

Question Number	Answer	Mark
1(a)(i)	The only correct answer is c – 660 minutes <i>A is incorrect because G1 lasts just under half of 23 hours which is $11 \times 60 = 660$ minutes</i> <i>B is incorrect because G1 lasts just under half of 23 hours which is $11 \times 60 = 660$ minutes</i> <i>D is incorrect because G1 lasts just under half of 23 hours which is $11 \times 60 = 660$ minutes</i>	(1)

Question Number	Answer	Additional guidance	Mark
1(a)(ii)	1. one of two (DNA) molecules that make up a chromosome / eq ; 2. Idea that DNA replicates (in S phase) / eq ;	ACCEPT equivalent wording for mark points 1 and 2 1.ACCEPT each chromatid contains one DNA molecule 1.IGNORE strand	(2)

Question Number	Answer	Mark
1(a)(iii)	The only correct answer is c –  <i>A is incorrect because the cell is in metaphase</i> <i>B is incorrect because the cell is in anaphase</i> <i>D is incorrect because the cell is in interphase</i>	(1)

Question Number	Answer	Mark
1(b)(i)	The only correct answer is A – 1, 5, 6, 4, 3, 2 <i>B is incorrect because the coverslip has to be put on before the cells are squashed</i> <i>C is incorrect because the cells cannot be teased apart before adding acid</i> <i>D is incorrect because the cells cannot be teased apart before adding acid</i>	(1)

Question Number	Answer	Additional guidance	Mark
1(b)(ii)	(acetic/ethanoic/propionic) orcein / Feulgen's (stain)/ toluidine (blue) / (aceto)carmine / methylene blue / Schiff's (reagent) ;	ACCEPT phonetic spellings DO NOT ACCEPT iodine	(1)

Question Number	Answer	Additional guidance	Mark
2(a)	Animal cells only: centriole ; Animal and plant cells: (cell) membrane / cytoplasm / Golgi (apparatus) / mitochondrion / endoplasmic reticulum / lysosome /nucleus / nucleolus / ribosome ; Plant cells only: chloroplast / cell wall / amyloplast / tonoplast / plasmodesma / {large / permanent / sap/ eq} vacuole ;	ACCEPT plural names ACCEPT phonetic spellings DO NOT ACCEPT when more than one answer is given in one part of the diagram if one of these answers is incorrect for the cell type ACCEPT centrosome/cortical granules ACCEPT <u>correctly</u> qualified answers e.g plasma membrane / rough ER /smooth ER / 80S ribosome IGNORE vacuole ACCEPT pits / middle lamella	(3)

Question Number	Answer	Additional guidance	Mark
2(b)	1. peptidoglycan cell wall ; 2. loop of DNA / nucleoid ; 3. plasmids ; 4. pili ; 5. (slime) capsule ; 6. 70 S ribosomes	DO NOT ACCEPT flagellum, glycogen granules, cytoplasm, membrane, ribosomes, 80S ribosomes 1.ACCEPT murein cell wall 2.ACCEPT circular DNA 4. ACCEPT fimbriae 5. ACCEPT slime layer 6. IGNORE small ribosomes 7. ACCEPT mesosome	(3)

Question Number	Answer	Additional guidance	Mark
2(c)	1. idea that classification was based on {anatomy / morphology /physical structure / eq}; 2. idea of use or availability of {improved / electron} microscopes ; 3. use of molecular phylogeny; 4. idea that {more / new} species {have been / will be} discovered ; 5. idea that in the future, technology will continue to develop ;	IGNORE references to natural selection 2. and 3. named equipment or methods must be given 3.ACCEPT a name or description of chemical analysis e.g. proteomics / DNA profiling / DNA analysis 4. DO NOT ACCEPT new organisms 4. IGNORE references to speciation, this has to be in context of discovery or identification of species 5. e.g. improved technology / chemical analysis / DNA analysis (in the future)	(3)

Question Number	Answer	Mark
3(a)(i)	The only correct answer is C – 46 23 <i>A is incorrect because mitosis does not halve the number of chromosomes</i> <i>B is incorrect because mitosis does not halve the number of chromosomes but meiosis does</i> <i>D is incorrect because meiosis halves the number of chromosomes</i>	(1)

Question Number	Answer	Additional guidance	Mark
3(a)(ii)	1. to increase the number of primary spermatocytes; 2. idea that large numbers of sperm cells are produced ;	1. the cells must be named 2. ACCEPT many more sperm are produced 2. ACCEPT increase the number of sperm	(2)

Question Number	Answer	Mark
3(b)(i)	The only correct answer is A – P <i>B is incorrect because the acrosome is in the front of the head</i> <i>C is incorrect because the acrosome is in the front of the head</i> <i>D is incorrect because the acrosome is in the head</i>	(1)

Question Number	Answer	Mark
3(b)(ii)	The only correct answer is C – S <i>A is incorrect because the mitochondrion is located in the neck</i> <i>B is incorrect because the mitochondrion is located in the neck</i> <i>D is incorrect because the mitochondrion is located in the neck</i>	(1)

Question Number	Answer	Additional guidance	Mark
3(b)(iii)	1. (L=) $0.6 \times 5 / 3$ (μm) ; 2. (M=) $10 \times 5 / 50$ (μm) ; 3. (total length =) 58 (μm) ;	Correct answer alone gains three marks	(3)

Question Number	Answer	Additional guidance	Mark
4(a)	any two dominant alleles only one dominant allele p p q q r r ;	e.g. p p Q q R r e.g. p p q q R r	(1)

Question Number	Answer	Additional guidance	Mark
4(b)(i)	1. idea that one {characteristic / phenotype / eq} determined by more than one gene ; 2. skin colour determined by {three genes / P, Q and R} ;	1. ACCEPT trait, feature, physical appearance, external appearance as eq to characteristic 1.DO NOT award mp1 if answer is in context of genes at the same loci 1.DO NOT award in the context of alleles 2. ACCEPT PP QQ RR unless answer is in context of alleles	(2)

Question Number	Answer	Additional guidance	Mark
4(b)(ii)	1. {observable / expressed / eq} {characteristic / feature / eq} ; 2. skin colour ;		(2)

Question Number	Answer	Additional guidance	Mark
4(b)(iii)	1. idea that there is a range of {phenotypes / characteristics / traits / eq} ; 2. credit list of {skin colours / numerical values} ;	1. ACCEPT normal distribution 2. More than two should be stated or listed	(2)

Question Number	Answer	Additional guidance	Mark
4(c)(i)	as one variable / factor increases the other decreases	ACCEPT converse ACCEPT lighter the skin the greater the risk of developing skin cancer ACCEPT skin colour increases / numerical value increases as eq to darker ACCEPT inverse relationship DO NOT ACCEPT answers that state a causal relationship	(1)

Question Number	Answer	Additional guidance	Mark
4(c)(ii)	1. idea that skin colour is genetic and (exposure to) ultraviolet light is environmental ; 2. ultraviolet (light / radiation) is known to {cause mutations / be a mutagen} ; 3. credit example of result of mutation (at gene level) ; 4. idea that control of cell cycle is lost ;	1.Piece together if necessary 1.ACCEPT melanin production is genetic 1.ACCEPT genotype as eq to genetic 2.IGNORE radiation 3 e.g. DNA repair mechanisms decrease, formation of oncogene, tumour suppressor gene affected 4 e.g. cell growth cannot be controlled, cell division cannot be controlled, no Hayflick limit	(3)

Question Number	Answer	Additional guidance	Mark					
5(a)	<table><tr><th>Xylem</th></tr><tr><td>cellulose and lignin ; (ignore pectin)</td></tr><tr><td>absent / eq ;</td></tr><tr><td>absent / eq ;</td></tr><tr><td>Any two from: transport of water transport of mineral (ions) support / eq ;</td></tr></table>	Xylem	cellulose and lignin ; (ignore pectin)	absent / eq ;	absent / eq ;	Any two from: transport of water transport of mineral (ions) support / eq ;	CARE two correct functions must be stated to gain the one available mark	(4)
Xylem								
cellulose and lignin ; (ignore pectin)								
absent / eq ;								
absent / eq ;								
Any two from: transport of water transport of mineral (ions) support / eq ;								

Question Number	Answer	Additional guidance	Mark
5(b)	1. (starch) contains {large numbers of glucose molecules / polymer of glucose molecules} ; 2. branched so that it can be {hydrolysed / release energy} easily / eq ; 3. compact so that {more/ a lot of} glucose can fit into a particular space / eq ; 4. insoluble so no osmotic effect / eq ;	1. ACCEPT starch can store a large amount of energy 2. ACCEPT broken down 2. ACCEPT readily hydrolysed 2. ACCEPT if amylopectin stated rather than starch 3.ACCEPT if amylose / amylopectin is stated rather than starch 4. ACCEPT insoluble so is not lost from the cell / storage organ	(3)

Question Number	Answer	Additional guidance	Mark
5(c)	1. supplies water {for photosynthesis / to keep cells turgid} / eq ; 2. supplies magnesium (ions) for synthesis of chlorophyll / eq ; 3. supplies nitrate for synthesis of {amino acids / protein / DNA / eq} ; 4. supplies calcium (ions) for cell wall structure / eq ; 5. supplies phosphate for synthesis of {ATP /DNA /eq} ; 6. supports the leaves so they are exposed to sunlight ;	1. to 5. ACCEPT answers in context of (parenchyma) cells need these materials 3. DO NOT ACCEPT nitrogen 5.DO NOT ACCEPT phosphorus 6.IGNORE supports the plant	(3)

Question Number	Answer	Additional guidance	Mark
6(a)	1. the {number / variety / range} of species ; 2. in a habitat / eq ; OR 1. the {variety / types} of alleles ; 2. in a {gene pool / population / species} ;	1. DO NOT ACCEPT organisms 1. ACCEPT amount 1. ACCEPT species richness 2. ACCEPT area / region / ecosystem	(2)

Question Number	Answer	Additional guidance	Mark
*6(b)(i)	1. idea of testing {different / named} parts of each plant ; 2. idea of grinding the plant material up ; 3. idea of preparing a lawn of bacteria ; 4. credit description of how extract will be added to culture ; 5. incubating bacteria at temperature in range 20° to 35 °C and stated time in range 1 to 7 days; 6. idea of measuring {diameter / area} of zones of inhibition ; 7. indication of using aseptic technique ; 8. repeat experiment and calculating a mean ;	QWC focusing on logical sequence 1. Do not award if context is using whole plant 2. ACCEPT make / use an extract 3. ACCEPT add bacteria to agar / broth / eq 4. e.g. adding extract to wells, soaking discs in extract 6. ACCEPT measuring the clarity of broth 7. e.g. using sterile equipment 8. ACCEPT taking several diameter measurements and calculating mean	(5)

Question Number	Answer	Additional guidance	Mark
6(b)(ii)	1. testing which bacteria were affected ; 2. determining the concentration to use ; 3. animal testing ; 4. testing on (small group of) healthy people ; 5. testing on a small group of patients / eq ; 6. idea of testing on a large group of patients / eq ;	2. ACCEPT dosage 3. ACCEPT cell toxicity or tissue culture 5. ACCEPT 100-300 if no written description 6. ACCEPT ≥ 1000 if no written description	(4)

Question Number	Answer	Additional guidance	Mark
6(c)	1. store seeds ; 2. in a seed bank ; OR 3. take cuttings ; 4. and grow them in {greenhouses / eq} ; OR 5. make certain areas of the rainforest into protected areas ; 6. so that they cannot be used for {deforestation / housing / eq} ;	If two methods are described credit the one that yields the higher mark 2. ACCEPT at low temperature and low humidity 3. ACCEPT take explants 4. ACCEPT growing in tissue culture	(2)

Question Number	Answer	Additional guidance	Mark
7(a)	1. both {divide indefinitely / are unspecialised / eq} ; 2. idea that totipotent stem cells can become all cell types but pluripotent stem cells can become {many / most} cell types ;	Piece together answers if necessary 1.ACCEPT undifferentiated 1.ACCEPT no Hayflick limit 2. ACCEPT totipotent can give rise to all cells, pluripotent cannot give rise to placental / extraembryonic cells	(2)

Question Number	Answer	Additional guidance	Mark
*7(b)	1. mitosis to increase number of cells / eq ; 2. idea of responding to {chemical / environmental} stimulus ; 3. reference to differential gene expression ; 4. credit example from question of genes switched on ; 5. credit example from question of genes switched off ; 6. idea of {transcription / mRNA produced} at active genes ; 7. {proteins / polypeptides / eq} produced (from this mRNA) ; 8. idea that this protein (permanently) modifies cell OR idea that this protein determines {cell structure / function} ;	QWC focus on clarity of expression 2. ACCEPT hormone / external stimulus 4. e.g. gene for production of insulin switched on in pancreatic cells 5. e.g. gene for production of insulin switched off in nerve cells / muscle cells / heart muscle cells 7. ACCEPT mRNA is translated	(6)

Question Number	Answer	Additional guidance	Mark
7(c)	1. idea they {monitor research / ensure research is necessary} ; 2. idea that they issue licences (for stem cell research) ; 3. idea they monitor sources of stem cells ; 4. ensure that only early stage embryos are used (as sources of stem cells) ; 5. prevent unethical use of stem cells ;	1. ACCEPT to ensure experiments are not unnecessarily repeated 2.ACCEPT idea of giving permission for the research 2.ACCEPT idea that guidelines are adhered to 4. in the UK this is up to 14 days 4. ACCEPT to determine the maximum age of embryos that can be used 5. e.g. human cloning, genetic manipulation 5. IGNORE designer babies, playing God, right to life	(3)

Question Number	Answer	Mark
8(a)(i)	The only correct answer is B – behavioural anatomical <i>A is incorrect because wading is behavioural</i> <i>C is incorrect because possessing feathers is anatomical</i> <i>D is incorrect because wading is behavioural</i>	(1)

Question Number	Answer	Additional guidance	Mark
8(a)(ii)	1. (the birds) occupy different niches ; 2. they have different length of beak / eq; 3. idea they have different sources of food / eq; 4. to avoid competition with each other / eq ;	Piece together answer if necessary 3.ACCEPT idea of their food is at different depths 3.ACCEPT they have different food 4.ACCEPT less competition	(3)

Question Number	Answer	Additional guidance	Mark
8(b)(i)	1. idea of water supplying the food ; 2. idea of water containing oxygen ; 3. {gills / large surface area} for the uptake of oxygen ; 4. idea of being protected from predators ;	1.ACCEPT nutrients 3. IGNORE gas exchange	(3)

Question Number	Answer	Additional guidance	Mark
8(b)(ii)	1. The range is the same in winter and summer ; 2. tunnels are deeper in the winter / eq ; 3. more tunnels in winter ; 4. greater variation in the number in winter / eq ;	ACCEPT converse for summer throughout 1. ACCEPT the range is 30mm in both 3.IGNORE comments about one specific depth	(2)

Question Number	Answer	Additional guidance	Mark
8(b)(iii)	1. there is not enough food ; 2. (so) there is competition for {food / lugworms} ; 3. credit explanation of how competition is avoided ;	1.ACCEPT not enough lugworms 2. ACCEPT between godwits or with other species 3. e.g. move to where the lugworms are not buried so deeply, move to where there are lugworms e.g. change to another food source, feed on species still available, feed on species nearer the surface IGNORE change their diet	(3)