Helicate

HELICATE · AS AND A-LEVEL BIOLOGY · TOPIC BANK

3.2.2 All cells arise from other cells

Topic question bank

Version 2 · 9 October 2026

Name

Date

QUESTIONS	TOTAL MARKS	TIME	YOUR SCORE
8	53	No time limit	/ 53

Contents

Subtopic	Questions	Marks
The cell cycle and mitosis Specification 3.2.2	01–03	18
Uncontrolled cell division and cancer treatment Specification 3.2.2	04	7
Binary fission and the replication of viruses Specification 3.2.2	05–06	13
Required practical 2: root tip squashes and mitotic index Specification 3.2.2	07–08	15
Total		**53**

Instructions

- Answer the questions in the spaces provided. Show all your working.
- The marks for each question are shown in brackets. Use them to judge how much detail to give.
- Work through a subtopic at a time, then mark your answers with the matching mark scheme.

Original questions by Helicate for AQA AS and A-level Biology (7401/7402), specification section 3.2.2. Not affiliated with or endorsed by AQA.

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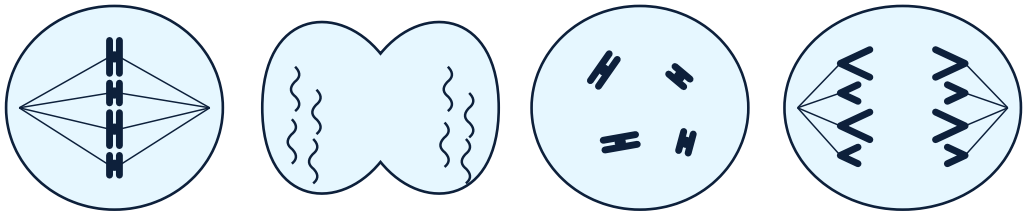
The cell cycle and mitosis 3.2.2

Figure 1 shows four cells, **P**, **Q**, **R** and **S**, from a culture of animal cells. Each cell is at a different stage of mitosis.

The drawings show only the cell-surface membrane, the chromosomes and the spindle fibres.

Figure 1



0 1 . 1 Which shows the order in which stages **P**, **Q**, **R** and **S** occur during mitosis?
Tick (✓) one box.

[1 mark]

P → R → S → Q ☐

R → P → S → Q ☐

R → S → P → Q ☐

R → P → Q → S ☐

0 1 . 2 Explain the appearance of the chromosomes in cell **S**.

[2 marks]

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Question 1 continues on the next page

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Substance K prevents spindle fibres from forming. A scientist added substance K to a culture of these animal cells.

- Before substance K was added, the mitotic index of the culture was 0.05.
- Three hours after substance K was added, the mitotic index was 0.19. Almost all of the cells in mitosis looked like cell **R**, and none looked like cells **P**, **Q** or **S**.

The scientist concluded that substance K does not stop cells from starting mitosis, but does stop them from completing it.

0 1 . 3 Explain how these results support the scientist's conclusion.

[3 marks]

6

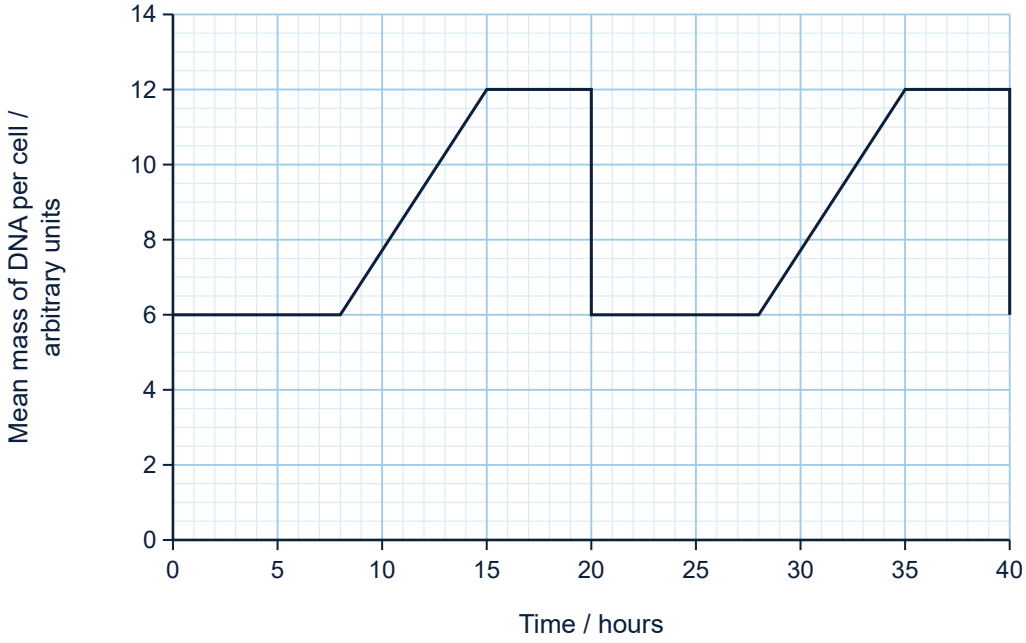
Turn over for the next question

Do not write outside the box

Scientists grew a culture of mouse cells. They treated the cells so that all of the cells went through the cell cycle at the same time.

Figure 2 shows how the mean mass of DNA per cell changed over 40 hours.

Figure 2



0 2 . 1 Name the process that causes the change in the mean mass of DNA per cell between 8 hours and 15 hours.

[1 mark]

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0 2 . 2 Use Figure 2 to calculate the percentage of the cell cycle during which DNA is being replicated.

[2 marks]

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.....

.....

Answer ..... **%**

Question 2 continues on the next page

Do not write outside the box

0 2 . 3 Explain why the mean mass of DNA per cell halves at 20 hours.

[2 marks]

0 2 . 4 Many types of cell in the body of a mouse, such as nerve cells, do not keep the ability to divide.
Describe what Figure 2 would look like over 40 hours for a culture of nerve cells.

[1 mark]

6

Turn over for the next question

Do not write outside the box

0 3 A cell has just finished interphase.
Describe what happens during mitosis and cytokinesis in this cell. In your answer, explain how the two cells produced come to have identical copies of the DNA in the original cell.

[6 marks]

6

Turn over for the next question

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Uncontrolled cell division and cancer treatment 3.2.2

0 4 . 1 Which statement describes a tumour?
Tick (✓) one box.

[1 mark]

A mass of cells produced by uncontrolled mitosis ☐

A mass of cells produced by uncontrolled meiosis ☐

A group of cells that have lost the ability to divide ☐

A group of cells in which DNA replication has stopped ☐

Question 4 continues on the next page

Do not write outside the box

Drug D is used to treat some types of cancer. Drug D binds to spindle fibres and stops them from shortening. Cells that cannot complete mitosis die.

Scientists gave a single dose of drug D to mice with tumours. Before treatment, the scientists measured the mitotic index of cells in five tissues. Five days after treatment, they measured the percentage decrease in the number of cells in each tissue.

Table 1 shows their results.

Table 1

Tissue	Mitotic index before treatment	Decrease in number of cells 5 days after treatment / %
Tumour	0.110	62
Lining of small intestine	0.085	45
Hair follicles in skin	0.060	31
Liver	0.004	3
Heart muscle	0.000	0

0 4 . 2 Use Table 1 and the information about drug D to explain the differences between the tissues in the decrease in the number of cells.

[3 marks]

Question 4 continues on the next page

Do not write outside the box

0 4 . 3 A doctor suggested that drug D would be a suitable treatment for cancer in humans.
Use Table 1 to evaluate this suggestion.

[3 marks]

7

Turn over for the next question

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Do not write outside the box

Binary fission and the replication of viruses 3.2.2

0 5 . 1 Which process happens during binary fission of a bacterium but does **not** happen during the cell cycle of an animal cell?
Tick (✓) one box.

[1 mark]

Replication of DNA ☐

Division of the cytoplasm ☐

Replication of plasmids ☐

Condensation of chromosomes ☐

Question 5 continues on the next page

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Scientists investigated one type of plasmid in a species of bacterium. They used a dye that binds only to this plasmid to count the plasmids in individual cells.

They counted the plasmids in five parent cells just before binary fission, and in both of the daughter cells produced by each parent cell.

Table 2 shows their results.

Table 2

Parent cell	Number of plasmids in parent cell just before division	Number of plasmids in daughter cell 1	Number of plasmids in daughter cell 2
1	24	11	13
2	18	9	9
3	30	12	18
4	22	14	8
5	26	10	16

A student concluded that each daughter cell receives half of the plasmids in the parent cell.

0 5 . 2 Use Table 2 to evaluate the student's conclusion.

[2 marks]

Question 5 continues on the next page

Do not write outside the box

0 5 . 3 The scientists also found that every daughter cell contained exactly one molecule of circular DNA.
Explain why every daughter cell receives one molecule of circular DNA but the number of plasmids varies.

[2 marks]

5

Turn over for the next question

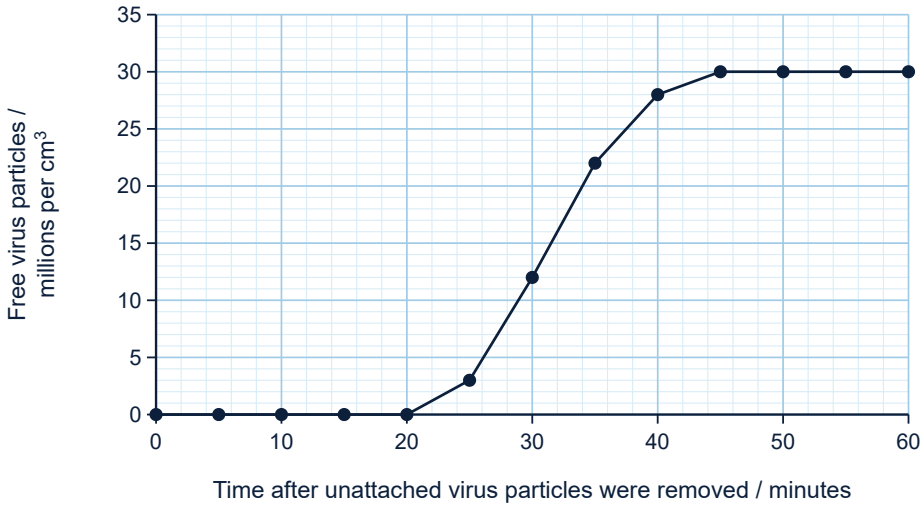
Do not write outside the box

Virus T infects bacteria. Scientists mixed virus T with a culture of bacteria for 5 minutes, so that virus particles could attach to the bacteria. They then removed all of the virus particles that had not attached.

After this, they measured the number of free virus particles in the culture at 5-minute intervals.

Figure 3 shows their results.

Figure 3



0 6 . 1 Viruses do not undergo cell division.
Describe how virus T infects a bacterium and how new virus particles are then produced.

[4 marks]

Question 6 continues on the next page

Do not write outside the box

0 6 . 2 No free virus particles were detected during the first 20 minutes.
What can you conclude about events inside the infected bacteria during these 20 minutes? Explain your answer.

[2 marks]

0 6 . 3 At the start, the culture contained 2.0×10^5 infected bacteria per cm^3. Each infected bacterium released the same number of virus particles.
Use Figure 3 to calculate the number of virus particles released by each bacterium.

[2 marks]

Answer .....

8

Turn over for the next question

Do not write outside the box

Required practical 2: root tip squashes and mitotic index 3.2.2

To see cells in mitosis, a student made a squash from the tip of a pea seedling root. The student cut off the last 3 mm of a root and warmed it in hydrochloric acid at 60 °C for 5 minutes. After rinsing it in water, the student placed it on a microscope slide and added a few drops of a stain that binds to DNA. Then the student covered the tissue with a coverslip, pressed down firmly and looked at the slide with an optical microscope.

0 7 . 1 The student used only the last 3 mm of the root.
Explain why.

[2 marks]

0 7 . 2 Explain why the student used a stain that binds to DNA.

[1 mark]

Question 7 continues on the next page

Do not write outside the box

The student counted the number of cells at each stage of the cell cycle in five fields of view. Table 3 shows the totals.

Table 3

Stage of the cell cycle	Number of cells
Interphase	425
Prophase	42
Metaphase	15
Anaphase	6
Telophase	12

0 7 . 3 Use Table 3 to calculate the mitotic index of these cells.

[1 mark]

Answer .....

0 7 . 4 The cell cycle of these root tip cells lasts 16 hours. Assume that the proportion of cells at each stage is proportional to the time the cells spend at that stage.
Use Table 3 to calculate the time these cells spend in metaphase. Give your answer in minutes.

[2 marks]

Answer ..... **minutes**

Question 7 continues on the next page

Do not write outside the box

0 7 . 5 The student photographed one field of view and printed the image. On the printed image, at a magnification of ×600, one cell in interphase was 24 mm long.
Calculate the actual length of this cell in μm.

[2 marks]

Answer ..... **μm**

0 7 . 6 The student then made a scientific drawing of one cell in anaphase.
Give **two** things the student should do so that the drawing follows scientific conventions.

[2 marks]

1 .....

.....

2 .....

.....

10

Turn over for the next question

Do not write outside the box

Another student investigated the effect of temperature on the mitotic index of pea root tips. She grew pea seedlings at five different temperatures for 4 days.

At each temperature, she prepared squashes of 10 root tips. She found the mitotic index of each root tip using one field of view. She then calculated the mean and standard deviation for each temperature.

Table 4 shows her results.

Table 4

Temperature / °C	Mean mitotic index	Standard deviation
10	0.041	0.012
15	0.074	0.013
20	0.112	0.021
25	0.126	0.024
30	0.078	0.012

She concluded that the rate of cell division in pea root tips increases as temperature increases.

Question 8 continues on the next page

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0 8 Evaluate her conclusion.

[5 marks]

5

END OF QUESTIONS

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