DNA and Genetics - Mark Scheme

Q1.

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

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

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

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

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

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

Question Number	Answer	Additional Guidance	Mark
(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. ACCEPT may choose termination 5. ACCEPT risk of spontaneous abortion	(2) Exp

Question Number	Answer	Additional Guidance	Mark
(d) (ii)	1. genotype of parents shown ; 2. alleles in the gametes shown ; 3. possible genotypes of children shown AND corresponding phenotypes shown ; 4. (probability =) 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) Exp

Q2.

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

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

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

Question Number	Answer	Additional guidance	Mark
(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. IGNORE mRNA 4. ACCEPT named bond e.g. hydrogen, ionic, disulphide NOT peptide 5. ACCEPT enzyme is not made 6. ACCEPT no enzyme-substrate complex made	(4)

Question Number	Answer	Additional guidance	Mark
(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)

Q3.

Question Number	Answer	Additional Guidance	Mark
	idea that the (RNA) nucleotides attach to this strand OR idea of {nucleotide / base } sequence that directs the synthesis of {complementary sequence / mRNA / eq} ;	ACCEPT complementary to RNA nucelotides, codes for mRNA, {part of the DNA / antisense } strand that the mRNA is built along, NOT DNA nucleotides, plural strands	(1)

Q4.

Question Number	Acceptable Answer	Additional guidance	Mark
	A description that makes reference to the following: • DNA {unzips / unwinds} and hydrogen bonds between complementary strands broken (1) • the {antisense / coding / template} strand used for mRNA synthesis (1) • RNA polymerase used to join RNA nucleotides (1) • complementary base pairing of A with U, not T (1)		**(4)**

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	Nucleus	Allow phonetic spelling Do not allow Nuclease, nucleolus, nuclears	**(1)**

Question Number	Answer	Additional Guidance	Mark
(ii)	**D** ATGCGACTG / AUGCGACUG		**(1)**

Q6.

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

Question Number	Answer	Additional Guidance	Mark
*(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)**

Q7.

Question Number	Answer	Additional Guidance	Mark
(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
* (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. ACCEPT clear description 2. ACCEPT unzipped / hydrogen bonds broken / eq 3. NOT RNA OR one strand only described IGNORE bases line up 4. ACCEPT description, NOT uracil / U 5. NOT between nucleotides in the same strand ACCEPT between (DNA) strands 8. e.g. (DNA) *polymerase*, (DNA) *helicase, ligase*	(5)

Q8.

Question Number	Answer	Additional Guidance	Mark
(i)	• dominant (allele)		(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	• both parents heterozygous (1) • correct offspring genotypes (from genetic diagram) (1) • correct probability (1)	ALLOW from gametes in diagram ALLOW ECF 0.25/ 25% / $\frac{1}{4}$ ALLOW ECF	(3)

Question Number	Answer	Additional Guidance	Mark
(iii)	• Pre-implantation genetic diagnosis / PGD / PIGD	ALLOW Pre-implantation genetic screening / PGS	(1)

Question Number	Answer	Additional Guidance	Mark
(iv)	An explanation that makes reference to two of the following: either • it may result in a choice of an abortion (1) • it is unethical to cause the death of a foetus (1) or • (risk of) {incorrect result / false positive / false negative } (1) • healthy foetus could be aborted / parents not prepared for child with {genetic disease / achondroplasia} (1)	ALLOW can result in embryos being discarded ALLOW unethical to destroy a potential human being ALLOW can result in healthy embryos being discarded	(2)