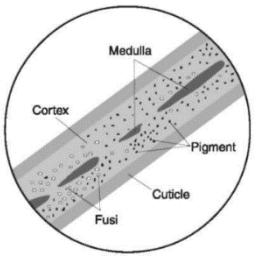
Year 10 Forensic Science
Biology Practise Test
Short Answer (25 marks)

Draw a typical human hair and label the three major parts. (1 ½)



cuticle (½)
cortex (½)
medulla (½)
(central core and pigment optional)

← Available at : http://what-when-how.com/forensic-sciences/comparison-microscopic/

How can fibre be used as legal evidence? (1)
Fibres provide evidence of association as the fibres present on the clothing of a particular person known to be at the scene of crime can be traced back to them.

What are the steps of a Polymerase Chain Reaction? Describe. (3)
Denaturing (95 degrees) → the high temperature allows the DNA to uncoil and the template strand then separates into two single-stranded sections (ingredients: hot water & template DNA)
Annealing (55 degrees) → PCR primers join onto the template strands of DNA as they are able to bind at this temperature. This prepares for the next step in the PCR.
Elongating (72 degrees) → free-floating nucleotides are added to the PCR buffer and the increased temperature allows the reaction to occur faster than before. TAQ polymerase is a protein complex able to attach to DNA and add nucleotides to it by annealing to a primer and it elongates the original strand in this way.

What is the importance of the changes in temperature during the reaction? (1)
Denaturing must occur at a high temperature to ensure that DNA is broken down sufficiently through a process similar to melting. Then, the temperature is lowered for annealing to ensure that only the PCR primers can bind to the template DNA and nothing else. Increasing the reaction later on means that it can occur at a faster rate as molecules in the solution will move around faster, therefore binding to the DNA quicker too.

What is TAQ Polymerase and what is its purpose? (2)
Thermus AQuaticus Polymerase is very similar to DNA Polymerase in that it synthesises DNA for replication. The main difference is that TAQ can withstand much higher temperatures without denaturing and therefore can be used to artificially elongate DNA very accurately.

What is the difference between Taq Polymerase and DNA Polymerase?

Taq Polymerase vs DNA Polymerase	
Taq DNA polymerase is an enzyme which creates DNA. It is a thermostable enzyme found in thermophiles	DNA polymerase is an enzyme which facilitates the DNA replication and found in both prokaryotic and eukaryotic organisms.
Degradation at High Temperatures	
Taq polymerase is active at high temperatures.	DNA polymerases degrade at protein denaturing high temperatures.
Use	
This is widely used in PCR	Taq polymerase replaced theDNA polymerase from *coli* originally used in PCR.

Available at: https://www.differencebetween.com/difference-between-taq-polymerase-and-vs-dna-polymerase/

Which is more effective (in your opinion); blood evidence or DNA profiling? Why? (2)

if BLOOD EVIDENCE = (example) Blood is often much easier to identify than DNA as it requires less advanced technology. It is simple to identify blood groups and therefore suspects can be eliminated quickly.

if DNA PROFILING = (example) DNA profiling is much more accurate in identifying suspects as each individual's DNA is different. Although it requires much more expensive, advanced technology, it can provide a wide range of results to be used in different situations (i.e. family linkage, nature of crime (if hair was shed or forcibly removed, if saliva was involved, etc.).

In DNA extraction, the three main steps are called Lysis, Precipitation and Purification. What is used in each step? (3)

LYSIS – detergent is added to the solution to aid in the disruption of the cellular and nuclear membranes. Mechanical disruption (often with a rod) is also undertaken.

PRECIPITATION – DNA is insoluble in alcohol (isopropanol) so when they are mixed a precipitate forms, with DNA at the top of the glass due to its density.

PURIFICATION – a different type of alcohol (ethanol) is used to remove cellular debris, effectively rinsing the DNA.

What is the purpose of alcohol in the reaction? (2)

Isopropanol creates a precipitation reaction with the DNA, allowing scientists to remove it. On the other hand, ethanol rinses the DNA in order to remove other cell organelles.

What are STRs and how are they useful in DNA profiling? (2)

Short Tandem Repeats are specific nucleotide sequences in non-coding DNA that occur in different quantities in people depending on their parents. By using gel electrophoresis and restriction enzymes, these STRs can be cut and compared between people using their molecular weight (number of nucleotides).

Identify the three main types of fingerprints. (1½)

Arch
Loop
Whorl

Describe how to distinguish <u>one of those</u> in detail. (2)

if ARCH:

- ridges enter and exit on opposite sides
- plain or tented (spike @ centre)
- no deltas

if LOOP:

- ridges enter and exit on the same side
- RADIAL (opens to thumb) & ULNAR (opens to pinkie)
- one delta

if WHORL:

- at least one ridge that typically forms a complete circuit
- at least two deltas but if more than 2, most likely an accidental
- plain/central pocket/double loop/accidental

What is gel electrophoresis and when is it used? (2)

Gel electrophoresis is a procedure that compares DNA fragment sizes to be used in DNA profiling. It uses restriction enzymes to separate Short Tandem Repeats from non-coding DNA sections. Using gel, fluorescent dye and an electric current, this process makes the most of DNA's negative charge by forcing it to travel through a buffer. The shorter fragments travel the most distance as they can be pushed further by the same electrical force. By analysing the fragments as compared to a molecular weight (MW), their lengths can be

found. Gel electrophoresis is used when analysing DNA and requires a PCR beforehand (to amplify DNA) and restriction enzymes.

How do restriction enzymes work? (2)

Restriction enzymes can only chemically bind to very specific nucleotide sequences but when they do, they wrap around the DNA, causing it to break. They can produce blunt (straight) or sticky (staggered) cuts but they only read nucleotides from the 5' end.