

Model Answers: Easy

1a

(a) The term recombinant DNA can be defined as follows...

- (DNA that) contains bases/nucleotides/genes from different species / different sources; [1 mark]

[Total: 1 mark]

1b

(b) (i) The names of the enzymes that cut DNA at specific base sequences are...

- Restriction endonuclease(s)/enzyme(s); [1 mark]

(b) (ii) Enzymes that are used to make a single-stranded DNA copy of a piece of mRNA are...

- Reverse transcriptase(s); [1 mark]

(b) (iii) Enzymes that pieces of DNA together are...

- (DNA) ligase(s); [1 mark]

[Total: 3 marks]

1c

(c) An example, other than the desired gene, of a section of DNA that might be found in a plasmid during genetic engineering is...

- Promoter (region); [1 mark]
- Allows RNA polymerase to bind / transcription/expression (of the desired gene) to occur; [1 mark]

OR

- Marker gene / gene for antibiotic resistance / gene for fluorescence/GFP; [1 mark]
- Allows identification of transformed cells / cells that contain the recombinant plasmid/DNA; [1 mark]

[Total: 2 marks]

1d

(d) The name of the component that is used to transfer DNA into the cells of organisms is...

- Vector; [1 mark]

[Total: 1 mark]

Plasmids are just one example of a **vector**; other examples include viruses and liposomes.

2a

(a) The purpose of PCR is to...

- Amplify / produce many (identical) copies of a DNA sequence/strand; [1 mark]

[Total: 1 mark]

2b

(b) (i) The purpose of primers is to...

- Bind to the start of the desired gene / produce a double stranded section of DNA **SO** that the polymerase enzyme can attach/bind/begin copying; [1 mark]

(b) (ii) The purpose of a buffer solution is to...

- Control the pH **SO** that the DNA/enzymes do not denature; [1 mark]

(b) (iii) The purpose of free DNA nucleotides is to...

- Provide a source/supply of nucleotides **SO** that new DNA strands can be built / assembled / made / synthesised; [1 mark]

[Total: 3 marks]

The question here has asked you to state **and** explain the purpose of each component added to the PCR machine, so be sure that you do this.

2c

(c) At point X in Fig. 1...

- The DNA strand is denaturing / the two strands of the DNA molecule are separating/breaking apart; [1 mark]

This is occurring because...

- High temperatures/95 °C temperatures cause the hydrogen bonds (between the strands) to break; [1 mark]

[Total: 2 marks]

The breaking apart of the double helix at this stage in the PCR cycle exposes the bases, enabling each single strand to act as a template for the synthesis of new strands.

2d

(d) Taq polymerase is the enzyme used in the elongation stage of the PCR cycle rather than human DNA polymerase because...

Any **one** of the following:

- Taq polymerase does not denature at high temperatures (the thermocycler reaches temperatures of up to 95 °C); [1 mark]
- Taq polymerase has an optimum temperature of 72 °C (and high temperatures are required to break apart the DNA double strands); [1 mark]

[Total: 1 mark]

Human DNA polymerase would denature at the temperatures required to break apart the double helix in the PCR machine. In addition to this, at the optimum temperature of human DNA polymerase the DNA single strands would anneal back together again, preventing the synthesis of new DNA copies.

3a

(a) VNTRs are useful for carrying out genetic fingerprints like that shown in Fig. 1 because...

- The length of VNTRs varies between people / the chances of two people having the same lengths of VNTR are very small / only identical twins will have the same length VNTRs; [1 mark]

[Total: 1 mark]

The coding DNA of every human is almost identical, so coding DNA is not very useful for distinguishing between individuals, but VNTRs vary in number from one individual to another, so when analysing several VNTRs at the same time the chances of all of them being the same length are virtually zero (unless two people are identical twins).

3b

(b) DNA fragments travel through the gel because...

- The DNA fragments move/travel towards the positive electrode **OR** the DNA fragments are negatively charged so are attracted to the positive electrode; [1 mark]

DNA fragments appear as bands at different positions because...

- Smaller/lighter DNA fragments travel more quickly / larger/heavier DNA fragments travel more slowly; [1 mark]

[Total: 2 marks]

3c

(c) The suspect likely to have been present at the crime scene is...

- (Suspect) 2; [1 mark]

This is because...

- The DNA bands for suspect 2 are at the same positions as the bands from the crime scene sample / suspect 2 has the same length VNTRs/DNA fragments as the crime scene sample; [1 mark]

[Total: 2 marks]

3d

(d) Other applications of genetic profiling techniques are...

Any **two** of the following:

- Identifying individuals at risk of genetic disease / diagnosing genetic disease (when a specific mutation sequence isn't known, or when several genetic variants could be involved); [1 mark]
- Determining family relationships (e.g. paternity testing) / ancestry testing; [1 mark]
- Determining relatedness of animals/plants in captive breeding programmes (breeding closely related organisms together can cause inbreeding depression); [1 mark]
- Determining genetic variation in a population (for conservation purposes); [1 mark]

[Total: 2 marks]