Oxford Cambridge and RSA

GCSE Biology A (Gateway)

J247/03 B1-B3 and B7 Higher (Higher Tier)

Question Set 20

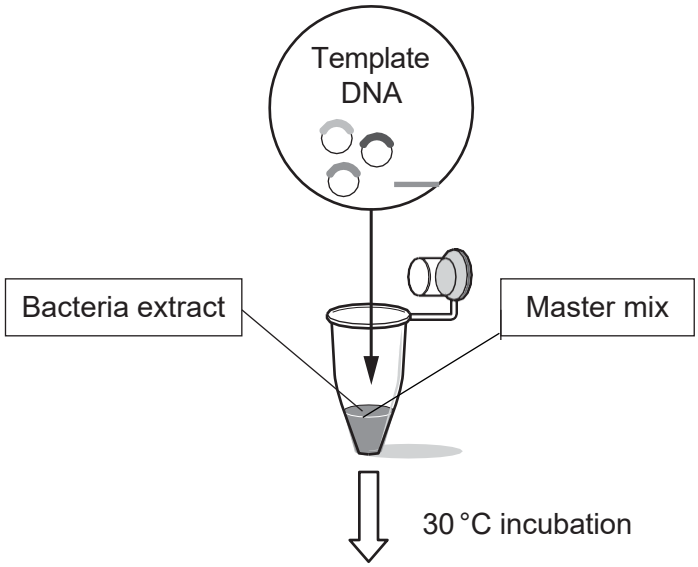
1 (a) Scientists can make the proteins they need outside of living cells (*in vitro*).

To do this they use cell free protein synthesis kits.

The kit includes three different parts:

- A template DNA molecule
- An extract from bacteria containing mRNA and tRNA nucleotides
- A master mix containing amino acids, energy sources, enzymes and ribosomes.

To make a protein the three different parts are mixed together and incubated for 3 hours at 30 °C.



(i) Describe the role of the DNA template and mRNA nucleotides in the production of the protein.

DNA is the primary genetic material, containing the gene that codes for the protein. It serves as a template for the production of mRNA. The mRNA nucleotides pair up with their complementary bases on the DNA template and join up to produce a single strand of mRNA. **[2]**

(ii) Describe the role of the tRNA nucleotides and ribosomes in the production of the protein.

The tRNA nucleotides form the anticodon of a tRNA molecule which is complementary to one or more triplets in the mRNA molecule tRNA serves as a carrier molecule, transferring specific amino acids to the ribosomes in the correct order, the order of mRNA triplets. The ribosomes join the amino acids together, forming the protein encoded for by the gene, by joining them with peptide bonds. **[2]**

(b) Thirty years ago, identifying a person from their DNA required a large sample of DNA.Polymerase chain reaction (PCR) is a technique developed in 1983.

PCR allows a single copy or segments of DNA to quickly make multiple copies of a DNA sequence.

(i) Many crimes committed over 30 years ago can now be solved using PCR.

Explain why.

Small samples of DNA stored from crimes 30 years ago, the quantity of which would previously have been insufficient to analyse, can now be amplified. This enables the production of millions of copies of target DNA segments which can be used for a variety of different analyses. Comparisons of DNA isolated from crime scenes with that of possible suspects can help to solve cases **[2]**

(ii) Which part of the cell cycle takes place in PCR?

Synthesis, or S, stage

[1]

(c) **(i)** DNA databases involve storing a person's individual DNA profile. The DNA profile identifies DNA sequences present in an individual.

DNA databases are used by many different organisations.

Solving crimes is one use of a DNA database.

Suggest **other** reasons why organisations might need a DNA database.

Medical DNA databases may be used to help estimate the prevalence of different genes in populations. They can be used in the analysis of genetic diseases as well as the identification of disease-causing alleles and other risk factors. Some organisations also use DNA databases for genealogical purposes e.g. determining maternal or paternal lineages. **[2]**

(ii) Write down **one** reason why people might **not** want to be included on a DNA database.

Risk of DNA profile theft.

[1]

Total Marks for Question Set 20: 10