Assessment Schedule – 2005

Biology: Describe gene expression (90715)

Evidence Statement

Q	Achievement	Achievement with Merit	Achievement with Excellence
1(a)	Describes the process of transcription. Eg: the gene / DNA unwinds, unzips and RNA polymerase joins complementary nucleotides / bases to the template strand of DNA to make mRNA.		
1(b)	Describes a feature of tRNA that is needed for it to produce the final gene product. Eg: • tRNA carries the amino acids to the ribosome • each tRNA carries only one (specific) amino acid • tRNA anticodons join to the messenger RNA at the ribosome.	Explanation shows why tRNA is needed for the formation of the final gene product. Eg: tRNA is needed to translate the message of the mRNA into a polypeptide. tRNA carries the appropriate amino acid up to the ribosome where the anticodon of the tRNA matches with the codon of the mRNA. Then the rRNA joins the amino acid onto the polypeptide chain by forming a peptide bond.	
1(c)	Description relating to the function of DNA polymerase and replication of DNA or of Okazaki fragments. Eg: • DNA polymerase joins new nucleotides to the unzipped DNA during replication. • It joins the new nucleotides from the 3' end to the 5' end only / in one direction only. • Okazaki fragments are short segments of newly replicated DNA (along the lagging strand).	Explanation of how DNA polymerase works so that Okazaki fragments are formed on one side. Can be in diagram form. Eg: DNA polymerase / The enzyme joins new nucleotides to the unzipped DNA during replication. It joins the new nucleotides from the 3' end to the 5' end only / in one direction only. Because DNA polymerase only works from the 3' end to the 5' end it has to form the DNA in short segments on the lagging strand.	
1(d)	Describes a feature of the genetic code or its redundancy that relates to more than one sequence of DNA forming the same protein. Eg: The genetic code has a sequence of three bases coding for one amino acid. • Each amino acid may have more than one triplet coding for it. • The same sequence of amino acids may have different sequences of codes on the DNA.	Explanation includes links between the amino acids and the number of triplets coding for them. Eg: Because there are 20 amino acids and only four bases, each amino acid may have more than one triplet / codon coding for it, so different sequences could code for the same protein.	Discussion links the 61 (codon / triplet) combinations / degeneracy of the code to codes for amino acids. It includes the definite sequence of codons when mRNA is used, **compared** with the multiple different codons that may be sequenced when proteins are used, as each amino acid may have more than one triplet coding for it. So when protein is used to sequence the DNA coding for the amino acids, there may be more than one sequence on the cDNA that would give the same protein outcome.
Q	**Achievement**	**Achievement with Merit**	**Achievement with Excellence**

2(a)	Amino acid sequence given as: Arg, val, tyr, thr. (If puts 'stop' at end OK.)		
2(b)	Describes the nucleotides that make up codons as being composed of ribose sugar, a phosphate and one of the nitrogenous bases C / cytosine, G / guanine, A / adenine or U / uracil**. Description must be clearly of RNA nucleotide.** Eg: • Nucleotides are made up of a sugar, a phosphate and a base (A, C, G, or U) • Nucleotides are made up of ribose sugar, a phosphate and a base. **NS if mentions deoxyribose sugar or Thymine/T**		
2(c)	Describes one of a deletion **OR** substitution point mutation. Eg: • A substitution point mutation is one where one of the bases / nucleotides on DNA is replaced by another in a gene. • A deletion point mutation is one where one of the nucleotides on DNA is lost from a gene.	Explains the effect of a deletion **OR** a substitution point mutation on DNA. Eg: • A substitution point mutation is one where one of the bases / nucleotides on DNA is replaced by another in a gene. This may affect one of the amino acids in the gene sequence the gene codes for, but will not alter the rest of the amino acids or the length of the gene. • A deletion point mutation is one where one of the nucleotides on DNA is lost from a gene. This means that there is a frame shift for the rest of the nucleotides in the gene, meaning that the amino acids coded from there on are different and so the protein is different.	Discusses the consequences of **BOTH** substitution and deletion point mutation at the point X marked on the sequence concerned. Eg: A substitution point mutation is one where one of the bases / nucleotides on DNA is replaced by another in a gene. This may affect one of the amino acids in the gene sequence that the gene codes for, but will not alter the other amino acids or the length of the gene. Eg in this case a substitution will not alter the amino acid as it is the last base of a triplet that is being changed and, for this triplet which codes for the amino acid arg(inine), it does not make a difference to the amino acid formed. Whereas a deletion point mutation is one where one of the nucleotides on DNA is lost from a gene. This means that there is a frame shift for the rest of the nucleotides in the gene, meaning that the amino acids coded from there on are different and so the protein is different. In this case it would cause the sequence to now read GCC, CCA, TAT, GGA, TC. This would now read off as arg, cys, asn, pro then either ser or arg, again depending what the next nucleotide is. The protein would no longer be terminated and the sequence changes from the mutation point on as well. This would probably render the protein dysfunctional, whereas the slight change in the substitution may not.

Q	Achievement	Achievement with Merit	Achievement with Excellence
3(a)	Description of polygene inheritance **OR** describes that the 10 genes are not an example of polygene inheritance. Eg: • Polygene inheritance occurs when a single phenotype is determined / controlled by more than one gene. • In this case the 10 genes code for different characteristics such as coat colour and stripes.	Description of polygene inheritance **AND** explains why the 10 genes are not an example of polygene inheritance. Eg: • Polygene inheritance occurs when a single phenotype is determined / controlled by more than one gene. Here each gene has its own phenotype and does not contribute to a gradation in one phenotype.	
3(b)	Describes an aspect of epistasis. Eg: • This pathway shows epistasis because the presence of genes at one locus affects the expression of genes at a different locus (resulting in one phenotype). • A homozygous recessive genotype will alter the outcome of the pathway so that the cat's coat is not orange.	Explains how epistasis relates to the metabolic pathway shown. Eg: • Epistasis occurs when genes at different loci interact to produce one phenotype. It usually involves a metabolic pathway where one gene precedes the other so that the gene product from one gene affects the function of the second gene. So in the pathway shown, a homozygous recessive genotype/cc/absence of allele C will not produce the intermediate for genes B and then O to act on. • A homozygous recessive genotype/bb/absence of allele B would not produce eumelanin for the gene O to act on and produce phaeomelanin.	Discusses how epistasis relates to the metabolic pathway shown by expanding the consequences to the one phenotype expressed of homozygous recessive alleles even when the other sites have the expression of dominant alleles. Eg: As for Merit, and states that if only two dominant alleles are expressed in the pathway, the presence of the 3rd gene in homozygous recessive form will affect the phenotypic outcome and the cat will not be orange / have phaeomelanin.
3(c)	Describes incomplete dominance. Eg: Incomplete dominance occurs when one allele does not completely dominate another allele in the heterozygous condition, and the phenotype of the heterozygote (of Burmese and Siamese) is intermediate / blend to both types of cat.		
3(d)	Describes how alleles are involved. Eg: • They are multiple alleles, any one cat can only have two. • C allows intermediate substance to be formed. • Dominant allele(s) allow the metabolic pathway to proceed / pigment to form.	Explains relationship between alleles **and** different **enzymes**. Eg: This gene has multiple alleles, each with their own enzyme product. The intermediate substance is only produced if the C allele for tyrosinase is present. Combinations of any of the other alleles will produce different enzyme products and outcomes.	

<table>
<tr><th>Q</th><th>Achievement</th><th>Achievement with Merit</th><th>Achievement with Excellence</th></tr>
<tr><td>3(e)
(i)</td><td>Description that relates to sex determination in cats.
Eg:
• Male cats have only one X chromosome and females have two.
• Males are XY, females XX.
• Males have only one allele for the O genes, females have two.
• The orange gene is sex linked.</td><td>Explains sex linkage with reference to cat coat colour.
Eg:
The orange gene is sex linked. This means it is carried on the X chromosome. Males have only one X chromosome so show whatever colour the gene on their X chromosome, allows. Whereas females have two X chromosomes, so may show both orange and black together if they have both alleles.</td><td></td></tr>
<tr><td>3(e)
(ii)</td><td>Describes a feature that may result in a sterile male tortoiseshell cat.
Eg:
• Sex chromosomes fail to separate properly during meiosis / gamete formation.
• Males could have somehow inherited three sex chromosomes. Two X’s and a Y.
• Organisms with three of any chromosome / sex chromosomes are sterile.

Neg if polyploidy mentioned.</td><td>Explains how a male tortoiseshell cat could occur OR why animals with a trisomy are sterile.
Eg:
• If the sex chromosomes fail to separate properly during meiosis / gamete formation a male could have inherited three sex chromosomes. Then he could have genes for both orange colour to form on one X chromosome and black on the other, as well as the Y which makes him male.
• If an organism has three of any chromosome, they are usually sterile as the chromosomes cannot pair up and separate properly during gamete formation / meiosis. So if the cats have three sex chromosomes they cannot form gametes and are sterile.

Neg if polyploidy mentioned.</td><td>Discusses how non-disjunction of the sex chromosomes could lead to a male tortoiseshell cat, AND discusses why such cats would be sterile.
Eg:
If the sex chromosomes fail to separate properly during meiosis / gamete formation a male could have inherited three sex chromosomes. Then he could have genes for both orange colour to form on one X chromosome, and the other black, as well as the Y which makes him male. In this case it is likely to have occurred in the female as shown in the Punnett square:
<table><tr><td></td><td>XO Xo</td><td>-</td></tr><tr><td>Xo</td><td>XO Xo
Xo</td><td>Xo-</td></tr><tr><td>Y</td><td>XO Xo
Y</td><td>Y-</td></tr></table>
This would be the tortoiseshell male. If an organism has three of any chromosome they are usually sterile as the chromosomes cannot pair up and separate properly during gamete formation / meiosis. So if the cats have three sex chromosomes they cannot form gametes and are sterile.
Neg if polyploidy mentioned.</td></tr>
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Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
Total of SEVEN opportunities answered at Achievement level (or higher). *or* SIX opportunities answered, with at least FOUR at Merit level or higher. $7 \times A$ *or* $2 \times A + 4 \times M / E$	Total of NINE opportunities answered, with at least FIVE at Merit level or higher. $5 \times M + 4 \times A$	Total of ELEVEN opportunities answered. At least TWO at Excellence level *and* THREE at Merit level. $2 \times E + 3 \times M + 6 \times A$