

1.

The table below shows details of the Sanger technique of gene sequencing.
(9 marks)

1.	Label 4 test tubes labelled A, T, C and G. Into each test tube add: a sample of the DNA to be sequenced (containing millions of individual molecules), the 4 DNA nucleotides and the enzyme DNA polymerase.	
2.	In each test tube add a small amount of a special modified nucleotide * that cannot form a bond and so stops further synthesis of DNA. Tube A = A*, tube T = T*, tube C = C* and tube G = G*. The * nucleotides are present at about 1% of the concentration of the normal nucleotides.	
3.	Let the DNA polymerase synthesise many copies of the DNA sample. From time to time at random a * nucleotide will be added to the growing chain and synthesis of that chain will then stop. A range of DNA molecules will be synthesised ranging from full length to very short. The important point is that in tube A, all the fragments will stop at an A nucleotide. In tube T, all the fragments will stop at a T nucleotide, and so on.	
4.	The contents of the four tubes are now run side by side on an electrophoresis gel.	

- (i) Give the sequence of the bases in the DNA used in this example by interpreting the developed gel shown in stage 4.
(1 mark)

3. Techniques in biotechnology use DNA material to analyse sequences which can be used to modify life. Scientists use repeating patterns to identify traits for particular proteins, genetic disorders and show evolutionary relatedness of different species.
(14 marks)

a) Describe a gene (1 mark)

b) ¹⁴ The process of DNA electrophoresis, a particular enzyme is used. Name the enzyme and state its function (2 marks)

i. Enzyme:

Function:

c) Summarise the difference between DNA sequencing and DNA profiling (2 marks)

1. a i

TATGACCG

TATGACCG

ii

AUACUGGC

AUACUGGC

b

- The section of DNA you want to sequence is isolated
 - 4 test tubes are prepared containing one of tagged A, tagged G, tagged C, tagged T
 - PCR is performed on these tubes
 - A gel is prepared and A loaded in one well, C loaded on another, G in another, T in another
 - Electricity is applied, DNA moves to the positive end
 - Fragments are separated according to size/smallest travel the farthest
 - Sequence is read from the smallest fragment to the largest to give the sequence
- Any 5

c

- Show evolutionary relationships
 - Identify disease genes/ function of genes
 - Personalise drug treatments
- Any two (or another that is reasonable and linked to the syllabus)

2a

BCE BEP

b

They all were

c

- They share many of the same bands (all have 6 or 7 of the 10 bands)
 - All share 1, 4 and 9
- * & says with a known family history?

d

- Could start monitoring breast health early to identify any change
- Could undergo preventative mastectomy
- Could change lifestyle to limit mutagens

3a

- A piece of DNA that codes for a protein/trait

b