Meiosis, Mitosis and Stem Cells (Topic 3): Edexcel SNAB A Level Biology Exam Questions by Topic

20 questions · 54 marks · about 65 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · AS Paper 2 · June 2016 · Q8(b) · 2 marks

(b) This man produces gametes. Each gamete contains only one allele of each gene.

Describe how each gamete receives only one allele of each gene.

(2)

Question 2 · A level Paper 2 · November 2021 · Q2(a) · 2 marks

2 Children are different from their parents due to genetic variation and other factors.

Genetic variation can be the result of meiosis and random fertilisation of gametes.

(a) Describe how meiosis leads to genetic variation in the gametes produced.

(2)

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Question 3 · information from earlier in the question

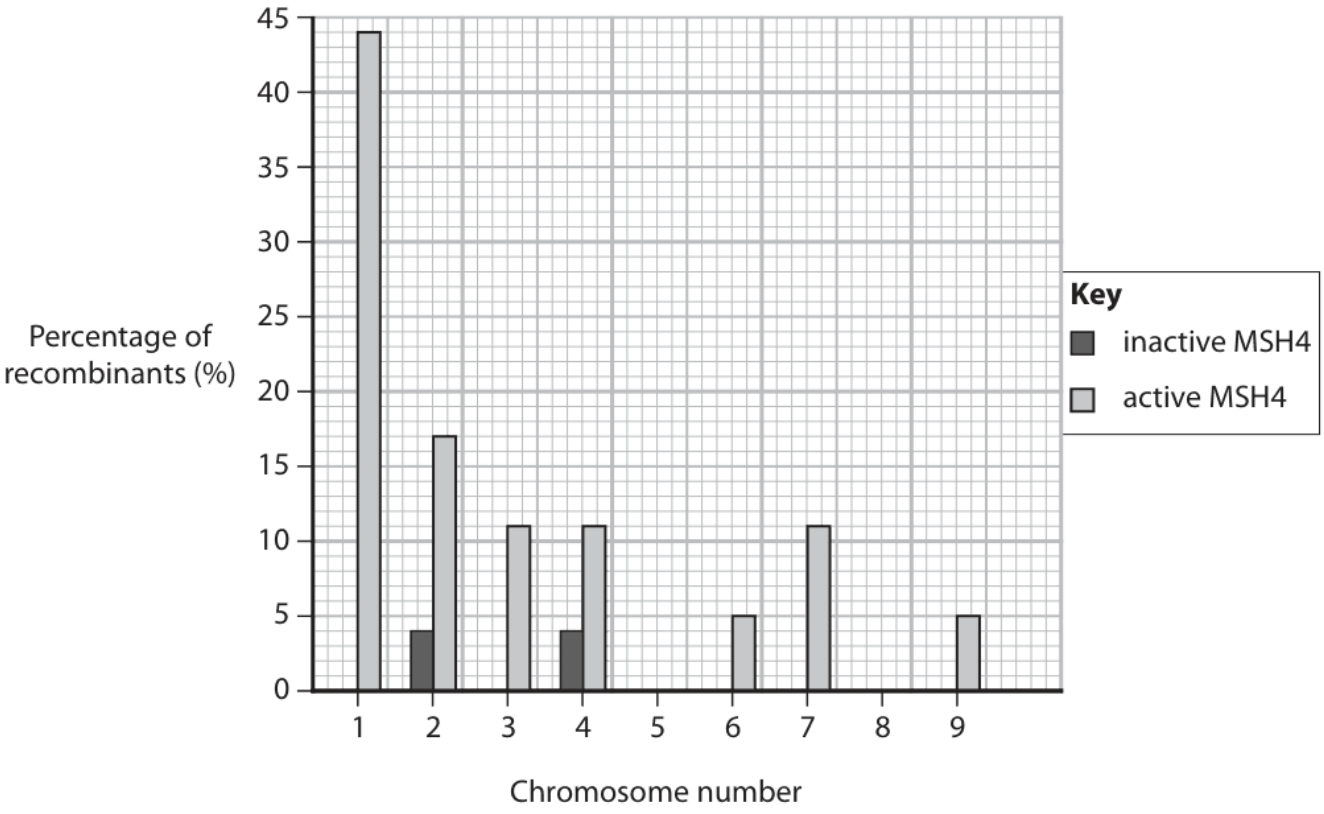
7 Chromosomes are able to transfer sections of DNA between homologous pairs during meiosis.

This forms recombinant chromosomes.

(a) The MSH4 gene affects crossing over during cell division.

The graph shows the effect of MSH4 gene activity on the percentage of recombinant chromosomes formed during meiosis.

Chromosomes are numbered according to length, with chromosome number 1 being the longest.



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Question 3 · AS Paper 2 · June 2024 · Q7(a)(ii) · 3 marks

(ii) Deduce the effect of the MSH4 gene on the gametes produced.

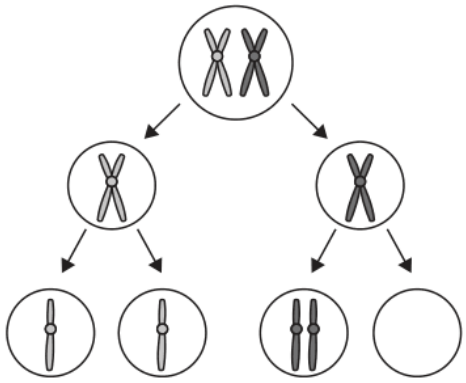
(3)

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Question 4 · AS Paper 2 · June 2024 · Q7(b) · 2 marks

(b) During the process of meiosis, chromatids may not separate properly.

The diagram shows this effect.



Deduce how this can cause problems at fertilisation.

(2)

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10 The modern bread wheat plant (*Triticum aestivum*) has been developed from other plant species that have different genomes.

Three species of plant and their genomes are shown in the images.



Triticum aestivum
Genomes A, B and D

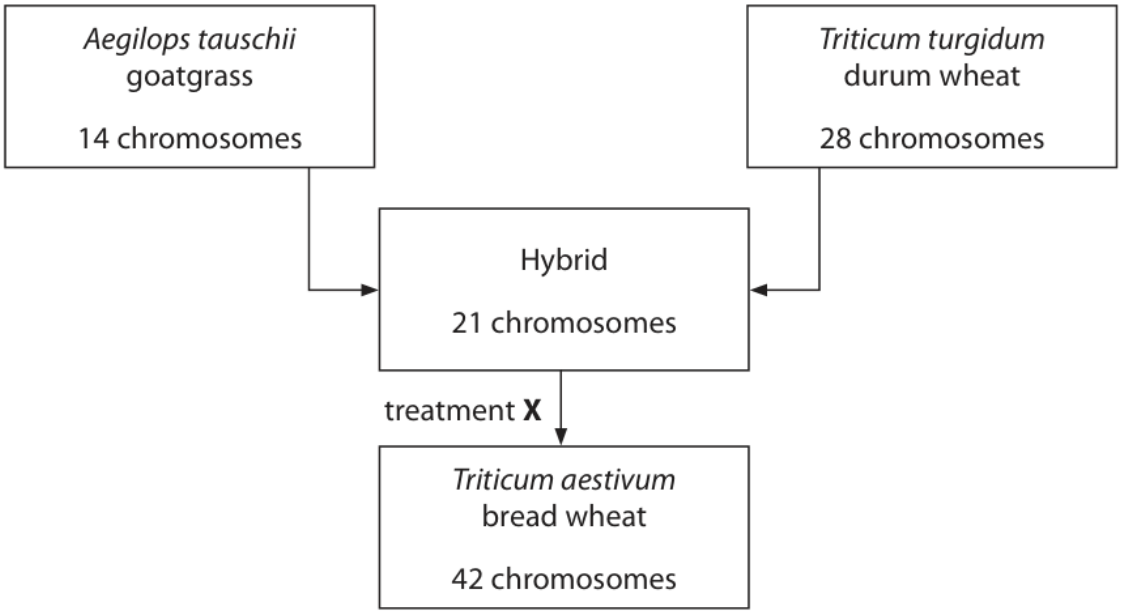


Triticum turgidum
Genomes A and B



Aegilops tauschii
Genome D

The diagram shows how chromosomes from different species have combined to produce the bread wheat species used to produce flour.



(a) Explain why each cell of the hybrid plant has 21 chromosomes in its nucleus.

(2)

Questions, mark schemes and examiners' report extracts © Pearson Education Ltd.

Question 6 · A level Paper 2 · June 2017 · Q10(c) · 2 marks

(c) Explain why the hybrid plant cannot produce haploid gametes.

(2)

Question 7 · A level Paper 2 · June 2017 · Q10(d) · 3 marks

(d) Treatment **X** in the diagram uses the chemical colchicine.

Colchicine breaks down spindle fibres in dividing cells.

Explain how treatment of cells of the hybrid plant with colchicine could result in the development of fertile *Triticum aestivum* plants.

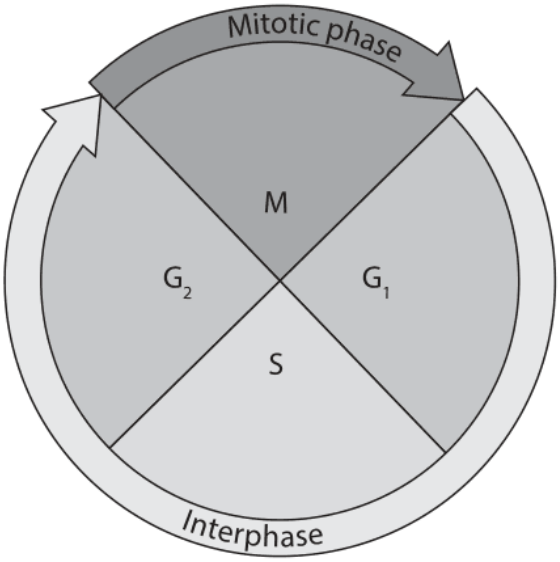
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Question 8 · A level Paper 1 · June 2025 · Q3(a)(i) · 2 marks

3 The cell cycle allows cells to divide and produce new cells for growth and repair.

(a) The diagram shows the stages of the cell cycle.



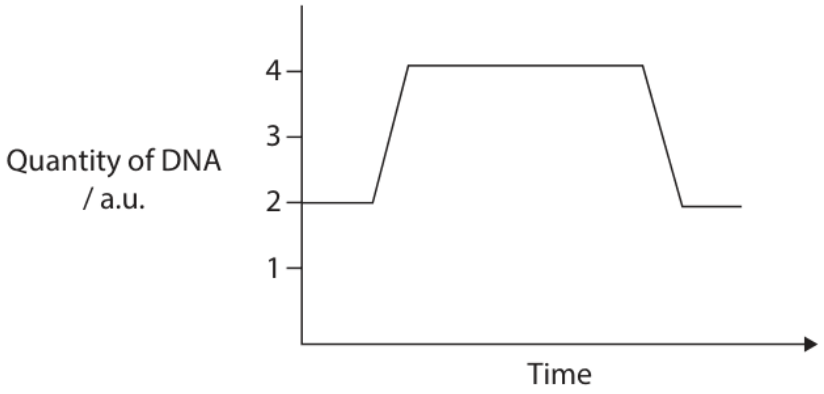
(i) Describe what happens in the **G_1** phase of the cell cycle.

(2)

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Question 9 · A level Paper 1 · June 2025 · Q3(a)(ii) · 3 marks

(ii) The graph shows the change in DNA content of a cell during the cell cycle.



Explain the changes in the quantity of DNA in a cell during the cell cycle.

(3)

Question 10 · AS Paper 2 · November 2021 · Q1(a)(iii) · 2 marks

(iii) Explain why the nucleus cannot be observed at the end of prophase in a eukaryotic cell.

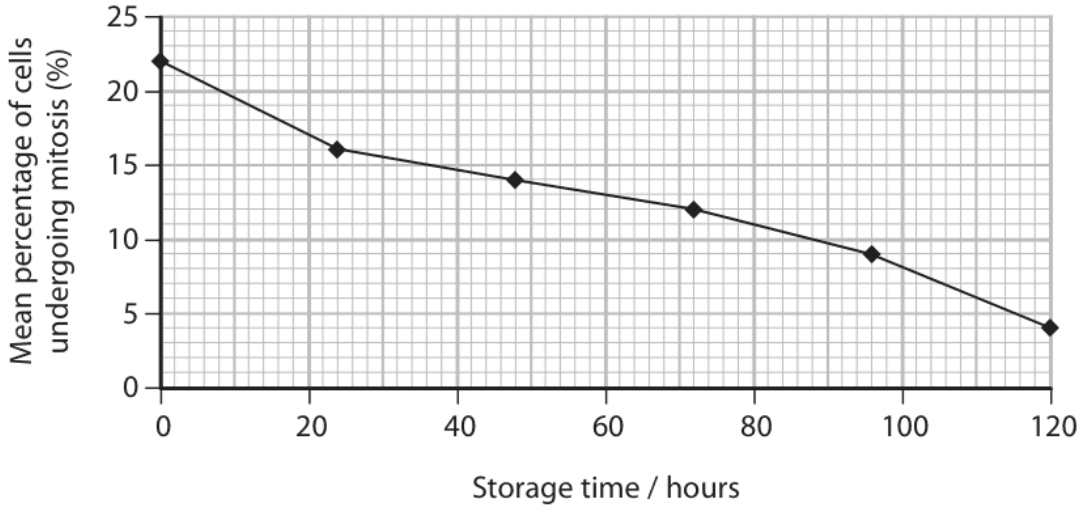
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Question 11 · A level Paper 3 · June 2018 · Q4(b)(i) · 3 marks

(b) Root tips were removed from the seedlings of variety Q. The percentage of cells from these root tips undergoing mitosis was recorded.

The results are shown in the graph.



(i) Describe the appearance of the chromosomes in the cells undergoing the metaphase stage of mitosis.

(3)

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Question 12 · A level Paper 2 · June 2024 · Q6(c)(ii) · 3 marks

(ii) Stem cells divide by mitosis.

Describe the role of centromeres in mitosis.

(3)

Question 13 · AS Paper 2 · June 2023 · Q1(c)(iii) · 4 marks

(iii) Describe what happens in the cell during the telophase stage of mitosis.

(4)

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Question 14 · A level Paper 1 · June 2024 · Q3(c) · 3 marks

(c) Paclitaxel is a drug used in the treatment of cancer.

Cancer involves cells dividing repeatedly in an uncontrolled manner.

Paclitaxel prevents spindle fibres from changing in length.

Deduce why Paclitaxel prevents cell division in cancer cells.

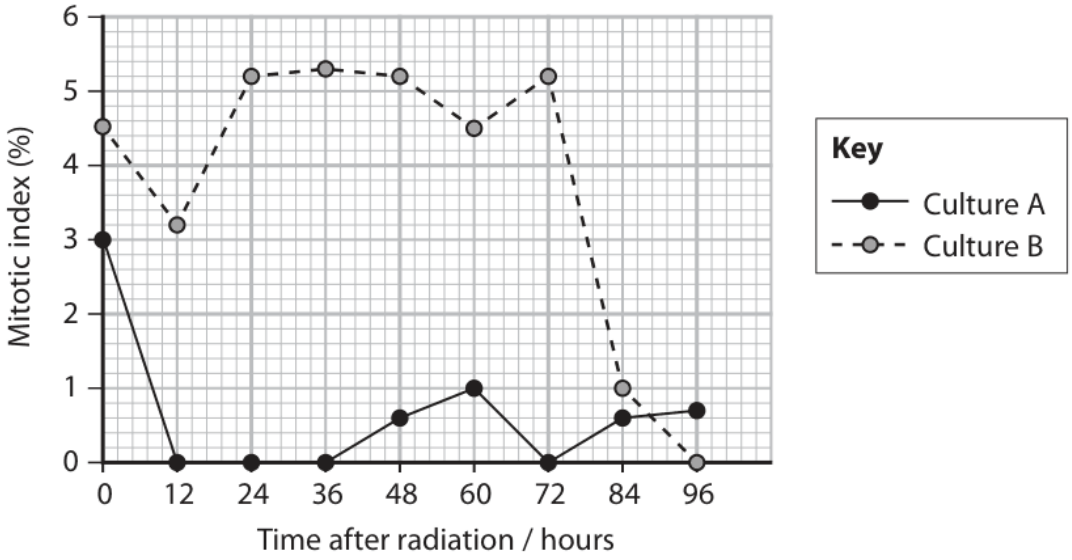
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Question 15 · AS Paper 2 · November 2021 · Q4(b) · 4 marks

(b) Two cultures of cells were used to investigate the cell cycle.
The cells in culture A have a functioning gene called P21.
The cells in culture B have no functioning P21 gene.

Both cultures were treated with gamma radiation that can cause damage to DNA.
They were then sampled at intervals of 12 hours and the mitotic index calculated.
The results are shown in the graph below.



Deduce the effect of the P21 gene on the cell cycle when cells are treated with gamma radiation.

(4)

Questions, mark schemes and examiners' report extracts © Pearson Education Ltd.

Question 16 · AS Paper 2 · June 2024 · Q4(b)(i) · 2 marks

(b) Eukaryotic organisms can be multicellular.

They contain stem cells that can give rise to specialised cells.

(i) State what is meant by the term **totipotent stem cell**.

(2)

Question 17 · A level Paper 2 · June 2024 · Q6(c)(i) · 3 marks

(c) At fertilisation, a zygote is formed. The zygote is a totipotent cell. The zygote then divides repeatedly to form an embryo. There are pluripotent cells in a five-day-old embryo.

(i) Describe the differences between pluripotent stem cells and totipotent stem cells.

(3)

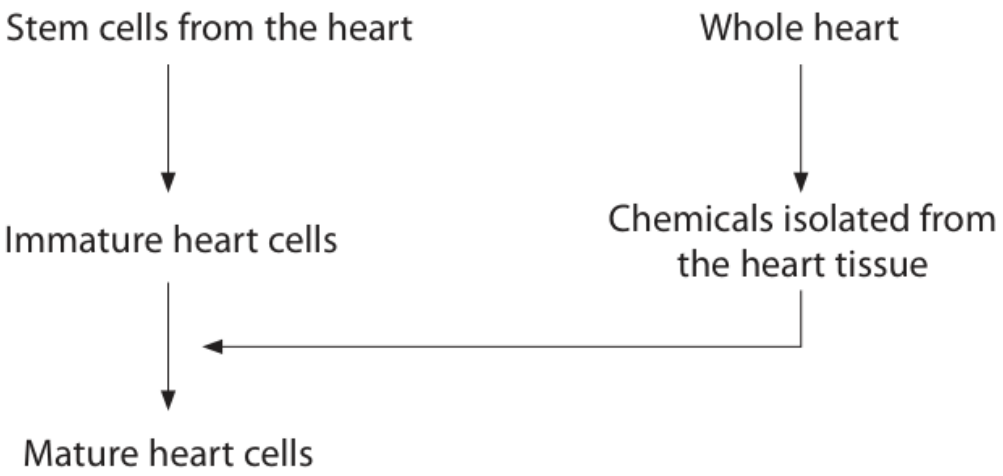
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Question 18 · information from earlier in the question

6 Stem cells can be used to repair damaged organs.

Stem cells from the heart can be used to produce mature heart cells.

The diagram below shows one method used to produce mature heart cells.



Question 18 · AS Paper 2 · November 2021 · Q6(b)(i) · 3 marks

(b) Part of the eye contains stem cells. These cells can be used to repair damaged corneas in the eye.

(i) Explain why stem cells from the heart cannot be used to grow cells to repair the cornea.

(3)

Questions, mark schemes and examiners' report extracts © Pearson Education Ltd.

Question 19 · AS Paper 2 · June 2019 · Q8(b)(iii) · 3 marks

(iii) Dystrophin is a protein needed to maintain the structure of muscle cells. In DMD the affected allele prevents the production of this protein, leading to symptoms that include a progressive effect on muscle tissue.

Stem cells are a potential treatment for DMD.

Explain why stem cells from a healthy donor may provide a treatment for this disorder.

(3)

Question 20 · AS Paper 2 · November 2021 · Q6(c) · 3 marks

(c) Human embryos are another source of stem cells used in medical therapies.

Describe the decisions that society has to make about the use of these embryonic stem cells.

(3)

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Mark schemes

Question 1 · AS Paper 2 · June 2016 · Q8(b) · 2 marks

Question Number	Answer
8(b)	A description making reference to two of the following: • (in meiosis) homologous chromosomes (carrying alleles for the same genes) are separated from one another (1) • sister chromatids (containing copies of the same alleles) are (also) separated from one another (1) • spindle (fibres) pull the { chromosomes / chromatids } to opposite poles of the cell (1)

Additional Guidance	Mark
IGNORE crossing over IGNORE independent assortment IGNORE reference to stages of meiosis ALLOW split for separated	(2)

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Question 2 · A level Paper 2 · November 2021 · Q2(a) · 2 marks

Question Number	Answer
2(a)	A description that makes reference to the following: • (produces non-identical gametes due to) independent assortment (of chromosomes) (1) • crossing over between (non-sister) chromatids (of homologous chromosomes) (1)

Additional Guidance	Mark
ALLOW description of independent assortment e.g. random which chromosome of each pair moves to which pole ALLOW description of crossing over e.g. swapping of alleles between (non-sister) chromatids	**(2)**

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Question 3 · AS Paper 2 · June 2024 · Q7(a)(ii) · 3 marks

Question number	Answer
7(a)(ii)	A description that makes reference to three of the following: • greater genetic variation in gametes (1) • (active MSH4 gene) increases number of recombinants (1) • due to more crossing over (1) • (MSH4 has) a greater effect on longer chromosomes (1)

Additional guidance	Mark
ALLOW less effect on shorter chromosomes ALLOW decreased effect as chromosome number increases	(3)

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Question 4 · AS Paper 2 · June 2024 · Q7(b) · 2 marks

Question number	Answer
7(b)	An explanation that makes reference to the following: • the zygote may not contain { homologous pairs of chromosomes / diploid nucleus } / zygote not diploid (1) • because gametes can be produced with incorrect number of chromosomes / haploid gametes not produced (1)

Additional guidance	Mark
ALLOW odd numbers of chromosomes {in zygote/ when egg fertilised/ at fertilisation} ALLOW some gametes have extra chromosomes ALLOW daughter cell for gamete	(2)

Question 5 · A level Paper 2 · June 2017 · Q10(a) · 2 marks

Question number	Answer
10(a)	An explanation that makes reference to the following points: • because 7 come from (the gametes of) { goatgrass / *Aegilops tauschii* }(1) • because 14 come from (the gametes of) {durum wheat / *Triticum turgidum* } (1)

Additional guidance	Mark
ALLOW *A.tauschii* ALLOW *T.turgidum*	(2)

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Question 6 · A level Paper 2 · June 2017 · Q10(c) · 2 marks

Question number	Answer
10(c)	An explanation that makes reference to two of the following points: • there is an odd number of chromosomes (1) • therefore it does not have homologous pairs of chromosomes (1) • therefore meiosis cannot take place / meiosis requires chromosome pairs (1)

Additional guidance	Mark
ALLOW uneven number ALLOW non-homologous chromosomes	(2)

Question 7 · A level Paper 2 · June 2017 · Q10(d) · 3 marks

Question number	Answer	Additional guidance	Mark
10 (d)	An explanation that makes reference to three of the following: • chromosomes copied before mitosis / interphase occurs and DNA replicates (1) • without spindle fibres { the chromatids are not separated / both copies of chromosomes remain in same cell } (1) • therefore producing cells with { chromosomes pairs / double the chromosome number } (1) • allows production of haploid gametes / adult plants with diploid cells (1)		(3)

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Question 8 · A level Paper 1 · June 2025 · Q3(a)(i) · 2 marks

Question Number	Answer
3(a)(i)	A description that makes reference to two of the following: • proteins are synthesised (1) • organelles are formed (1) • increase in size of {cell / cell membrane} / an increase in cytoplasm (1) • a relevant named function of the cell (1)

Additional guidance	Mark
e.g. enzymes ALLOW organelles duplicate ALLOW named examples ALLOW cell grows in size e.g. respiration, secretion, photosynthesis, contraction	(2)

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Question 9 · A level Paper 1 · June 2025 · Q3(a)(ii) · 3 marks

Question Number	Answer
3(a)(ii)	An explanation that makes reference to the following: • the DNA increases because replication is taking place (1) • the quantity of DNA doubles (1) • the DNA halves when {cell division/cytokinesis} takes place (1)

Additional guidance	Mark
IGNORE incorrect references to stages of cell cycle ALLOW DNA duplicated	(3)

Question 10 · AS Paper 2 · November 2021 · Q1(a)(iii) · 2 marks

Question Number	Answer	Additional guidance	Mark
1(a)(iii)	An explanation that makes reference to the following: • because the nuclear membrane is broken down (1) • because DNA is { coiled / condensed } into individual chromosomes (1)		**(2)**

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Question 11 · A level Paper 3 · June 2018 · Q4(b)(i) · 3 marks

Question Number	Answer
4(b)(i)	A description that makes reference to three of the following: • condensed / visible (1) • seen as pairs of chromatids (held together by a centromere) (1) • joined to the spindle (fibres) (1) • aligned on the equator of the cell (1)

Additional Guidance	Mark
ALLOW from annotated drawing ALLOW thickened /shortened ALLOW correct reference to sister chromatids ALLOW middle for equator	(3)

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Question 12 · A level Paper 2 · June 2024 · Q6(c)(ii) · 3 marks

Question Number	Answer
6(c)(ii)	A description that makes reference to three of the following: • keep (pairs of) chromatids together (1) • {bind / attach} to spindle (fibres) (1) • during metaphase (1) • point at which the (sister) chromatids separate during anaphase (1)

Additional Guidance	Mark
ALLOW joined, attached, bind, for keep	3

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Question 13 · AS Paper 2 · June 2023 · Q1(c)(iii) · 4 marks

Question Number	Answer
1(c)(iii)	A description that makes reference to four of the following: • spindle fibres break down (1) • chromosomes {decondense / uncoil} (1) • nucleoli form (1) • nuclear {membrane / envelope } forms (1) • two separate { nuclei / sets of chromosomes }(1)

Additional guidance	Mark
ALLOW nucleolus reforms ALLOW sets of chromosomes at opposite sides of the cell	(4)

Question 14 · A level Paper 1 · June 2024 · Q3(c) · 3 marks

Question Number	**Answer**
3(c)	An answer that makes reference to the following • shortening of the spindle (fibres) separates the chromatids (1) • if spindle fibres cannot shorten, the { chromatids / chromosomes } cannot be pulled to opposite poles of the cell / cell remains in metaphase stage (1) • (if the spindle cannot shorten) the cell cannot enter { anaphase / telophase } / mitosis cannot be completed (1)

Additional guidance	**Mark**
ALLOW pull chromatids apart	(3)

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Question 15 · AS Paper 2 · November 2021 · Q4(b) · 4 marks

Question Number	Answer
4(b)	An answer that makes reference to the following: • radiation can cause damage to chromosomes (1) • cells with (a functioning) P21 gene show reduced cell division (1) • with faulty P21 gene cell division remains high (1) • suggests P21 prevents cell progressing through mitosis if DNA damaged (1)

Additional guidance	Mark
ALLOW after 72 hours mitosis is reduced as cells are not viable ALLOW P21 regulates the cell cycle	**(4)**

Question 16 · AS Paper 2 · June 2024 · Q4(b)(i) · 2 marks

Question number	Answer
4(b)(i)	An answer that makes reference to the following: • a cell that can differentiate (1) • into any type of (specialised) cell (1)

Additional guidance	Mark
ALLOW a cell that can specialise	(2)

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Question 17 · A level Paper 2 · June 2024 · Q6(c)(i) · 3 marks

Question Number	Answer
6(c)(i)	A description that makes reference to three of the following: • totipotent stem cells have the potential to give rise to all cell types (1) • pluripotent stem cells can give rise to { most / some } cell types (1) • totipotent stem cells can give rise to a whole organism (pluripotent cannot) (1) • in totipotent stem cells no genes are inactivated / pluripotent stem cells have some genes inactivated (1)

Additional Guidance	Mark
ALLOW any cell type for all cell types ALLOW all cells except extra-embryonic cells / cannot give rise to extra-embryonic cells ALLOW placental cells for extra-embryonic cells ALLOW expressed for activated ALLOW differential gene expression	3

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Question 18 · AS Paper 2 · November 2021 · Q6(b)(i) · 3 marks

Question Number	Answer
6(b)(i)	An explanation that makes reference to the following: • cells are not totipotent (1) • therefore some genes have already been activated and deactivated (1) • therefore, will not be able to specialize into cornea cells (1)

Additional guidance	Mark
ALLOW cells are only pluripotent ALLOW some genes have already been switched on or off ALLOW will only be able to become a specific selecton of cells	**(3)**

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Question 19 · AS Paper 2 · June 2019 · Q8(b)(iii) · 3 marks

Question Number	Answer
8(b)(iii)	An explanation that makes reference to the following: • stem cells can differentiate into muscle cells (1) • these cells will not have the affected allele (1) • {the protein / dystrophin} will be produced (1)

Additional Guidance	Mark
ALLOW 'specialise' instead of 'differentiate' ALLOW will have normal allele for dystrophin	(3)

Question 20 · AS Paper 2 · November 2021 · Q6(c) · 3 marks

Question Number	Answer	Additional guidance	Mark
6(c)	A description that makes reference to three of the following: • embryonic stem cells are totipotent and can be used in a wider range of therapies (1) • source of embryonic stem cells has to be {considered / regulated} (1) • {moral / ethical} issues as the use of embryonic stem cells destroys embryos (1) • need for research establishments to be {regulated / licensed} (1)		(3)

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