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

Question Number	Answer	Additional Guidance	Mark
2 (a) (i)	B ;		**(1) comp**

Question Number	Answer	Additional Guidance	Mark
2 (a) (ii)	B ;		**(1) comp**

Question Number	Answer	Additional Guidance	Mark
2 (a) (iii)	C ;		**(1) comp**

Question Number	Answer	Additional Guidance	Mark
2 (b) (i)	C **;**		**(1) comp**

Question Number	Answer	Additional Guidance	Mark
2 (b) (ii)	D ;		**(1) comp**

Question Number	Answer	Additional Guidance	Mark
2 (c)	nucleus ;	ACCEPT chloroplast, mitochondria	**(1) clerical**

Question Number	Answer	Additional Guidance	Mark
2 (d) (i)	Advantage any **one** from: 1. prevent child dying late in pregnancy / eq 2. idea of less stress for parents / eq 3. parents can prepare for child { with / without } achondroplasia / eq 4. idea of making an informed choice ; Disadvantage any **one** from: 5. risk of miscarriage of healthy child / eq 6. idea of more stress for parents / eq 7. cost / eq 8. risk of false { negatives / positives } / eq ;	4. CCEPT may choose termination 5. CCEPT risk of spontaneous abortion	**(2)** **p**

Question Number	Answer	Additional Guidance	Mark
2 (d) (ii)	1. genoty of parents shown ; 2. alleles in the gametes shown ; 3. possible genotype of children shown AND corresponding phenotypes shown ; 4. (probabilit =) 1/4 / 25% / 1 in 4 / 0.25 ;	4. NOT a ratio e.g. 1:4 ACCEPT 1/3, 33(.3)% , 1 in 3, 0.3 this assumes AA dies	**(4)** **p**

Question Number	Answer	Additional Guidance	Mark
3(a)	A = adenine C = cytosine G = guanine T = thymine ;	**Accept** reasonable phonetic spellings **Not:** adenosine cysteine glycine thiamine, thyosine, tyrosine	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	1. idea that each amino acid is coded for by three {nucleotides / bases} ; 2. credit quoted example / idea that 12 {nucleotides / bases} code for 4 amino acids ;	**Accept** in context of RNA AAT / AAC = leucine, CAG = valine, TTT = lysine	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(b)(ii)	1. idea that each {triplet is discrete / each base is only used once in a triplet / eq } ; 2. idea that AAT + AAC + CAG + TTT gives 4 (distinct) {triplets / codes} ;	**Accept** a specific example eg the first T can only be used in code for first leucine **Accept** a description of how the code could be read if overlapping	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(b)(iii)	1. idea that more than one code can be used for a {particular amino acid/ stop code} ; 2. AAT and AAC code for leucine ;	**Accept** more codes than are needed to code for all the amino acids (and stop code)	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(c)	B ;		**(1)**

Question Number	Answer	Additional Guidance	Mark
3*(d)	QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence 1. reference to mRNA with sequence UUA UUG GUC AAA ; 2. idea that ribosome is involved ; 3. idea that each tRNA molecules is attached to one (specific) amino acid ; 4. credit example of tRNA anticodon with specific amino acid 5. reference to anticodons on tRNA {bind / link to / line up against / eq} codons on mRNA ; 6. credit a specific example (from this DNA) ; 7. idea of hydrogen bonds between bases (of tRNA and mRNA) ; 8. reference to formation of peptide {bonds / links} between (adjacent) amino acids ;	**QWC emphasis is logical sequence** **NB The mps do not have to be given in this order necessarily** **Not** tRNA carries amino acids AAU /AAC = leucine, CAG = valine, UUU = lysine **Ignore** complementary eg UUA codon and AAU anticodon **Accept** between codon and anticodon	**(5)**

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	{Met Gly Ile} / {methionine glycine isoleucine} ;	**Not** other abbreviations	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	idea that each {triplet is discrete / base is only used once in a triplet / eq} ;	**Accept** a description of how the code could be read if overlapping	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(b)(i)	1. idea that each amino acid needs a code ; 2. idea that {using three bases give enough codes / using less bases does not give enough codes} ; 3. idea of three bases means there can be 64 {triplets / codes / combinations / eq} ;	**Accept** codons	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)	1. idea that {effects of mutations are reduced / the amino acid may not be altered} ; 2. reference to the third base (being the one that can be changed with no effect) ; 3. no effect on (resulting) {polypeptide / protein} / eq ;	**1. Accep** description of effect **Accept** from a description of a specific example **Accept** always results in same amino acid **Not** similar amino acid **2 NB** If mp 2 is awarded it will usually incorporate mp 1 as well = 2 marks	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(c)	1. reference to (TAA, TAG and TGA as) stop codons ; 2. occur at the end of the gene (on the DNA) / eq ; 3. reference to transcribed as mRNA / eq ; 4. as AUU, AUC and ACU ; 5. idea that they are recognised by ribosome ; 6. idea that they signal the end of the polypeptide (chain) ; 7. reference to (during) translation ;	**1. No** codes, triplets **6. Accep** stops the synthesis of the polypeptide / the polypeptide is finished	**(4)**

Question Number	Answer	Additional Guidance	Mark
4(d)	1. ref to peptide {bond / link} ; 2. between (amino group / NH_3 / NH_4^+} and {carboxyl group / COOH / COO^-} ; 3. ref to condensation (reaction) ; 4. idea of role of {tRNA / ribosome / enzymes / correctly named enzyme} in joining amino acids together ;	**Accept** mp 1 and 2 from correctly drawn and labelled diagram **2. N** formulae must be correct if only these are given **4. Accep** e.g. hold the amino acids next to each other, ribosome contains enzyme	**(3)**