WJEC EDUQAS A-LEVEL BIOLOGY · COMPONENT 2

BIOLOGY



EXAM QUESTION PACK

2.2 CELL DIVISION

SCORE	PERCENTAGE
/103	%

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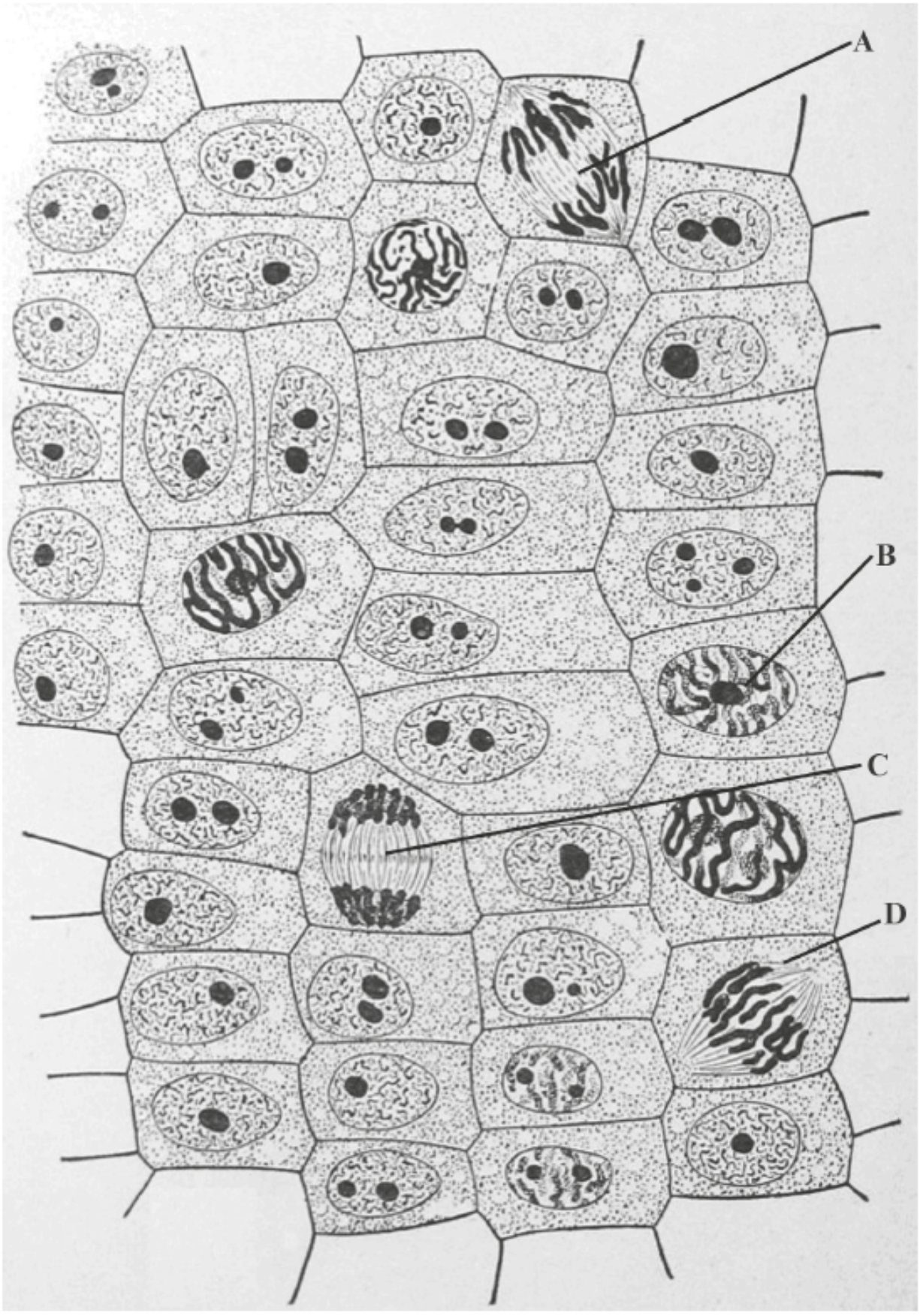
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1. The drawing below is taken from plant tissue which shows cells undergoing mitosis.



(a) What plant tissue could be observed to produce this drawing? [1]

.....

(b) Identify from the diagram opposite the stages of mitosis labelled **A** to **D**.

A

.....

B

.....

C

.....

D

.....

(c) One stage of the **cell cycle** shown on the diagram is present in greater numbers than the others. Name this stage and explain this observation.

[2]

Stage:

.....

Explanation:

.....

.....

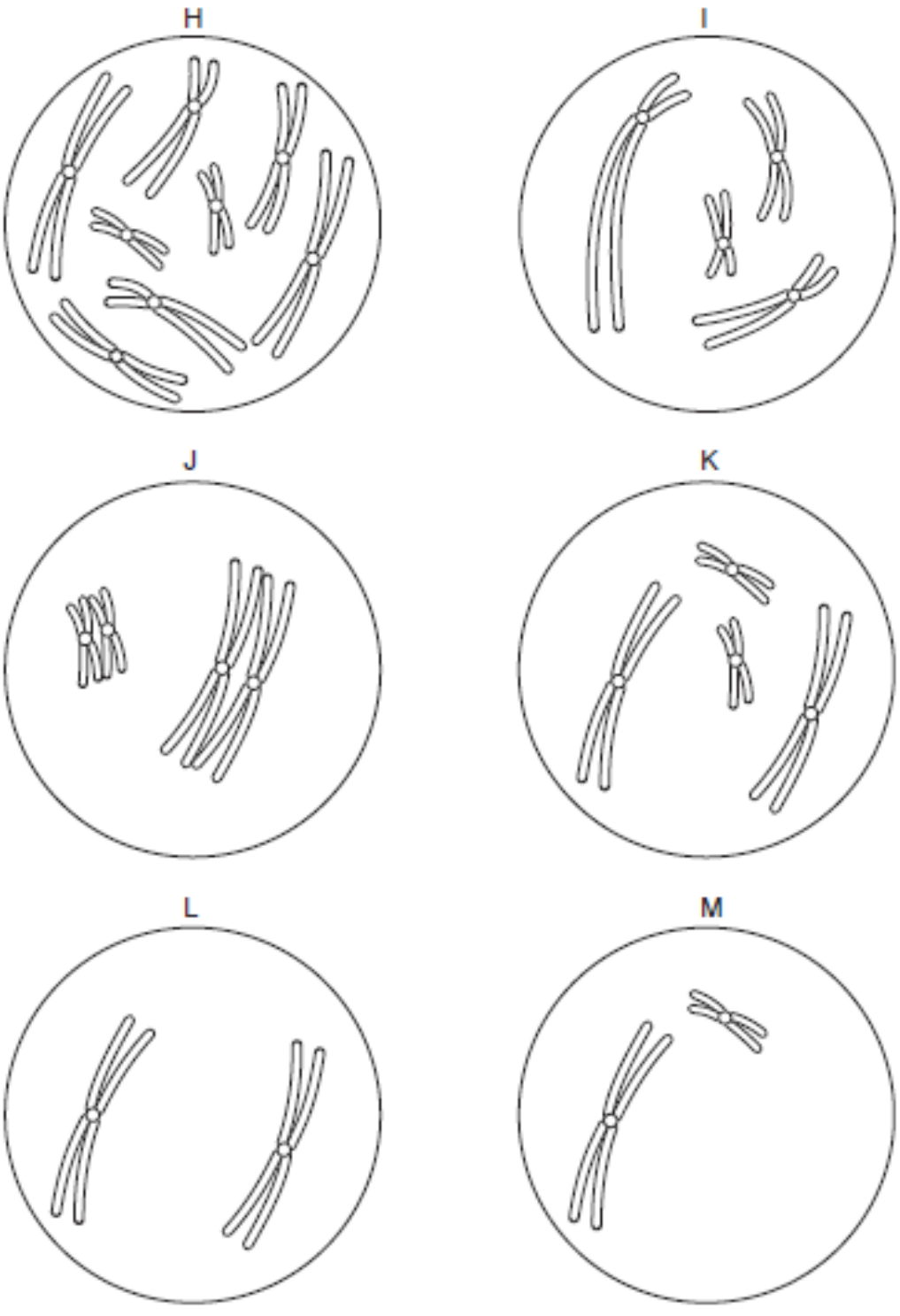
(d) How would cells produced by meiosis differ from those produced by mitosis?

[2]

Total [9]

2. Spider mites are small invertebrates which are related to spiders and scorpions. One species, *Eutetranychus africanus*, which is native to the island of Mauritius, has very few chromosomes, 2n = 4.

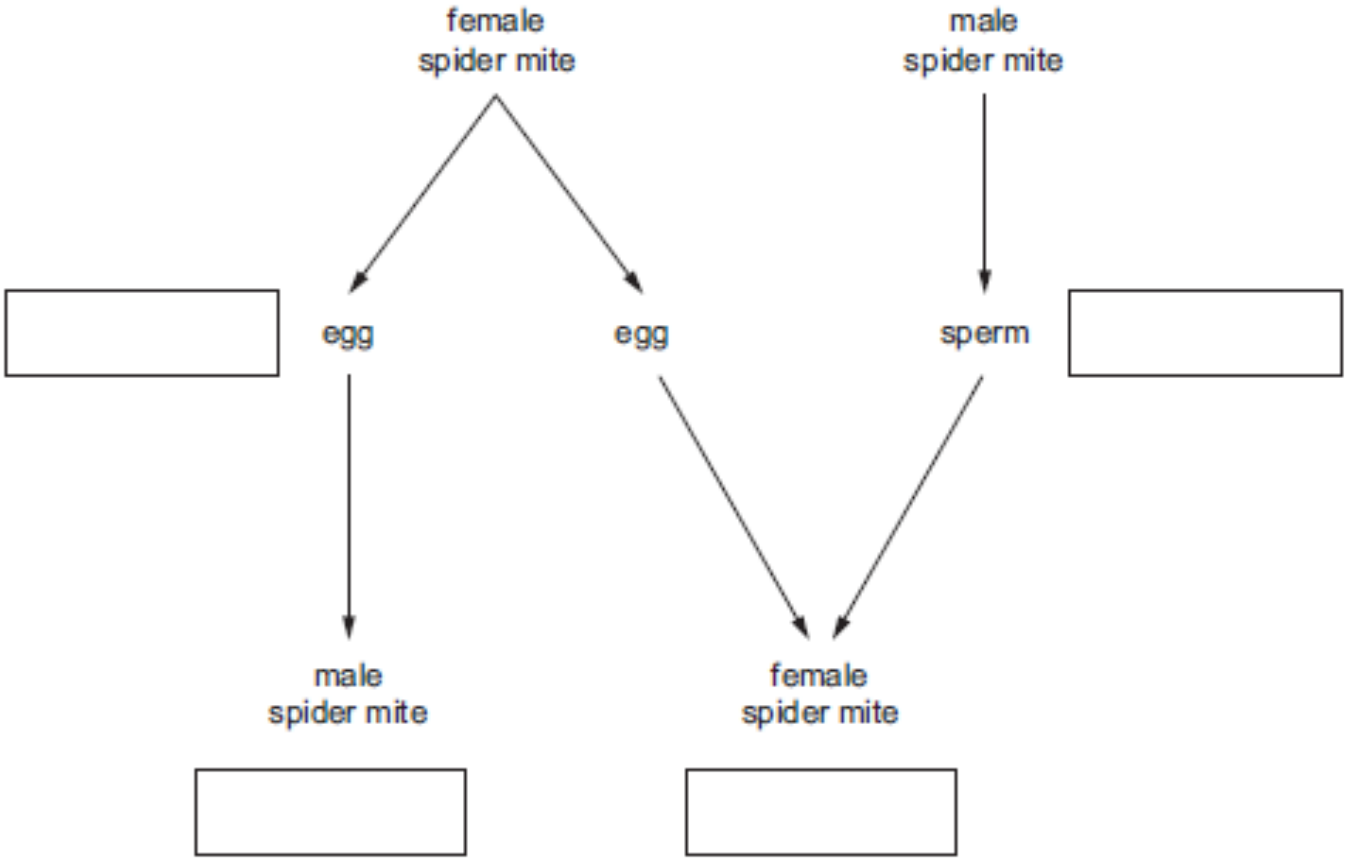
The diagrams below show the chromosomes in some cells undergoing mitosis or meiosis.



(a) Identify the cells that belong to this species of spider mite. [2]

.....

(b) The diagram below shows the individuals that make up a colony of spider mites. Female spider mites are produced when a male sperm fertilises a female's egg. Male spider mites develop from an unfertilised female egg.



(i) **Complete** the diagram to state which stages are **haploid** or **diploid**. [2]

(ii) What conclusions can be made about the formation of male and female gametes in spider mites? [2]

.....

.....

.....

(c) (i) A sample of tissue from the **leg muscle** of a young spider mite was analysed. The mass of DNA in some of the cells was 6.8 arbitrary units (au), whilst in other cells it was 3.4 au. Suggest explanations for this difference using your knowledge of the cell cycle. [3]

.....

.....

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.....

(ii) The table below shows the percentage of cells, with either 3.4 au or 6.8 au of DNA, in the leg muscle of a young spider mite and an older spider mite.

	Percentage of cells	
Mass of DNA in cell /au	Young spider mite	Older spider mite
6.8	20	5
3.4	80	95

What conclusions can be drawn from the data regarding the significance of mitosis in these spider mites? [2]

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3.

(a) Meiosis is a type of cell division.

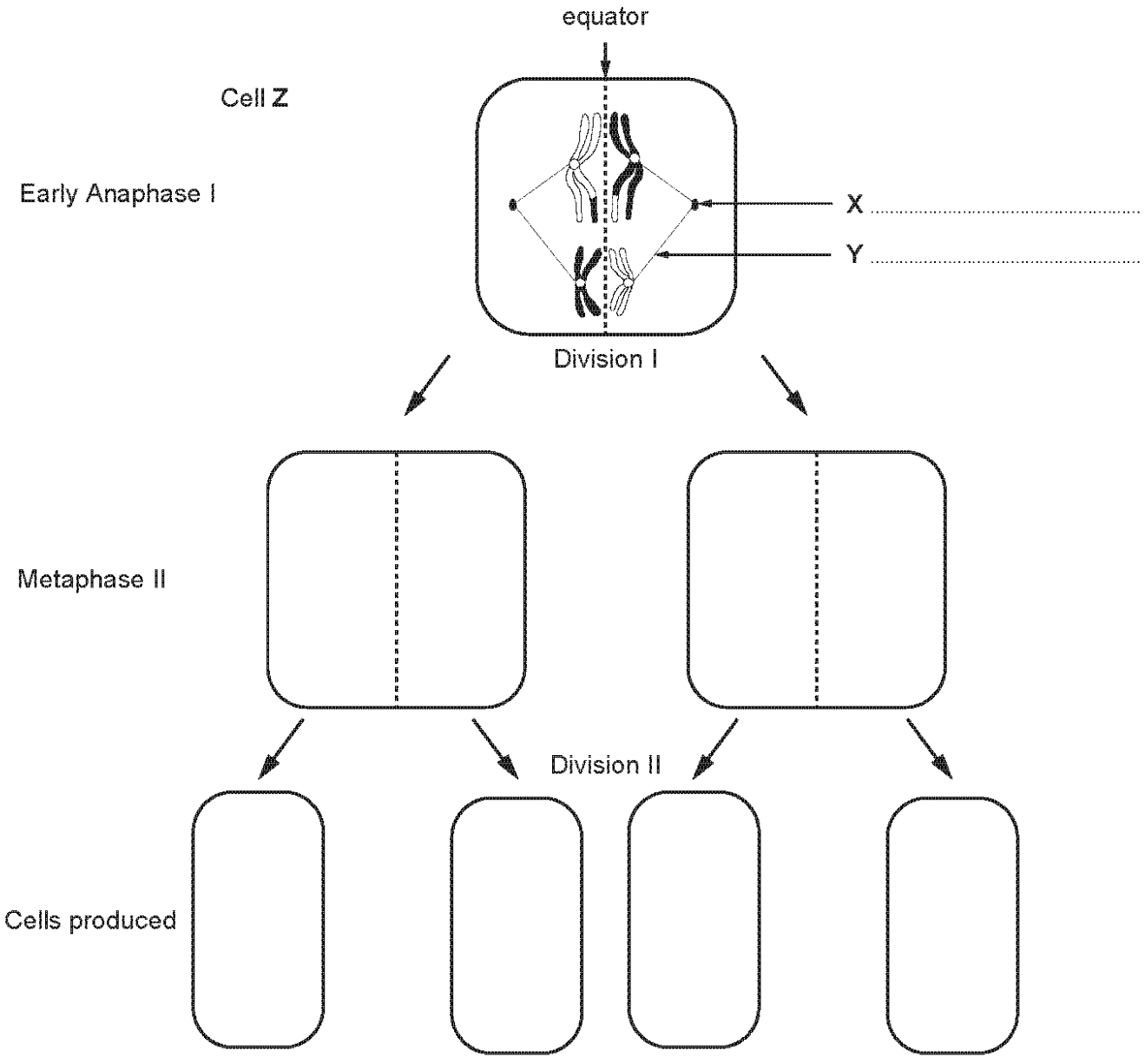
(i) State the purpose of meiosis. [1]

.....

(ii) Name the organs in animals where meiosis occurs. [1]

.....

(b) The diagram below represents meiosis in a cell with two pairs of chromosomes.



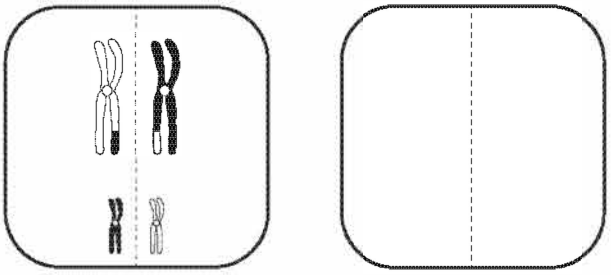
(i) Label parts **X** and **Y**. [1]

(ii) Draw chromosomes in the cell outlines for: [4]

I. metaphase II

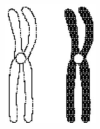
II. the cells produced

(c) The drawing of cell **W** below is an outline of another cell from the same individual as cell **Z**. Complete the drawing of cell **W** to show how **independent assortment** could produce an alternative outcome. [1]



Cell **Z** Cell **W**

(d) The drawing below shows the two larger chromosomes from cell **Z** at a different stage of meoisis



(i) Name the stage of meiosis. [1]

.....

(ii) Explain with the aid of diagrams how the larger chromosomes in cell **Z** took on the appearance shown in part *(c)*. [2]

(iii) Name the process shown in your drawings. [1]

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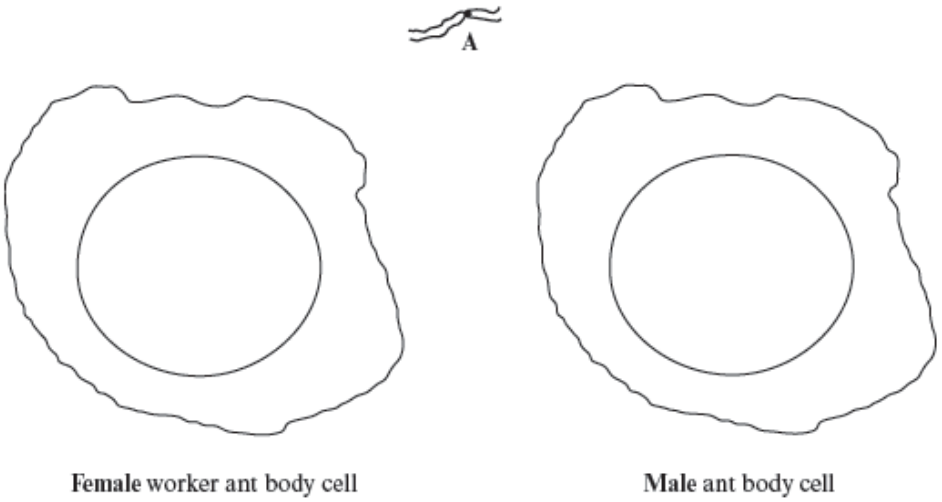
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4. An Australian ant, Myrmecia pilosula, carries all its genetic information in a single pair of homologous chromosomes. Female worker ants are diploid, males are haploid.

(a) Complete the drawings of the ant body (somatic) cells below, using drawings similar to structure A shown below to represent a single chromosome.

[2]



Female worker ant body cell

Male ant body cell

(b) Using the cell outlines provided below, make labelled drawings to show the appearance of the female worker ant cells at the following stages.

[4]

(i) metaphase of mitosis, (ii) anaphase of mitosis.



(iii) Adult ants emerge from pupae fully grown. Describe the purpose of mitosis in female worker ants.

[2]

(iv) Suggest the additional purpose of mitosis in fully grown male ants.

[1]

(v) In ant colonies only some ants, called 'queens', produce egg cells and lay eggs.
Name the type of cell division that the 'queens' use to produce haploid egg cells.

[1]

(vi) What is the significance of the queens producing haploid egg cells?

[1]

(c) During a mating flight the queen collects sperm cells from male ants, which she stores in an organ called the spermatheca. The haploid egg cells from the queen's ovaries pass the spermatheca as they are laid. Some eggs are fertilised as they pass out, some eggs pass out unfertilised.

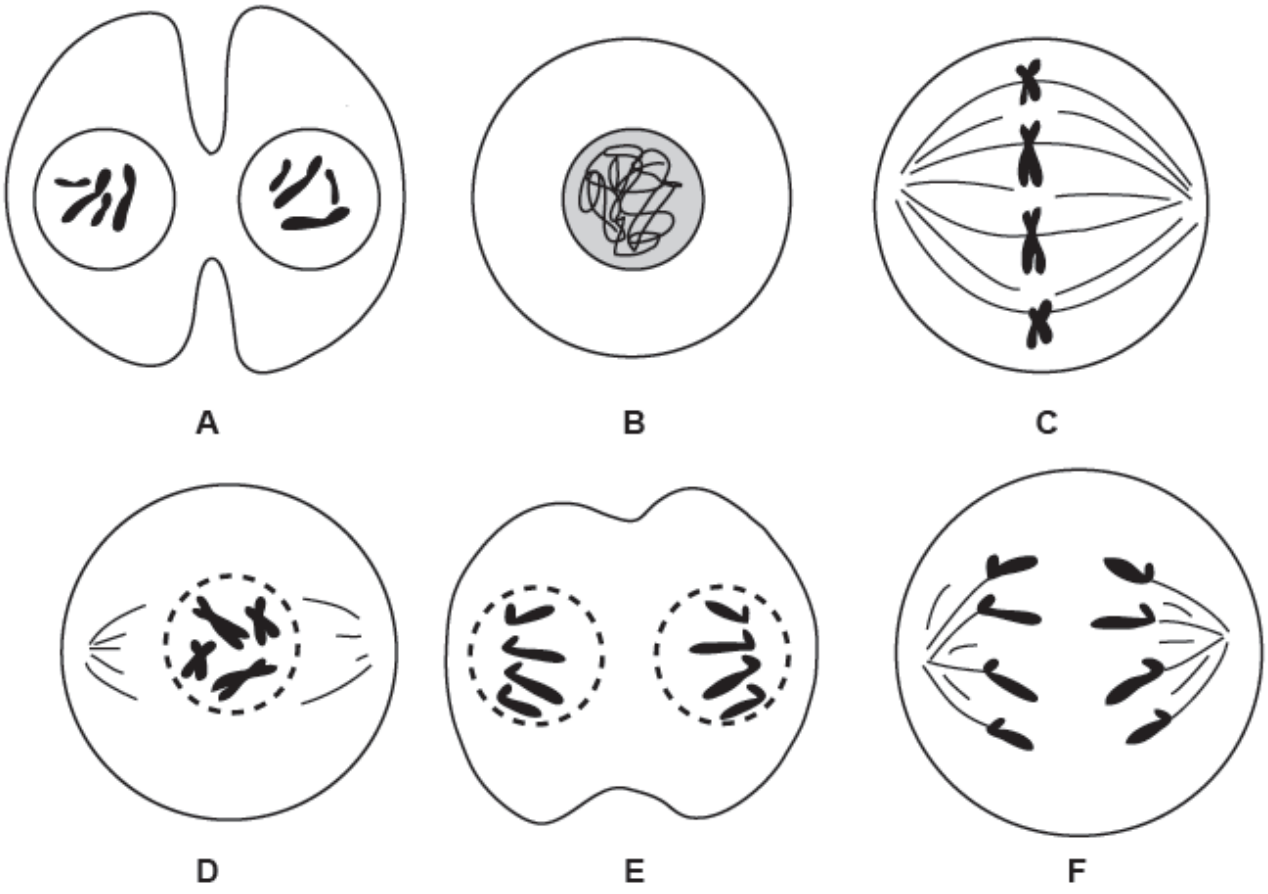
How will the ants that develop from fertilised egg cells differ from the ants that develop from unfertilised egg cells?

[1]

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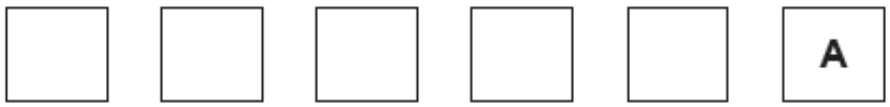
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5. The diagrams below show the different stages of the cell cycle in a body cell from an animal



(a) (i) Put the stages from the diagrams above in the correct sequence. The last stage has been done for you.

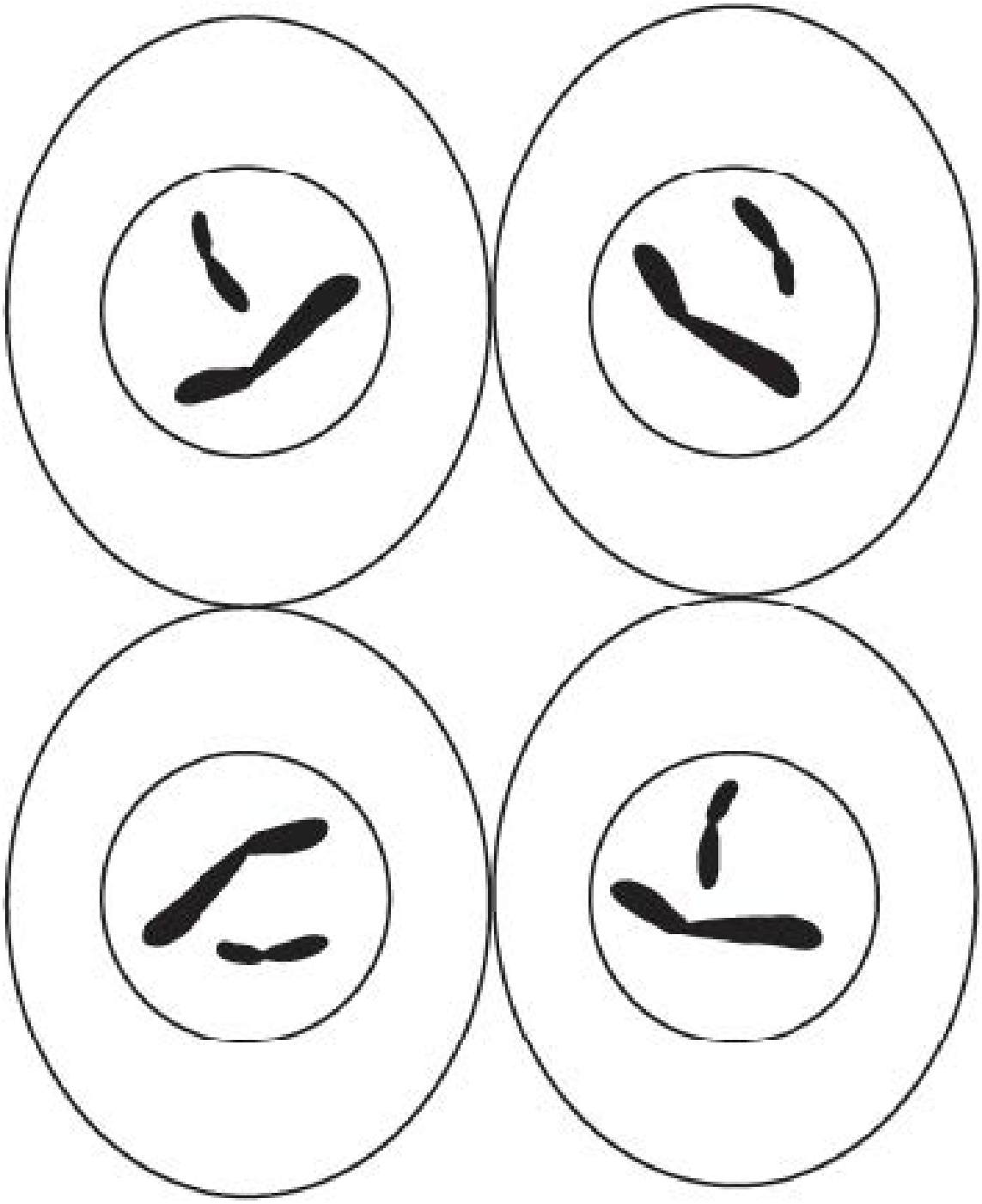
[1]



(ii) Name the process represented in diagram A.

[1]

Cell division also occurs in the ovaries of animals. The diagram below shows the final stage of cell division in the ovary of the same animal.



(b) (i) Using the diagrams above, describe and explain one difference between these cells and those produced in part (a) opposite. [2]

(ii) Explain the importance of this type of cell division in the animal.

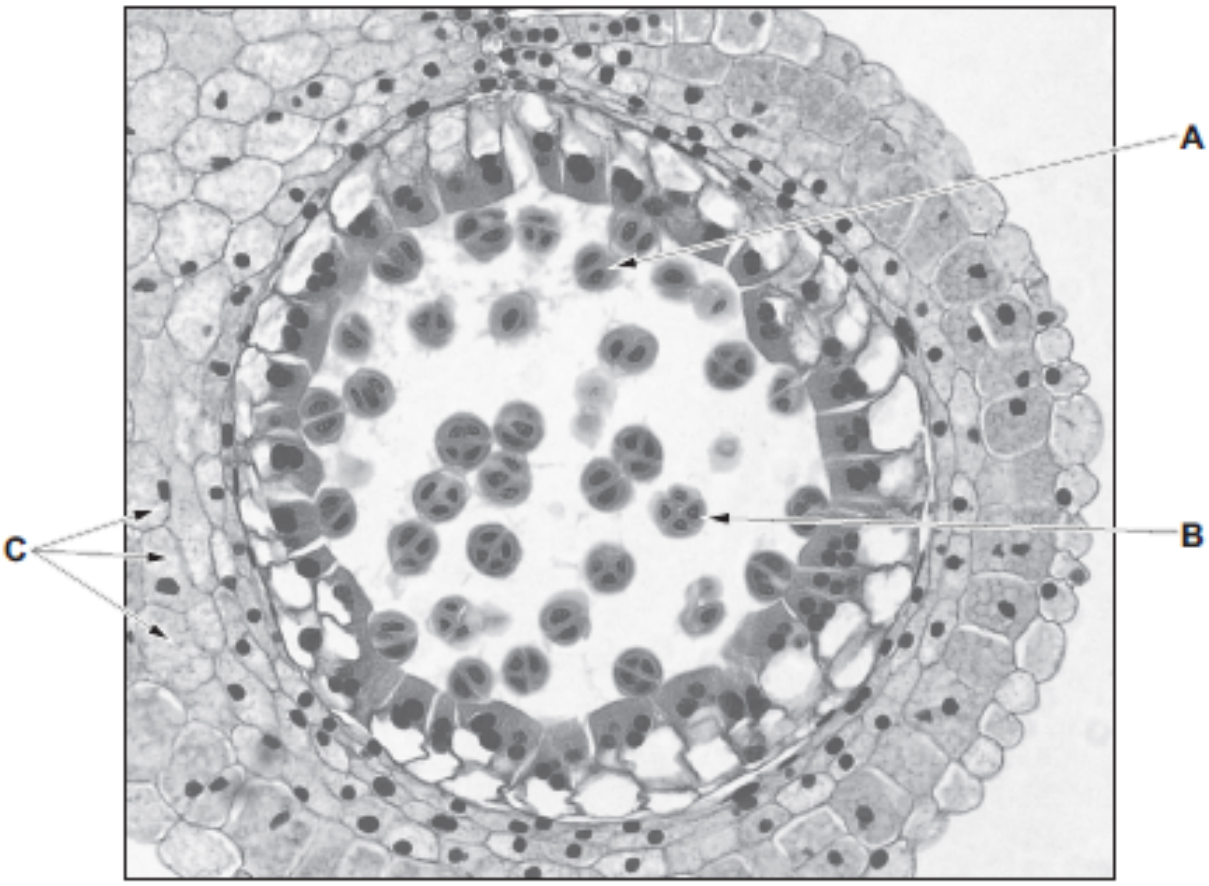
[2]

6.

Mitosis and meiosis are both forms of nuclear division. Both types of nuclear division are involved in the production of gametes.

(a) Image 1 below shows a section through part of an anther of *Lilium sp.* showing stages in the production of pollen grains.

Image 1



(i) It was concluded that structure **A** had just completed meiosis I and structure **B** had just completed meiosis II. Explain how you would draw these conclusions from the photomicrograph. [1]

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.....

(ii) The cells labelled **C** are in interphase. Explain why nuclei are only visible in some cells and, where nuclei are visible, why they appear to be of different sizes. [2]

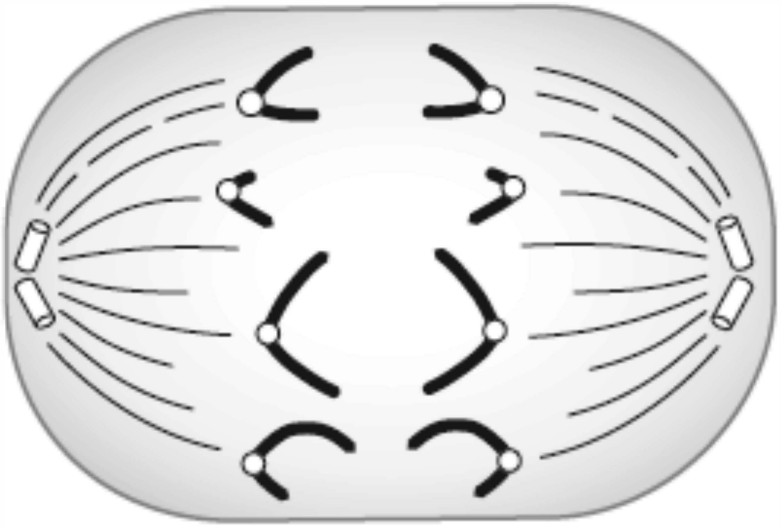
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(b) A drawing was made of an animal cell during anaphase. The diploid number in this cell is eight.



Deduce whether this cell is undergoing anaphase of mitosis, anaphase I of meiosis or anaphase II of meiosis. Explain your answer.

[3]

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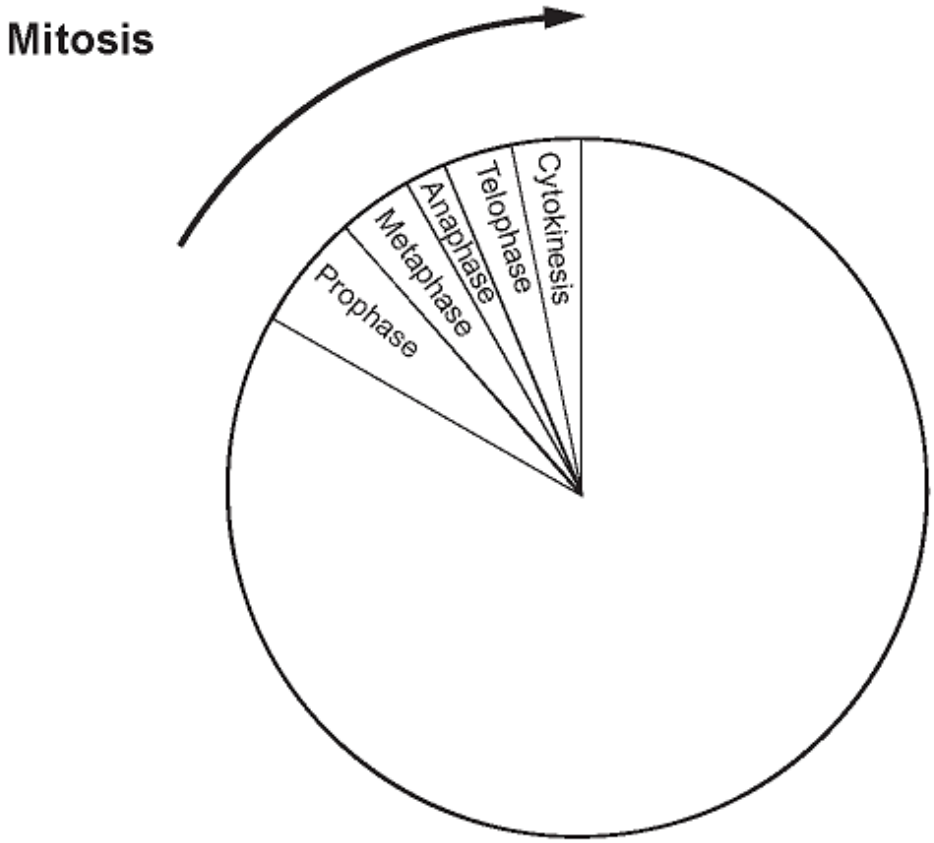
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7. The diagram below shows the relative lengths of the cell cycle in actively dividing cells taken from the root tip of a garlic plant.



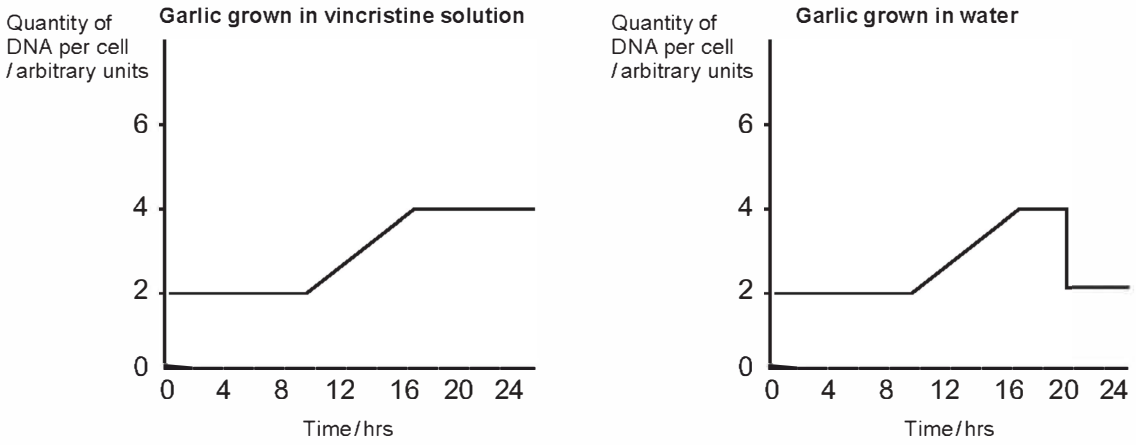
(a) Describe the changes that occur to a plant cell during prophase. [4]

(b) The percentage of cells in each stage of the cell cycle is proportional to the length of that stage. Using a microscope, a student observed 100 cells and found 5 undergoing prophase. If the total length of the cell cycle is 24 hours, calculate the length of prophase in minutes. Show your working.

[2]

Answer = ... minutes

(c) Vincristine is a chemical which inhibits mitosis by preventing the formation of the spindle fibres. Garlic bulbs were grown in a solution of vincristine and the quantity of DNA present in a cell from the root tip was measured over the 24 hour length of the cell cycle. The results are shown below together with the results from garlic bulbs grown in water.



Using your knowledge of the cell cycle, explain how the results of this experiment show that vincristine inhibits mitosis.

[3]

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(d) Meiosis produces four daughter cells, whereas mitosis only produces two daughter cells. Describe **two** *other* ways in which the cells produced by meiosis would differ from those produced by mitosis. [2]

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11

8. (a) Complete the table to show whether each role applies to mitosis, meiosis or both. If the role applies put a tick (✓) and a cross (×) where it does not apply.

Role	*Mitosis*	*Meiosis*
Involved in growth		
Produces variation		
Produces haploid cells		
Occurs in plants		

[4]

(b) In the space below draw a labelled diagram to show a single chromosome as it appears during prophase of mitosis. [2]

(c) Describe and explain what happens to chromosomes during anaphase of mitosis. [3]

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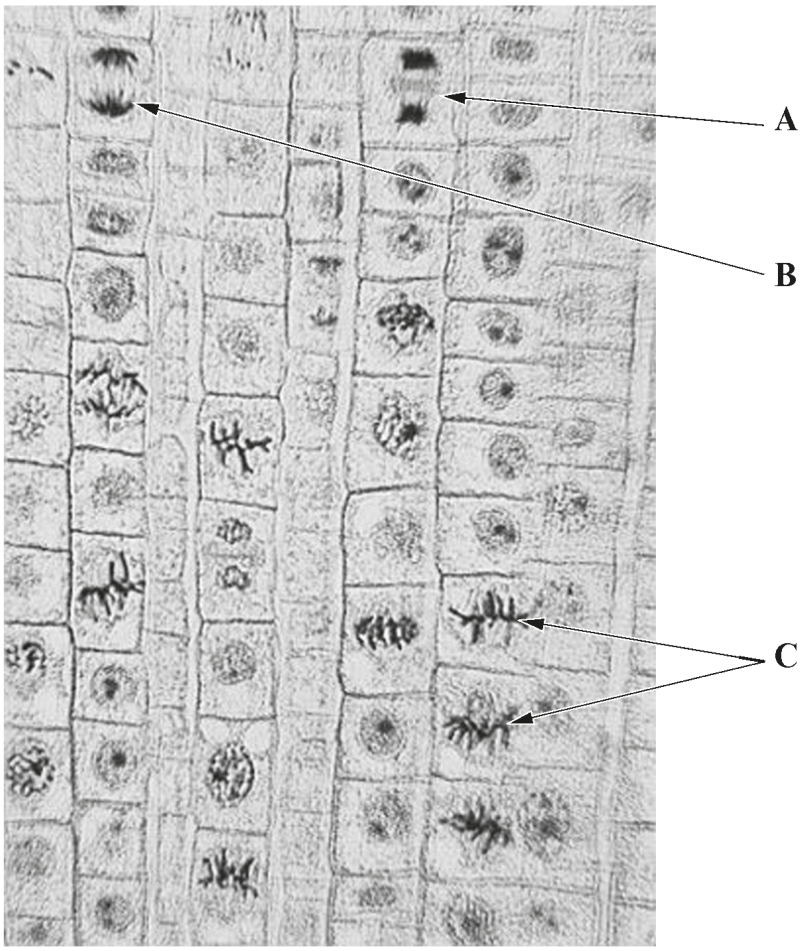
(d) Name the cell organelle responsible for the production of the spindle fibres. [1]

.....

(Total 10 marks)

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9. The photograph below shows a preparation of garlic (*Allium sativum*) root tip undergoing cell division – the stages of the cell cycle are clearly visible.



(a) (i) Name the stages shown in the diagram labelled **A** and **C**. [2]

Stage **A** .....

Stage **C** .....

(ii) Describe and explain the events occurring during the stage labelled **B**. [2]

.....

.....

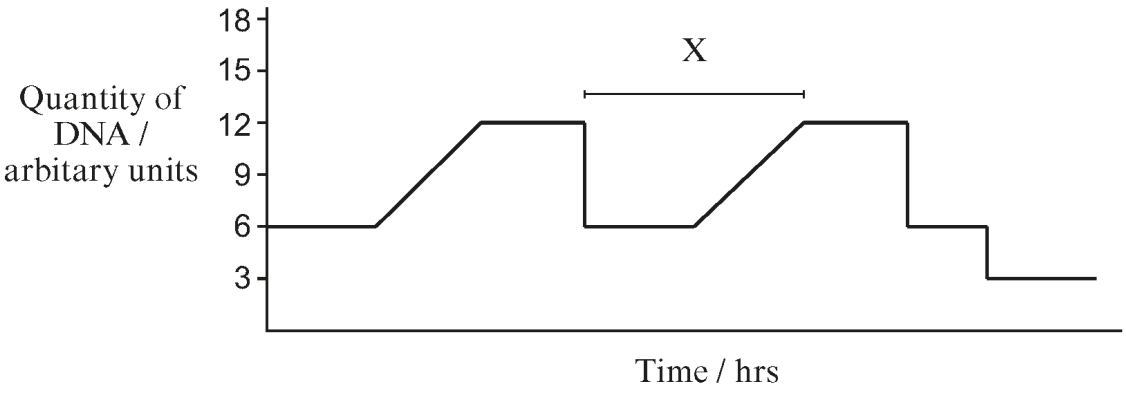
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(b) The graph below shows the relative quantity of DNA in an animal cell during **two** complete cell cycles.



(i) Name the stage in the cell cycle which is represented by the time period labelled X on the graph above. [1]

.....

(ii) Using evidence from the graph, give a reason for your answer in part *(b)*(i). [1]

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.....

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(iii) State the type of nuclear division that is shown in the second cell cycle and explain how the evidence in the graph led you to this conclusion. [2]

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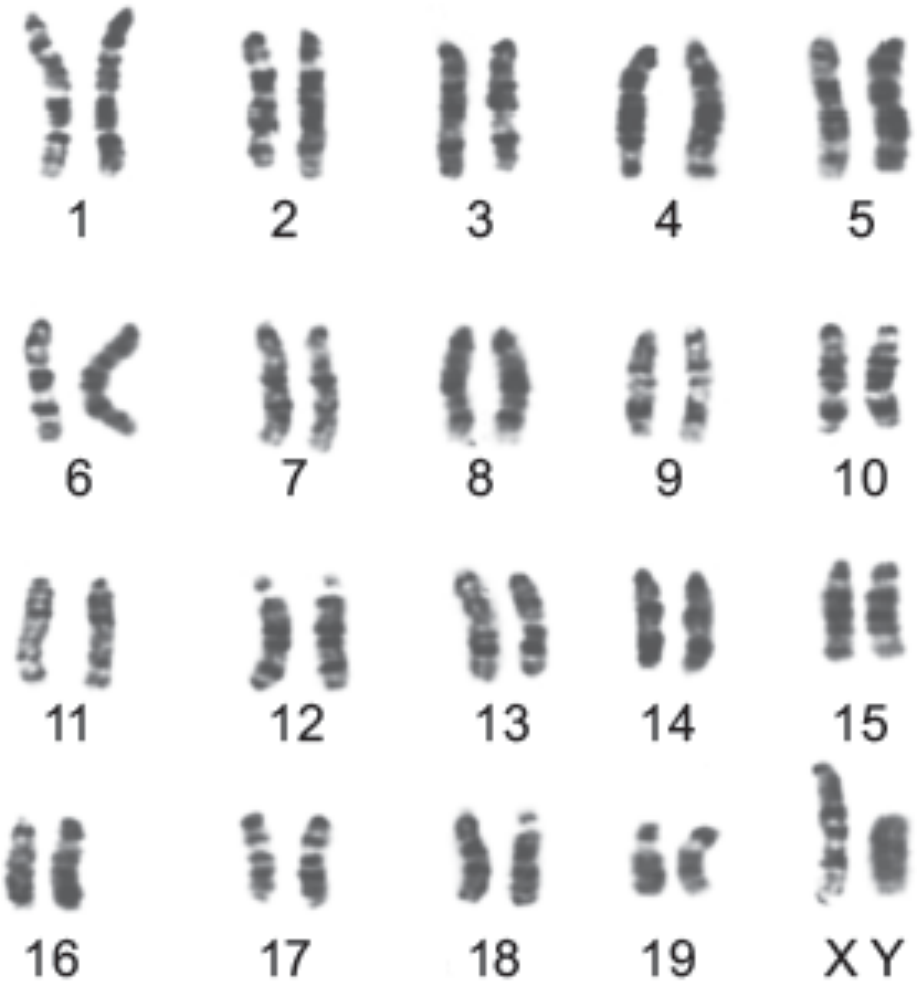
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(Total 8 marks)

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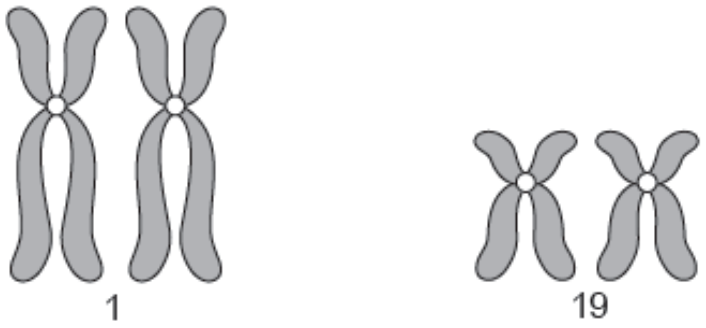
10. The photograph below shows the pairs of chromosomes found in a body cell of a mouse.



(a) What is the diploid number of the mouse?

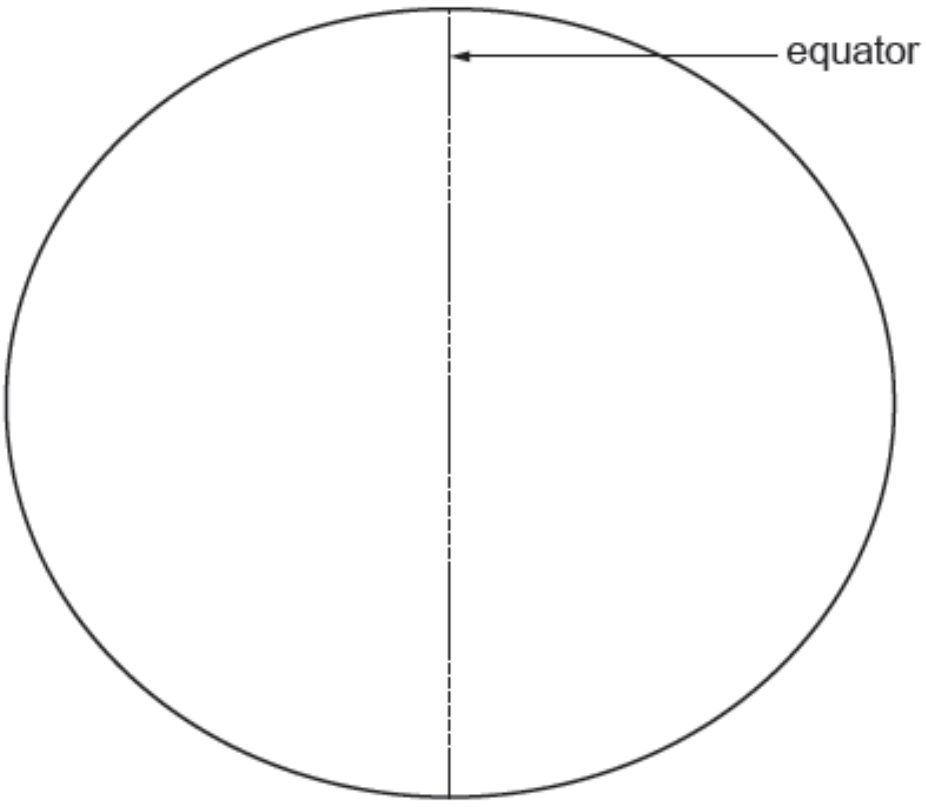
[1]

(b) The chromosomes in pairs 1 and 19 are commonly represented diagrammatically as:



(i) Using the cell outline below draw diagrams to show how these pairs of chromosomes are arranged in **metaphase I** of meiosis.

[1]

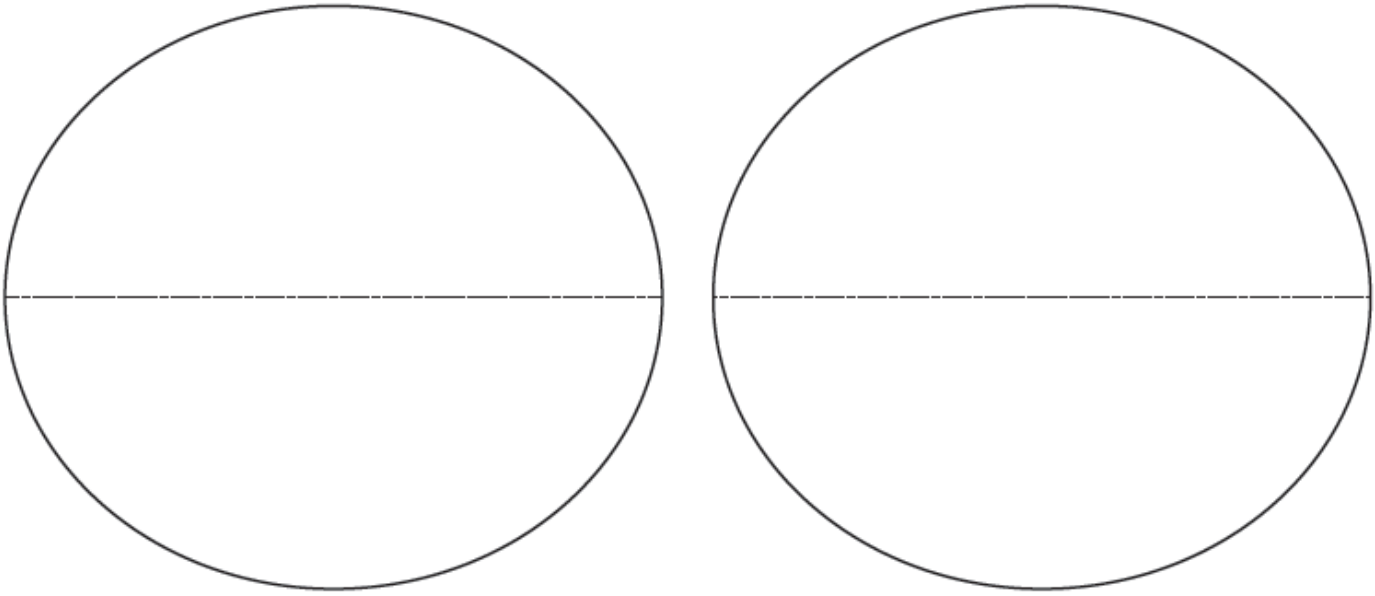


(ii) On your drawing label; chromatid, centromere, centriole, spindle fibres

[2]

(iii) Using the cell outlines below draw diagrams to show how the chromosomes would subsequently be arranged in **metaphase II** of meiosis.

[1]



(iv) State **three** ways in which meiosis contributes to variation in mouse offspring.

[3]

11. The photographs show chromosomes during the stages of mitosis.



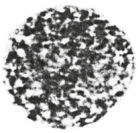


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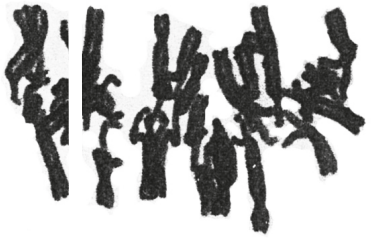
I



J



K



L

(a) (i) Place the stages into the correct sequence. The first box has been completed. [1]

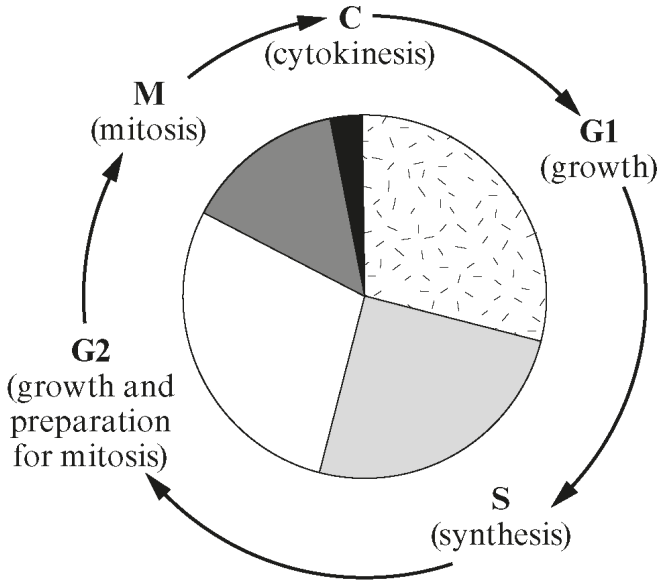
J				

(ii) Name stages: [2]

I .....

L .....

(b) The diagram represents the events that take place during the cell cycle.



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The table below shows the DNA content of a cell measured during one cell cycle.

Stage	*DNA content of cell/arbitrary units*
G1	20
S	20 increasing to 40
G2	40
M	40
C	40 decreasing to 20

(i) State the name of the period in the cell cycle that includes stages G1, S and G2. [1]

.....

.....

(ii) State **two** events that occur during this period. [2]

.....

.....

(c) Using information provided in the diagram and the table, explain why it is important that the DNA content of the cell increases during stage **S** and decreases during stage **C**. [2]

.....

.....

.....

(d) Explain how mitosis maintains genetic stability. [2]

.....

.....

.....

(Total 10 marks)

12. The photograph shows all the chromosomes from a blood cell of a mammal.



(a) (i) Explain why red blood cells could not have been used to produce the photograph of the chromosomes. [1]

.....

(ii) Use the photograph to deduce the sex of the mammal and explain your choice. [1]

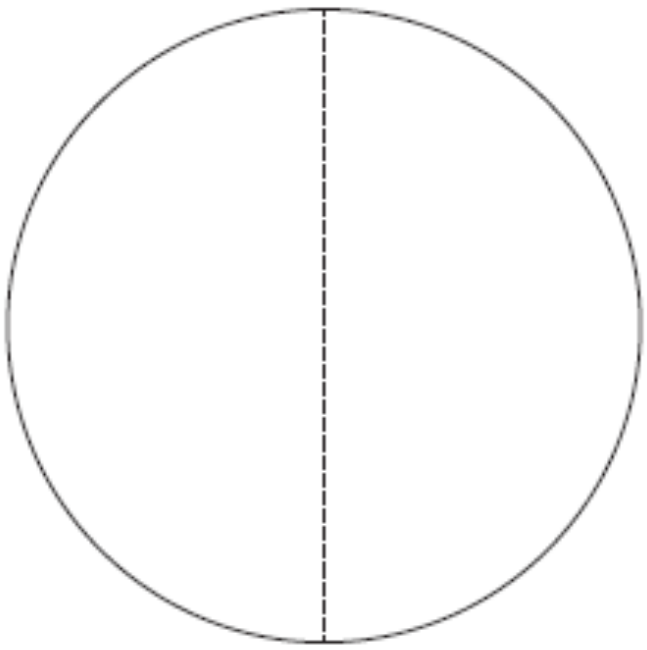
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(iii) In this mammal, how many chromosomes would be present in [1]

I. a kidney cell; .....

II. gametes? .....

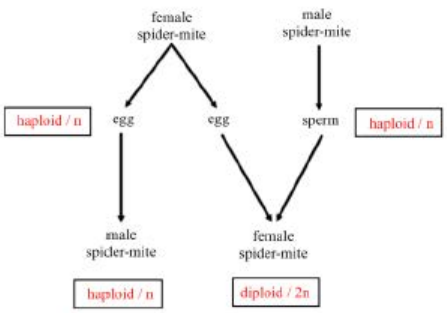
(iv) The circle below represents the outline of the mammal cell at metaphase I of meiosis, and the dotted line the equator of the cell.
Complete the drawing to show the spindle and how **the sex chromosomes** as shown above would be arranged. [2]



1.

Question			Marking details	Marks Available
1.	(a)		Root tip/ shoot tip/ meristem;	1
	(b)		A Anaphase; B Prophase; C Telophase; D Metaphase;	4
	(c)		Interphase; It is the longest phase;	2
	(d)		(All cells) would be {haploid/half the number of chromosomes}; NOT cells have fewer/ less chromosomes (All cells) would be **genetically** different;	2
			Question 1 Total	[9]

2.

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			J, K & M = 2 marks 2 correct = 1 marks 0/1 correct = 0 marks If use more than three letters then deduct one mark for each additional letter		2		2		
	(b)	(i)		 4 correct for 2 marks 2/3 correct for 1 mark 0/1 correct = 0		2		2		
		(ii)		Eggs/ female gametes/ ova are produced by meiosis (1) Sperm/male gametes are produced by mitosis (1)			2	2		
	(c)	(i)		1. 3.4 units DNA {before replication / in early interphase}/ {quantity of DNA halves/ returns to original value} {following cytokinesis / (at the end of)telophase} (1) 2. {6.8 units of DNA/ DNA doubles} due to DNA replication (1) 3. (6.8 units of DNA will be present during) (Late) interphase/ prophase/ metaphase/ anaphase(1)		3		3		
		(ii)		{mitosis is faster/ more mitosis} in young spider mites than older spider mites/ ORA (1) Young spider mite - mitosis required for growth (and repair of muscle tissue) / Older spider mite – mitosis required for repair (of muscle tissue only) (1)			2	2		
				Question 2 total	**0**	**7**	**4**	**11**	**0**	**0**

3.

Question			Marking details	Marks Available
3	*(a)*	(i)	Produce {gametes / sex cells} / halves chromosome number / produces haploid cells / introduce genetic variation;	1
		(ii)	Testes / ovaries;	1
	(b)	(i)	X–centriole **AND** Y–spindle (fibre) / microtubules;	1
		(ii)	**div I** 2 chromosomes in each cell 1 big 1 little; straddling equator; Ignore lack of crossing over **div II** 2 chromosomes in each cell 1 big 1 little; showing correct recombinants;	4
	(c)		1 pair reversed across equator;	1
	(d)	(i)	Prophase I; NOT prophase alone	1
		(ii)	Drawing showing non sister chromatids crossing over; and parts being exchanged; Accept correct annotations or second diagram	2
		(iii)	Crossing over / chiasmata;	1
			Question 3 Total	**[12]**

4. (a)

2 chromosomes in female cell;

1 chromosome in male cell;

Diagrams must match each other.

Accept 'chromatids' in each cell. Do not accept chromatid in male cell if chromosomes drawn in female cell or opposite. [2]

(b)

(i)

2 Chromosomes arranged on equator of spindle; (ignore orientation) [2]

2 V shaped {chromosomes / chromatids} with centrosomes towards each centriole/pole;

Ecf from one diagram to other.

(ii)

Labelling: chromatids, centromere, spindle, centrioles, equator, cell membrane.

2 marks for 4 correct labels on either diagram;

1 mark for 3. [2]

(iii)

To provide {genetically identical cells / clones};

Repair / replacement {of cells / tissue} / regeneration qualified;

NOT growth. [2]

(iv)

Making gametes / sperm cells / sex cells / produce haploid cells for reproduction; [1]

(v)

Meiosis / reduction division;

Spelling must be correct. [1]

(vi)

Genetic variation (in the offspring) / restore diploid number (in zygote) OWTTE; [1]

(c)

Fertilised eggs will develop into females, unfertilised eggs into males; (both for 1 mark);

Accept: fertilised will give genetically varied ants, unfertilised would give clones;

IGNORE haploid / diploid. [1]

Question total 12

5.

Question			Marking details	Marks Available
5	*(a)*	(i)	B, D, C, F, E;	1
		(ii)	Cytokinesis;	1
	(b)	(i)	4 cells are produced compared with 2 / cells are haploid as oppose to diploid/only contain one set of chromosomes compared with two sets of chromosomes; NOT 2 chromosomes (can be neutral) As a result of two (consecutive) divisions;	2
		(ii)	(Meiosis produces haploid gametes which) allows the diploid state to be restored {at fertilisation/in the zygote} / prevents doubling of the chromosome number at fertilisation; Meiosis produces <u>genetically</u> different {gametes/cells} / results in <u>genetic</u> variation (in the offspring);	2
			Question 5 Total	**[6]**

6.

Question				Marking details		Marks Available					
						AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)		{A has/meiosis I results in} two {cells/nuclei} and {B has/ meiosis II results in} 4 / A results from one division and B results from two divisions (1)			1		1		1
		(ii)		plane/angle of section of through cell may not include a nucleus (1) (where nucleus visible) may have been cut at different {levels/planes} (1)		1	1		2		2
	(b)			anaphase II meiosis (1) **Any two (x1) from:** Cell is haploid as only 4 chromosomes / resulting cells will {only have one copy of each chromosome/be haploid} (1) if mitosis two copies of each chromosome / lack of homologous pairs (1) if anaphase I each chromosome would have 2 chromatids / (anaphase II) involves the separation of (sister) chromatids (1)			2	1	3		
				Question 6 total		**1**	**4**	**1**	**6**	**0**	**3**

7.

Question			Marking details	Marks Available
7	*(a)*		Any **4** from 1. {nuclear membrane / nucleolus} disappear; 2. <u>chromosomes</u> {shorten / thicken / contracts / condense} / chromatin condenses; 3. (appear as) {<u>two / pair / sister</u>} chromatids; NOT pairing up 4. chromatids joined at centromere; 5. spindle forms; Reject ref to centrioles making spindle fibres Accept labelled diagram for 3, 4 and 5	Max 4
	(b)		5/100 x (24x60) or (24 x 60)/20 = 72 Correct Answer = 2 marks correct calculation, incorrect answer = 1 mark	2
	(c)		Any **3** from 1. both show <u>interphase</u> because DNA {doubles / changes from 2 to 4 / replicates}; NOT DNA increases unqualified 2. (with vincristine) there is {no halving of DNA / DNA does not decrease from 4 to 2 arbitrary units}; 3. (lack of spindle fibres) prevents chromatids being pulled to the {poles / ends of spindle}(in anaphase); allow chromosomes 4. therefore no cytokinesis / no separation into two cells; 5. daughter cells not produced	Max 3
	(d)		meiosis produces <u>genetically</u> different cells AND mitosis produced {<u>genetically</u> identical cells / clones}; meiosis halves chromosome number AND mitosis maintains chromosome number / cells produced by meiosis are haploid AND those by mitosis are diploid ;	2
			Question 7 total	**[11]**

8. (a) **[4]**

Role	Mitosis	Meiosis
	✓	X
	X	✓
	X	✓
	✓	✓

(not: hybrid ticks)

(b) joined pair of chromatids;
chromatid labelled and centromere labelled; **[2]**

(c) centromere splits;
chromatids pulled to (opposite) poles;
by shortening/ contraction of spindle fibres; **[3]**

(d) centrioles; **[1]**

(Total 10 Marks)

9.

(a) (i) Stage A – telophase; 2
Stage C – metaphase;

(ii) Centromeres split/ divide; 2
Chromatids/ chromosomes are being pulled to (opposite) poles;
(due to) contraction/ shortening of the spindle (fibres);

(b) (i) Interphase; 1

(ii) The (quantity of) DNA has doubled / (quantity of) DNA changes from 6 to 12; NOT increase 1

(iii) Meiosis; (correct spelling) 2
(At the end of the cell cycle) the (quantity) of DNA has been halved (and halved again) / can describe with numbers /involves 2 (consecutive) divisions;
Ignore reference to chromosomes

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10.

Question		Marking details	Marks Available
(a)		40;	1
(b)	(i)	Correct diagram; two chromosome pairs vertically orientated one of each pair on each side of the equator one pair of chromosomes bigger than the other	1
	(ii)	Correct **labelling** of chromatid, centromere, centriole, spindle fibres 2 marks for 4 correct labels 1 mark for 2 or 3 correct labels	2
	(iii)	Correct diagrams; Two chromosomes in each cell (one large and one small) Centromeres on dotted line	1
	(iv)	{Random/ independent} assortment of {chromosomes/ chromatids}/ description of {random/ independent assortment}; crossing over/ chiasmata; produces haploid cells;	3
		Question 10 Total	**[8]**

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11. (a) (i) J K L H I — 1

(ii) I = telophase — 1

L = metaphase — 1

(b) (i) interphase — 1

(ii) ATP production/ metabolically active; — 2

Replication of DNA; NOT synthesis/ doubling

{Making/ replacing} new organelles/ replication of mitochondria/ chloroplasts

NOT replication of organelles

Protein synthesis;

Cell increase in size (not growth) (any two)

(c) DNA Doubled / DNA content increased from 20 to 40 — 1

and then halved (to maintain DNA content) (in two daughter cells.) — 1

(ignore reference to chromosomes)

(d) Two genetically identical daughter cells are produced; — 2

{Genetically identical/ clone} of parent cell.

(Total 10 marks)

12.

Question				Marking details	Marks Available					
					AO1	AO2	A03	Total	Maths	Prac
12	(a)	(i)		They have no nucleus/chromosomes NOT DNA	1			1		
		(ii)		Male + Not all homologous/ Different sex chromosomes/ there is one pair where the chromosomes are different/ one large and one small/ X and Y chromosomes It has a Y chromosome	1			1		
		(ii)		I = 6 chromosomes/3pairs + II = 3 chromosomes	1			1		
		(iv)		One large X shaped chromosome and one small ^ shaped chromosome drawn either side of the equator (1) Spindle fibres drawn (1)		2		2		
				Question 2 total	**3**	**2**	**0**	**5**	**0**	**0**