Mutation and Meiosis: AQA A Level Biology Exam Questions by Topic

18 questions · 49 marks · about 64 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Paper 1 · November 2020 · Q10.3 · 4 marks

1 0 . 3 Define 'gene mutation' and explain how a gene mutation can have:

- no effect on an individual
- a positive effect on an individual.

[4 marks]

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Question 2 · AS Paper 2 · November 2021 · Q03.2 · 1 mark

0 3 . 2 Define the term mutagenic agent.

[1 mark]

Question 3 · AS Paper 2 · June 2016 · Q07.1 · 4 marks

0 7 . 1 HIV attaches to a specific protein receptor on helper T cells. A low percentage of people have a mutation of the *CCR5* gene which codes for this protein receptor. This mutation results in a non-functional protein receptor.

Explain how this mutation can result in the production of a non-functional protein receptor.

[4 marks]

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Question 4 · information from earlier in the question

0 6 . 2 **Table 3** shows mRNA codons and the amino acid coded by each codon.

Table 3

First base	Second base				Third base
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
					C
	Leu		Stop	Stop	A
				Trp	G
C	Leu	Pro	His	Arg	U
					C
			Gln		A
					G
A	Ile	Thr	Asn	Ser	U
					C
	Met		Lys	Arg	A
					G
G	Val	Ala	Asp	Gly	U
					C
			Glu		A
					G

Figure 5 shows the mRNA base sequence produced when part of a gene coding for an enzyme is transcribed.

Figure 5

UUU	**CGG**	**GCG**

Use **Table 3** to give the amino acids coded by the mRNA base sequence in **Figure 5**.

[1 mark]

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Question 4 · A level Paper 1 · June 2024 · Q06.3 · 4 marks

0 6 . 3 A mutation occurred in the part of the gene transcribed in Question **06.2**.

Figure 6 shows the mRNA base sequence produced when the identical part in the mutated gene is transcribed.

Figure 6

UUU	**AGG**	**GCG**

The amino acids coded by this mRNA base sequence form part of the enzyme's active site.

Use all the information in this question to:

- name the type of mutation that occurred to produce the mutated gene
- give the change in **DNA** caused by this mutation
- explain the effect this mutation will have on the function of the enzyme.

[4 marks]

Type of mutation _____

Change in DNA _____

Explanation of effect on function of enzyme _____

_____

_____

_____

_____

_____

Question 5 · information from earlier in the question

Table 3 shows **mRNA** codons for some amino acids.

Table 3

Serine	Proline	Glycine	Threonine	Alanine
UCU	CCU	GGA	ACU	GCA
UCC	CCA	GGG	ACC	GCG

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0 6 . 3 **Figure 6** shows the DNA template nucleotide base sequence that determines the sequence of four amino acids.

Figure 6

AGG CGT CCT GGA

Use information from **Table 3** and **Figure 6** to give the amino acid sequence determined by this sequence of nucleotides.

[1 mark]

Question 5 · AS Paper 1 · November 2020 · Q06.4 · 2 marks

0 6 . 4 A mutation in the nucleotide sequence shown in **Figure 6** resulted in the following amino acid sequence.

Serine Glycine Glycine Proline

A student concluded that the mutation involved the addition of one nucleotide within the sequence shown in **Figure 6**. Does information in this question support the student's conclusion? Give reasons for your answer.

[2 marks]

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Question 6 · AS Paper 2 · June 2024 · Q07.1 · 2 marks

0 7 . 1 Edwards' syndrome is a condition resulting from an extra chromosome 18.
A chromosome mutation in the second meiotic division is the most frequent cause of Edwards' syndrome.

Explain how a chromosome mutation in the second meiotic division could result in an extra chromosome 18.

In your answer, **name** the type of chromosome mutation which would result in the extra chromosome.

[2 marks]

Question 7 · A level Paper 1 · June 2025 · Q07.4 · 3 marks

0 7 . 4 A mutation can produce a gamete with **one** extra chromosome.

Name the type of mutation that produces a gamete with one extra chromosome.

Explain how meiosis can produce a gamete with one extra chromosome.

[3 marks]

Type of mutation _____

Explanation _____

Question 8 · information from earlier in the question

A trout body cell contains 80 chromosomes.

Farmed female trout are treated so that they produce diploid egg cells.

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Question 8 · AS Paper 2 · November 2020 · Q06.5 · 2 marks

0 6 . 5 The offspring produced from farmed trout are sterile. Suggest and explain why.

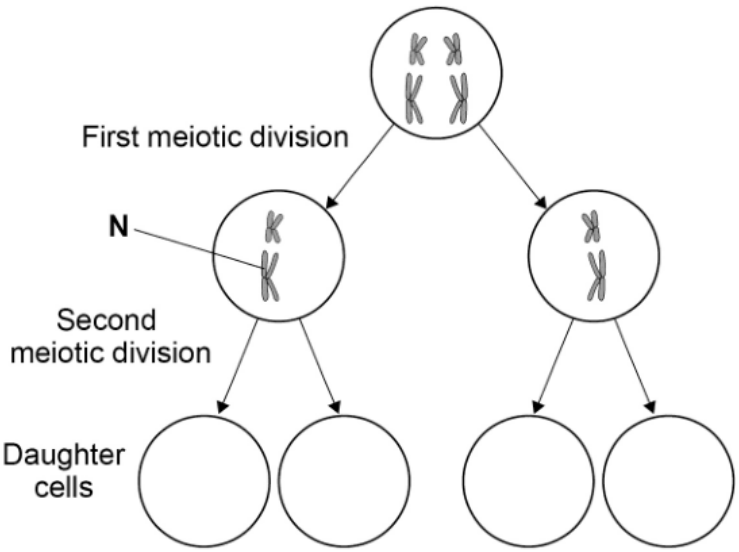
[2 marks]

Question 9 · A level Paper 1 · June 2022 · Q04.3 · 2 marks

Figure 6 represents a cell undergoing meiosis. It shows the chromosomes in the parent cell and in the two cells formed after the first meiotic division.

The second division of meiosis proceeds normally except that non-disjunction occurs in the chromosome labelled **N**.

Figure 6



0 4 . 3 Complete **Figure 6** to show the chromosomes inside the daughter cells formed after the second meiotic division.

[2 marks]

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Question 10 · AS Paper 1 · June 2017 · Q06.2 · 2 marks

0 6 . 2 Explain how the chromosome number is halved during meiosis.

[2 marks]

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Question 11 · AS Paper 2 · June 2025 · Q09.1 · 5 marks

0 9 . 1 Describe how meiosis results in haploid cells and how it increases genetic variation.

[5 marks]

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Question 12 · A level Paper 1 · June 2023 · Q10.3 · 4 marks

10.3 Mutation can result in an increase in genetic variation within a species.

Describe and explain the **other** processes that result in increases in genetic variation within a species.

[4 marks]

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Question 13 · AS Paper 2 · June 2019 · Q06.2 · 2 marks

In the life cycle of *Neurospora* most stages are haploid. Fusion of two haploid strains of this fungus produces diploid zygotes. Nuclear division in these zygotes occurs by meiosis.

0 6 . 2 Give **two** differences between mitosis and meiosis.

[2 marks]

1 _____

_____

_____

_____

2 _____

_____

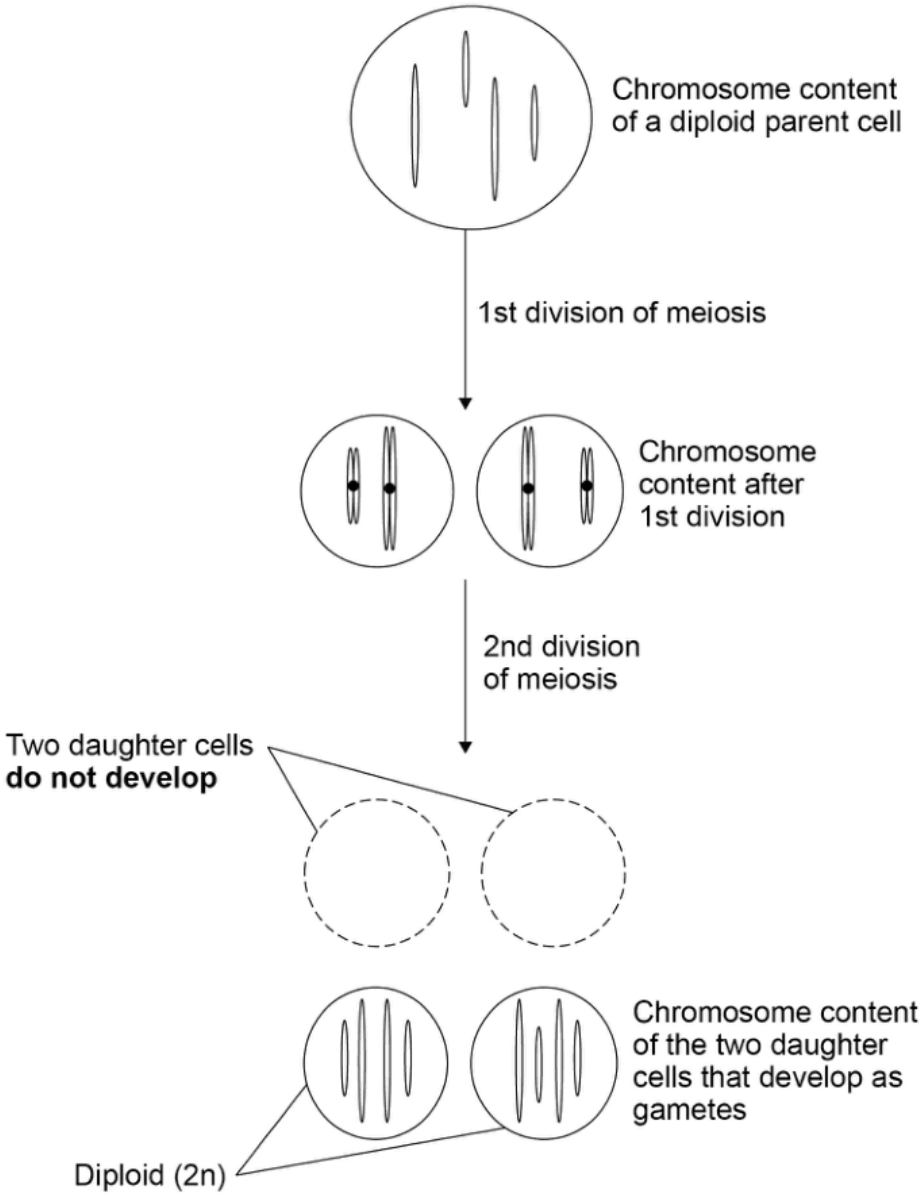
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0 6 **Figure 6** shows a faulty form of meiosis that can occur in some plants.

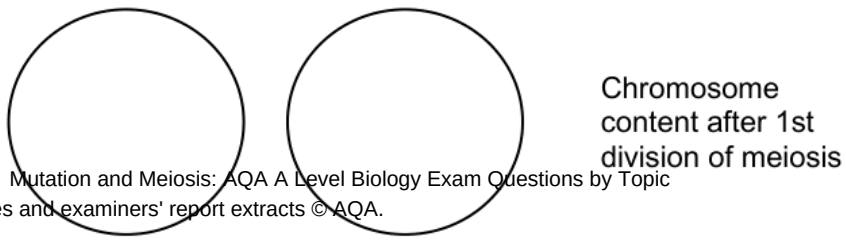
Figure 6



0 6 . 1 Complete **Figure 7** to show the chromosome content of the cells that would result from a normal meiotic division of the diploid parent cell shown in **Figure 6**.

[2 marks]

Figure 7

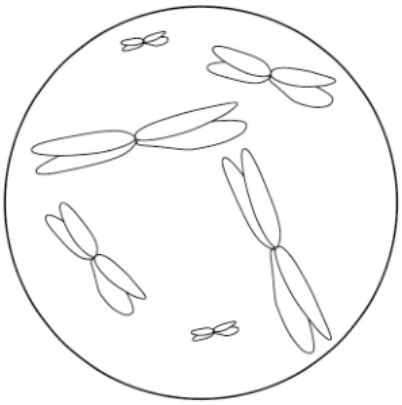


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0 7 . 3 A PS cell contains 46 chromosomes.

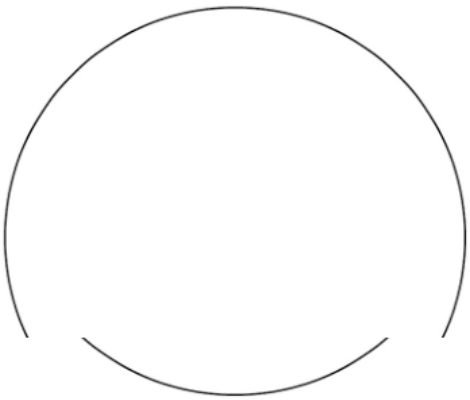
Figure 9 shows the appearance of six of those chromosomes just as a PS cell enters meiosis.

Figure 9



Using the information in **Figure 9**, draw chromosomes in **Figure 10** as they would appear in **one** cell at the end of the first meiotic division.

Figure 10



[1 mark]

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0 6 . 2 A trout body cell contains 80 chromosomes.

Table 2 shows the number of chromosomes and the mass of DNA in different nuclei. All the nuclei are from the same trout.

Complete **Table 2**.

[2 marks]

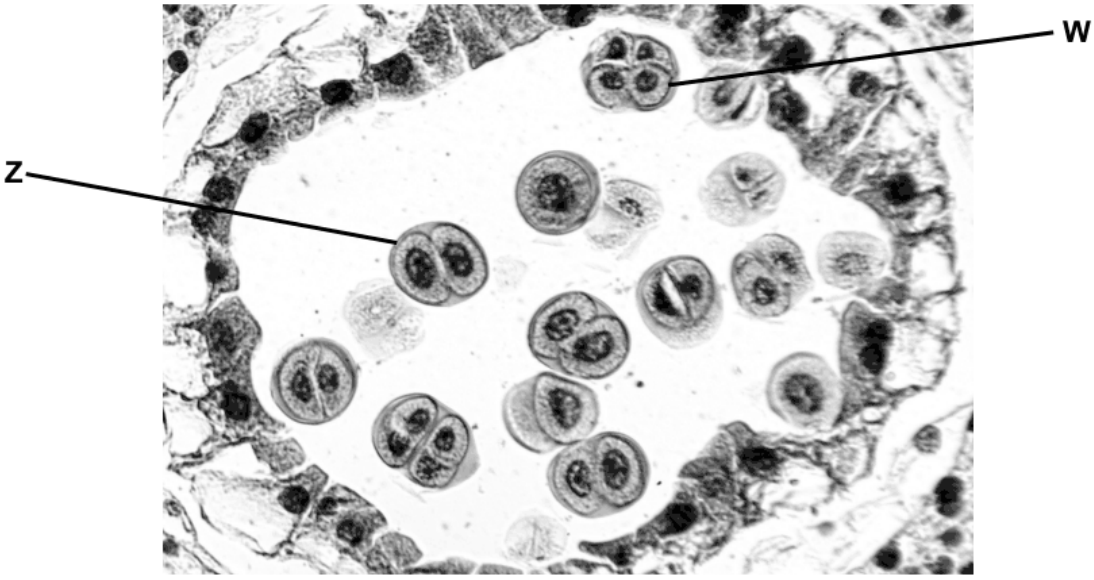
Table 2

Nucleus	Number of chromosomes	Mass of DNA / arbitrary units
At prophase of mitosis	80	
At telophase of mitosis		25
From an egg cell		

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1 0 . 2 **Figure 6** shows an image from an optical microscope of meiosis occurring in a flower bud of a flowering plant. **W** and **Z** are undergoing meiosis.

Figure 6



Explain the appearance of **W** and **Z**.

[4 marks]

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Question 18 · information from earlier in the question

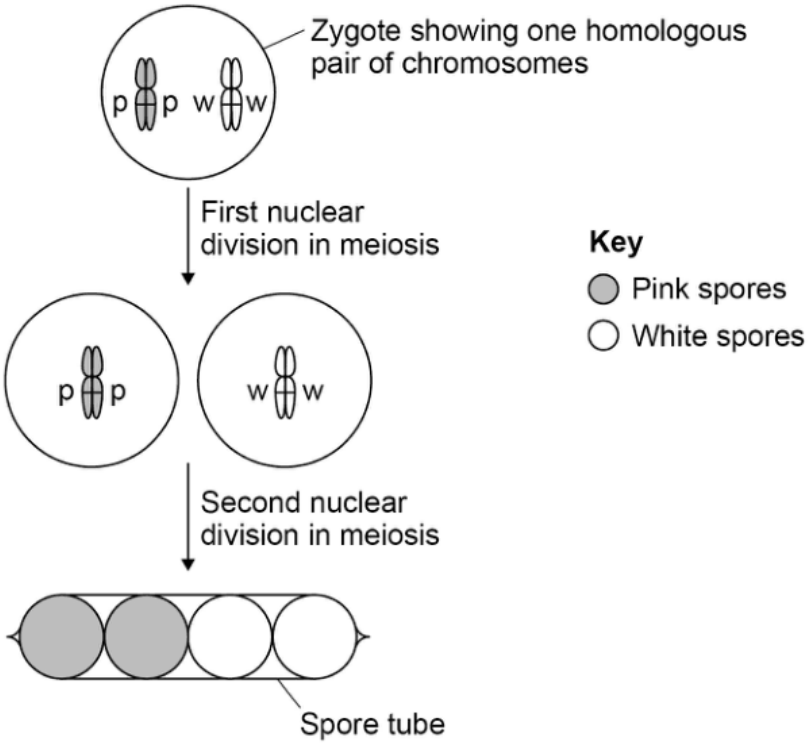
In the life cycle of *Neurospora* most stages are haploid. Fusion of two haploid strains of this fungus produces diploid zygotes. Nuclear division in these zygotes occurs by meiosis.

At the end of meiosis, this fungus produces cells called spores.
The spores are produced in narrow tubes that restrict their movement. As a result, each tube contains a single line of spores. The spores are coloured either pink or white.

The spore colour gene is located on a pair of homologous chromosomes. Each zygote produced in this cross has one chromosome with a pink allele (p) and one chromosome with a white allele (w).

This is shown in **Figure 7**.

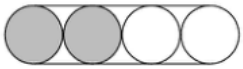
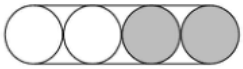
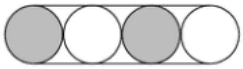
Figure 7



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The scientist recorded the arrangement of coloured spores inside many narrow tubes. His results are shown in **Table 2**.

Table 2

Type of spore tube	Arrangement of coloured spores	Number of narrow tubes
1		81
2		78
3		10

0 6 . 4 Using all the information in this question, what can you conclude from the scientist's results about the movement of chromosomes in meiosis in this fungus?

[3 marks]

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Mark schemes

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Question 1 · A level Paper 1 · November 2020 · Q10.3 · 4 marks

10.3	(Definition of gene mutation) 1. Change in the base/nucleotide (sequence of chromosomes/DNA); 2. Results in the formation of new allele; (Has no effect because) 3. Genetic code is degenerate (so amino acid sequence may not change); OR Mutation is in an intron (so amino acid sequence may not change); 4. Does change amino acid but no effect on tertiary structure; 5. (New allele) is recessive so does not influence phenotype; (Has positive effect because) 6. Results in change in polypeptide that positively changes the properties (of the protein) OR Results in change in polypeptide that positively changes a named protein; 7. May result in increased reproductive success OR May result in increased survival (chances);	4 max

For 4 marks at least one mark must be scored in each section of the answer.

1. Accept named mutation for 'change'.
3. Accept description of 'degenerate', eg

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Question 2 · AS Paper 2 · November 2021 · Q03.2 · 1 mark

03.2	(A factor that) increases (the rate of) mutations;	1

Question 3 · AS Paper 2 · June 2016 · Q07.1 · 4 marks

07.1	1. Change in DNA base/nucleotide (sequence); 2. Change in amino acid (sequence)/primary structure; 3. Alters (position of) hydrogen/ionic/disulfide bonds; 4. Change in tertiary structure (of receptor);	4	1. Accept: mutation in DNA base (sequence). 1. Accept: deletion/substitution/addition of a DNA base/nucleotide. 2. Reject: different amino acid formed. 2. Ignore: change in code for amino acid. 4. Reject: any reference to active site. 4. Ignore: 3^{o}.

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06.3	(Name of mutation) 1. (Single base) substitution; (Change in DNA) 2. Guanine to thymine **OR** G to T **OR** GCC to TCC; (Explanation) 3. (So) Arg (still) present **OR** No change in amino acid; 4. (So) no change in primary structure **OR** (So) no change in tertiary structure **OR** (So) no change in active site (shape);	4 (4 x AO2)	Marks can be achieved in any section 2. Reject thiamine 3. Reject amino acids are formed

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Question 5 · AS Paper 1 · November 2020 · Q06.4 · 2 marks

06.4	Mark as pairs. 1 and 2 **or** 3 and 4. (No) 1. G to C (in the second codon/for Glycine) **OR** CGT to CCT (in second codon/for Glycine); 2. (So), substitution (not addition mutation); **OR** 3. (If addition) frameshift / all triplets moved; 4. (So), affects more than one amino acid;	2
TOTAL		**7**

2. Reject if substitution of Glycine (for Alanine)

Question 6 · AS Paper 2 · June 2024 · Q07.1 · 2 marks

07.1	1. Chromatids do not separate; 2. Non-disjunction;	2 (2 x AO2)	1. Accept 'chromosomes' for chromatids but reject **homologous** chromosomes.

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Question 7 · A level Paper 1 · June 2025 · Q07.4 · 3 marks

07.4	1. Non-disjunction; 2. Homologous chromosomes/pairs **not separated** **OR** Chromatids **not separated**; 3. (Because) both chromosome(s)/chromatid(s) pulled/moved to (one) pole/end/side (of cell) **OR** (Because) both chromosome(s)/chromatid(s) not attached to spindle (fibres);	3 max (3 x AO1)

1. Accept trisomy **OR** aneuploidy

1. Reject polyploidy/ multiple sets

2. Accept segregated for 'separated'

2. Accept 'bivalent' for 'homologous chromosomes'

3. Accept labelled diagram showing chromosome /chromatid movement to one pole/cell

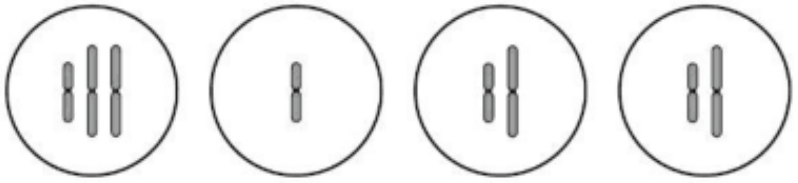
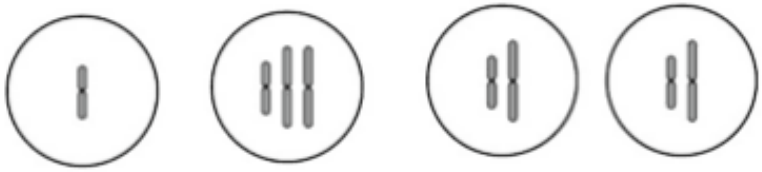
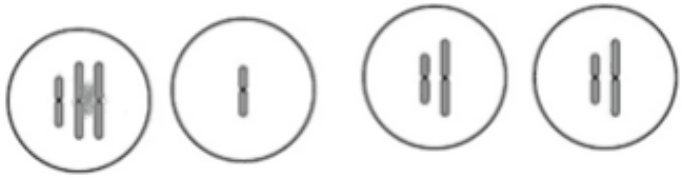
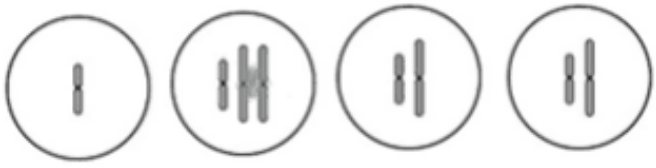
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Question 8 · AS Paper 2 · November 2020 · Q06.5 · 2 marks

06.5	1. Too many/extra set/three copies of chromosomes; 2. (Homologous) chromosomes do not pair **OR** (Homologous) chromosomes do not separate (evenly); 3. (So) no meiosis;	2 max	1. Accept 1 paternal, 2 maternal 2. Accept divide for separate

TOTAL		**8**	

Question 9 · A level Paper 1 · June 2022 · Q04.3 · 2 marks

04.3	 **OR**  **OR**  **OR**  1. 2 cells on left correct, ignore differences in chromosome length in drawn cells; 2. 2 cells on right correct, ignore differences in chromosome length in drawn cells;	2 (2 x AO2)

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Question 10 · AS Paper 1 · June 2017 · Q06.2 · 2 marks

06.2	1. Homologous chromosomes (pair); 2. One of each (pair) goes to each (daughter) cell / to opposite poles;	2	Ignore descriptions of the second division of meiosis.

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Question 11 · AS Paper 2 · June 2025 · Q09.1 · 5 marks

09.1	1. Two divisions produce 4 (haploid) cells/gametes/nuclei; 2. Separation of homologous chromosomes (in first division); 3. Separation of chromatids (in second division); 4. Independent segregation/assortment of homologous chromosomes; 5. Crossing over leads to exchange of parts of chromatids/alleles between homologous chromosomes;	5 (5 x AO1)

1. Accept meiosis I **and** meiosis II
1. Accept description that clearly describes two divisions

3. Accept 'chromosomes' for 'chromatids' but reject homologous chromosomes. Accept annotated diagrams for MP1–MP3

4. Accept description eg maternal and paternal chromosomes are reshuffled in any combination

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10.3	1. Independent segregation of homologous Chromosomes/pairs; 2. Crossing over between homologous chromosomes/pairs; 3. Random fertilisation of gametes; 4. (Produces) new combinations of <u>alleles</u>;	4 (4 x AO1)	If no marks awarded accept one principle mark 'Meiosis producing cells that are genetically different (from one another)' 1. For 'independent' accept 'random' 1. For 'segregation' accept 'assortment' 2. Accept 'within bivalent' for 'between homologous pair' 3. Ignore 'random mating' 3. Accept 'random fusion' for 'random fertilisation' Accept as an additional mark point 5. (Produces) new combinations of maternal and paternal chromosomes Ignore reference to epigenetics

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Question 13 · AS Paper 2 · June 2019 · Q06.2 · 2 marks

06.2	Mitosis given first 1. One division, two divisions in meiosis; 2. (Daughter) cells **genetically** identical, daughter cells **genetically** different in meiosis; 3. Two cells produced, (usually) four cells produced in meiosis; 4. Diploid to diploid/haploid to haploid, diploid to haploid in meiosis; 5. Separation of homologous chromosomes only in meiosis; 6. Crossing over only in meiosis; 7. Independent segregation only in meiosis;	2 max

Differences must be given as comparisons

Ignore references to asexual / sexual reproduction, growth, repair & replacement

2. Reference to 'genetically' needed once

4. Accept same number chromosomes in mitosis, but half the number in meiosis

Question 14 · A level Paper 1 · June 2018 · Q06.1 · 2 marks

06.1	1. 1 long and 1 short chromosome, each made up of 2 chromatids held (by centromere), in each cell of 1st division; 2. 1 long and 1 short (separate) chromosome in each cell of 2nd division;	2	2. Allow ECF for correct chromosomes shown in each cell from candidate's 1st division cells. 2. Ignore drawing of centromere.

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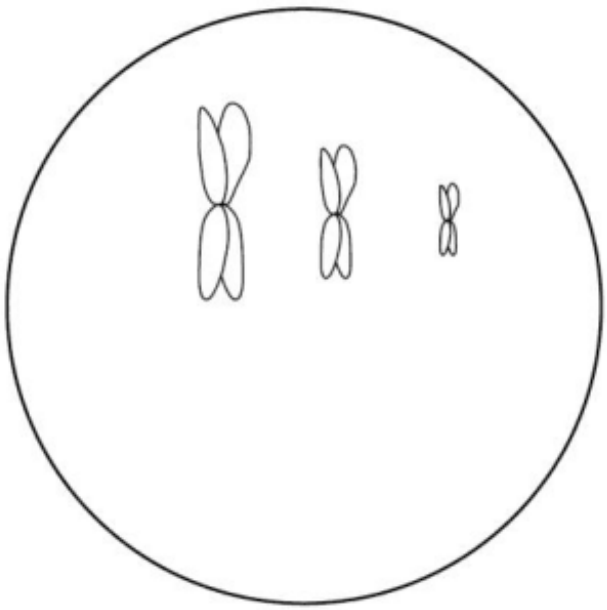
Question 15 · A level Paper 1 · June 2025 · Q07.3 · 1 mark

07.3

Accept for 1 mark,

3 chromosomes, each of different size and each with 2 chromatids, drawn in any order;

For example,



1 (1 x AO1)

Question 16 · AS Paper 2 · November 2020 · Q06.2 · 2 marks

06.2 Mark each column;; 2

Number of chromosomes	Mass of DNA / arbitrary units
	50
80	
40	12.5

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10.2 1. **W** has 4 cells/nuclei since it is at the (end of) 2nd division (of meiosis); 4

2. **Z** has 2 cells/nuclei since it is at the (end of) 1st division (of meiosis);

3. **W** shows haploid cells/cells containing n chromosomes;

4. (Cells in) **W** contain half the (mass of) DNA of (Cells in) **Z**;

OR

(between **Z** and **W**) chromatids have separated;

OR

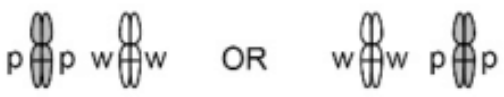
In **Z** homologous chromosomes have separated;

Ignore '**Z** shows diploid cells/contains 2n chromosomes'

4. Accept '**W** contains half the amount of DNA of **Z**'

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06.4	1. Separation of homologous chromosomes (occurred) **OR** (Independent) segregation (occurred); 2. (Arrangement/separation/segregation of chromosomes is) random/ (almost) equally frequent (in tubes 1 and 2); 3. Crossing over occurred in tube 3/10 tubes; 4. (Crossing over) is rare/infrequent/in only 10 tubes;
TOTAL	

3 max	1. Accept description of homologous chromosome movement for 'separation' 1. Accept alleles for 'chromosomes' 1. Accept as a labelled diagram of chromosomes eg  3. Accept as labelled diagram of crossing over 3 and 4 'Crossing over occurred in only

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