Past-paper walk-through

Genetic modification ▪ 21.3

eXercise

Questions in this set

- 0610/21 N25 Q40 ▪ 1 mark
- 0610/23 N25 Q40 ▪ 1 mark
- 0610/21 J25 Q40 ▪ 1 mark
- 0610/23 J25 Q40 ▪ 1 mark
- 0610/42 J25 Q3 ▪ 15 marks
- 0610/22 M25 Q40 ▪ 1 mark

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

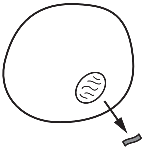
Question 40

0610/21 N25 ▪ Q40 ▪ 1 mark

40 The diagrams show the stages in the production of human insulin.

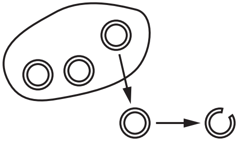
Which stage uses the enzyme DNA ligase?

A



The gene for insulin is identified and removed from a human cell.

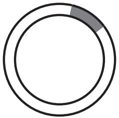
B



A plasmid is removed from a bacterium and cut open.

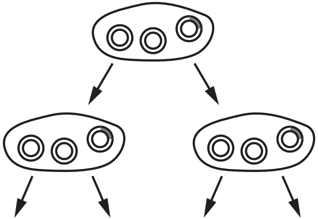
Question 40

C



The gene for insulin is inserted into the plasmid.

D



The plasmid is inserted into a bacterium that reproduces, and insulin is produced.

Solution 40

Answer: **C**

Why

- Restriction enzymes *cut* DNA, opening the plasmid and cutting out the gene.
- DNA ligase *joins* DNA, sealing the gene into the cut plasmid.
- So ligase is used at the stage where the insulin gene is inserted into the plasmid.

Question 40

0610/23 N25 ▪ Q40 ▪ 1 mark

40 Human insulin can be produced in large quantities by genetically modified bacteria.

Four of the steps in the processes of genetic modification and insulin production are listed.

1 Insulin is removed from the bacterial culture.

2 An enzyme is used to cut out the insulin gene from a human chromosome.

3 The insulin gene is placed into the plasmid of a bacterium.

4 Bacteria with the insulin gene reproduce very rapidly.

What is the order of these steps?

A $1 \rightarrow 2 \rightarrow 3 \rightarrow 4$

B $2 \rightarrow 3 \rightarrow 4 \rightarrow 1$

Question 40

C $3 \rightarrow 2 \rightarrow 4 \rightarrow 1$

D $4 \rightarrow 1 \rightarrow 2 \rightarrow 3$

Solution 40

Answer: **B**

Why

- The gene must be cut out and the plasmid opened, both with restriction enzymes.
- Ligase then seals the gene into the plasmid, and the plasmid is taken up by the bacterium.
- Only after that can the bacteria be grown in a fermenter and the insulin extracted.

Question 40

0610/21 J25 ▪ Q40 ▪ 1 mark

40 Some of the processes involved in the production of insulin by genetic modification are listed.

1 cutting of bacterial plasmid DNA with restriction enzymes

2 expression in bacteria of the human gene to make insulin

3 insertion of recombinant plasmids into bacteria

4 multiplication of bacteria containing recombinant plasmids

In which order do these processes occur?

A $1 \rightarrow 3 \rightarrow 4 \rightarrow 2$

B $2 \rightarrow 1 \rightarrow 3 \rightarrow 4$

C $3 \rightarrow 1 \rightarrow 2 \rightarrow 4$

Question 40

D $4 \to 1 \to 3 \to 2$

Solution 40

Answer: **A**

Why

- First the gene wanted is cut out and the plasmid is cut open, both with restriction enzymes.
- The gene is joined into the plasmid with ligase, and the plasmid is put into a bacterium.
- The bacterium then expresses the gene, so cutting comes before expression.

Question 40

0610/23 J25 ▪ Q40 ▪ 1 mark

40 Some processes involved in the production of human insulin by genetic modification are listed.

1 insertion of the human insulin gene DNA into a cut bacterial plasmid

2 bacteria containing recombinant plasmids multiply and make human insulin

3 human insulin gene DNA is isolated using restriction enzymes

4 recombinant plasmids are inserted into bacteria

What is the sequence of these processes in genetic modification?

A $1 \rightarrow 3 \rightarrow 2 \rightarrow 4$

B $1 \rightarrow 4 \rightarrow 3 \rightarrow 2$

C $3 \rightarrow 1 \rightarrow 4 \rightarrow 2$

Question 40

D $3 \to 2 \to 1 \to 4$

Solution 40

Answer: **C**

Why

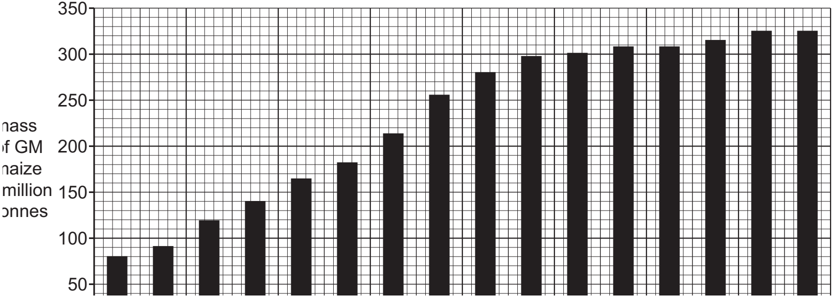
- The human gene must first be inserted into the cut plasmid, and joined with ligase.
- The plasmid then goes into the bacterium.
- Only then can the bacteria be grown and made to express the gene, so insertion comes first.

Question 3

0610/42 J25 ▪ Q3 ▪ 15 marks

3 Scientists developed genetically modified (GM) maize.

Fig. 3.1 shows the mass of GM maize grown in one country from 2000 to 2015.



Question 3

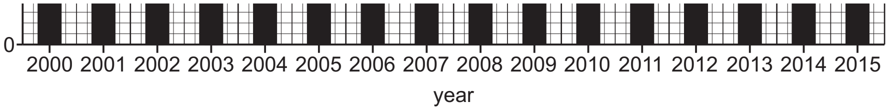


Fig. 3.1

(a) Calculate the percentage increase in the mass of GM maize grown between 2000 and 2015.

Give your answer to **two** significant figures.

Space for working.

Question 3

Question 3

(b) To develop GM maize, a gene for producing a natural insecticide was taken from a bacterium and transferred into maize plant cells.

(i) Genes are found at specific positions on a biological molecule.

State the name of this biological molecule.

Question 3

(ii) Scientists who develop GM crop plants breed them for many generations before allowing farmers to grow the crop plants.

Suggest why scientists breed the GM crop plants for many generations.

Question 3

(iii) Human proteins can also be made using bacteria that have been genetically modified.

Describe how a gene can be transferred from one organism to another using genetic modification.

Question 3

(c) Some people are worried that GM crops could pollinate wild plants.

(i) Suggest how pollination between GM crops and wild plants could be prevented.

Question 3

(ii) State **two** advantages of GM crops **other than** insect resistance.

Question 3

[2]

[Total: 15]

Solution 3

(a) Mark scheme

- 310 (%) ;;;
- 3 MP1 correct readings from graph
- (80 and 325$\pm$2)
- MP2 correct calculation to any number of
- significant figures e.g. 306.25%
- MP3 correct rounding to two significant figures
- from their calculation
- ecf from previous step

Solution 3

(b)(i)

Mark scheme

- DNA ;
- 1
- 0610/42
- May/June 2025
- Guidance

Solution 3

(b)(ii) Mark scheme

- any two from:
- 1
- to check (that the GM crops) inherit / have / express, gene / allele
- (to produce insect resistance) ;
- 2
- to check (that the GM crops) have the same / a high enough
- yield / good (described) quality product / AW ;
- 3

Solution 3

- to check (that the GM crops) can grow in, intended / different
- environments / AW ;
- 4
- to check the gene / allele / GM / crop / plant, does not cause any
- unexpected / unwanted, effects / AW ;
- 5
- idea of building up a large quantity of, seed / plants / crops (to sell
- to farmers) ;
- 2
- MP1 A all offspring show the gene in the

Solution 3

- phenotype

Solution 3

(b)(iii) Mark scheme

- any six from:
- 1
- section of DNA / gene / allele, is isolated / cut / AW(from one
- organism's chromosome / DNA) ;
- 2
- restriction enzymes used (to cut / isolate, gene / DNA / plasmid) ;
- 3
- bacterial plasmid DNA and section of (one organism's)

Solution 3

- DNA / gene, cut with the same (restriction) enzyme ;
- 4
- sticky ends formed (when restriction enzymes are used) ;
- 5
- (sticky) ends / base pairs (of bacterial plasmid DNA and other
- organism DNA) are complementary ;
- 6
- section of (one organism's) DNA / gene / allele, is inserted into
- (bacterial) plasmid (DNA) ;
- 7

Solution 3

- (DNA) ligase used (to insert, gene / DNA, into plasmid) ;
- 8
- recombinant, plasmid / DNA, is formed (when, gene / DNA, and
- plasmid are joined) ;
- 9
- (recombinant / plasmid, DNA) inserted into, bacteria / another
- cell / organism ;
- 10 AVP; multiplication / reproduction / division / growth, of (GM)
- bacteria OR use of a fermenter for (GM) (for multiplication of
- bacteria) OR protein from (one organism's) gene / allele,

Solution 3

- made / expressed, in (GM) bacteria
- 6
- 0610/42
- May/June 2025
- Guidance

Solution 3

(c)(i) Mark scheme

- any one from:
- 1
- isolate / separate, (GM) crops and wild plants ;
- 2
- grow (GM) crops in glasshouses ;
- 3
- cover flowers (of GM crop) ;
- 4

Solution 3

- remove, stamens / anthers / pollen (of GM crop) ;
- 5
- plant another species around the (GM) crop ;
- 1
- MP4 A use sterile GM crops

Solution 3

(c)(ii) Mark scheme

- any two from:
- 1,2 confer resistance to,
- herbicides / pesticides / disease / salinity / cold / hot / drought / wind
- (e.g. thicker stems) / heavy metals ;;
- 3
- provide additional, nutrients / AW (to humans) ;
- 4
- improved, yield / shelf life (of product) / flavour / quantity /

Solution 3

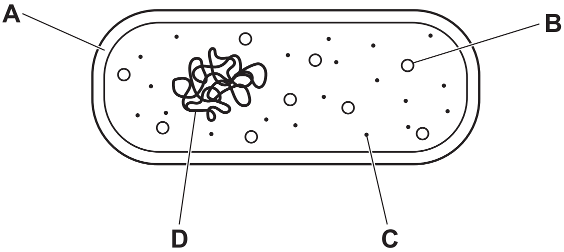
- appearance / AW ;
- 5
- reduced pollution OR less / no, use of, fertiliser / pesticides ;
- 2
- MP4 A improved taste / grow faster
- Guidance

Question 40

0610/22 M25 ▪ Q40 ▪ 1 mark

40 The diagram shows a bacterial cell.

Which cell structure makes bacteria useful in genetic modification?



Question 40

Solution 40

Answer: **B**

Why

- Genetic modification needs a small circle of DNA that can be cut open and have a gene inserted.
- That is the plasmid, which bacteria carry in addition to their main chromosome.
- It can then be taken back up by the bacterium, which expresses the new gene.