Assessment Schedule – 2005

Biology: Describe applications of biotechnological techniques (90718)

Evidence Statement

Q	Achievement	Achievement with Merit	Achievement with Excellence
1(a)	Describes the purpose of DNA profiling Eg: The purpose of DNA profiling is to create patterns (bands) which allow comparison of the genetic material of two or more samples of DNA (to determine whether they are related).		
1(b)	Describes that DNA samples can be profiled and compared to establish patterns that show relationships. Eg: Matching patterns in the DNA profile will be present between father and son / to identify the parents.	Explains how banding pattern in DNA profile can be compared to establish patterns that show relationships. Identifies that matching patterns in the DNA will be present between father and son **AND** links this to the concept that the child will have received half of their DNA from the father and this is the reason why there will be matching profile patterns between father and son, which identify this relationship. Eg: Gel electrophoresis separates out the bits of DNA so that they show bands to compare, to identify the parents. Because the child has received half of their DNA from each parent, some of the bands will be from the mother and these can be deleted from the comparison when her DNA bands are compared. The remaining bands must be from the father and if they match up the father can be confirmed. If not he can be eliminated as the father / OR if the mother's DNA is unavailable, a significant number of matches compared to the number of matches that you would find in a random sample would indicate paternity.	

Note:
- do not accept comparison of sequence of genes
- do not accept gene map
- do accept comparison of base sequence
- do accept looking for the presence of a faulty gene.

Q	Achievement	Achievement with Merit	Achievement with Excellence
1(c)	Describes one feature of the use of DNA profiling in crime solving, relevant to why purity of source is critical. Eg: • Contamination will show up in / change the profile. • Useful DNA samples at crime scenes are often small e.g. semen samples, blood spots, DNA from hair / under fingernails of victim. • Samples increased in amount by PCR. • Electrophoresis of DNA fragments from victim and suspects and samples compared. • DNA profile from victim and suspects and crime scene samples compared. • DNA from a sample could be contaminated in the process of collection or amplification. • Contaminants will be PCR'd / profiled and show up as bands as well.	Explains one feature of the use of DNA profiling in crime solving relevant to why purity of source is critical. States one relevant point related to the reason why purity is critical and explains why this is critical to solving the crime. Eg: • Sample from victim, sample from blood stains / semen / hair follicle / skin under fingernails etc at crime scene and sample from suspects are compared to see if there is correlation between the bands to show a relationship. DNA is specific to the person it comes from. If there is contamination of the sample, accurate comparisons will not be possible. • Small samples will need to be PCR'ed and if contaminated, the contaminant DNA will also be amplified / and electrophoresis will be run, and confuse the comparison with the suspect's DNA.	Discusses why purity of sources for DNA profiling is critical, linking **how DNA profiling is used** in crime solving to **why the source of DNA must be pure** so that the process is effective. Eg: Because the sample from the crime scene (blood stains / semen / hair follicle / skin under fingernails etc) is small, amplification (via PCR) will be required to ensure that there is adequate DNA to perform DNA profiling. Samples from the victim and suspects are also taken and amplified, separated by gel electrophoresis so that the profiles of evidence, victim and suspect can be compared. This is to see if there is correlation between the bands to show a relationship as DNA is specific to the person it comes from. Matches will help to eliminate innocent and identify guilty people. If the crime scene sample is pure, the DNA profile from the crime scene will show bands that match the suspect and the victim, proving that the sample from the crime scene belongs to the suspect. If there is not a match with the suspect, they will be eliminated. The researchers need to ensure that no foreign DNA, like cells from their mouth during speaking, or from their hair as they work, gets into the sample as it will also be amplified resulting in a banding pattern that will be a mixture of DNA from the suspect and other known or unknown contaminant sources and will therefore not be a perfect match. In terms of solving the crime this will bring the validity of the sample into question.

Q	Achievement	Achievement with Merit	Achievement with Excellence
2(a)	Sequence of biotechnological processes given as: • obtain gene and isolate (using restriction enzyme) • find suitable vector (virus / liposome / plasmid) and cut its DNA using (same) restriction enzyme • ligase to join wanted gene to vector. All three points in the process identified in the correct order.		
2(b)	Describes an advantage of using the synthetic gene Eg: • could just inject it anywhere • won't affect cells that are not muscles • no undesired side effects in other tissues • improved delivery of the protein / increased expression • may produce more stable mRNA • synthetic gene may have a modified promoter.	Explains an advantage of **using the synthetic gene.** Eg: • Vector could be injected (into bloodstream) without needing to target muscles as the gene will only respond when in a muscle cell / reduced risk of affecting germ cells / all muscles targeted. • Introns removed, enabling the gene to fit into a smaller vector for delivery • More stable mRNA may lead to improved delivery of the protein • Synthetic gene may have a modified promoter which will lead to an improved rate of protein production in the tissue.	
3(a)	Improve health as a result of research / availability of omega-3 / consumption (GM chickens) implied: To reduce heart disease / reduce cancer / reduce amount of omega-6 fatty acids in diet / to increase the availability of foods containing omega-3 fatty acids / provide a cheaper source of omega 3 fatty acids / provide a commercially sustainable source of omega 3 fatty acids. States one correct idea.		
3(b)	Insert gene into egg cell / sperm producing cell (spermatocyte) / gamete / (pro-nucleus) of zygote / germ cell. One correct answer given.		

Q	Achievement	Achievement with Merit	Achievement with Excellence
3(c)	Describes an advantage **OR** a disadvantage of using a virus for gene insertion. Eg: Advantage • Uses vector that has ability to put genetic material / DNA into host cell / integrate into host chromosomes (if retrovirus). • Low cost to mass produce a therapeutic product. • Can use a virus that targets specific tissues. Disadvantage • Can't carry much DNA • May damage / harm the cell • May reject the virus.	Give a reason for ONE advantage **AND** ONE disadvantage of using a virus for gene insertion. Eg: Advantage: • Uses vector that has ability to insert genetic material / DNA to host cell without any assistance like electric shock or chemicals. • Viruses infect and reproduce inside the target cell. In so doing they are also reproducing and therefore spreading the introduced gene. • If a retrovirus - vector has the ability to integrate into the host DNA (chromosomes) and therefore, there is the potential for permanent expression (do not need to re-treat). Disadvantage: • Small size. Only small amounts of DNA can be carried, so if cascade of genes required there may not be enough space. • Infective material from the virus that has had pathenogenicity removed, may be regained and thus host animal could be harmed. • Host immune system could reject virus before fat-1 incorporated. • Virus may harm the host because it could regain some pathenogenicity / not all pathogenic material removed when it should have been in development of the vector / may have unknown / unpredicted side effects.	Considers advantages AND disadvantages (minimum THREE in total – all three explained) of using a virus for gene insertion. **OR** – Considers <u>an</u> advantage and disadvantage and EVALUATES. Eg: A virus is a useful vector as it is capable of reproducing once inside the host cell, and in doing this it reproduces multiple copies of the DNA containing the introduced gene which can then infect further cells. This means that a small, effective initial infection can result in a large delivery of the genes to the organism. However, a virus is only capable of carrying small amounts of DNA. If a cascade of genes is required to produce the desired protein, the virus may not be able to carry the genetic information required, making it an inappropriate vector. Another issue of concern with the use of the virus as a vector is that the host immune system may attack / reject the virus. This would mean that a new form of the vector would need to be developed. When making a choice about the type of vector that is to be used for insertion of the gene into the chickens, the scientists would need to consider the size of the gene and evaluate whether the virus was in fact an appropriate vector and consider the likelihood of rejection by the host immune system.

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
Total of FIVE opportunities answered at Achievement level or higher. 5 × A	Total of FIVE opportunities answered with TWO at Merit level or higher. 2 × M + 3 × A	Total of FIVE opportunities answered with at least ONE at Excellence level *and* TWO at Merit level. 1 × E + 2 × M + 2 × A