Question Number	Answer	Mark
1(a)(i)	1. {sequence / order} of amino acids ; 2. joined by peptide bonds ;	**(2)**

Question Number	Answer	Mark
1(a)(ii)	1. idea that primary structure determines (three-dimensional) folding / eq ; 2. reference to types of amino acids determine {types of bonds / (other than peptide bonds) / named bond}; 3. reference to position of amino acids determines position of{bonds / correctly named bond} ; 4. correct reference to two cys (amino acids) form bonds ; 5. idea that {shape / position / eq} of active site is determined by position of amino acids ; 6. reference to shape of active site being correct to bind to substrate ; 7. reference to {amino acids / R groups} involved in {chemical reaction / eq} ; 8. reference to {globular/ soluble / enzyme }molecules being {relatively short /small / made up of relatively few amino acids} ; 9. reference to {globular / soluble proteins/ enzyme} having relatively high number of { polar / small{ { amino acids / R groups} ; 10. reference to {polar R groups / eq} facing outwards ;	**max (5)**

Question Number	Answer	Mark
1(b)(i)	1. reference to mRNA as a copy of the {genetic code / DNA} ; 2. of the protein (being synthesized) / eq ; 3. moves {out of the nucleus / to ribosomes } / eq ; 4. idea that it {acts as a template / has the instructions} for translation ;	**max (3)**

Question Number	Answer	Mark
1(b)(ii)	1. correct reference to translation ; 2. binds to an amino acid / takes the amino acid to the {ribosome / mRNA} ; 3. reference to tRNA being specific to amino acid ; 4. holds the amino acid in place / eq ;	**max (3)**

Question Number	Answer		Mark
2(a)	1. {scientific / peer reviewed} {papers / journals / magazines / article} ; 2. (scientific) {conferences / lecture / forums} ; 3. media reports ;	3. e.g. TV, radio. newspaper ' internet	**(2) RAD**

Question Number	Answer	Additional Guidance	Mark
***2(b)(i)**	**QWC focussing on spelling** 1. idea of using *proteomics* (to study protein); **Any 5 from :** 2. idea of using DNA {*profiling / fingerprinting*} (to study DNA) ; 3. idea of obtaining {*tissue / cell*} sample from tomcod ; 4. multiple copies of DNA made / eq ; 5. using {PCR / *polymerase chain reaction*} ; 6. ref to *restriction* {*enzymes / endonucleases*} to produce DNA {fragments / eq} ; 7. reference to (*gel) electrophoresis* ; 8. idea of {loading / eq} the DNA onto the { / *named gel*}; 9. idea that an {*electric current / charge}* is applied ; 10. reference to use of {dye / *fluorescent staining* / UV light /*Southern blotting / gene probes / radioactive labelling* / eq};	4. IGNORE refs to amplification, large amounts 8. .g. *agarose, agar* 9. CCEPT apply *potential difference*	**(6) XP**

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	1. same number of chromosomes ; 2. idea that the mutation affected the sequence of DNA ; **OR** 3. idea that (all / most of) the {bands / eq} are the same (size / position / width) ; 4. idea that only {a small region of DNA / the AHR2 gene} is affected ;	1. ACCEPT both contain AHR2 gene	**(2) XP**

Question Number	Answer	Additional Guidance	Mark
2(b)(iii)	1. a protein with a different {structure / amino acids / function} / eq ; 2. idea that the mutation will affect the DNA ;	1. ACCEPT two AAs missing 2. .g. two codons missing	**(2) XP**

Question Number	Answer	Additional Guidance	Mark
3(a)	1. platelets ; 2. thromboplastin ; 3. enzymes ; 4. prothrombin ; 5. thrombin ;	NB: allow phonetic spelling 1. CCEPT thrombocytes 2. ACCEPT enzyme if not given in Mp3 3. ACCEPT thromboplastin if not given in Mp2	**(5)**

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	1. central carbon with {R / H / eq} and H attached by single bonds ; 2. {NH_2 / NH_3^+ } attached to a carbon by single bond ; 3. {COOH / COO^- } attached to a carbon by single bond ;	Mp1 Must show C, H and R or a plausible R-group MP2 and 3 ACCEPT groups attached to a central C that is not shown (chemical notation) ACCEPT groups written wrong way round e.g. C-H_2N NOT incorrect bonding within groups if shown e.g. C=OH ACCEPT if correct group attached to wrong molecule e.g. glucose	**(3)**

Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	peptide (bond) ;	ACCEPT peptide link NOT polypeptide or dipeptide	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(b)(iii)	1. Idea that fibrinogen is globular and fibrin is fibrous ; 2. fibrinogen is soluble and fibrin is insoluble ; 3. Idea that they are different sizes ;	ACCEPT marks to be pieced together across the response. NB: answers must be comparative e.g. fibrin is fibrous fibrinogen is not 1. CCEPT fibrinogen globular and fibrin (long) strand or chain. 3. CCEPT fibrinogen is {smaller / larger / more amino acids} than fibrin	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(a)	1. mutation changes the sequence of bases / eq ; 2. reference to stop code / idea of {insertion / deletion / eq} changes all triplets / frame shift / eq ; 3. {transcription / translation} does not occur / mRNA too short / protein too short / a different protein is made / eq ;	1. CCEPT correct sequence of bases not there 2. IGNORE changes one triplet / codon ACCEPT no start codon, no ribosome binding site 3. IGNOR change of an amino acid ACCEPT wrong protein made, different sequence of amino acids	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(b)	1. in the (cell surface) membrane ; 2. of mucus-producing cells / eq ;	1. ACCEPT in phospholipid bilayer, apical membrane NOT on, attached, basal membrane 2. ACCEPT {epithelial/endothelial / lining} cells of appropriate named organ or system e.g. cells lining respiratory, digestive, reproductive	(2)

Question Number	Answer	Additional Guidance	Mark
4(c)	1. (change in) {number / type / sequence / eq} of {amino acids / R groups} ; 2. So the {bonding / named bond } will be different / eq ;	2. CCEPT hydrogen, disulfide bridges, van der Waal forces, ionic NOT peptide, glycosidic, ester bond, etc IGNORE references to shape including active sites	(2)

Question Number	Answer	Additional Guidance	Mark
4(d)	1. CFTR is a channel protein / eq ; 2. idea that {fewer / no} chloride ions will be able to {enter / bind to / pass through / eq} the CFTR protein ; 3. idea that fewer chloride ions will leave the cell ;	NOT chlorine penalise once 1. NOT carri 2. ACCEPT CFTR has a specific shape for chloride ions ACCEPT other ions can pass through	(2)

Question Number	Answer	Additional Guidance	Mark
7(e)	1. less {chloride ions / water} in mucus / eq ; 2. idea that mucus is different e.g. thicker, stickier ; 3. in the {respiratory system / lungs / digestive system / pancreas / reproductive system / oviducts / fallopian tubes / cervix / sperm duct / vas deferens / eq } ; 4. credit correct reference to a consequence of thicker mucus ;	E.g. less ventilation, enzyme release, absorption of nutrients, more chest infections, reduced fertility, etc	(2)

Question Number	Answer	Additional Guidance	Mark
7(f)	1. by {enzymes / proteases} ; 2. by hydrolysis / eq ; 3. of peptide bonds ;		(2)