19.3 Genetically Modified Organisms in Agriculture

Question Paper

Course	CIE A Level Biology
Section	19. Genetic Technology
Topic	19.3 Genetically Modified Organisms in Agriculture
Difficulty	Medium

Time allowed: 40

Score: /29

Percentage: /100

Question 1a

Farmers use genetic engineering to quickly introduce genes that benefit the health and value of their livestock. Protein **Q** is a protein that gives pigs resistance to a disease that is killing livestock. Goats can be genetically engineered to produce Protein **Q** in their milk. Fig. 1 shows the stages involved in the process.

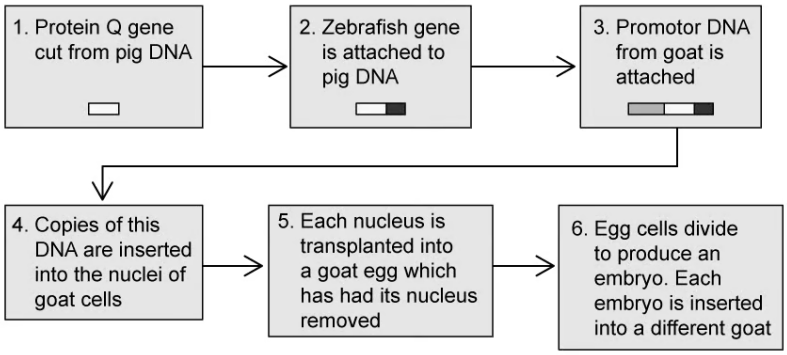

Fig. 1

The zebrafish gene attached to the pig Protein **Q** gene in stage **2**, codes for a protein that glows blue under fluorescent light.

Explain why this gene has been attached.

[2 marks]

Question 1b

State the role of a promoter **and** suggest why a goat promoter specific to the milk gland was used instead of a pig promoter.

[3 marks]

Question 1c

There are very few live births that result from the multiple embryos that are implanted. The likelihood of producing offspring from genetically modified eggs is low. Suggest **one** reason why few live births result from the many embryos that are implanted.

[2 marks]

Question 1d

When pigs are bred on farms, it is important to ensure only unrelated pigs breed.

Suggest how genetic fingerprints might be used to do this.

[1 mark]

Question 2a

Salty soils can inhibit the growth of crop plants, such as tomatoes, particularly in coastal areas. Scientists have genetically modified some species of tomato to increase their salt tolerance. Fig. 1 shows the process used to introduce a gene for a sodium-pump protein obtained from another species of plant (*Arabidopsis*), into the genome of tomato plants. The gene resulted in increased tolerance of the tomato plants to high salt soil, without affecting the taste or salt content of the fruit produced.

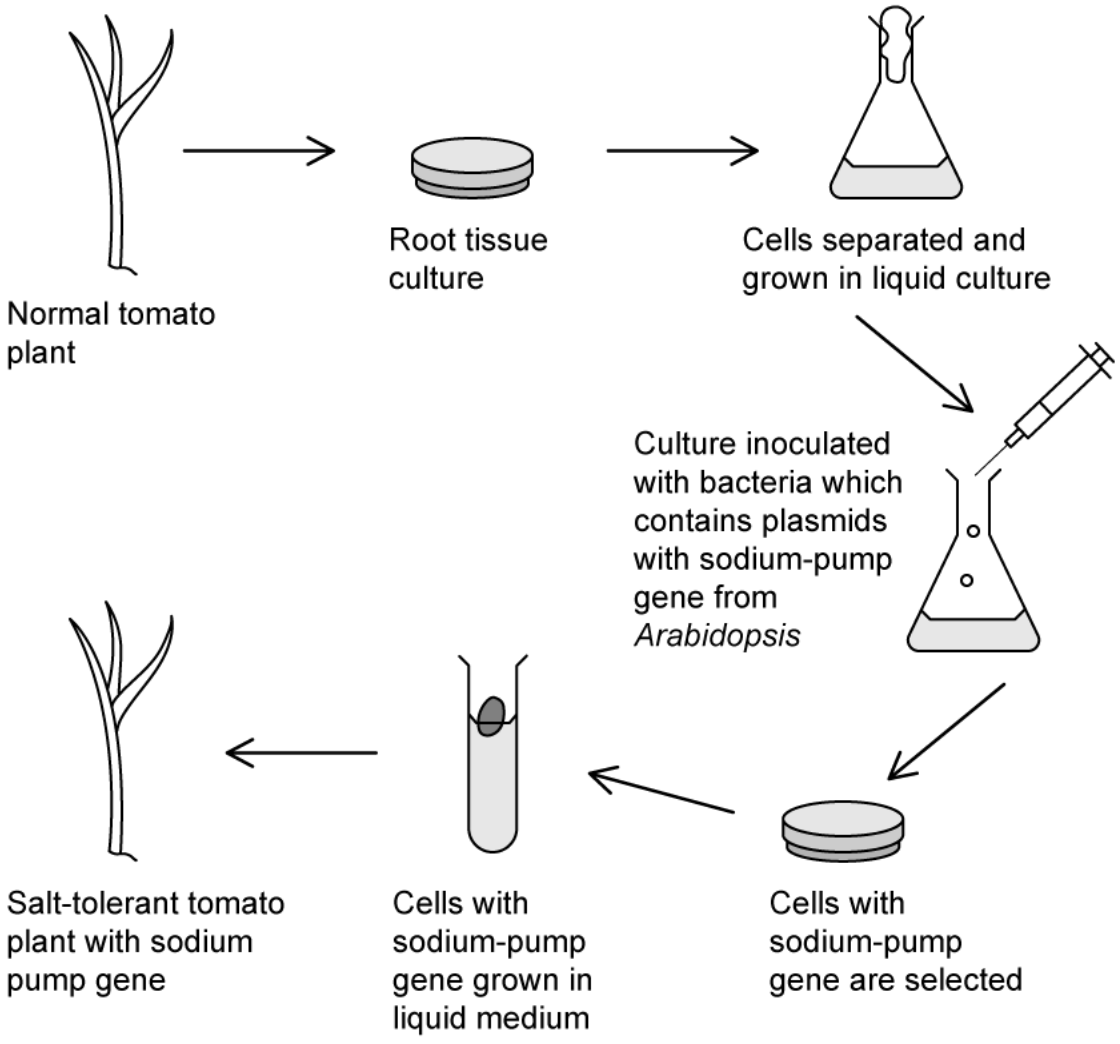

Fig. 1

Describe **three** methods that could be used to obtain the DNA fragment which contains the gene for the sodium pump protein.

[3 marks]

Question 2b

In the process shown in Fig. 1, the required gene sequence is extracted from *Arabidopsis* and is inserted into the tomato plant.

Explain why the transgenic tomato plant is able to produce the sodium pump protein despite being a different species to the donor plant.

[2 marks]

Question 2c

Suggest **two** possible ways that cells with the sodium pump gene might be selected in stage **4** of Fig. 1.

[4 marks]

Question 2d

Explain the evidence from Fig. 1 that the genetically modified tomato plant cells are totipotent.

[2 marks]

Question 3a

Many scientists believe that genetic engineering could help solve the global food crisis by improving the quality and productivity of farmed animals and crop plants. In 2015 AquaAdventure Salmon was approved by the US Food and Drug Authority (FDA) for human consumption.

Scientists combined a growth hormone gene from Chinook salmon (*Oncorhynchus tshawytscha*) with the promoter gene from a cold-water fish, Ocean pout (*Zoarces americanus*). Ocean pout can thrive in near-freezing waters. Fig. 1 depicts the two different types of salmon: GM salmon and non-GM salmon (both fish are 18 months old).

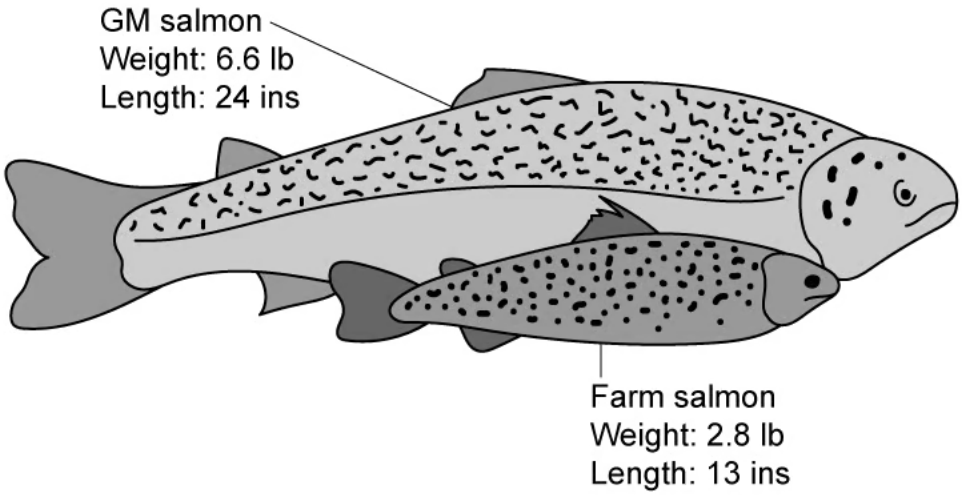

Fig. 1

Using the information above, describe **and** explain the main benefit of this genetic modification for the producers involved.

[3 marks]

Question 3b

The GM salmon in Fig. 1 was deliberately made sterile by scientists.

Suggest why this was done.

[1 mark]

Question 3c

Discuss the ethical and social implications of using genetically modified organisms (GMOs) in food production. Use at least **one** named example in your answer.

[6 marks]