

Exercise walk-through

Biotechnology ■ 6.8

eXercise

You must be able to

- describe **PCR** 聚合酶链式反应, **gel electrophoresis** 凝胶电泳, and **genetic engineering** 基因工程
- state what each technique is used for
- interpret a simple gel result

Method — PCR

PCR (polymerase chain reaction) makes **many copies** of a DNA segment. Cycles of heating and cooling with a polymerase double the DNA each cycle — useful when only a tiny sample exists.

Method — Gel electrophoresis

Gel electrophoresis separates DNA fragments by **size**. An electric field pulls the negatively charged DNA through a gel; **smaller** fragments move **farther**. It produces a pattern of bands.

Method — Reading a gel

Bands nearer the far end are smaller fragments; matching band patterns between samples suggest a match (used in DNA fingerprinting/forensics).

Method — Genetic engineering

Genetic engineering inserts a gene from one organism into another (using a vector like a plasmid), e.g. putting the human insulin gene into bacteria so they make insulin.

Practice 2.1 ■ 1 mark

What does PCR do?

Solution 2.1

Worked steps

Makes many copies of a DNA segment **B1**.

Practice 2.2 ■ 1 mark

What property separates DNA in gel electrophoresis?

Solution 2.2

Method: Gel electrophoresis

Worked steps

Size (length) of the fragments **B1**.

Practice 2.3 ■ 1 mark

Which fragments travel farther in a gel?

Solution 2.3

Method: Gel electrophoresis

Worked steps

The smaller fragments **B1**.

Exam-style 3.1 ■ 1 mark

Gel electrophoresis separates DNA fragments according to their

A color

B size

C base sequence only

D temperature

Solution 3.1

Method: Gel electrophoresis

A color

B size



C base sequence only

D temperature

Worked steps

B — size.

Exam-style 3.2 ■ 1 mark

Bacteria are engineered to produce human insulin.

- (a) Name the technique used to insert the human gene.
- (b) Explain why bacteria can make a human protein from this gene.

Solution 3.2

Method: Genetic engineering

Worked steps

(a) Genetic engineering (using a plasmid/vector) **B1**. (b) The genetic code is universal, so the bacterium's ribosomes read the human gene's codons and translate it into human insulin **M1 A1**.

Exam-style 3.3 ■ 3 marks

A crime-scene DNA sample is tiny. Explain how PCR and gel electrophoresis together could help identify a suspect.

Solution 3.3

Method: PCR

Worked steps

PCR amplifies the tiny sample into many copies **M1**; gel electrophoresis separates the DNA into a band pattern **M1**; matching the pattern to a suspect's DNA can identify them **A1**.