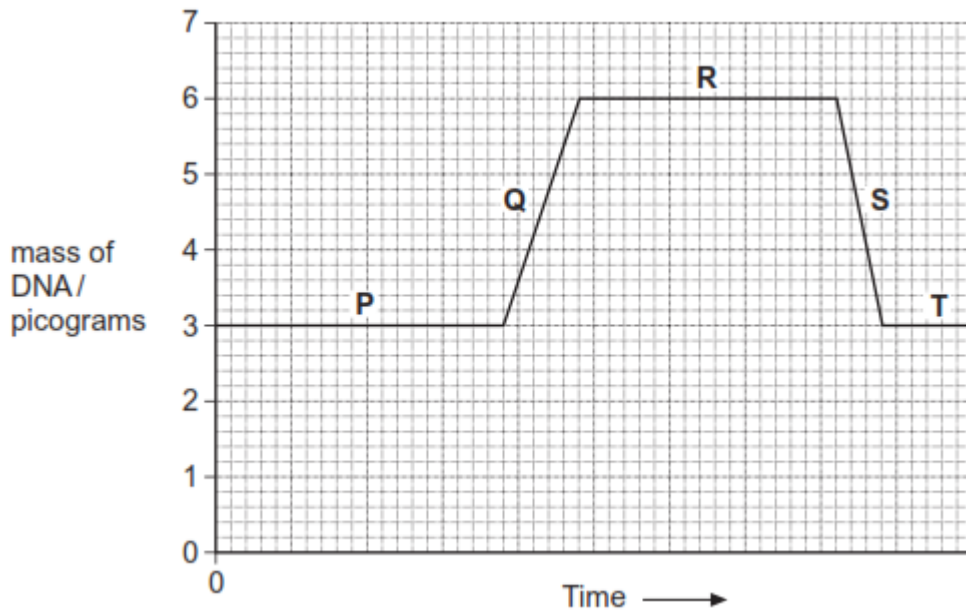
Complete the table by entering the appropriate letter.

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(3)



- (b) The graph shows changes in the mass of DNA in a cell during one cell cycle. Five stages have been identified on the graph.



- (i) Which letter represents the stage when DNA is replicating?

(1)

- (ii) Explain the change in the DNA content during stage **S**.

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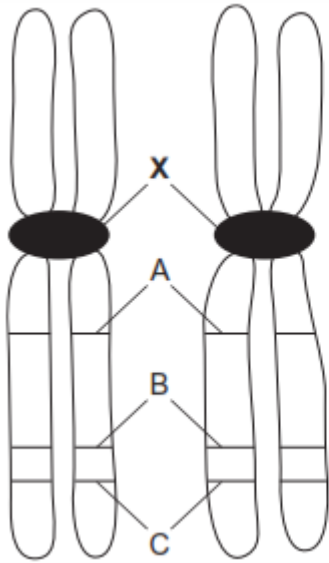
(1)

(Total 5 marks)



21

The diagram shows two chromosomes in a cell undergoing mitosis.



A – Gene for feature A  
B – Gene for feature B  
C – Gene for feature C

(a) Name **X**.

\_\_\_\_\_

(1)

(b) These are homologous chromosomes. Give **two** pieces of evidence from the diagram that support this.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

(2)

(c) What will happen to these chromosomes in anaphase?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2)

(Total 5 marks)



22

Read the following passage.

The idea that bacteria could be used as a cancer treatment originated over 100 years ago. A doctor noticed that some cancer patients with bacterial infections showed signs of recovery from the cancer. Attempts to use the bacteria as a treatment were disappointing, however. Experiments showed that the bacteria made an impressive  
5 onslaught on tumours, but a ring of cancerous tissue around the edge usually survived.

Bacteria are once again being used in the war on cancer. Scientists have genetically engineered a harmless strain of *Clostridium* to carry the gene for an enzyme. This enzyme converts a harmless “prodrug” into an active drug which acts as a powerful  
10 toxin. In people, this strain of *Clostridium* will only grow in tumours. Scientists hope that when they inject the prodrug into a cancer patient’s blood, the bacteria will convert it into an active drug. This will destroy tumours from the inside, leaving healthy tissues unharmed.

The idea of converting a harmless prodrug into an active drug that only kills cancer  
15 cells is not new. Apart from the use of genetically modified *Clostridium*, other methods have been tried. One of these involved attaching an enzyme to an antibody that binds only to cancer cells. This enzyme then activates the drug. Unfortunately, different types of cancer require different antibodies, making the treatment expensive to develop. Scientists hope their bacterial approach will offer a way of delivering the  
20 enzymes to any cancer cell.

(a) Describe how scientists could genetically engineer *Clostridium* bacteria to produce the enzyme which activates the prodrug. (lines 7-8)

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