

Gene technology: practice questions

8 questions • 30 marks • mark scheme at the back

For Pearson Edexcel International AS Biology XBI11 and International A Level Biology YBI11. **A Level only** is IA2 content (Units 4 to 6), not needed for the International AS.

Name

Total / 30

1 UNIT 5 STYLE [1 mark]

Which statement correctly describes the roles of the enzymes used to make recombinant DNA?

- A. ☐ Restriction endonuclease joins DNA fragments; DNA ligase cuts DNA at a recognition site
- B. ☐ Restriction endonuclease cuts DNA at a recognition site; DNA ligase forms phosphodiester bonds between fragments
- C. ☐ Restriction endonuclease forms hydrogen bonds between sticky ends; DNA ligase cuts the plasmid
- D. ☐ Restriction endonuclease makes cDNA from mRNA; DNA ligase breaks phosphodiester bonds

2 UNIT 5 STYLE [5 marks]

Describe how a gene can be inserted into a plasmid to form recombinant DNA.

3 UNIT 5 STYLE [3 marks]

Scientists made the human insulin gene by extracting mRNA from beta cells of the pancreas rather than cutting the gene from human DNA. Explain this approach.

4

UNIT 5 STYLE

[4 marks]

Describe how bacteria that have taken up a recombinant plasmid can be identified and separated from those that have not. The plasmid contains a gene for antibiotic resistance.

5

UNIT 5 STYLE

[4 marks]

Explain the advantages of using genetically modified bacteria, rather than animals, to produce human insulin.

6

UNIT 5 STYLE

[4 marks]

(a) Describe how a microarray is used to find out which genes are active in a sample of cells. (3) (b) State what is meant by bioinformatics. (1)

7

UNIT 5 STYLE

[3 marks]

Describe how a gene can be transferred into (a) plant cells and (b) an animal. (Accept any one method for each.)

Golden rice has been genetically modified to produce beta-carotene, which the body converts to vitamin A. Evaluate the risks and benefits of growing GM crops such as this.

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Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

B B (1) Restriction enzymes cut; ligase joins by phosphodiester bonds.

2. [5]

- cut the gene and plasmid with the same restriction endonuclease (1)
- at its recognition site / specific base sequence (1)
- staggered cut leaves complementary sticky ends (1)
- gene and plasmid mixed so sticky ends join by complementary base pairing / hydrogen bonds (1)
- DNA ligase joins the sugar-phosphate backbones / forms phosphodiester bonds (1)
- Max 5

3. [3]

- beta cells make large amounts of insulin mRNA (1)
- reverse transcriptase makes a cDNA copy of the mRNA (1)
- cDNA has no introns, which bacteria cannot remove, so the gene can be expressed in bacteria (1)

4. [4]

- bacteria spread on agar containing the antibiotic (1)
- bacteria with the plasmid have (and express) the resistance gene (1)
- so they survive and grow into colonies (1)
- bacteria without the plasmid are killed / do not grow (1)
- colonies are picked off / subcultured to grow a culture of transformed bacteria (1)
- Max 4. Ignore description of how the plasmid was inserted (calcium chloride, heat shock)

5. [4]

- insulin is identical to human insulin / gene is the human gene, so less chance of an immune response (1)
- bacteria reproduce quickly / large amounts can be made in fermenters (1)
- cheaper / reliable supply (1)
- fewer ethical objections as animals are not killed (1)
- Max 4

6. [4]

- mRNA extracted from the cells and converted to labelled (fluorescent) cDNA (1)
- cDNA binds to complementary DNA probes on the array (1)
- spots that fluoresce show the gene is active / brighter spot means more mRNA (1)
- (b) use of computer science / software to store, analyse and interpret biological data (e.g. DNA sequences) (1)

7. [3]

- (a) gene inserted into the Ti plasmid of Agrobacterium / DNA coated onto gold or tungsten particles (1)
- (a) Agrobacterium infects plant cells and transfers the gene into the plant genome / particles fired into plant cells with a gene gun (1)
- (b) gene microinjected into the nucleus of a fertilised egg (1)
- (b) embryo implanted into a surrogate mother, which gives birth to a transgenic animal (1)
- Max 3. At least one mark from each part for full marks

8. [6]

- benefit: reduces vitamin A deficiency / improves nutrition in people with a rice-based diet (1)
- benefit: higher yield / pest-resistant crops / less pesticide, so greater food security (1)
- risk: gene transfer by pollen to wild relatives / weeds (1)
- risk: harm to non-target organisms / reduced biodiversity (1)
- risk: unforeseen health effects / allergies; long-term effects not fully known (1)
- economic / ethical: seeds patented and costly for farmers; some object to modifying organisms (1)
- reasoned judgement that weighs benefits against risks / suggests monitoring and testing (1)
- Max 6