Question Number	Answer	Mark
1(a)(i)	D phosphodiester bonds ;	(1)

Question Number	Answer	Mark
1(a)(ii)	B 200 ;	(1)

Question Number	Answer	Mark
1(a)(iii)	C 0% thymine;	(1)

Question Number	Answer	Additional Guidance	Mark
1(b)	1. ontains {Ribose / 5C sugar / pentose} AND phosphate ; 2. reference to (nitrogenous) base / adenine / guanine / cytosine / uracil / eq ;	IGNORE references to bonds ACCEPT correctly labelled diagram which might use Pi 1. oth components needed for the mark NOT deoxyribose, sugar with no 5C, phosphate head, P 2. NOT thymine, IGNORE A, G, C, U NOT plural bases if only referring to one mononucleotide	(2)

Question Number	Answer	Additional Guidance	Mark
1(c) *QWC	**(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence)** 1. reference to ribosome (attaches to mRNA) ; 2. idea that tRNA carries an amino acid ; 3. idea of {anticodon codon interaction / complementary base pairing } between tRNA and mRNA ; 4. formation of hydrogen bonds (between the tRNA and mRNA) ; 5. reference to peptide bond (between amino acids) ; 6. (peptide bond) formed by a condensation reaction ; 7. idea that tRNA released from {mRNA / ribosome} ; 8. idea that ribosome {attaches to / detaches from / eq} {sequence / eq} on mRNA ;	**QWC emphasis answer must be in a logical sequence** Penalise once for point out of sequence / context IGNORE descriptions of transcription ACCEPT AA for amino acid 1. ACCEPT rough endoplasmic reticulum, RER 2. NOT amino acid**s** unless tRNA plural 3. ACCEPT description of complementary base pairing 5. ACCEPT peptide link 6. ACCEPT by an enzyme 8. ACCEPT ribosome moves along mRNA, a start codon / AUG, stop codon / UAA / UAG / UGA	(5)

Question Number	Answer	Mark
2(a)(i)	A ;	(1)

Question Number	Answer	Mark
2(a)(ii)	8 ;	(1)

Question Number	Answer	Additional guidance	Mark
2(b)	Transcription ;		(1)

Question Number	Answer	Additional guidance	Mark
2(c)	1. idea that there is a change in the {DNA sequence / base sequence of a gene / eq } ; 2. change in amino acid / change in primary structure of { protein / enzyme } ; 3. reference to different R groups ; 4. leading to different {type / position / eq} bonding ; 5. idea of change in {shape / properties} of the active site ; 6. idea of {phenylalanine / substrate / eq} does not fit in the enzyme's active site ;	1. GNORE mRNA 4. ACCEPT named bond e.g. hydrogen, ionic, disulphide NOT peptide 5. CCEPT enzyme is not made 6. ACCEPT no enzyme-substrate complex made	(4)

Question Number	Answer	Additional guidance	Mark
2(d)	1. loss causes whole amino acid sequence (beyond mutation) to change / causes frame shift / eq ; 2. replacement only changes one {codon / amino acid / may not change the amino acid if third base / eq } eq ; 3. idea that the number of amino acids remains the same with replacement ;		(2)

Question Number	Answer	Additional guidance	Mark
*3(a)	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. reference to CFTR {protein / channel} / eq ; 2. idea of a different {amino acid / sequence of amino acids / primary structure / eq} ; 3. {shape / function} of {CFTR / protein/ channel / eq} changed / eq ; 4. role of protein in transporting chloride ions / eq ; 5. (chloride) ions not {moving out of cells / going into mucus} / eq ; 6. water does not move out (of cells) / water moves in (to cells) / eq ; 7. reference to osmosis ; 8. mucus (on cell surface) {is not diluted / becomes thicker / becomes stickier} / eq ; 9. (thickened mucus) cannot be moved by {cilia / coughing} ;	QWC –answer must be organised in a logical sequence)	**(5)**

Question Number	Answer	Additional guidance	Mark
3(b)	1. reference to using {alleles / genes / eq} coding for the CFTR {protein / channel} ; 2. reference to introducing the {alleles / genes / eq} into the cells of the {lungs / pancreas / reproductive tracts / that produce mucus / eq} ; 3. using a {vector / named vector} ; 4. credit suitable delivery mechanism e.g. nebuliser, injection ; 5. idea that treatment needs to be repeated (due to cell replacement) ; 6. idea that {transcription / translation} of the gene produces the {normal/ functioning / CFTR / eq} protein ;	2. NOT replaces/ repairs	**(3)**

Question Number	Answer		Mark
4(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
***4(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
4(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
4(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
5(a)	1. triplet code / 3 bases to each code / eq ; 2. reference to adenine, thymine, guanine and cytosine ; 3. idea that each triplet of bases codes for one amino acid ; 4. idea that the code is not overlapping ; 5. idea that code is universal ; 6. idea that code is degenerate ;	1. IGNORE codon, triple 2. ACCEPT phonetic spelling	**(2)**

Question Number	Answer	Additional Guidance	Mark
***5(b) QWC**	(QWC– Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. reference to *semi-conservative replication* ; 2. DNA (*molecule* / strands) {unwinds / separate / eq} ; 3. *(mono)nucleotides* line up along (both) strands / eq ; 4. reference to *complementary* pairing between bases ; 5. reference to *hydrogen bonds* formed (between bases) ; 6. reference to formation of *phospho(di)ester* bonds (between adjacent *mononucleotides*) ; 7. ref. to condensation reaction; 8. name of an enzyme involved in DNA replication ;	QWC– Spelling of technical terms must be correct – penalise 1st error only – can still reach Max 5 marks if 6 points given. **If context is transcription, Max 2 marks from Mp2, 5, 6, 7, 8.** 1. CCEPT clear description 2. ACCEPT unzipped / hydrogen bonds broken / eq 3. NOT RNA OR one s and only described IGNORE bases line up 4. ACCEPT description, NOT uracil / U 5. NOT betwee nucleotides in the same strand ACCEPT between (DNA) strands 8. e.g. (DNA *polymerase*, (DNA) *helicase, ligase*	**(5)**