Question			Expected Answers	Mark	Additional Guidance
1	(a)		**X** phosphate **;** **Y** deoxyribose **;** **Z** thymine **;**	3	**Mark the first answer for each letter.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then **= 0 marks** **DO NOT CREDIT** PO_4 or 'phosphate **,** molecule / backbone' **IGNORE** group **DO NOT CREDIT** deoxyribulose **IGNORE** (pentose) sugar **DO NOT CREDIT** incorrect spelling **IGNORE** (nitrogenous) base / T

Question			Expected Answers		Mark	Additional Guidance
1	(b)					**CREDIT** answers from clearly labelled diagram **IGNORE** anything after it becomes clear that a candidate is ***describing*** transcription
			1	semi-conservative (replication) ;		
			2	(double) helix, untwists / uncoils / unwinds / unravels ;		2 **IGNORE** straightens **DO NOT CREDIT** α-helix
			3	hydrogen bonds (between bases) break ;		3 **IGNORE** unzips
			4	each strand acts as the template (for the formation of a new molecule) ;		
			5	free (DNA) nucleotides (align with exposed bases) ;		5 **IGNORE** in cytoplasm
			6	complementary base pairing / purine to pyrimidine ;		6 **IGNORE** A to T / C to G (as given in Q) **ACCEPT** base pair rule
			7	hydrogen bonds (re)form ;		
			8	sugar-phosphate backbone forms / adjacent nucleotides join ;		8 **CREDIT** formation of phosphodiester bond
			9	DNA polymerase joins , backbone / strands ;		9 **ACCEPT** in context of H bonds forming
			10	each new molecule has 1 old and 1 new strand ;		10 **DO NOT CREDIT** half old and half new strand
			11	AVP ;		11 e.g. correct ref to , (DNA) helicase (in context of unwinding or unzipping) / (DNA) ligase (in context of joining Okazaki fragments or role in backbone formation) / leading or lagging strand / 3' / 5' / antiparallel / activation of free nucleotides / 3 H bonds between C and G / 2 H bonds between A and T / Okazaki fragments / proof reading
					6 max	
			QWC ~ events in correct sequence so long as no ref to transcription / translation , seen ;		**1**	1 mark from mps **2** to **4** ***then*** 1 mark from mps **5** to **7** ***then*** mp **8** or **9**
				Total	**[10]**	

Question			Expected Answer	Mark	Additional Guidance
2	(a)			6	**Award** 1 mark for each correct row **DO NOT CREDIT** if more than one letter in a box

statement	DNA only (**D**) or RNA only (**R**) or both DNA and RNA (**B**)	
contains thymine	**D**	
contains ribose	**R**	;
consists of 2 chains connected to each other with hydrogen bonds	**D**	;
has a sugar-phosphate backbone	**B**	;
has 4 different nitrogenous bases	**B**	;
contains a pentose sugar	**B**	;
is found in the nucleus and cytoplasm	**R**	;

Question			Expected Answer	Mark	Additional Guidance
2	(b)	(i)			
		1	(information used to) decide which, group / taxon, organism / species / named example, fits in **;**		**1** answers must refer to the information provided by the study of DNA, rather than simply the job of taxonomists**,** e.g. **ACCEPT** 'it can be used to put organisms into groups' **1 IGNORE** 'for classification' unqualified – look for idea of: groups **1 CREDIT** ref to belonging to same taxonomic group, e.g. 'to see if it belongs in the genus *Homo*'
		2	compare the proportion of (different) bases **;**		**2 IGNORE** 'examine proportion of bases' **2 CREDIT** idea for looking at similarities / differences
		3	compare the DNA / genes / sequence of bases **;**		**3 IGNORE** 'examine sequence of bases' **3 CREDIT** idea for looking at similarities / differences
		4	*idea of:* the more similar the, DNA / genes, the closer the relationship / AW **;**	**2 max**	**4** Must contain reference to similarity of DNA
2	**(b)**	**(ii)**			**Mark the first <u>two</u> suggestions** **IGNORE** ref to genetics as DNA is 'biochemical'
		1	fossil record **;**		
		2	anatomy / physiology / behaviour **;**		**2 ACCEPT** AW for anatomy, e.g. observable / physical features / cell structure **2 ACCEPT** AW for physiology, e.g. method of reproduction
		3	embryology / AW **;**	**2 max**	
2	**(c)**		**J ;** **T ;**	**2**	**DO NOT CREDIT** names

Question			Expected Answer	Mark	Additional Guidance
2	(d)	(i)			
		1	no DNA from living specimens in Wales analysed ;		
		2	population (may have) evolved / mutations have occurred / genetic variation, (since 1948) ;	1 max	**2 ACCEPT** description of evolved **2 DO NOT CREDIT** 'evolution' unqualified by context of pine marten population
2	(d)	(ii)			**ACCEPT** animals as AW for pine martens throughout answer
		1	(introduced) pine martens might not be adapted to local conditions / AW ;		**1 ACCEPT** not adapted to the habitat **1 DO NOT CREDIT** 'used to'
		2	(local) habitat, might have changed / is no longer suitable (for any pine martens) / AW ;		
		3	introduced, pine martens, might outcompete native, population / pine martens ;		**3 ACCEPT** introduced pine martens might kill native / Welsh pine martens **3 IGNORE** 'compete' unqualified
		4	introduced pine martens might bring disease ;		
		5	Welsh pine marten would lose its, distinctiveness / identity, because of interbreeding ;	1 max	
			Total	**14**	

Question			Expected Answer	Mark	Additional Guidance
3	(a)	(i)			**Mark the first response** but do not award the mark if a further answer is incorrect or contradictory **DO NOT CREDIT** refs to length as given in stem
		1	(m)RNA is single stranded / DNA is double stranded **;**		***1*** **ACCEPT** DNA is a double helix (as stranded is implied) **for this mp** **DO NOT CREDIT** DNA is a double *molecule*
		2	(m)RNA is non helical / DNA is helical **;**	**1**	***2*** **ACCEPT** (mRNA) not twisted / not coiled / not spiral / straight / ora
3	(a)	(ii)			**Mark the first response to (a)(ii)** – but but do not award the mark if a further answer is incorrect or contradictory
		1	RNA contains ribose **and** DNA contains deoxyribose **;**		
		2	RNA contains, uracil / U, **and** DNA contains, thymine / T **;**		***2*** **DO NOT CREDIT** thyamine
		3	3 / more than 1, forms of RNA **;**		***3*** **ACCEPT** 'one form of DNA'
		4	RNA is, single stranded / non helical, **and** DNA is, double stranded / helical **;** *if not already* ***awarded*** *as answer in (i)*	**1**	
3	(a)	(iii)	gene **;**	**1**	**IGNORE** allele / operon
3	(a)	(iv)	too big to / does not, fit through pore (in nuclear envelope) **;**	**1**	**ACCEPT** 'too long to fit … pore'
3	(a)	(v)	*idea that* only copies one, gene / section / part / AW, (of DNA) **;** *idea that* DNA comprises many, genes / alleles **;**	**2**	e.g. mRNA only codes for 1 protein **DO NOT CREDIT** '1 DNA molecule contains *all* the genes' 'mRNA only codes for 1 protein but DNA codes for many proteins' = 2 marks

Question			Expected Answer	Mark	Additional Guidance
3	(b)	(i)			
		1	non-competitive (inhibitor) ;		
		2	(α-amanitin / inhibitor / toxin) fits into, allosteric site / a place other than active site ;		
		3	active site changes, shape / configuration / conformation / structure ;		3 **ACCEPT** 'distortion of active site'
		4	substrate no longer, fits / complementary to, active site ;		4 Mark to be awarded in context of active site (although need not be repeated if stated in mp 3) **IGNORE** ESC
				2 max	
3	(b)	(ii)			
		1	inhibits production of mRNA / mRNA not produced ;		1 **CREDIT** prevents transcription
		2	prevents protein synthesis / AW ;		2 **CREDIT** translation
		3	e.g. of, specific named protein / (vital) process, that may be affected ;		3 e.g. respiration / photosynthesis (as question refers to 'an organism') / haemoglobin / cytochrome C oxidase
				2 max	
3	(c)	(i)	sequence / order, of amino acids ;	1	**IGNORE** number / organisation
	(c)	(ii)			**ALLOW** phonetic spelling
			A = ionic ;		
			B = hydrogen ;		
			C = disulfide (bond / bridge) ;		**DO NOT CREDIT** disulfate
				3	
3	(d)	1	increased kinetic energy ;		1 must contain the idea of more than normal
		2	(any part of protein molecule) vibrates ;		
		3	hydrophilic / hydrophobic / hydrogen / ionic, bonds / interactions, break ;		3 **IGNORE** Van der Waals **DO NOT CREDIT** if disulfide / covalent / peptide bonds are included
		4	change in, 3D shape / conformation (of protein) ;		4 **IGNORE** tertiary / structure (as in question) **IGNORE** refs to, active site / enzymes
		5	denatures ;		
				3 max	
			Total	**17**	

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)			
		1	similar / same, cells / metabolism ;		*1* **ACCEPT** they are all eukaryotic cells
		2	similar / same / share, genes **or** have genes in common ;		
		3	similar / same, (embryonic) development ;		
		4	shared, ancestry / ancestor **or** all related by evolution ;		*4* **CREDIT** due to phylogeny **ACCEPT** all same kingdom **IGNORE** 'they are all animals'
				max 2	
4	(a)	(ii)			**Mark the FIRST answer on each numbered line**
		1	small ;		
		2	short life cycle ;		*2* **ACCEPT** fast development / mature quickly / fast reproductive rate / short generation time
		3	easy to, keep / breed / AW ;		*3* **ACCEPT** produce many offspring
		4	cheap (to buy / keep) ;		
		5	readily available / common / not rare ;		
		6	large cells ;		
		7	previously well-studied / many known mutants ;		*7* **ACCEPT** genome has been, mapped / sequenced
				max 2	
4	(b)	(i)	scanning ; electron (microscope) ;	2	**CREDIT** SEM = 2 marks **ACCEPT** transmission electron / TEM = 1 mark **IGNORE** micrograph
4	(b)	(ii)	description of legs in place of antennae in, mutant / 3.2 / AW ;	1	**ACCEPT** projections on head / antennae / feelers, longer (in Fig. 3.2) **DO NOT CREDIT** antennae / projections vs. none **DO NOT CREDIT** mandibles / fangs **DO NOT CREDIT** incorrect statement e.g. legs on mouth
4	(b)	(iii)	homeotic / homeobox / hox ;	1	

Question			Expected Answers	Marks	Additional Guidance
4	(c)	1	*synthesis*		**MAX 6** marks for synthesis **MAX 6** marks for roles
		2	DNA, copied into / →, mRNA **or** described ;		
		3	transcription / transcribed ; one strand copied ;		***1*** **DO NOT CREDIT** descriptions that contain errors
		4			
		5	complementary base-pairing ;		***3*** **ACCEPT** coding / sense / non-sense / template, strand (implying one only)
		6	triplet code / code read in threes / codon is 3 bases ;		
		7	base sequence determines amino acid sequence ;		***4*** **CREDIT** description of base pairing as correct to context
		8	translation ;		
		9	ribosomes ; role of tRNA described ; **(max 6)**		***9*** e.g. "tRNA brings amino acid" or "tRNA anticodon binds to mRNA codon"
		10	*roles of polypeptides*		
		11	(named) structural protein ; enzymes / catalyse reactions / control metabolism ;		***10*** e.g. actin / myosin / collagen / keratin
		12			
		13	hormones / growth factors ;		
		14	receptor proteins ; adenyl cyclase / cAMP ;		***12*** **CREDIT** growth hormone / GH / somatotrophin / FSH
		15			
			idea of switching genes, on / off ;		***14*** most likely to be expressed in context of mp 12
		16			
		17	homeotic / homeobox, genes **or** homeodomain proteins ; *idea of* master switch gene / one gene turns on/off whole set of other genes / cascades of gene switching ;		***15*** **CREDIT** transcription factors / regulatory proteins / repressor proteins
		18			
			apoptosis ; **(max 6)**	**7 max**	
			QWC – balanced account ;	**1**	At least 2 marks from points 1 - 9 **and** at least 2 marks from points 10 – 18
			Total	**16**	