1. June/2022/Paper_41/No.4

In 1973 a technique for genetic engineering was used for the first time. Recombinant DNA was made using a plasmid and this was successfully transferred into an organism.

In 2012 a new technique for genetic engineering, called gene editing, was developed.

(a) Table 4.1 lists some statements about the two genetic engineering techniques.

Complete Table 4.1 to compare the original genetic engineering technique using a plasmid vector with the newer technique of gene editing. For each row, place a tick (✓) in the correct column if the statement applies and leave a blank if the statement does not apply.

Table 4.1

statement	genetic engineering using a plasmid	gene editing
It can produce a transgenic organism.		
It can modify the characteristics of an organism.		
It can delete unwanted DNA.		
It uses an enzyme that cuts DNA.		
It can use RNA to precisely locate the target gene.		

[5]

(b) Orange trees, *Citrus sinensis*, produce fruits that are an important food crop. The functional leaf area of orange trees may be reduced by the growth of citrus canker bacteria. These bacteria cause citrus canker disease.

Scientists used gene editing to develop two types of orange tree with different mutations (changes to the DNA). The mutant orange tree leaves showed resistance to citrus canker disease.

Fig. 4.1 shows the area of leaf with citrus canker disease in wild type (not gene edited) and gene edited orange tree leaves after they have been exposed to citrus canker bacteria.

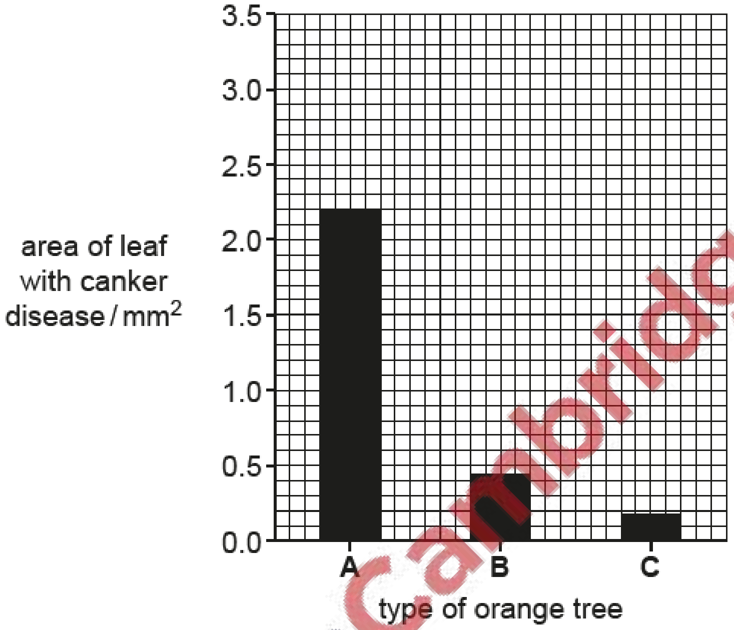

Fig. 4.1

(i) Identify the letter that represents the wild type orange trees on Fig. 4.1.

.... [1]

(ii) Explain the social benefits of this example of gene editing.

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.... [3]

[Total: 9]

2. June/2022/Paper_42/No.4

In 1973, a technique for genetic engineering was used for the first time. Recombinant DNA was made using a plasmid and this was successfully transferred into an organism.

In 2012, a new technique for genetic engineering, called gene editing, was developed.

(a) Table 4.1 lists some statements about the two genetic engineering techniques.

Complete Table 4.1 to compare the original genetic engineering technique using a plasmid vector with the newer technique of gene editing. For each row, place a tick (✓) in the correct column if the statement applies and leave a blank if the statement does not apply.

Table 4.1

statement	genetic engineering using a plasmid	gene editing
It may cause the organism to produce a different protein.		
It may cause a single base pair in a gene to be changed.		
The success of the technique can be evaluated using marker genes.		
It may use the CRISPR system.		
It uses DNA ligase.		

[5]

(b) Cassava plants, *Manihot esculenta*, produce roots that have a high starch content. These roots are an important food source in tropical regions. The growth of cassava plants is reduced by competition from weeds.

Scientists used gene editing to develop two types of cassava plant with different mutations (changes to the DNA). The gene edited cassava plants showed resistance to the herbicide glyphosate. In susceptible plants, glyphosate prevents synthesis of three amino acids from a precursor molecule called shikimate.

Fig. 4.1 shows the concentration of shikimate in the wild type (not gene edited) and the two types of gene edited cassava plant after they were exposed to three different concentrations of glyphosate.

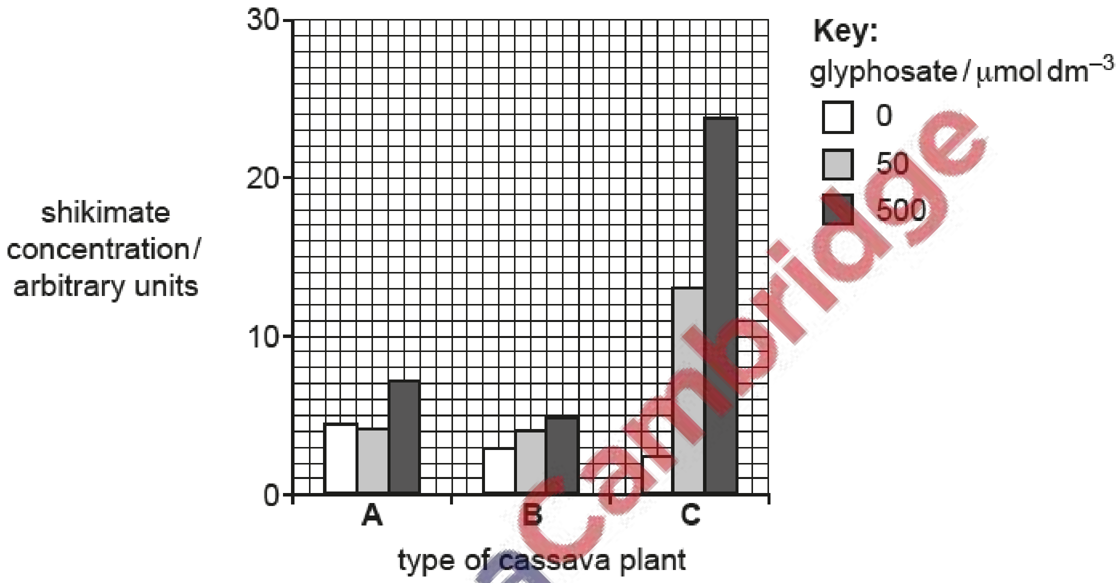

Fig. 4.1

(i) Identify the letter in Fig. 4.1 that represents the wild type cassava plant.

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(ii) Explain the social benefit of this example of gene editing.

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.... [3]

[Total: 9]

3. June/2022/Paper_43/No.4

In 1973, a technique for genetic engineering was used for the first time. Recombinant DNA was made using a plasmid and this was successfully transferred into an organism.

In 2012, a new technique for genetic engineering, called gene editing, was developed.

(a) Table 4.1 lists some statements about the two genetic engineering techniques.

Complete Table 4.1 to compare the original genetic engineering technique using a plasmid vector with the newer technique of gene editing.
For each row, place a tick (✓) in the correct column if the statement applies and leave a blank if the statement does not apply.

Table 4.1

statement	genetic engineering using a plasmid	gene editing
It can add a new phenotypic characteristic to an organism.		
It can change an A–T base pair to C–G.		
It can inactivate a desired selected gene in an organism.		
It may change DNA in a way that cannot be distinguished from a natural mutation.		
It requires a DNA donor and a recipient.		

[5]

(b) *Camelina sativa* is a fast-growing plant with oil-rich seeds.

C. sativa grows in dry and poor soils and so it may be important as a food crop in the future. The oil from its seeds has a high content of polyunsaturated fatty acids. This shortens the time that the oil can be stored for, which is a disadvantage.

Scientists used gene editing to develop two types of *C. sativa* with different genetic changes. The gene edited *C. sativa* seeds produced oil with longer storage times.

Fig. 4.1 shows the percentage composition of fatty acids in the oil extracted from seeds of gene edited and wild type (not gene edited) *C. sativa*.

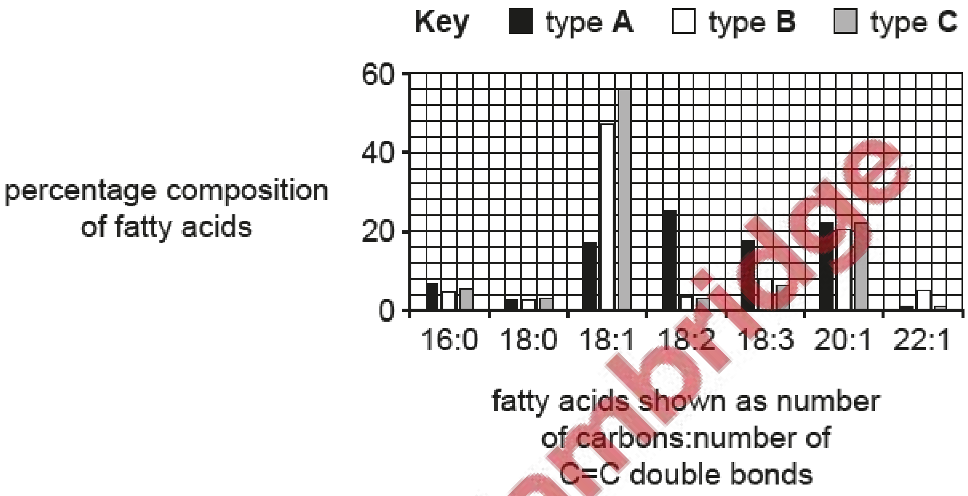

Fig. 4.1

(i) Identify the letter that represents the oil of the wild type *C. sativa* on Fig. 4.1.

.... [1]

(ii) With reference to Fig. 4.1, discuss the social benefits of this example of gene editing.

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.... [3]

[Total: 9]