Question number	Answer	Additional guidance	Mark
8(a)	An explanation that includes the following points: • because the {phenotype / blood group} of individual 3 is {different / combination} from that of individual 1 and 2 (1) • because neither of the alleles are dominant / both alleles are expressed (1)	**ACCEPT** the phenotype of the heterozygote is different from the phenotype of either homozygote MM gives you blood group M + NN gives you blood group N but MN gives you a different blood group offspring have both the blood types (in their phenotype) **ACCEPT** both alleles are equal / equally dominant	**(2)**

Question number	Answer	Additional guidance	Mark
8(b)	An answer that includes the following points: • genotypes of individuals 3 and 4 shown / alleles in gametes of individuals 3 and 4 shown (1) • possible genotypes of children shown (1) • corresponding phenotypes given (1) • 1 type M : 1 type N : 2 type MN (1)	genotypes : MN / MN gametes : M or N / M or N MM and NN and 2 × MN MM = blood group M and NN = blood group N and MN = blood group MN **DO NOT ACCEPT** blood group MM / NN **ACCEPT** in any order provided it is clear which phenotype each number relates to	**(4)**

Question number	Answer	Additional guidance	Mark
8(c)(i)	An explanation that includes three of the following points: • individual 3 will have both (M and N) proteins (on the surface the of the red blood cells) (1) • because individual 3 will {be heterozygous / have one allele for M and one allele for N / have the genotype MN} (1) • (both) genes will be transcribed / mRNA produced for (both) genes (1) • and translated (1)	**ACCEPT** one gene for M and one gene for N **ACCEPT** {alleles / DNA} will be transcribed	**(3)**

Question number	Answer	Mark
*8(c)(ii)	**Substitution mutation:** • substitution swaps one base for another • may not alter the amino acid coded for • as the genetic code is degenerate • triplet codon codes for the same amino acid • therefore, no effect on the protein • therefore, no effect on the phenotype • amino acid could be different • therefore, shape of protein may or may not be (significantly) different • depending on significance the phenotype may stay the same • depending on the significance the phenotype may become the same as one of the parents • a stop codon could be coded for • so the protein may be {shorter / not coded for} • so the phenotype may become the same as one of the parents **Insertion / deletion mutation:** • deletion removes one base • insertion adds in a base • causing a frameshift • this will probably have a huge effect on protein • phenotype may become one of parents • may have little effect on protein if near the end of the gene sequence • and therefore, have very little effect on phenotype	**(6)**

			Additional guidance
Level 0	0	No awardable content	
Level 1	1-2	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context.	Simple links made between mutation and effect on protein or phenotype 1 mark = one comment 2 marks = three comments
Level 2	3-4	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts / concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure.	Extended links made between mutation and effect on protein or effect on phenotype in the context of the question 3 marks = extended comments about one effect of one type of mutation 4 marks = extended comments about one effect of two types of mutations OR extended comments about two effects of one mutation
Level 3	5-6	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant biological facts / concepts. Consequences are discussed which supported throughout by sustained linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	Clear discussions on all aspects of mutations and effect on protein and effect on phenotype in the context of the question 5 marks = extended comments about one effect of one type of mutation 6 marks = extended comments about one effect of two types of mutations OR extended comments about two effects of one mutation

Question Number	Answer	Mark
4(a)(i)	**C -** formation of synaptic connections in the cortex The only correct answer is C *A is not correct because exposure to light does not stimulate division of optic nerve cells* *B is not correct because exposure to light does not stimulate formation of rhodopsin* *D is not correct because exposure to light does not stimulate growth of rod cells*	**(1)**

Question Number	Answer	Mark
4(a)(ii)	**D –** aspect K and aspect L The only correct answer is D *A is not correct because J would not be affected at 2 years* *B is not correct because J would not be affected at 2 years* *C is not correct because, aspect L and aspect M are also affected at two years*	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(a)	peptide ;	ACCEPT amide	(1)

Question Number	Answer	Additional Guidance	Mark
3(b)	1. both parents correctly drawn ; 2. all four offspring correctly drawn ;	IGNORE Punnet squares Marks are independent	(2)

Question Number	Answer	Additional Guidance	Mark
3(c)(i)	1. amniocentesis / chorionic villus sampling / CVS ; 2. correct location of sample obtained ; 3. correct timescale for procedure in weeks: 4. identify/test {the mutated / eq} {gene / allele / DNA / eq} ; OR culture the cells obtained :	Mp1 ACCEPT chronic A testing for sampling MP2 amniotic fluid, placenta Mp3 must be a stated week within the range or correct range (amniocentesis 14 to 20 or CVS 8 to 14)	(4)

Question Number	Answer	Additional Guidance	Mark
3(c)(ii)	1. idea that there may not be a family history of this condition ; 2. idea of {cost being high / lack of availability of testing} ; 3. risks to fetus ;	IGNORE refs to religion / ethics MP1 ACCEPT 'it is a rare condition' IGNORE ref to parents are carriers	(2)