

Question		Answer	Marks	Guidance																								
1	(a)	<table border="1"> <thead> <tr> <th>control element</th> <th>made of protein</th> <th>binds to a protein</th> <th>codes for protein</th> </tr> </thead> <tbody> <tr> <td>insulin</td> <td>✓</td> <td>✓</td> <td>x</td> </tr> <tr> <td>c AMP</td> <td>x</td> <td>✓</td> <td>x</td> </tr> <tr> <td><i>lac</i> I (inhibitor) gene</td> <td>x</td> <td>✓</td> <td>✓</td> </tr> <tr> <td><i>lac</i> O (operator) gene</td> <td>x</td> <td>✓</td> <td>x</td> </tr> <tr> <td>homeotic gene product</td> <td>✓</td> <td>x</td> <td>x</td> </tr> </tbody> </table>	control element	made of protein	binds to a protein	codes for protein	insulin	✓	✓	x	c AMP	x	✓	x	<i>lac</i> I (inhibitor) gene	x	✓	✓	<i>lac</i> O (operator) gene	x	✓	x	homeotic gene product	✓	x	x	5	<p>Award one mark for each correct row. DO NOT CREDIT blank spaces, multiple answers or hybrid ticks (a tick that has been crossed through, so it cannot be judged if it is a tick or a cross.)</p>
control element	made of protein	binds to a protein	codes for protein																									
insulin	✓	✓	x																									
c AMP	x	✓	x																									
<i>lac</i> I (inhibitor) gene	x	✓	✓																									
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homeotic gene product	✓	x	x																									

Question		Answer	Marks	Guidance
1	(b)	<p><i>RNA polymerase</i></p> <p>1 makes (m / messenger / t / transfer / r / ribosomal) RNA ;</p> <p>2 <u>transcription</u> ;</p> <p>3 one strand (DNA) used / short section used / one strand formed ;</p> <p><i>DNA polymerase</i></p> <p>4 <u>DNA replication</u> ;</p> <p>5 semi-conservative / both strands used / whole length used / 2 strands formed ;</p> <p>6 before , nuclear / cell , division ;</p>	4	<p>2 CREDIT transcribes / transcribed</p> <p>3 Must be a clear statement</p> <p>4 CREDI replicates / replicated</p> <p>5 Must be a clear statement</p> <p>6 CREDIT before , mitosis / meiosis / cytokinesis CREDIT in S phase (of interphase) IGNORE interphase unqualified</p>
1	(c)	<p>1 apoptosis ;</p> <p>2 cytoskeleton ;</p> <p>3 enzymes ;</p> <p>4 phagocytosis ;</p> <p>5 mitosis / mitotic cell division ;</p> <p>6 tumour ;</p>	6	<p>Mark the first answer on each prompt line. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>1 ACCEPT 'apoptosis' as phonetic</p> <p>2 ACCEPT cell skeleton</p> <p>3 CREDIT proteases / lysosomes</p> <p>6 ACC PT cancer / carcinoma</p>
Total			15	

Question		Answer	Marks	Guidance
2	(a)	homeotic / regulatory, (gene) ; contains, 180 bp / homeobox, sequence ; that codes for homeodomain (on protein) ; (gene product) binds to DNA ; initiates transcription / switch genes, on / off ; control of, development / body plan ;	2	IGNORE <i>hox</i> CREDIT controls gene expression, ref. transcription factor(s) ACCEPT description, eg polarity, segmentation, position of limbs
	(b)	these genes very important ; mutation would, have big effects / alter body plan ; many other genes would be affected / knock-on effects ; mutation likely to be, lethal / selected against ;	2 max	ACCEPT example, eg no arms CREDIT selected against in context of survival, not reproduction DO NOT CREDIT ora, not beneficial so not selected for
	(c)	protein synthesis / transcription and translation ; respiration ; DNA replication ; mitosis ; cytokinesis ; apoptosis ; differentiation / gene switching ;	2 max	Mark the first two suggestions only IGNORE growth ACCEPT programmed cell death
	(d)	fungi / plants ;	1	
Total			7	

Question		Expected Answers	Marks	Additional Guidance
3	(a)	1 methionine 2 arginine 4 threonine 5 tryptophan ; ;	2	AWARD 2 marks if all four correct AWARD 1 mark if two or three correct AWARD 0 marks if only one correct IGNORE incorrect spelling if meaning is clear
	(b)	<u>translation</u> ; <u>ribosome</u> / <u>rough</u> ER / <u>RER</u> ;	2	IGNORE ER alone DO NOT CREDIT smooth ER
	(c)	messenger / m ; RNA / ribonucleic acid ;	2	<i>mRNA</i> ' = 2 marks IGNORE incorrect 'r' or 't' prefix for 2 nd mark
	(d)	UAA and UAG and UGA ; do not code for an amino acid / no matching tRNA ;	2	NEED all 3 for one mark ACCEPT do not code for anything ACCEPT no , matching / complementary , anticodon
	(e)	neutral / silent / substitution / point ;	1	
			9	

Question		Answer	Marks	Guidance	
4	(a)	metaphase I and metaphase II ; prophase I ; anaphase II ; telophase II ; anaphase I ;	5	Mark the first answer on each prompt line. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks	
	(b)	to, halve chromosome number / reduce from 2n to n ; to separate homologous pairs (of chromosomes) and sister chromatids ; because, DNA (previously) replicated / chromosomes are two chromatids at start ;	2	IGNORE all references to mitosis CREDIT 'from diploid to haploid' ACCEPT 'from 46 to 23 chromosomes' IGNORE halve, genetic material / DNA ACCEPT genetic, material / information	
	(c)	(i)	sequence / order, of bases / nucleotides ;	1	CREDIT base pairs DO NOT CREDIT amino acid sequence
		(ii)	different, primary / secondary / tertiary, structure ; (protein) shorter due to, deletion / stop codon OR longer due to, insertion / duplication ; (protein) unchanged due to, silent mutation / non-coding DNA altered ; (function is) lost / worse / better ;	3	ACCEPT different <u>sequence</u> or <u>order</u> of amino acids ACCEPT different 3D folding or 3D shape for 'silent' CREDIT 'neutral' or a description of more than one triplet coding for one amino acid IGNORE different / altered function ACCEPT idea that change is harmful
			Total	11	

Question			Answer	Marks	Guidance
5	(a)	(i)	<i>idea of tentative / uncertain / developing / advancing / improving / dynamic ;</i>	1	IGNORE change(s), changing, changeable (as given in question)
		(ii)	<p>1 conservation / keep rare plants / save endangered plants ;</p> <p>2 <u>gene bank</u> OR genetic resource / store of alleles ;</p> <p>3 teaching / education ;</p> <p>4 leisure / amenity / visitor attraction / aesthetic value ;</p>	2	<p>Read as prose.</p> <p>1 ACCEPT prevent extinction / maintain biodiversity</p> <p>3 IGNORE 'research' (as given in question)</p>
	(b)	(i)	<p>to, amplify / make (many) copies of, <u>DNA</u> ;</p> <p>(range of) different lengths ;</p>	2	<p>IGNORE refs. to single stranded / coding strand / template strand</p> <p>CREDIT idea of, chain terminating / dideoxy, nucleotides attaching at different points along sequence</p>
		(ii)	<p>to put DNA pieces in size order ;</p> <p>to read, base sequence / order of bases ;</p>	2	<p>IGNORE speed or rate of movement, look for distance or position or pattern, e.g. shortest / lightest / smallest, lengths first or lighter move further and heavier move less far</p> <p>DO NOT CREDIT 'put genome back in order'</p>
		(iii)	<p>to cut (genome DNA) into, small(er) / 750 bp, fragments ;</p> <p>to cut, vectors / BACs / plasmids, (for gene library) ;</p>	2	ACCEPT fragment size in range 500-1000 base pairs

Question		Answer	Marks	Guidance
	(c)	genome, too big / very large ; accuracy better / fewer errors (with small fragments) ; divide job over, time / different labs ;	2	ACCEPT ORA only, small sections / 750bp, can be sequenced (at a time) CREDIT ORA large sections sequenced less accurately ACCEPT otherwise would take <u>too</u> long / be unmanageable / be impractical IGNORE ref to efficiency
	(d)	(i) 1 160 000 ; ;	2	Correct answer = 2 marks (no units) CREDIT 1.16 <u>million</u> or 1.16×10^6 If answer incorrect, award 1 mark for $870 \text{ (million)} \div 750$ AWARD 1 max correct answer has inappropriate units (e.g. 1 160 000 Mbp = 1 mark)
		(ii) (monkey flower) has, <u>smaller</u> genome / <u>fewer</u> Mbp DNA ; fewer lab hours / fewer staff needed / quicker / cheaper ;	2	Read as prose. ACCEPT ORA but must be comparative IGNORE refs to chromosome number ACCEPT ORA but must be comparative
		(iii) larger (in size) ;	1	ACCEPT bigger / plumper / juicier

Question		Answer	Marks	Guidance
	(e)	<p><i>phylogenetic approach</i></p> <p>no need to test for interbreeding ;</p> <p>ref. common ancestor / <u>monophyletic</u> groups ;</p> <p>can apply to organisms that reproduce asexually ;</p> <p>can apply to, extinct organisms / fossils ;</p>	2	<p>ORA for biological species concept – (importance of members of same species) (inter)breeding to give fertile offspring</p> <p>IGNORE clades</p> <p>ORA for biological species concept – doesn't apply to asexually reproducing organisms</p> <p>ORA for biological species concept – doesn't apply to, extinct organisms / fossils</p>
			Total	18

Question			Expected Answer	Mark	Additional Guidance
6	(a)	(iii)	<p>1 artificial insemination / AI ;</p> <p>2 in vitro fertilisation / IVF ;</p> <p>3 <i>idea of</i> progeny testing ;</p> <p>4 embryo transplantation / use of surrogate mother ;</p> <p>5 cloning ;</p> <p>6 genetic screening / use of gene probes ;</p> <p>7 AVP ;</p> <p>8 AVP ;</p>	2 max	<p>Mark the first suggestion on each line</p> <p>1 : IGNORE performance testing</p> <p>2</p> <p>3</p> <p>4 : CREDIT embryo splitting</p> <p>5</p> <p>6 : ACCEPT genetic engineering</p> <p>7 eg • sex selection technique / screening X and Y sperm</p> <p>8 eg • portmanteau animals</p>
6	(b)	(i)	<i>idea of</i> change to , <u>DNA</u> / <u>base(s)</u> / <u>nucleotide(s)</u> ;	1	
6	(b)	(ii)	natural / directional , selection ;	1	ACCEPT evolution DO NOT CREDIT genetic drift
+	(c)	(i)	<p><i>regulatory</i> <i>idea that</i> makes , repressor protein / transcription factor or <i>idea that</i> product switches (structural / another) gene , on / off ;</p> <p><i>structural</i> <i>idea that</i> makes , enzyme / polypeptide / protein ;</p> <p><i>relationship between the 2</i> <i>idea that</i> regulatory <u>gene</u> , controls / affects , the expression of structural <u>gene</u> ;</p>	2 max	<p>ACCEPT 'makes regulatory protein'</p> <p>ACCEPT 'switching on / off' for idea of control IGNORE explanation involving repetition of word "regulates"</p>

Question			Expected Answer	Mark	Additional Guidance
6	(c)	(ii)	<p>lactose has been , removed / digested / respired / broken down (by bacteria) ;</p> <p>to , lactic acid / lactate / other sugars ;</p> <p>yogurt still a good source of , calcium / vitamins ;</p>	2 max	<p>DO NOT CREDIT if context wrong (eg heat)</p> <p>eg • glucose (and galactose)</p>
6	(d)		<p>1 lactose binds to repressor protein ;</p> <p>2 changes , shape / structure (of protein) ;</p> <p>3 removes it from / stops it binding to , operator ;</p> <p>4 RNA polymerase binds to promoter ;</p> <p>5 <i>idea that</i> (so that Z and Y) are , transcribed / <u>m</u>RNA made ;</p>	3 max	<p>1 DO NOT CREDIT regulator substance</p> <p>2 IGNORE ref. to active site</p> <p>3</p> <p>4 DO NOT CREDIT DNA polymerase</p> <p>5 CREDIT lactose permease and β-galactosidase for Z and Y</p> <p>IGNORE gene , switched on / expressed</p>
Total				16	