# Cell Division and the Cell Cycle: AQA A Level Biology Exam Questions b

18 questions · 45 marks · about 58 minutes. Answer in the spaces, then check the mark schemes at the end.

**Question 1 · A level Paper 1 · June 2019 · Q06.1 · 2 marks**

**0 6** Scientists investigated the cell cycle in heart cells taken from mice 6 days before their birth and then at 4, 14 and 21 days after their birth.

Their results are shown in **Table 4**. Age 0 days = day of birth.

**Table 4**

| Age / days | Percentage of heart cells undergoing mitosis | Percentage of heart cells undergoing DNA replication |
|---|---|---|
| –6 | 13.9 | 8.5 |
| 4 | 8.5 | 2.6 |
| 14 | 1.6 | 0.2 |
| 21 | 0.6 | 0.0 |

**0 6 . 1** Describe and explain the data in **Table 4**.

**[2 marks]**

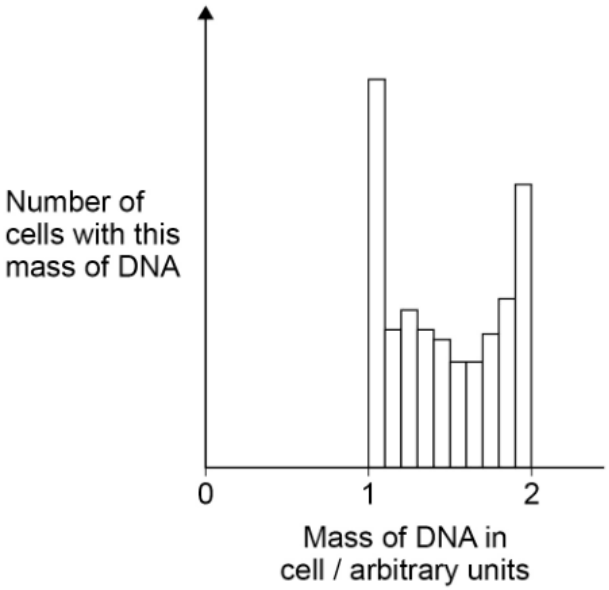
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**Question 2 · AS Paper 2 · June 2023 · Q07.1 · 3 marks**

**0 7 . 1** **Figure 4** shows the mass of DNA present in a group of healthy cells.

**Figure 4**




Use your knowledge of the cell cycle to explain the results shown in **Figure 4**.

**[3 marks]**


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**Table 2** shows some of the features of the phases of the eukaryotic cell cycle.

**Table 2**

| Phase | Features |
|---|---|
| First phase of interphase | Ribosomes synthesised<br>Proteins synthesised |
| Second phase of interphase | DNA replicated<br>Histones synthesised<br>DNA associates with histones |
| Third phase of interphase | Accuracy of DNA replication is checked<br>Membrane-bound organelles replicated |
| Stages of mitosis | Prophase, metaphase, anaphase, telophase |
| Cytokinesis | Cytoplasm divides<br>Cell-surface membrane formed |

**0 5 . 2** Use the information in **Table 2** to give **two** similarities and **two** differences between the eukaryotic cell cycle and binary fission.

**[4 marks]**

Similarity 1 _____

_____

_____

Similarity 2 _____

_____

_____

Difference 1 _____

_____


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**Question 4 · A level Paper 1 · June 2024 · Q05.1 · 4 marks**

**0 5 . 1** Describe the appearance **and** behaviour of chromosomes during prophase and during anaphase of mitosis.

**[4 marks]**

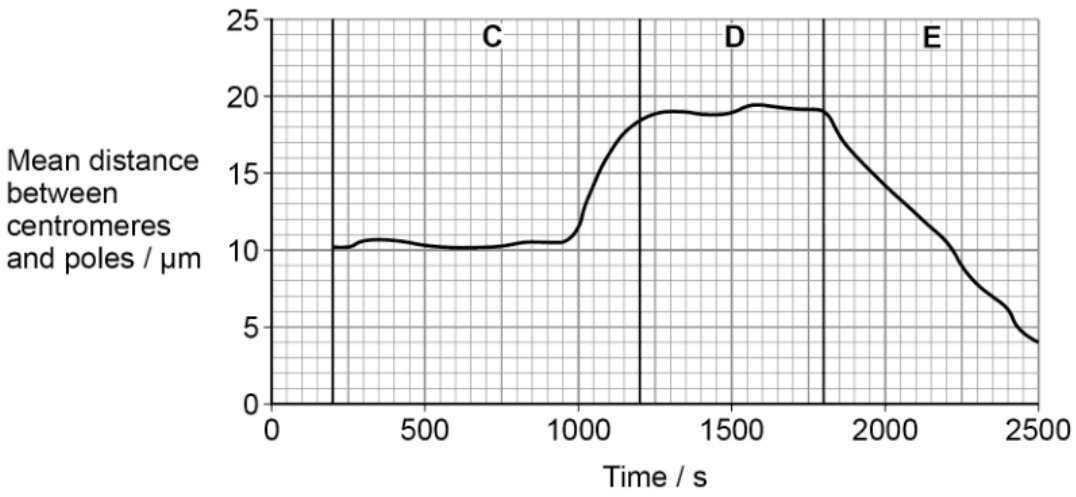
Prophase _____

Anaphase _____

**Question 5 · information from earlier in the question**

**0 6 . 1** **Figure 7** shows the mean distance between centromeres and the poles (ends) of the spindle during mitosis.

**Figure 7**




Calculate the rate of movement of the centromeres during phase **E**.

Give your answer in µm minute$^{-1}$ **and** to 3 decimal places.

**[2 marks]**


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**Question 5 · A level Paper 1 · November 2021 · Q06.2 · 5 marks**

**0 6 . 2** Name the three phases of mitosis shown by **C**, **D** and **E** on **Figure 7**.

Describe the role of the spindle fibres and the behaviour of the chromosomes during each of these phases.

**[5 marks]**

**C** _____

**D** _____

**E** _____


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**0 5 . 5** A scientist treated growing tips of onion roots with a chemical that stops roots growing. After 24 hours, he prepared a stained squash of these root tips.

**Figure 3** is a drawing showing the chromosomes in a single cell observed in the squash of one of these root tips in anaphase. This cell was typical of other cells in anaphase in these root tips.

**Figure 3**



Use all of this information to suggest how the chemical stops the growth of roots.

**[3 marks]**

**There are no questions on this page**


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**Question 7 · AS Paper 1 · June 2024 · Q03.4 · 2 marks**

**0 3 . 4** Animal cells replicate during the cell cycle.

**Figure 4** shows one animal cell at a stage of the cell cycle.

**Figure 4**



Identify the stage of the cell cycle shown in **Figure 4**.

Explain the appearance of the cell shown in **Figure 4**.

Do **not** refer to organelles in your answer.

**[2 marks]**

Identity of stage _____

Explanation _____

_____

_____


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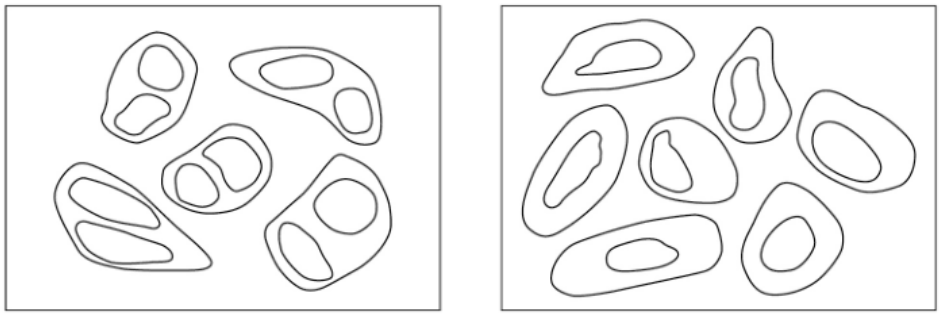
**0 8 . 1** Scientists investigated a drug called MiTMAB as a treatment for cancer. MiTMAB inhibits cytokinesis.

**Figure 8** shows drawings of cancer cells seen with an optical microscope from a:

- sample treated with MiTMAB
- control sample.

**Figure 8**

**A** **B**



The cells in drawing **A** can be identified as those treated with MiTMAB.

Explain why.

**[2 marks]**


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**Question 9 · AS Paper 2 · June 2024 · Q07.3 · 1 mark**

0 7 . 3 Mosaic trisomy 18 is another type of Edwards' syndrome. This occurs due to a chromosome mutation after fertilisation.

In mosaic trisomy, the body has cells with an extra chromosome 18 **and** cells with the correct number of chromosomes.

Explain how cells with different numbers of chromosomes are produced in mosaic trisomy.

**[1 mark]**

**Question 10 · AS Paper 1 · June 2022 · Q07.1 · 2 marks**

0 7 . 1 What is a tumour?

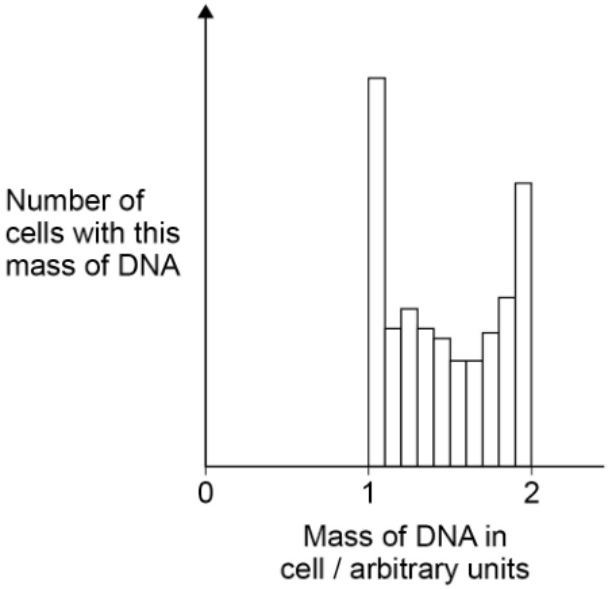
**[2 marks]**


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**Question 11 · information from earlier in the question**

**0 7 . 1** **Figure 4** shows the mass of DNA present in a group of healthy cells.

**Figure 4**




Use your knowledge of the cell cycle to explain the results shown in **Figure 4**.

**[3 marks]**

**Question 11 · AS Paper 2 · June 2023 · Q07.2 · 2 marks**

**0 7 . 2** Suggest **one** way **Figure 4** would be different if these cells were tumour cells.

Justify your answer.

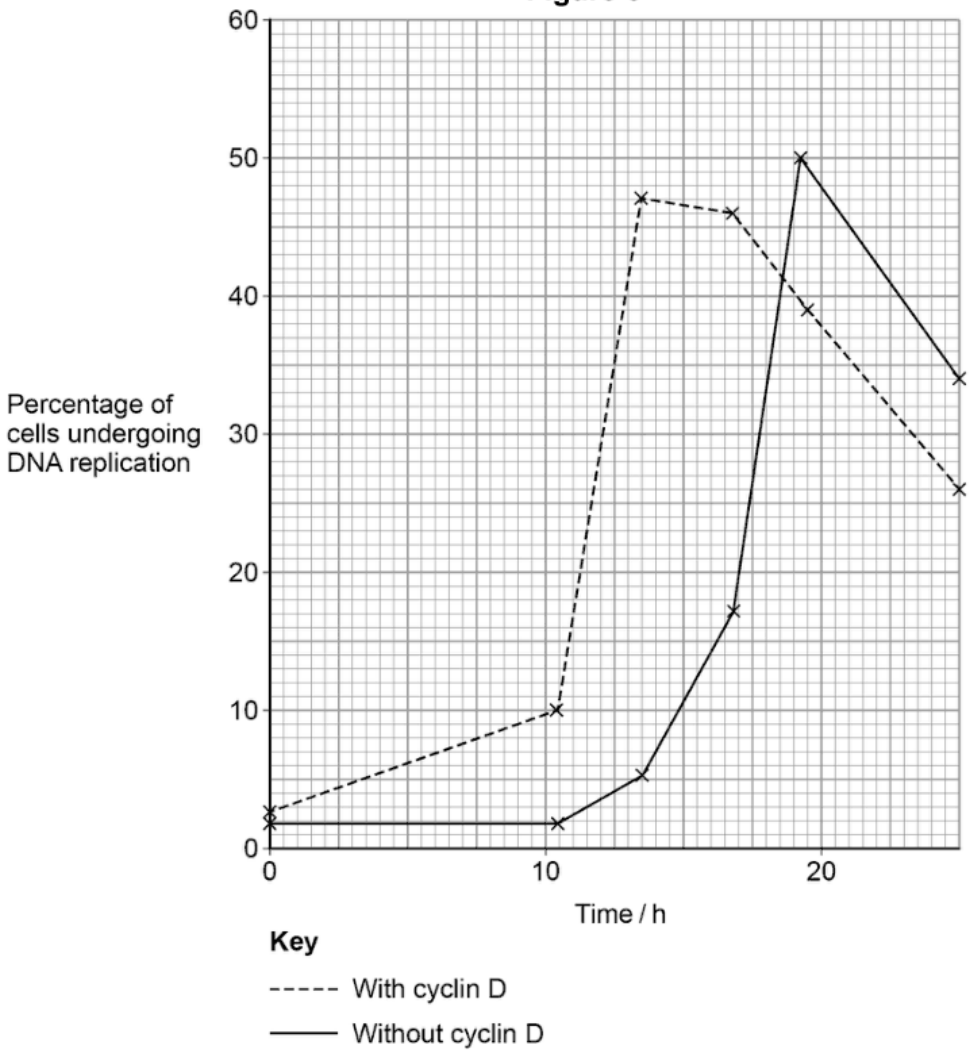
**[2 marks]**


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**Question 12 · information from earlier in the question**

**Figure 5** shows the percentage of rat cells undergoing DNA replication. Some cells contained a protein called cyclin D and some cells did not contain cyclin D. All cells were in early interphase at time 0

**Figure 5**





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**Question 12 · A level Paper 1 · November 2020 · Q05.4 · 2 marks**

**0 5 . 4** Some tumour cells contain higher than normal concentrations of cyclin D.

Use **Figure 5** to suggest why higher than normal concentrations of cyclin D could result in a tumour.

**[2 marks]**

**Question 13 · information from earlier in the question**

**0 9** Read the following passage.

In laboratory tests, scientists investigated the effects of a new drug called ABZ on stomach tumour cells. They found ABZ stopped mitosis by preventing the formation of spindle fibres. They also found that ABZ affected some healthy cells.

Mitosis is a controlled process. Cyclin B is a protein found in a cell's nucleus. It regulates the timing of mitosis during the cell cycle. Mitosis starts when the concentration of Cyclin B in the nucleus rises sharply and ends when it falls. The scientists found that ABZ increased, and maintained, a high concentration of Cyclin B in stomach tumour cells.

Programmed cell death is called apoptosis. Two nuclear proteins, Bcl-2 and Bax, are involved in controlling apoptosis. Apoptosis is prevented when the ratio of Bcl-2 to Bax is high and is promoted when this ratio is low. The scientists found that ABZ decreased the concentration of Bcl-2 and increased the concentration of Bax in stomach tumour cells.

From their results the scientists claimed that ABZ could be used for the successful treatment of stomach cancer.

Use information from the passage and your own understanding to answer the questions.


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**Question 13 · AS Paper 1 · June 2019 · Q09.2 · 1 mark**

**0 9 . 2** Suggest and explain why ABZ could be used as a treatment for cancer even though it affects some healthy cells (lines 3–4).

**[1 mark]**

**Question 14 · A level Paper 3 · June 2025 · Q01.1 · 3 marks**

**0 1 . 1** Describe binary fission in bacteria.

**[3 marks]**


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**0 8 . 5** A growing population of *B. thuringiensis* cells includes a:

- germination phase
- growth phase
- dormant phase.

A scientist incubated a culture of *B. thuringiensis* cells at 20 °C

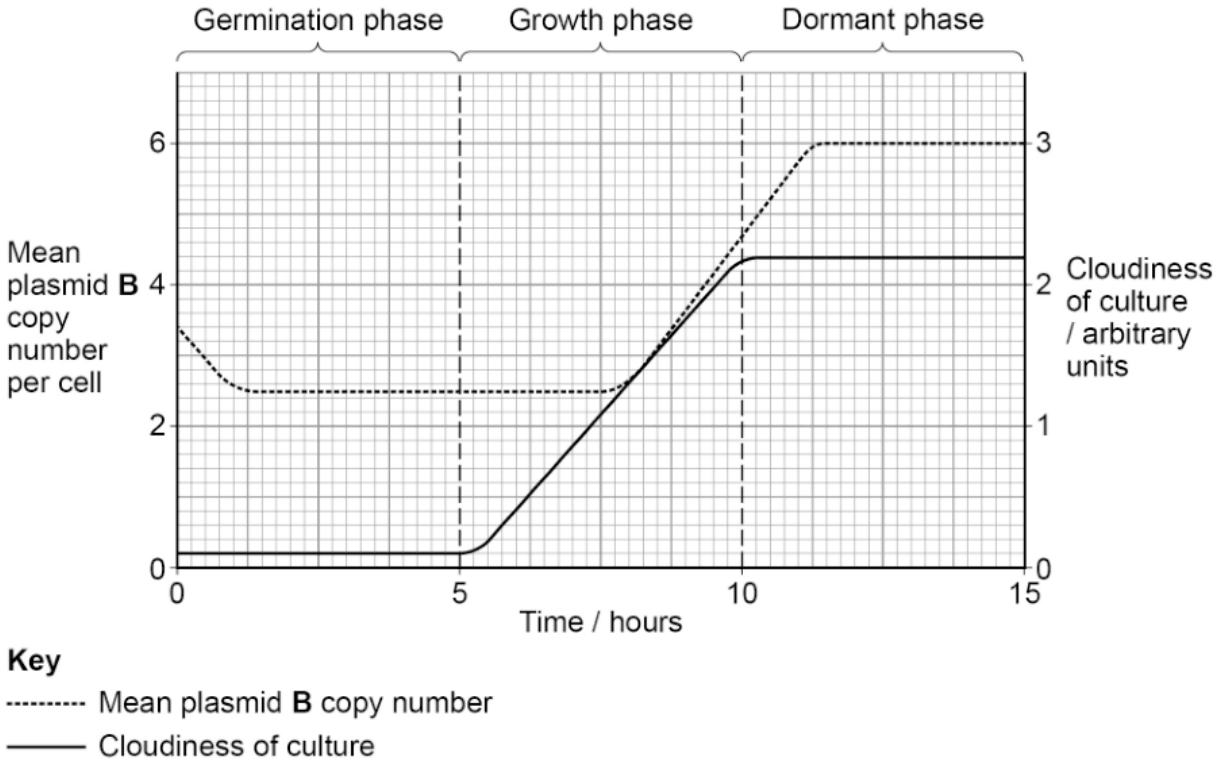
At intervals, the scientist:

- measured the cloudiness of the culture
- determined the mean plasmid **B** copy number per cell.

Cloudiness is a measure of the number of cells in a culture.

**Figure 11** shows the scientist's results.

**Figure 11**




Using information in **Figure 11**, what can you conclude about binary fission and the replication of plasmid **B** in the different phases of a growing population of *B. thuringiensis*?

**[3 marks]**


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**Question 16 · A level Paper 1 · June 2022 · Q04.1 · 3 marks**

0 4 . 1 Describe viral replication.

**[3 marks]**


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**Question 17 · AS Paper 1 · June 2024 · Q03.2 · 1 mark**

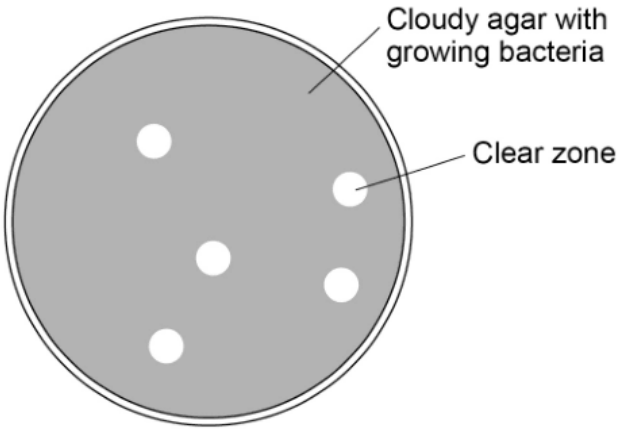
**0 3 . 2** A scientist investigated the effect of a virus species on a bacterial culture.

The scientist:

- mixed a diluted sample of the virus with a bacterial culture in liquid agar
- poured the liquid agar into a Petri dish and let the agar set
- incubated the virus-bacterial culture at 30 °C for 24 hours.

**Figure 3** shows the appearance of the Petri dish after 24 hours.

**Figure 3**




Explain why clear zones are present in **Figure 3**.

**[1 mark]**

**Question 18 · AS Paper 1 · June 2018 · Q04.4 · 2 marks**

**0 4 . 4** Some prokaryotic cells can divide every 30 minutes. A liquid culture contained a starting population of $1.35 \times 10^4$ cells.

Assuming each cell divides every 30 minutes, calculate how many cells there will be after 3 hours. Assume no cells die during this time.

**[2 marks]**

Answer = _____


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## Mark schemes


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| | |
|---|---|
| **6.1** | 1. (Trend of) slowing growth from before birth to 21 days<br>**OR**<br>(Trend of) decreasing percentage undergoing mitosis from before birth to 21 days<br>**OR**<br>(Trend of) decreasing percentage undergoing DNA replication from before birth to 21 days;<br>2. DNA replication happens before mitosis<br>**OR**<br>Heart growth slowing **until** (fully) developed<br>**OR**<br>These cells lost the **ability to** divide; |

| | |
|---|---|
| 2 | 1. Accept 'day -6' for 'before birth'.<br>1. For '21 days' accept 'until the end of the investigation'.<br>2. Accept 'Heart growing/developing before birth **and** becomes (fully) developed'.<br>2. Accept reference to only unipotent cells/cardiomycetes dividing (at 21 days). |


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**Question 2 · AS Paper 2 · June 2023 · Q07.1 · 3 marks**

| | | |
|---|---|---|
| **07.1** | 1. Mass of DNA equals 1 (indicates) (early) interphase<br>**OR**<br>No cells with mass of DNA less than 1 (indicates) mitosis only type of division occurring;<br>2. Mass of DNA equals 2 (indicates) mitosis<br>**OR**<br>Mass of DNA equals 2 (indicates) each chromosome consists of 2 chromatids;<br>3. Mass of DNA between 1 and 2 (indicates) some of the DNA has been replicated; | 3<br>(3 x AO3) |

1. Accept G1 phase

Accept no meiosis

2. Accept G2 / any named phase of mitosis

3. Accept S phase


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| | | | |
|---|---|---|---|
| **05.2** | Similarities<br>1. DNA replication;<br>2. Division of the cytoplasm<br>**OR**<br>Formation of the cell-surface membrane<br>**OR**<br>One division into two cells;<br>3. Synthesis of proteins/ribosomes;<br>Differences<br>4. No histones synthesised in binary fission<br>**OR**<br>No histones associated with DNA in binary fission;<br>5. No mitosis/interphase in binary fission;<br>6. No membrane-bound organelles replicated in binary fission; | 4 max (4 x AO2) | 2. Allow cytokinesis<br>4./5./6. Allow 'only'<br>4./5./6. Accept prokaryote/bacteria for binary fission<br>5. Accept a named stage of mitosis<br>6. Accept named membrane bound organelles |


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| | | |
|---|---|---|
| **05.1** | Max **two marks** for prophase<br>(In prophase)<br>1. Chromosomes/chromatids (continue to) condense;<br>2. Chromosomes/chromatids (become/are) visible;<br>3. Chromosomes attach to spindle (fibres)<br>**OR**<br>Chromatids attach to spindle (fibres)<br>**OR**<br>Centromeres attach to spindle (fibres);<br>(In anaphase)<br>4. Centromeres divide/split;<br>5. Chromosomes/chromatids moved/pulled to opposite poles/sides/ends; | 4 max<br>(4 x AO1) |

1. Accept chromatin for chromosomes

1. Accept shorten **OR** thicken **OR** coils **OR** a description of condensing for condense

2. Accept appear **OR** form **OR** present **OR** distinct for visible

5. Reject homologous chromosomes moved to opposite sides


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| | | |
|---|---|---|
| **06.2** | 1. C = prophase **and**<br>D = metaphase **and**<br>E = anaphase;<br>2. (In) prophase, chromosomes condense;<br>3. (In) prophase **OR** metaphase, centromeres attach to spindle fibres;<br>4. (In) metaphase, chromosomes/pairs of chromatids at equator/centre of spindle/cell;<br>5. (In) anaphase, centromeres divide;<br>6. (In) anaphase, chromatids (from each pair) pulled to (opposite) poles/ends (of cell);<br>7. (In) prophase/metaphase/anaphase, spindle fibres shorten; | 5 max |

**If mark point 1 is not credited = 4 max**

Do not carry forward error from 1.

Accept letters for stages as indicated in 1.

2. Accept chromatin for 'chromosomes' and for 'condense', shorten and thicken

6. Accept for 'chromatids', chromosomes but reject homologous chromosomes

7. Accept for 'shorten', contract


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**Question 6 · AS Paper 2 · June 2018 · Q05.5 · 3 marks**

| | | |
|---|---|---|
| **05.5** | 1. Stops anaphase / cell division / mitosis;<br>2. (By) stopping / disrupting / spindle fibres forming / attaching / pulling;<br>3. Preventing separation of (sister) chromatids;<br>4. (So) no new cells added (to root tip); | 3 max |

| |
|---|
| 1. Accept prevents telophase / cytokinesis<br>2. Ignore affects anaphase<br>3. Ignore chromosomes separate / split<br>3. Accept chromatids split |

**Question 7 · AS Paper 1 · June 2024 · Q03.4 · 2 marks**

| | | | |
|---|---|---|---|
| **03.4** | 1. Cytokinesis<br>**OR**<br>Telophase;<br>2. Division of cytoplasm<br>**OR**<br>Pinching of cell(-surface) membrane<br>**OR**<br>New cell(-surface) membrane forming<br>**OR**<br>Chromosomes are not visible; | 2 (2 x AO1) | 1. Ignore mitosis<br>2. Ignore reference to nucleus/nuclei or any named organelle<br>2. Accept separating or splitting for division<br>2. Accept a description of pinching eg inward movement of cell membrane<br>2. Accept chromosomes are not condensed or uncondensed or less distinct or long and thin or uncoiled for not visible |


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**Question 8 · A level Paper 1 · June 2023 · Q08.1 · 2 marks**

| | | | |
|---|---|---|---|
| **08.1** | 1. 2 nuclei (in cells)<br>**OR**<br>Cells (stopped) at telophase;<br>2. Cytokinesis prevented<br>**OR**<br>Stopped (new) cell membrane forming<br>**OR**<br>Stopped cytoplasm dividing; | 2<br>(2 x AO3) | 2. Accept cell membrane not dividing/splitting/ pinching (in the cell) |

**Question 9 · AS Paper 2 · June 2024 · Q07.3 · 1 mark**

| | | |
|---|---|---|
| **07.3** | Cells with extra chromosome (are produced) from cells with mutation<br>**OR**<br>Cells with correct number (of chromosome are produced) from cells without mutation; | 1<br>(1 x AO2) |

**Question 10 · AS Paper 1 · June 2022 · Q07.1 · 2 marks**

| | | | |
|---|---|---|---|
| **07.1** | 1. Mass of <u>cells/tissue</u><br>**OR**<br>Abnormal <u>cells/tissue</u>;<br>2. Uncontrolled mitosis/cell division; | 2<br>(2 x AO1) | 1. Accept idea of large number of cells in a lump/clump/cluster for 'mass'<br>2. Ignore growth |


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| | |
|---|---|
| **07.2** | 1. Fewer cells with mass of DNA = 1<br>**OR**<br>More cells with mass of DNA between 1 and 2<br>**OR**<br>More cells with mass of DNA 2;<br>2. Cell division is faster/uncontrolled<br>**OR**<br>More mitosis/cell division/cell replication; |

| | |
|---|---|
| 2<br>(2 x AO3) | 'Mass of DNA is higher' is insufficient<br><br>2. Ignore 'growth'<br>2. Accept 'uncontrolled mitosis' |


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**Question 12 · A level Paper 1 · November 2020 · Q05.4 · 2 marks**

| | | |
|---|---|---|
| **05.4** | 1. Shortens interphase<br>OR<br>Cells begin DNA replication earlier<br>OR<br>DNA replication (starts) faster;<br>2. Fast(er) **cell** cycle/division/multiplication/mitosis<br>OR<br>Uncontrolled cell division/mitosis;<br>3. (Resulting in) a mass/group of abnormal/excessive cells; | 2 max |

1. Accept '**starts** mitosis earlier'.
2. Accept '(May result in) mutation in a tumour suppressor gene' OR '(May result in) mutation in an oncogene'.

2 and 3. Ignore uncontrolled growth;

3. Accept '(Resulting in) **a** growth of abnormal/excessive cells'.


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**Question 13 · AS Paper 1 · June 2019 · Q09.2 · 1 mark**

| | | |
|---|---|---|
| **09.2** | 1. Cancer cells divide more/uncontrollably/rapidly<br>**OR**<br>Healthy cells divide less/slowly; | 1 |


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**Question 14 · A level Paper 3 · June 2025 · Q01.1 · 3 marks**

| | | |
|---|---|---|
| **01.1** | 1. Replication of (circular) DNA;<br>2. Replication of plasmids;<br>3. (New) membrane forms (dividing cell)<br>**OR**<br>Division of cytoplasm (to produce daughter cells); | 3 (3 x AO1) |

1. and 2. Accept doubling for replication

1. Reject chromosome
1. Reject mitosis
1. Reject single strand of DNA
2. Ignore (named) organelles replicate
3. Accept descriptions of either alternative
3. Accept cytokinesis (occurs)


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| | | |
|---|---|---|
| 08.5 | **Germination phase**<br>1. No DNA replication<br>**OR**<br>No plasmid (B) replication<br>**OR**<br>No binary fission;<br>**Growth phase**<br>2. Plasmid (B) replication occurs<br>**OR**<br>(Rate of) plasmid (B) replication increases<br>**OR**<br>Binary fission (only) occurs;<br>**Dormant phase**<br>3. Plasmid (B) replication occurs **and** no binary fission; | 3 max (3 x AO3) |

Each mark point must be clearly linked to the correct phase.

Accept correct time references to indicate each phase

Accept references to numbers to identify each phase, eg first phase for 'germination phase'

Accept 'cell division' for 'binary fission'


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**Question 16 · A level Paper 1 · June 2022 · Q04.1 · 3 marks**

| | | |
|---|---|---|
| **04.1** | 1. Attachment proteins attach to receptors;<br>2. (Viral) nucleic acid enters cell;<br>3. Nucleic acid replicated in cell<br>**OR**<br>Reverse transcriptase makes DNA from RNA;<br>4. Cell produces (viral) protein/capsid/enzymes;<br>5. Virus assembled and released (from cell); | 3 max<br>(3 x AO1) |

1. For 'attachment protein' accept gp41/gp120/ glycoprotein but ignore 'receptor protein' (on virus)

1. Accept bind for attach

2. Accept references to engulfment OR injection for enters

Ignore references to virus DNA/RNA incorporated into cell genome/nucleus/

chromosomes

2. and 3. Accept RNA/DNA/genetic material for 'nucleic acid'.

4. Accept capsomeres OR reverse


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**Question 17 · AS Paper 1 · June 2024 · Q03.2 · 1 mark**

| | |
|---|---|
| **03.2** | Virus (replication has) killed bacteria/cells (in clear zones); |

| | |
|---|---|
| 1 (1 x AO2) | Accept lysed or destroyed or burst for killed |

**Question 18 · AS Paper 1 · June 2018 · Q04.4 · 2 marks**

| | | |
|---|---|---|
| **04.4** | $8.64 \times 10^5$;; 2 | Accept 864 000 however expressed, e.g. $864 \times 10^3$<br>Allow one mark for<br>$2^6 = 64$<br>**OR**<br>$64 / 2^6 \times (1.35 \times 10^4)$ |


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