Cell Division Answers

Mitosis and Meiosis

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Question	Part	Sub Part	Marking Guidance	Mark	Comments
5	(a)		(Different) form/type/version of a gene / different base sequence of a gene;	1	
5	(b)		Two/sister chromatids;	1	2 max
			Due to <u>DNA</u> replication;	1	
			Joined by a <u>centromere</u> ;	1	
5	(c)	(i)	Crossing over;	1	Negate first marking point for answers which refer to
			Exchange (of alleles) between chromatids/chromosomes;	1	independent segregation.
					Chiasma/chiasmata = first marking point
5	(c)	(ii)	Is infrequent/rare;	1	References to it being 'random', 'occurs by chance' or 'doesn't always occur' should not be credited without a clear idea that it is rare or infrequent.
5	(d)	(i)	Three chromosomes shown;	1	For first mark point allow
			One from each homologous pair;	1	drawings showing three chromosomes as single or double structures.
5	(d)	(ii)	8;	1	

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Question	Marking Guidelines	Mark	Comments
2(a)(i)	Anaphase	1	
2(a)(ii)	 Sister/identical chromatids/ identical chromosomes; To (opposite) poles/ends/sides; 	2	Reject: Homologous chromosomes separate. Allow any reference to chromatids/ chromosomes being identical e.g. same DNA
2(b)(i)	 8.4/cells with twice DNA content = replicated DNA / late interphase / prophase / metaphase / anaphase; 4.2 = DNA not replicated / (early) interphase / telophase / cell just divided / finished mitosis; 	2	 Any reference to interphase must suggest towards end of interphase. 'Chromosomes replicate' is not enough for DNA replicates.
2(b)(ii)	2.1;	1	

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Question	Marking Guidelines	Marks	Comments
4(a)	 Growth / increase in cell number; Replace cells / repair tissue / organs /body; Genetically identical cells; Asexual reproduction /cloning; 	2 max	Ignore growth of cells Ignore repair cells Reject bacteria 3. 'Produces 2 genetically identical cells' does not reach MP1 as well as MP3 4. Allow example or description
4(b)(i)	(Ensures) representative (sample);	1	Accept find some cells in mitosis/not in interphase. Accept 'more reliable' only if linked to percentage (of cells).'Improves reliability' on its own does not gain this mark Neutral: Large sample
4(b)(ii)	 A = metaphase; Chromosome / chromatids lie on equator; B = anaphase; Chromatids /chromosomes separating / moving apart / moving to poles; 	4	2. Reject homologous chromosomes Allow centre/middle 4. Reject homologous chromosomes
4(c)	2 hours / 120 minutes;;	2	Allow 1 mark if working shows candidate understood that mitosis would take 10%

Question	Marking Guidance	Mark	Comments
8(a)	 Strands separate / H-bonds break; DNA helicase (involved); Both strands/each strand act(s) as (a) template(s); (Free) nucleotides attach; Complementary/specific base pairing / AT and GC; DNA polymerase joins nucleotides (on new strand); H-bonds reform; Semi-conservative replication / new DNA molecules contain one old strand and one new strand; 	6 max	 Q Neutral: strands split Accept: strands unzip Neutral: bases attach Accept: nucleotides attracted Reject: if wrong function of DNA polymerase Reject: if wrong context e.g. new DNA molecules contain half of each original strand
8(b)(i)	18;	1	Do not accept 17.5
8(b)(ii)	10;	1	
8(b)(iii)	 Horizontal until 18 minutes; (Then) decreases as straight line to 0 μm at 28 minutes; 	2	Allow +/- one small box 2. Allow lines that start from the wrong place, ending at 0 at 28 minutes
8(c)(i) 8(c)(ii)	Two marks for correct answer of 19.68 or 19.7;; One mark for incorrect answers in which candidate clearly multiplies by 0.82; 1. No visible chromosomes/chromatids;	2 1 max	Accept 19hrs 41mins Allow one mark for incorrect answers that clearly show 82% of 24 (hours)
	2. Visible nucleus;		
8(c)(iii)	 D (no mark) 1. Lower % (of cells) in interphase / higher % (of cells) in mitosis/named stage of mitosis; 2. (So) more cells dividing / cells are dividing quicker; 	2	 Accept: 'less' or 'more' instead of '%' Do not accept: higher % (of cells) in each/all stage(s) Accept: uncontrolled cell division Do not award if Tissue C is chosen



Question	Marking Guidance	Mark	Comments
1(a)(i)	Centromere;	1	Accept: if phonetically correct Reject: centriole
1(a)(ii)	 Holds chromatids together; Attaches (chromatids) to spindle; (Allows) chromatids to be separated/move to (opposite) poles / (centromere) divides/splits at metaphase/anaphase; 	2 max	3. Q Neutral: chromosomes or chromatids split/halved/divided 3. Reject: reference to homologous chromosomes being separated Accept 'chromosomes' instead of 'chromatids' Ignore incorrect names for X
1(a)(iii)	(Homologous chromosomes) carry different alleles;	1	Accept alternative descriptions for 'alleles' eg different forms of a gene / different base sequences Neutral: reference to maternal and paternal chromosomes
1(b)(i)	 (In Figure 2) Chromatids have separated (during anaphase); Chromatids have not replicated; Chromosomes formed from only one chromatid; 	1 max	1. Q Neutral: split/halved/divided 1. Reject: reference to homologous chromosomes being separated 1. & 2. Accept 'chromosomes' instead of 'chromatids' Accept converse arguments for Figure 1 Ignore references to the <i>cell</i> not dividing as in the question stem Ignore: named phases
1(b)(ii)	1. Three chromosomes;2. One from each homologous pair;	2	Ignore shading Only one mark for three chromosomes shown as pairs of chromatids

1(b)(iii)	Crossing over / alleles exchanged between chromosomes or chromatids / chiasmata formation / genetic recombination;	1	Accept: description of crossing over eg sections of chromatids break and rejoin
	Toolina adding		Neutral: random fertilisation
			Reject: reference to sister chromatids
			Q Neutral: genes exchanged
			Neutral: mutation

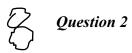
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	Question		Marking Guidance	Mark	Comments
,	8(a)	1.	Sugar-phosphate (backbone)/double stranded/helix so provides strength/stability /protects bases/protects hydrogen bonds;	6 max	Must be a direct link/obvious to get the mark
		2.	Long/large molecule so can store lots of information;		Neutral: reference to histones
		3.	Helix/coiled so compact;		Accept: can store in a small amount of space for 'compact'
		4.	Base sequence allows information to be stored/ base sequence codes for amino acids/protein;		Accept: base sequence allows transcription
		5.	Double stranded so replication can occur semi-conservatively/ strands can act as templates;		
		6.	Complementary base pairing / A-T and G-C so accurate replication/identical copies can be made;		
		7.	(Weak) hydrogen bonds for replication/ unzipping/strand separation;		Accept: 'H-bonds' for 'hydrogen bonds'
		8.	Many hydrogen bonds so stable/strong;		8. Must convey the idea of 'many'
	8(b)	1.	(Mutation) in E produces highest risk/1.78;	3	Must be stated directly and not implied
		2.	(Mutation) in D produces next highest risk/1.45;		E>D>C = 3 marks
		3.	(Mutation) in C produces least risk/1.30;		Accept: values of 0.78, 0.45 and 0.30 for MP1, MP2 and MP3 respectively
					If no mark is awarded, a principle mark can be given for the idea that all mutant alleles increase the risk

8(c)	180;	1	
8(d)	 (Similarities): Same/similar pattern / both decrease, stay the same then increase; Number of cells stays the same for same length of time; (Differences): (Per unit volume of blood) Greater/faster decrease in number of healthy cells / more healthy cells killed / healthy cells killed faster; Greater/faster increase in number of healthy cells / more healthy cells replaced/divide / healthy cells replaced/divide faster; 	3 max	2. Ignore: wrong days stated 3. & 4. Accept: converse for cancer cells 3. Accept: greater percentage decrease in number of cancer cells / greater proportion of cancer cells killed For differences, statements made must be comparative
8(e)	 More/too many healthy cells killed; (So) will take time to replace/increase in number; Person may die/have side effects; 	2 max	Neutral: will take time to 'repair'



(a)	(i)	DACB	1
	(ii)	Attachment of centromeres; Separation of (daughter) chromatids;	2
(a)		Meiosis halves the number of chromosomes; Restoration of diploid number at fertilisation;	
		Introduces variation; Correct reference to natural selection / survival;	2 max
(c)	(i)	Sperm is haploid, liver is diploid / sperm formed by meiosis, liver cell formed by mitosis;	1
	(ii)	It has no nucleus;	1



(a)	(i)	20		1
	(ii)	10		1
	(iii)	10		1
(b)	(i)	(Daughter) chromatids will not separate / centromere won't divided to the control of the control	ide;	2
	(ii)	Red blood cells <u>formed</u> / <u>produced</u> by mitosis;		1
			Total	6 marks

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(a) replication / duplication / doubling of chromosomes / replication of DNA / transcription of DNA;
 (b) (i) cell to show correct number of chromosomes; correct shape and position of centromere;
 (ii) as (i) except everything halved – *Ignore crossing over*; (if mitosis and meiosis reversed, allow 1 if otherwise correct)

(c) to replace cells;

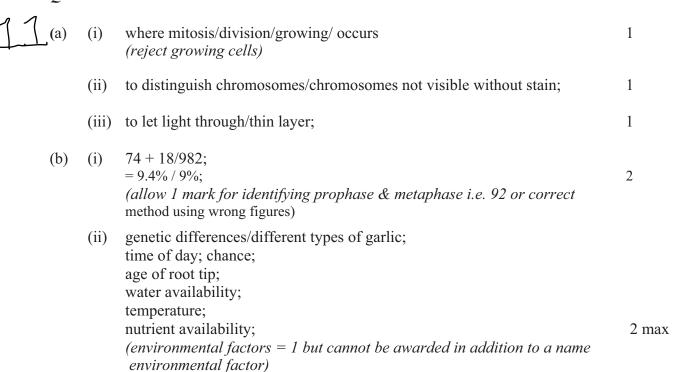
Total 6 marks

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70	Question	1
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(a)	(i)	Prophase;	1
	(ii)	Chromosomes/chromatids moved apart;	1
	(iii) A wide range of processes occurs during interphase. This list is by rexhaustive, but we would expect to see answers such as:		
		Increase in volume of cell/volume of cytoplasm / increase in mass / cell bigger; increase in number of organelles; synthesis of protein/named protein; DNA replication/increase / chromosomes copied; ATP synthesis / respiration; max	2
(b)		Divide real length of bar (in mm)/10 by 0.02;	1
(c)		12/200 x 24 / single error in otherwise correct method; 1.44 hours (1 hour 26 min);	2

Total 7 marks

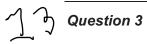


Chromosomes: $C = 8 \ and \ D = 4;$ $C = 300 \ and \ D = 150;$ DNA:

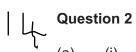
- testis / ovary; 1 (b) (i) accept anther / carpel / stamen / testicle
 - to make chromosomes / chromatids / DNA / genetic material (ii) visible; 1

Total 4

2



(a)	(i)	95 - 100 minutes;	1
	(ii)	It shows the distance between the (sister) chromatids increases at this po As they begin to separate/ move to opposite poles;	oint; 2
(b)		Chromatids cannot be seen; Valid reason, e.g. chromosomes have not condensed / too diffuse / still in interphase;	2
(c)	(i)	Zygote;	1
	(ii)	Avoids doubling of chromosomes number at each generation / maintains chromosome number from generation to generation/ diploid/correct number/ 46 restored at fertilisation;	1
		Total	7



(a)	(i)	Attaches (chromosome) to spindle/holds (sister) chromatids toget	her;	1
	(ii)	Separate chromatids/centromeres/chromosomes/ aligns chromos equator;	omes a	t 1
(b)	(i)	n,n,2n;		1
	(ii)	X on arrow going from 2n to n;		1
			Total	4

(a)		Interphase/S-(phase)/synthesis;	
(b)	(i)	B; Acts during DNA replication; Ignore reference to wrong named stage	:
	(ii)	This is when chromosomes/ chromatids are separating; Pulled by spindle fibres;	:
			Total :

16	(b)	(i)	One mark for curve basically similar in shape to that plotted; Two marks for curve basically similar in shape to that plotted and with values roughly twice those shown;; Q Max 1 if increase starts in regions E or G	2
		(ii)	Telophase;	1
		(iii)	Shortening of spindle (fibres); Q Answer must relate to spindle but accept references to chromatids/chromosomes/centromeres being pulled/separated by the specifical control of the specifical control of the specific cont	1 oindle
			fibres. Total	7

(a) (i) A anaphase; 1 (ii) (C) B,A,D; 1 (iii) (original) chromosome/DNA has been replicated; each chromosome consists of two chromatids/ chromatids attached at centromere; 2 (accept reference to condensed state of chromosomes) (b) 1 (i) it has doubled/now 8; (ii) chromosome/DNA replication but no separation/anaphase/cell division; 1

1 & Question 2

(a) meiosis halves the chromosome number / from diploid to haploid/produces haploid/n cells;
 when gametes fuse/at fertilisation, the diploid number is restored;
 this keeps the chromosome number constant/correct from one generation to the next/after sexual reproduction;
 introduces genetic variation/independent assortment/crossing over; 3 max
 (b) M between moss plant and spore; 1

(c) (gamete **B**, no mark)
gamete **B** has/**A** does not have:
few reserves/nutrients;
smaller size;
flagella, so mobile;

2 max

Total 6

(a) to get haploid/n/half number of chromosomes (in cells); so that each cell gets one copy of each chromosome/gene/full set of genes; so that fertilisation produces diploid/constant chromosome number; results in independent assortment; 2 max (b) (i) 4; 1 1 (ii) meiosis (has halved the chromosome number); (ii) (mitosis because) zygote gets two chromosomes from each gamete/ has four chromosomes; (accept haploid for two and diploid for four) gamete-producing plant has two chromosomes, so mitosis to produce gametes with two; 2 Total 6

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(a)	(i)	anaphase;	1
	(ii)	sister / identical <u>chromatids</u> (separate); move to opposite poles / ends / sides;	2
(b)	(i)	interphase;	1
	(ii)	<u>ATP</u> production / protein synthesis / replication of centrioles;	1
	(iii)	1.2;	1
(c)	short duration of interphase;		1

	Que	Question 2					
[]	(a)	(i)	(D) B E A C;	1			
		(ii)	metaphase;	1			
	(b)	interphas	se/S phase;	1			
	(c)	(i)	0.06 x 100; 6(%); (correct answer 2 marks)	2			
		(ii)	more (cancer cells) killed, cancer cells divide more (often) (so are more likely to be killed, more susceptible);	1			
		(iii)	longer time to recover; reduced rate of mitosis / divide more slowly/increased doubling time;	2			
				Total 8			



(a)



(b) bivalent;

1

- (c) (i) Ab, aB;
 - (ii) AB, ab;

2

(d) mutation;

different/new allele formed / genes deleted or duplicated/ sequence of genes changed (reject genetic information);

<u>random</u> fusion of gametes / fertilisation; new combination of alleles;

independent assortment (of chromosomes) (accept random); shuffling of maternal and paternal chromosomes/new combination of alleles;

(ignore references to stages of meiosis) any 2x2

4 max

(iii)

23	(a)	(i)	(D) B E A C;	1
		(ii)	metaphase;	1
	(b)	interphas	se/S phase;	1
	(c)	(i)	0.06 x 100; 6(%); (correct answer 2 marks)	2
		(ii)	more (cancer cells) killed, cancer cells divide more (often) (so are more likely to be killed, more susceptible);	1

reduced rate of mitosis / divide more slowly/increased doubling time;

longer time to recover;

Total 8

2

24 (a)

(i) Stage A is anaphase;

Chromatids/chromosomes moving apart/centomere divided;

2

(ii) Stage B is telophase;

Chromosomes are uncoiling;

(Accept new nuclei forming)

2

(b) Embryo split into separate cells;

These (cells) are undifferentiated/totipotent;

Each cell grows by mitosis (into new embryo/organism);

2 max



(a) Centromeres divide/chromatids separate;
 One chromatid/chromosome moves to each pole;
 Spindle fibres shorten;

2 max

(b) Rate of removal (of tubulin) proportional to shortening of spindle fibres/ speed of movement of chromatids/fibres control speed of movement; Provides force/pulls chromatids or chromosomes apart/movement linked to shortening of fibres;

2