

GCSE Biology (9 – 1)

Genetic Engineering

Name:

Group:

Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.



For markers use	
Question	Mark
1	/5
2	/12
3	/6
4	/3
5	/10
6	/12
Total	/48
%	
Grade	

Information

- The maximum mark for this paper is 48 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. Genetic engineering is a way scientists change the DNA of living things to give them new traits, like making crops resistant to pests or helping cure diseases.

Circle the letter of the correct answer for each.

- a) A gene for insulin is taken from a human cell and placed in a bacterium. The bacterium can then make human insulin. What is this process called?

A

Heterozygous inheritance

B

Artificial selection

C

Genetic engineering

D

Natural selection

(1 mark)

- b) Which of the following is a primary reason for using bacteria in the process of genetic engineering to produce human insulin?

A Bacteria naturally produce human insulin in small quantities

B Bacteria reproduce slowly, allowing for careful monitoring of insulin production.

C Bacterial plasmids can be easily modified to include the insulin gene and they replicate rapidly.

D Bacteria have complex cell structures that are ideal for synthesising human proteins.

(1 mark)

- c) A scientist wants to insert a gene for human growth hormone into a bacterial plasmid. Which enzyme would be essential for cutting the plasmid DNA at a specific sequence to make space for the new gene?

A

DNA Ligase

B

DNA Polymerase

C

Restriction Enzyme

D

Amylase

(1 mark)

- d) When genetic engineering is used to produce human insulin, the gene for human insulin is inserted into a bacterial plasmid.

What is this modified plasmid, now containing DNA from two different species, referred to as?

A

A hybrid chromosome

B

A designer gene

C

A protein synthesiser

D

Recombinant DNA

(1 mark)

- e) In genetic engineering, after bacterial cells have been mixed with recombinant plasmids, not all bacteria will take up a plasmid. To identify the bacteria that have successfully incorporated the plasmid, what is commonly included on the plasmid alongside the desired gene?

A A gene for the desired protein for example, insulin.

B An antibiotic resistance gene

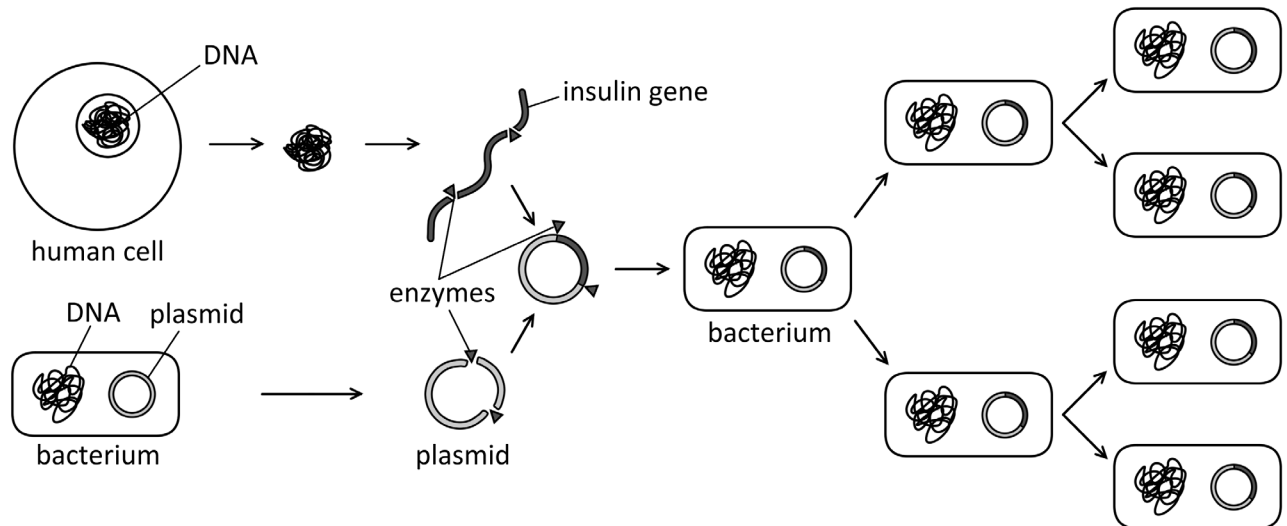
C A gene that prevents bacterial reproduction

D A gene that makes the bacteria glow in the dark naturally

(1 mark)

(Total for Question 1 is 5 marks)

2. The figure below shows some of the stages involved in the genetic engineering of bacteria to produce human insulin.



- a) From which type of cell is the gene for human insulin initially obtained? (1 mark)

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(1 mark)

- b) Name the small, circular piece of DNA labelled 'plasmid' that is extracted from the bacterium.

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(1 mark)

- c) An enzyme is used to cut the human DNA to isolate the insulin gene, and also to cut open the plasmid. What is the specific name for this type of enzyme?

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(1 mark)

- d) Another enzyme is then used to join the insulin gene into the cut plasmid. What is this enzyme called?

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(1 mark)

- e) The plasmid containing the human insulin gene is then inserted into a host bacterium. What term describes DNA that is formed by combining DNA from two different species, such as this modified plasmid?

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(1 mark)

- f) The diagram shows the host bacterium reproducing. Explain one advantage of using bacteria in this process of producing human insulin.

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(2 marks)

- g) Suggest why the bacteria that take up the modified plasmid might also contain a gene for antibiotic resistance.

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(2 marks)

- h) Scientists who develop genetically engineered varieties of crop plants often breed them for several generations before releasing them for farmers to use.

Suggest why the scientists do this.

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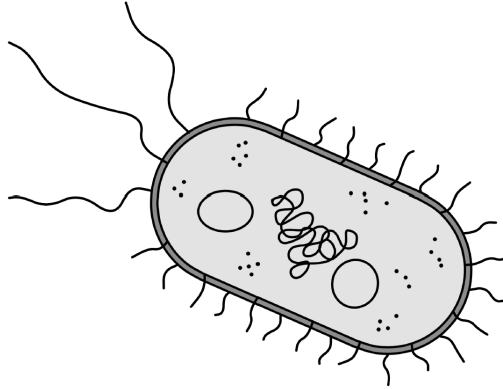
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(3 marks)

(Total for Question 2 is 12 marks)

4. Chymosin is an enzyme used in cheese making.
It can be produced by genetically modified bacteria. The figure below shows a typical bacterial cell.



Explain how to genetically modify a bacterial cell to produce chymosin.

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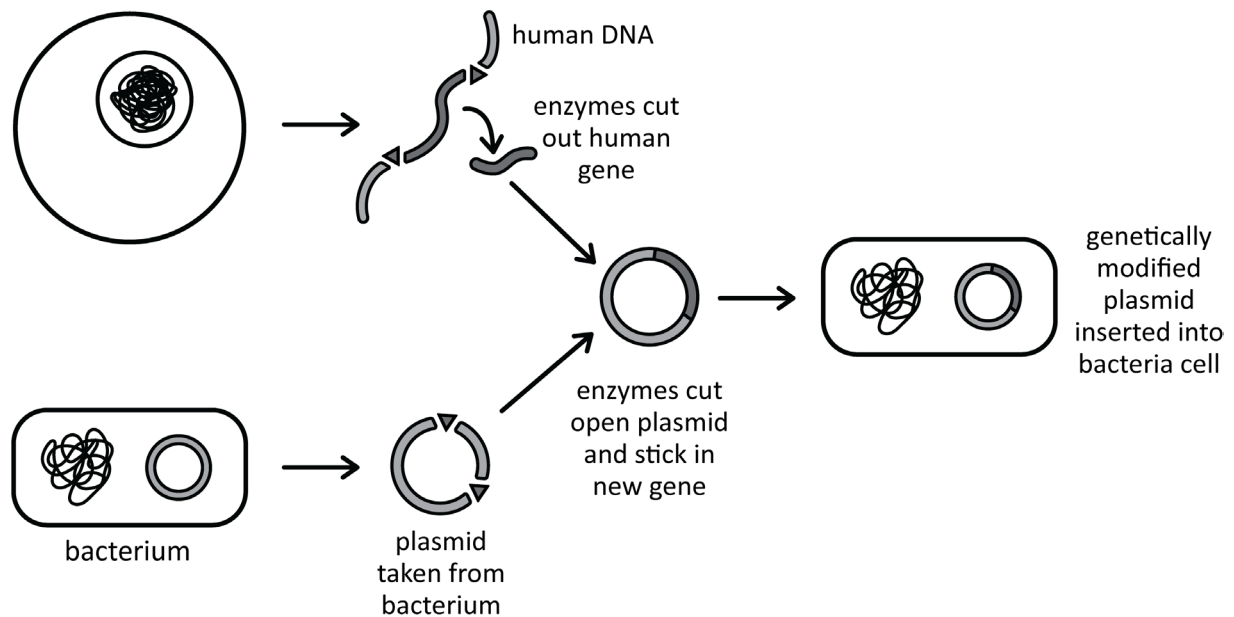
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(3 marks)

(Total for Question 4 is 3 marks)

5. The figure below shows some of the stages involved in creating a genetically modified bacterial cell.



a) The diagram states "enzymes cut out human gene" and "enzymes cut open plasmid". Name the specific type of enzyme used to perform these cutting actions.

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 (1 mark)

b) Why is it important to use the **same enzyme** to cut both the human DNA and the plasmid?

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 (2 marks)

c) The diagram also states enzymes "stick in new gene". Name the specific type of enzyme that performs this 'sticking' action.

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 (1 mark)

d) When the enzyme named in (a) cuts DNA, it can create 'sticky ends'. Explain what is meant by the term 'sticky ends'.

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 (2 marks)

- e) Human Growth Hormone (HGH) can be produced by genetically modified bacteria.

Outline the main steps involved in genetically modifying bacteria so that they can produce human growth hormone.

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(3 marks)

- f) Describe **one** medical condition that can be treated using the human growth hormone produced in this way.

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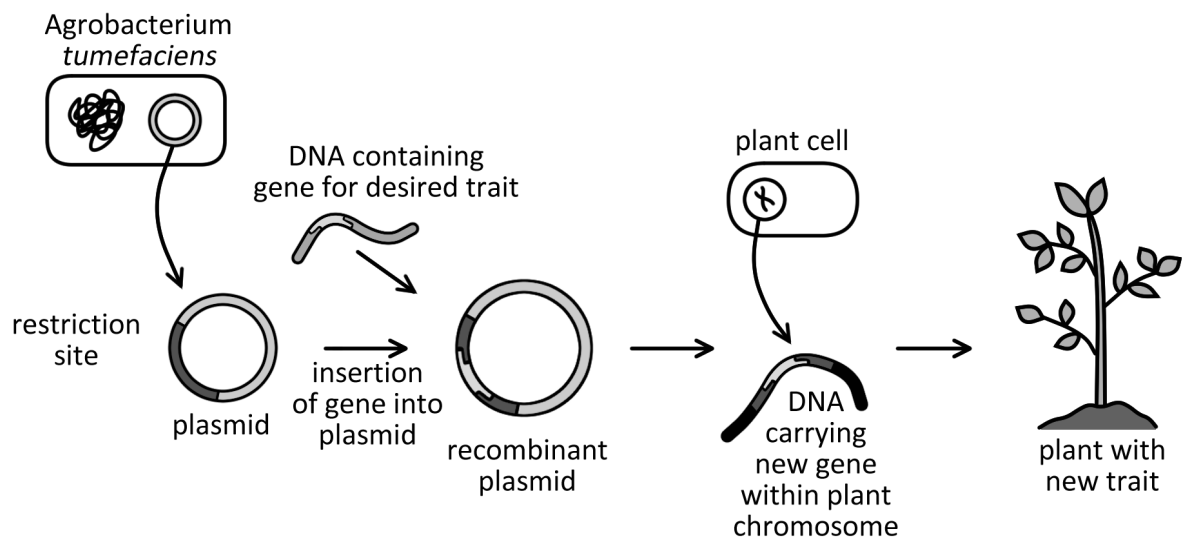
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(1 mark)

(Total for Question 5 is 10 marks)

6. Genetic engineering can be used to modify plants to give them desirable characteristics.

The figure below shows one method used to genetically modify plants.



a) A scientist wants to create a tomato plant that is resistant to a particular herbicide.

State **one** type of vector that could be used to transfer the herbicide resistance gene into the tomato plant cells.

(1 mark)

b) Describe the main stages involved in producing the genetically modified herbicide resistant tomato plant, starting from isolating the herbicide resistance gene.

(4 marks)

- c) Other than herbicide resistance, state one other characteristic that plants can be genetically modified to have, and explain one benefit of this modification.

Characteristic:

Benefit:

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(3 marks)

- d) The use of genetically modified (GM) crops can be controversial.
Describe two concerns that some people have about the widespread cultivation of GM crops.

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(2 marks)

- e) Explain how growing GM crops that are resistant to insect pests could lead to an increase in the yield of the crop.

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(2 marks)

(Total for Question 6 is 12 marks)