Cell Division, Cell Diversity and Cellular Organisation (2.1.6): OCR A Leve

20 questions · 31 marks · about 37 minutes. Answer in the spaces, then check the mark schemes at the end.

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2 (a) **Fig. 2.1** shows the larva of a European stag beetle, *Lucanus cervus*.



Fig. 2.1

These larvae can live for up to six years, feeding and growing in decaying wood. During this time, the cells in the larvae undergo mitosis to produce genetically identical cells.

Mitosis is part of the cell cycle. The cell cycle is shown in **Fig. 2.2**.

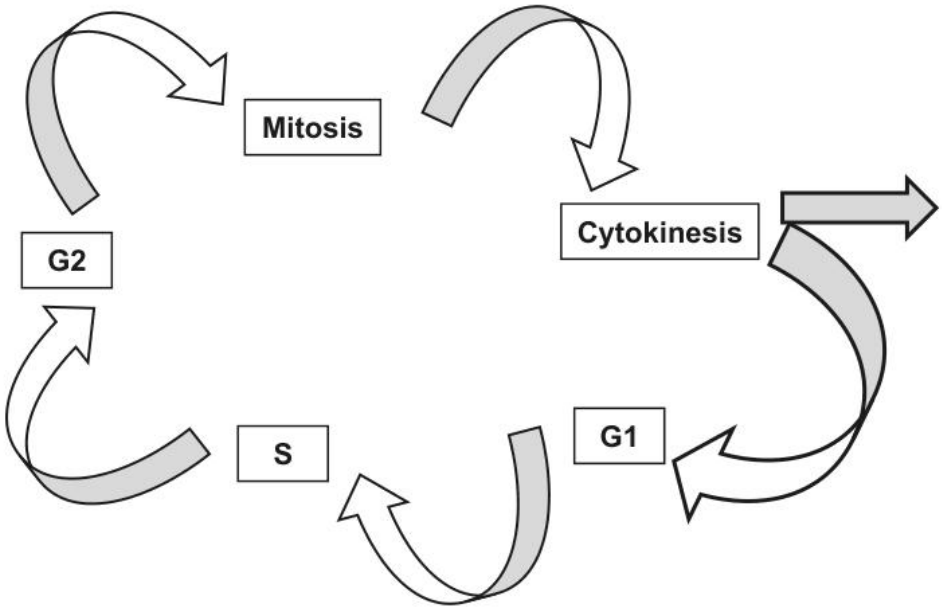


Fig. 2.2

(i) The size of the cell increases during stage **G2** in the cell cycle.

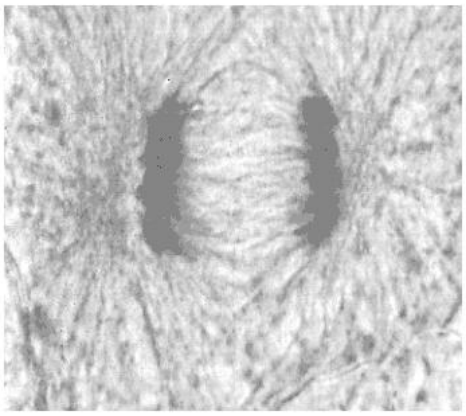
State **one** other process that takes place during stage **G2**.

..... **[1]**

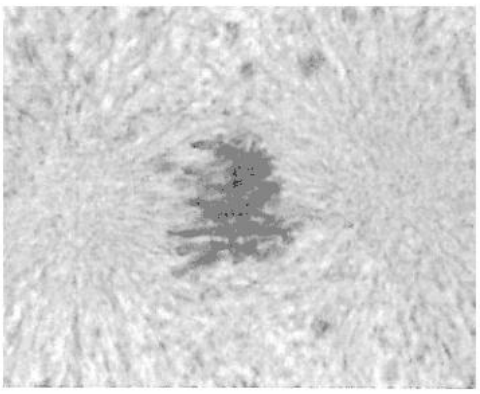
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Question 2 · AS Paper 1 · June 2019 · Q23(a)(i) · 1 mark

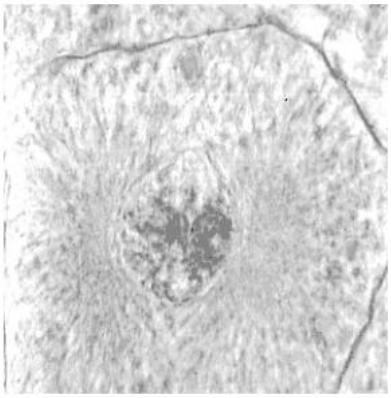
23 The photomicrographs shown in Fig. 23 below are taken from an animal cell undergoing mitosis.



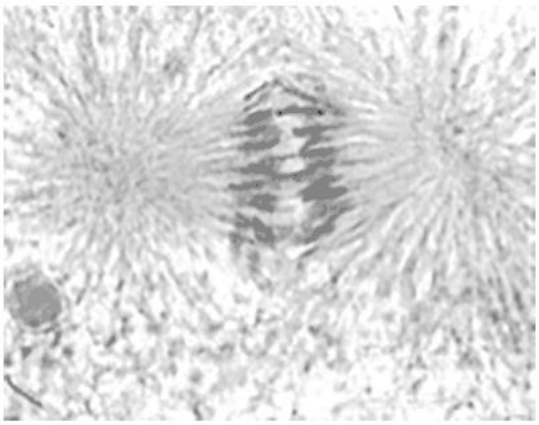
P



Q



R



S

Fig. 23

(a) (i) Write the letters of the images, **P** to **S**, in the correct mitotic sequence.

.... **[1]**

Question 3 · AS Paper 1 · June 2019 · Q23(a)(ii) · 2 marks

(ii) Describe in detail what is happening in image **Q**.

.....

.....

.....

.....

..... **[2]**

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Question 4 · A level Paper 2 · June 2023 · Q16(a) · 1 mark

16 Many organisms undergo asexual reproduction by mitosis.

(a) State **two** other roles of mitosis in organisms.

1 .....

2 .....

[1]

Question 5 · A level Paper 2 · June 2023 · Q16(b)(i) · 2 marks

(b) Plants reproduce asexually by mitosis.

(i) Explain why mitosis, and not meiosis, is used for asexual reproduction in plants.

.....

.....

.....

.....

..... **[2]**

Question 6 · AS Paper 1 · June 2025 · Q21(a)(ii) · 2 marks

(ii) Describe **two** features of homologous chromosomes.

1 .....

.....

2 .....

.....

[2]

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Question 7 · AS Paper 1 · June 2025 · Q21(b)(ii) · 3 marks

(ii) Meiosis allows organisms to make gametes.

Describe the **three** processes that occur during meiosis to cause genetic variation in gametes **and** state the stage in which each process occurs.

Process 1 .....

Stage .....

Process 2 .....

Stage .....

Process 3 .....

Stage .....

[3]

Turn over

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7 The diagrams below are of two specialised cells.

Fig. 7.1 shows a sperm cell from a mammal. **Fig. 7.2** shows a palisade cell from a plant.

Fig. 7.1

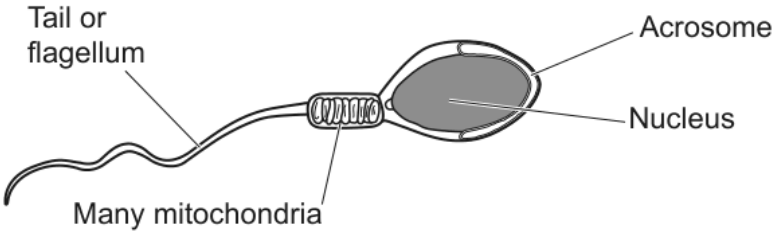
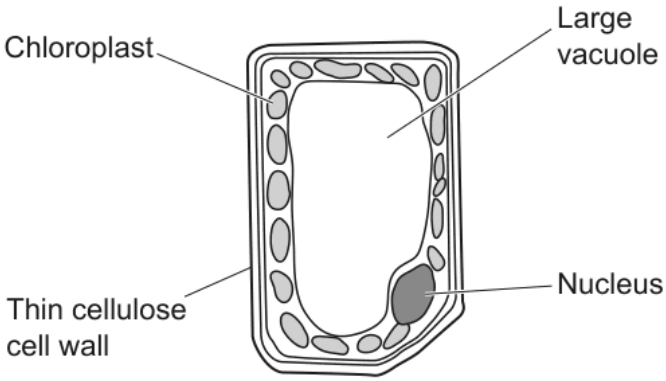


Fig. 7.2



(a) With reference to the features shown in **Fig. 7.1**, explain how the sperm cell is adapted to its function.

.....

.....

.....

.....

..... **[2]**

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Question 9 · AS Paper 2 · June 2022 · Q4(a)(i) · 1 mark

4 (a) **Fig. 4.1** shows a light micrograph of cells in the blood.

Cell **X** plays a role in the immune response.

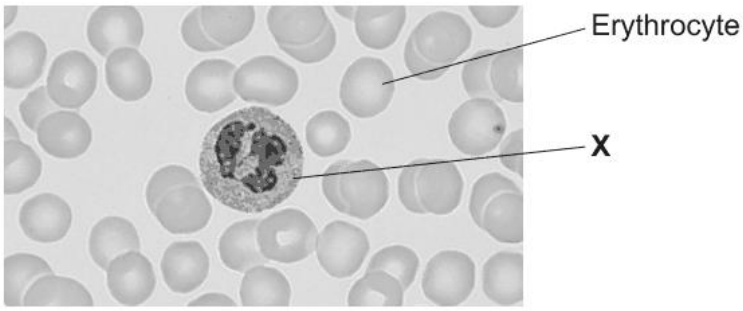


Fig. 4.1

(i) Name cell **X**.

..... **[1]**

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Question 10 · information from earlier in the question

23 Fig. 23 shows a microscope image of a cross section taken from the stem of a sunflower, *Helianthus annuus*.

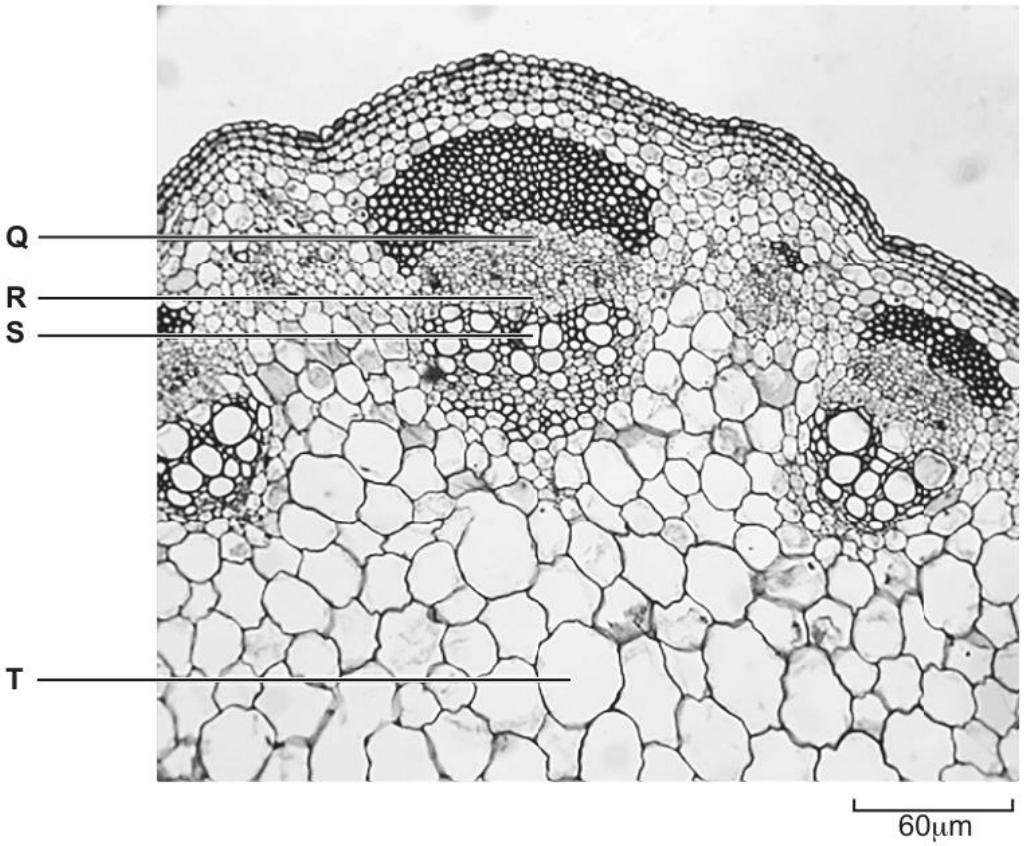


Fig. 23

(a) Calculate the magnification of this image.

..... **[2]**

Question 10 · AS Paper 1 · June 2018 · Q23(b)(i) · 1 mark

(b) (i) The cell labelled **T** on Fig. 23 is a parenchyma cell which carries out photosynthesis and stores starch. Suggest why cell **T** and the cells surrounding it, can be classified as parenchyma **tissue**.

.....

..... **[1]**

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Question 11 · AS Paper 1 · June 2018 · Q23(c) · 1 mark

(c) The tissues labelled **Q** and **S** in Fig. 23 are produced by mitosis from the tissue labelled **R** on Fig. 23. Identify the tissue labelled **R**.

R ..... **[1]**

Turn over

Question 12 · A level Paper 2 · June 2025 · Q16(b)(i) · 2 marks

(b)

(i) State **two** features of stem cells, **not** visible under the microscope, that distinguish them from specialised cells.

1 .....

.....

2 .....

.....

[2]

Question 13 · A level Paper 3 · June 2025 · Q7(b)(i) · 1 mark

(b) Neutrophils are white blood cells that contribute to the immune response against infection.

Neutrophils produce oxidative bursts as part of their response to infection.

An oxidative burst is the rapid production of highly reactive particles, including hydrogen peroxide (H_2O_2), inside the cell.

(i) State the location of the stem cells that differentiate into neutrophils.

..... **[1]**

Question 14 · AS Paper 1 · June 2022 · Q25(d) · 1 mark

(d) Name **one** potential use of stem cells in medicine.

.....

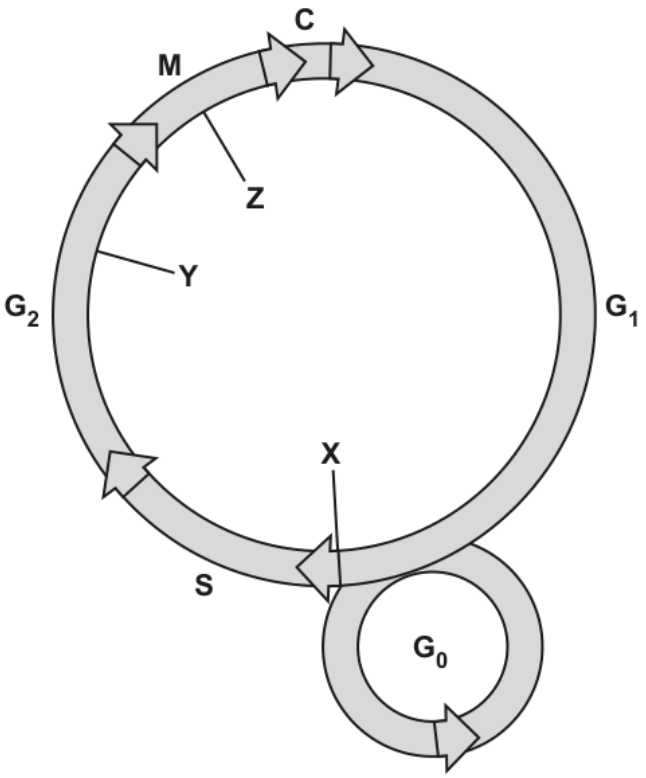
..... **[1]**

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Question 15 · AS Paper 1 · June 2024 · Q23(c) · 2 marks

(c) An outline of the eukaryotic cell cycle is shown below.

X, **Y** and **Z** represent checkpoints in the regulation of the cell cycle.



A cell that had completed the cell cycle had more chromosomes than its normal diploid number.

Identify which cell cycle checkpoint, **X**, **Y** or **Z**, had failed to work in this cell. Give a reason for your choice.

.....

.....

.....

.....

..... **[2]**

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(d) Hypothyroidism (underactive thyroid gland) is treated by taking thyroxine tablets.

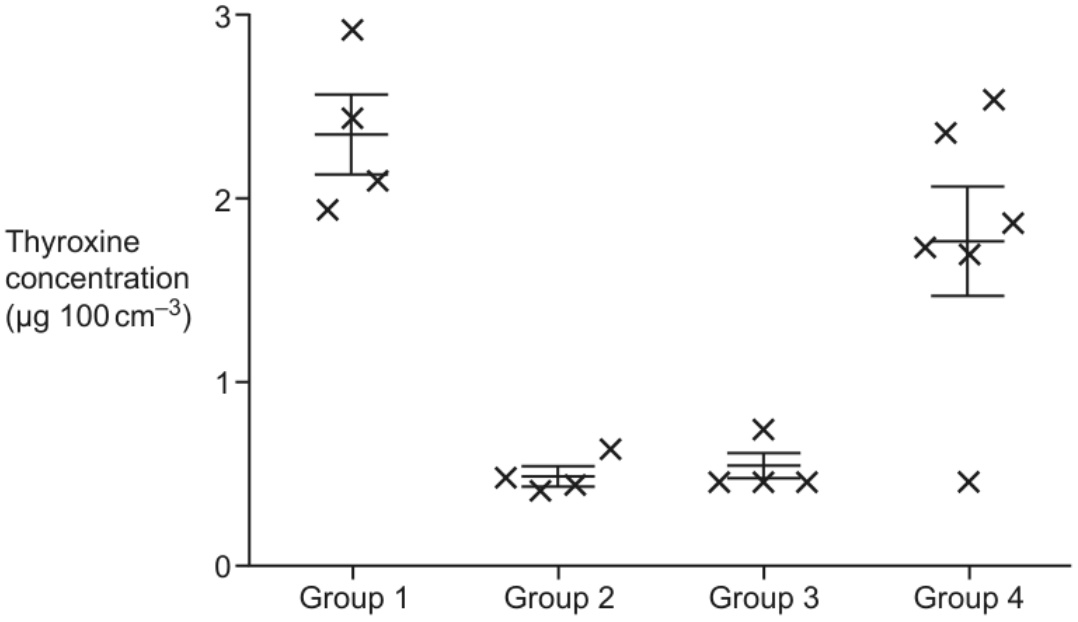
Scientists are investigating the use of stem cell transplants to treat hypothyroidism in which the thyroid glands of mice are destroyed using radioactive iodine.

The scientists obtained mouse embryonic stem cells (ESCs) and incubated them in culture with or without a mixture of growth factors for 30 days before transplanting them into the mice.

They divided the mice into four groups as shown in the table.

Group	Thyroid gland destroyed	ESCs transplanted into mice
1	No	No
2	Yes	No
3	Yes	Yes, incubated in culture without growth factors
4	Yes	Yes, incubated in culture with growth factors

After eight weeks they measured the thyroxine concentration in the four groups of mice. Their results are shown in the graph. Each cross represents a single mouse and the mean ± 2 standard deviations is shown for each group.



27

(i) The ESCs are described as pluripotent.

Explain what is meant by pluripotent.

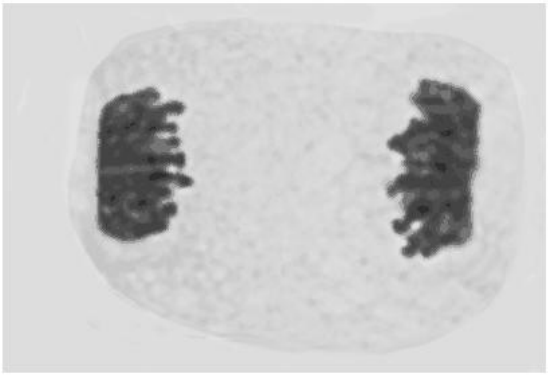
.....

Questions, mark schemes and examiners' report extracts © OCR

Question 17 · A level Paper 2 · June 2024 · Q21(a)(i) · 1 mark

21 Certain changes occur throughout the life of a cell. These changes are known as the cell cycle.

(a) The image shows an onion cell undergoing mitosis.



(i) Name the stage of mitosis shown in the image.

..... **[1]**

Question 18 · A level Paper 2 · June 2024 · Q21(a)(iii) · 1 mark

(iii) The cell in the image is from the root of an onion.

State why root tissue is frequently chosen to study mitosis.

.....

..... **[1]**

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(c) A student observed a prepared slide of an onion root tip under a microscope.
The total number of cells in the field of view was 265.

The number of cells at the different stages of the cell cycle are shown in Table 23.

Stage of cell cycle	Number of cells
interphase	207
prophase	42
metaphase	4
anaphase	6
telophase	6

Table 23

The cell cycle takes 20 hours. The number of cells visible at each stage is proportional to how long each stage of the cell cycle lasts.

Calculate the time taken for prophase to occur.

Give your answer in minutes to the nearest whole number.

time taken = ... min **[2]**

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Question 20 · A level Paper 2 · June 2023 · Q16(d) · 2 marks

(d) During meiosis, the independent assortment of chromosomes leads to the formation of genetically different gametes.

Gametes of the western clawed frog contain 10 chromosomes.

Calculate the number of genetically different gametes resulting from the independent assortment of chromosomes that would be produced by an individual frog.

Number of different gametes = ... **[2]**

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Mark schemes

Question 1 · AS Paper 2 · June 2022 · Q2(a)(i) · 1 mark

(a)	(i)	**1** (named) protein, synthesis / made ✓ **2** (named) organelle, replication / synthesis ✓ **3** energy stores increase ✓ **4** (replicated / new) DNA checked for errors ✓ **5** DNA repair ✓	**1 max**	AO 1.2

1 e.g. tubulin
2 e.g. mitochondria
2 ALLOW G2 checkpoint to ensure enough organelles
3 ALLOW G2 checkpoint to ensure enough energy stores

Question 2 · AS Paper 1 · June 2019 · Q23(a)(i) · 1 mark

23	**(a) (i)**	R, Q, S, P ✓	**1**

Question 3 · AS Paper 1 · June 2019 · Q23(a)(ii) · 2 marks

(ii)	chromosomes / centromeres, aligning on, equator / mitotic plate / metaphase plate (of cell) ✓ chromatids either side of, equator / mitotic plate / metaphase plate ✓ spindle fibres attaching to, chromosome / centromere / pole / centriole ✓	**max 2**

ALLOW centre / middle, of cell in mp 1 & 2

ALLOW microtubules for spindle fibres

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Question 4 · A level Paper 2 · June 2023 · Q16(a) · 1 mark

16	**(a)**			**1**	1.1
			growth (of organisms / tissues) **AND** repair (of organisms / tissues) ✓		

Both answers required for 1 mark
If more than two responses are given, **DO NOT AWARD** the mark if any of the responses is incorrect.

ALLOW controlling body plan

ALLOW clonal expansion / replacement of cells
IGNORE stem cells

Question 5 · A level Paper 2 · June 2023 · Q16(b)(i) · 2 marks

(b)	**(i)**		**2**	1.2
		produces genetically identical , cells / organisms ✓ maintains , chromosome / diploid , number (between generations) ✓		

ALLOW ora for meiosis

ALLOW offspring with identical genes
IGNORE clones

IGNORE produces diploid cells

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Question 6 · AS Paper 1 · June 2025 · Q21(a)(ii) · 2 marks

(ii)	1 are a similar / same , length ✓ 2 (consist of) one maternal and one paternal (chromosome) / AW ✓ 3 (have / carry the) same, genes / gene loci / AW ✓ 4 (both) have centromere, in same position ✓ 5 have same banding pattern ✓ 6 (may / can, have / contain) different, alleles / versions of the same gene / genotypes / AW ✓ 7 able to crossover (in prophase 1) ✓	**2 max**

1.1	**Mark as prose** **ALLOW** similar / same, shape / size **ALLOW** equal in length **ALLOW** ref to DNA instead of chromosome **ALLOW** one chromosome from each parent **DO NOT ALLOW** ref to single chromatid **DO NOT ALLOW** genetically identical / same genetic information / same alleles / same amount / same genotype **DO NOT ALLOW** in the middle **ALLOW** not genetically identical / different DNA

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Question 7 · AS Paper 1 · June 2025 · Q21(b)(ii) · 3 marks

		(ii)	Process: crossing over (of non-sister chromatids) / (formation of) chiasmata Stage: prophase 1 ✓ Process: independent assortment of, chromosomes / homologous pairs / bivalents Stage: metaphase 1 ✓ Process: independent assortment of, chromosomes / (sister) chromatids Stage: in metaphase 2 ✓	**3**	1.2	**ALLOW** ECF if they swap correct process and stage e.g. Process 1: prophase 1 & Stage: crossing over. Process 2: metaphase 1 & Stage: independent assortment of homologous pairs Would be awarded 1 mark for Process 2 & Stage 2 **ECF** **ALLOW** random for independent **ALLOW** anaphase 1 **ALLOW** random for independent **ALLOW** anaphase 2
			Total	**9**		

Question 8 · AS Paper 2 · June 2023 · Q7(a) · 2 marks

7	**(a)**	*Any two from* **F** tail / flagellum **AND** **R** (for) movement / swimming ✓ **F** (many) mitochondria **AND** **R** release / provide, energy/ATP, for, movement / swimming ✓ **F** acrosome **AND** **R** contains, hydrolytic/ digestive enzymes **OR** **R** (enzymes) allow sperm to penetrate ovum / to breakdown outer part of ovum ✓

Max 2	**2.5**	**Feature must match the role** **e.g.** sperm cell has flagellum and mitochondria that provide energy for the cell to move = 2 marks **IGNORE** break the egg membrane **ALLOW** sperm to fuse with the egg for 'sperm to penetrate ovum'

Question 9 · AS Paper 2 · June 2022 · Q4(a)(i) · 1 mark

4	**(a)**	**(i)**	phagocyte / neutrophil ✓	**1**	AO 1.1	**ALLOW** (non-human) macrophage **IGNORE** leucocyte / white blood cell

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Question 10 · AS Paper 1 · June 2018 · Q23(b)(i) · 1 mark

(b)	**(i)**	(similar) cells working together with, common / same / similar, (named) function ✓	1

Need to see both 'working together' **and** 'same function'
The named function must be storage of starch or photosynthesis

Question 11 · AS Paper 1 · June 2018 · Q23(c) · 1 mark

	(c)		cambium / meristem(atic) 1	
Question			**Answer** **Mark**	**Guidance**

Question 12 · A level Paper 2 · June 2025 · Q16(b)(i) · 2 marks

16	**(b)**	**(i)**	undifferentiated ✓ (named) potency ✓ capable of / AW , (continuous) mitosis ✓	**2 max**	**1.1**

Mark as prose (ignore prompt lines)

ALLOW unspecialised / have the ability to differentiate
IGNORE general descriptions of being unspecialised

ALLOW idea of self-renewing / immortal

Question 13 · A level Paper 3 · June 2025 · Q7(b)(i) · 1 mark

7	**(b)**	**(i)**	bone marrow ✓
Question			**Answer**

1	1.1	
Mark	**AO Element**	**Guidance**

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25	**(d)**	(medical) research ✓ treatment of, Alzheimer's / Parkinson's / named neurological condition ✓ to, repair / replace, (damaged) tissue / named (damaged) tissue ✓ AVP ✓

Max 1	e.g. spinal cord injury, retinopathy, paralysis e.g. skin / pancreatic tissue / islets of Langerhans / heart tissue / bone marrow / nervous tissue / nerves e.g. transplant stem cells for treatment of leukaemia / growing organs for transplant / treatment of blindness

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Question 15 · AS Paper 1 · June 2024 · Q23(c) · 2 marks

(c)	Checkpoint Z / M checkpoint / mitosis checkpoint ✓ because… chromosomes cannot have been, aligned correctly at the equator / attached correctly to the spindle **OR** not all <u>chromatids</u> have been, separated / pulled apart **OR** some <u>chromatids</u> have not been separated **OR** (daughter) cell did not receive correct number of, chromosomes/chromatids **OR** (daughter) cell received more than one copy of each chromosome/chromatid ✓	**2**

If wrong checkpoint given = 0 marks

ALLOW non-disjunction

ALLOW none / did not receive any

ALLOW too many

Question 16 · A level Paper 1 · June 2022 · Q21(d)(i) · 2 marks

21	**(d)**	**(i)**	can , differentiate / specialise , into , any / all , (adult) cell type / tissue type ✓ cannot form , whole organisms / extra-embryonic tissues ✓

2	1.2	**ALLOW** for extra-embryonic e.g. placenta **or** umbilical cord **or** amnion

Question 17 · A level Paper 2 · June 2024 · Q21(a)(i) · 1 mark

21	**(a)**	**(i)**	<u>telophase</u> ✓	**1**	**2.7**

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Question 18 · A level Paper 2 · June 2024 · Q21(a)(iii) · 1 mark

21	**(a)**	**(iii)**	many dividing cells / cells undergo frequent mitosis ✓	**1**	**3.3**

IGNORE meristem tissue

Question 19 · AS Paper 1 · June 2019 · Q23(c) · 2 marks

(c)	190 ✓✓	**max 2**
	Total	**8**

If the answer is incorrect or incorrectly rounded, award 1 mark for working:

42÷265 x1200

OR

42÷265 x20 x60

Question 20 · A level Paper 2 · June 2023 · Q16(d) · 2 marks

16	**(d)**		**FIRST CHECK ON ANSWER LINE** **If answer = 1024 award 2 marks** number of combinations = 2^n ✓ $2^{10} = 1024$ ✓	**2**	2.2	*If answer is incorrect* **ALLOW** 1 mark for 512 or 2048 or 1000

Question	Answer	Marks	AO element	Guidance

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