Do not write outside the box

1 Genomics is concerned with the biological molecule DNA.

(a) Describe the structure of DNA.

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.....**[4]**

(b) Genomics refers to the study of genomes.

The Human Genome Project (HGP) was an international scientific research project to determine the sequence of chemical base pairs that comprise DNA.

The general procedure used in the HGP is outlined below.

- Genomes were mapped to identify where in the genome they come from.
- The shotgun approach was then used.
- BACs were used to produce clone libraries.
- The BACs were then sequenced.

(i) Describe what is meant by the 'shotgun approach' and state its significance.

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.....**[2]**

(ii) Outline the role of BACs in the process of sequencing a genome.

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.....**[3]**

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(iii) Outline how the BACs are sequenced to determine the sequence of chemical bases that comprise DNA.

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.....**[3]**

(c) The HGP involves scientists working together internationally.

Suggest the benefits of working together in a scientific community.

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.....**[3]**

(d) Suggest reasons why scientists wanted to conduct the HGP.

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.....**[5]**

[Total: 20]

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2 **Figure 2.1** shows an experimental set up for electrophoresis.

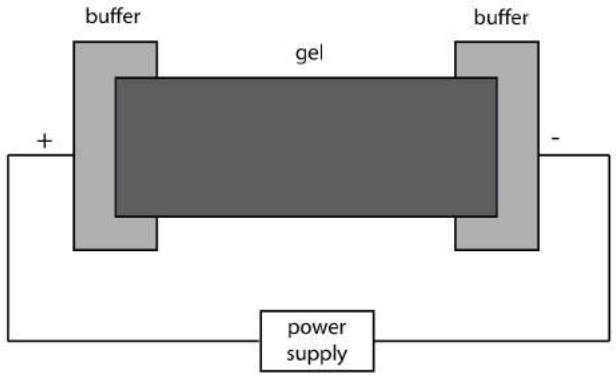

Figure 2.1

(a) (i) Add an arrow to **Figure 2.1** to show the direction the DNA fragments will move. **[1]**

(ii) Give a **biochemical** reason for this.

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.....**[1]**

(b) Given a DNA sample, describe how the DNA sample can be separated into fragments by size using electrophoresis.

In your answer, the quality of your written communication will be assessed and you should make clear the order of stages involved in the procedure.

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[Total: 10]

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3 An anti-cancer drug company wants to test the impact of their drug.

The drug is designed to work by changing the shape of specific proteins.

They do this using a procedure based on electrophoresis and it is outlined below.

- They grow the cancerous cell in question in-vitro.
- They split the grown cells into two groups, **A** and **B**.
- **A** is a control group and cells in group **B** were treated with the drug.
- The cells in both groups are then centrifuged and an extract of the solution is taken and pipetted into wells cut at one end of the gel.
- Electrophoresis then occurs.

(a) Explain the significance of group **A** for the drug company.

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.....**[2]**

(b) When the DNA fragments separate out, they will need to be visible.

Describe how the fragments can be made visible.

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.....**[1]**

(c) **Figure 3.1** shows the separated DNA fragments for both groups.

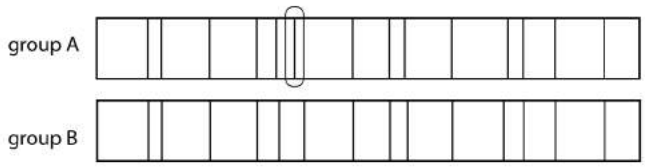

Figure 3.1

The protein that the drug company is interested in has been circled in group **A**.

Explain whether or not the drug is effective in achieving its purpose.

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.....**[3]**

(d) The company were able to identify the position of their protein in group **A**.

Suggest how.

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.....**[3]**

[Total: 9]

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4 In a crime scene, DNA samples are taken from the suspected murder weapon.

Forensic scientists then create multiple copies of this DNA sample.

(a) State the term given to multiplying the quantity of a DNA sample.

.....**[1]**

(b) The polymerase chain reaction (PCR) is used to do this.

PCR is similar to natural DNA replication.

Outline the similarities and differences between the polymerase chain reaction and natural DNA replication.

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.....**[6]**

(c) The scientists require 1000 copies of this DNA sample in order to have sufficient material for genetic profiling.

Calculate the minimum number of cycles of **one** polymerase chain reaction to produce 1000 copies of a DNA sample from a single starting copy.

.....turns

[1]

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(d) Once the forensic scientists generate sufficient material for genetic profiling, they used gel electrophoresis on the DNA sample from the murder weapon and the DNA samples obtained from the murder suspects.

Figure 4.1 shows the obtained results.

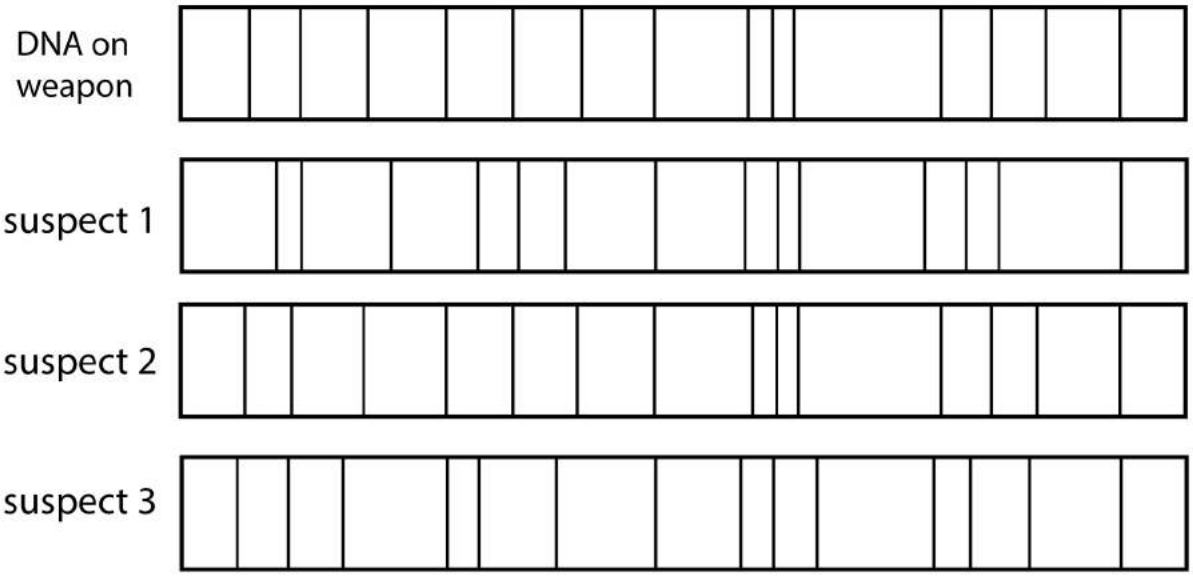

Figure 4.1

Giving reasons, explain which suspect is most likely to have killed the victim.

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.....**[3]**

(e) All of the suspects have some bandings that are in exactly the same position.

Suggest why.

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[Total: 14]

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5 Bacterial artificial chromosomes (BACs) in genome sequencing can be sequenced using an automated process.

(a) Outline the process of automated genome sequencing.

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(b) Before the use of automated processes, sequencing was done using radioactive markers. Suggest how the introduction of automated processes has benefited the scientific community.

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[Total: 8]

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