

1. Acrylamide is a chemical that is formed when bread is toasted.

During toasting, acrylamide is made from a chemical called asparagine.

Asparagine is produced in plant cells by an enzyme called asparagine synthetase.

The gene coding for asparagine synthetase needs to be switched on by other proteins.

- i. Complete these sentences about how genes are expressed.

Use words from the list.

coding DNA nucleus translation	denaturing ribosomes tRNA	non-coding DNA transcription
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Gene expression can be switched on by the action of other proteins on

When a gene is expressed, occurs which makes mRNA.

The mRNA then moves to the

Proteins, such as asparagine synthetase are then made by the process of

[4]

- ii. Scientists want to produce a variety of wheat that contains less asparagine.

This is done by preventing expression of the gene that codes for asparagine synthetase.

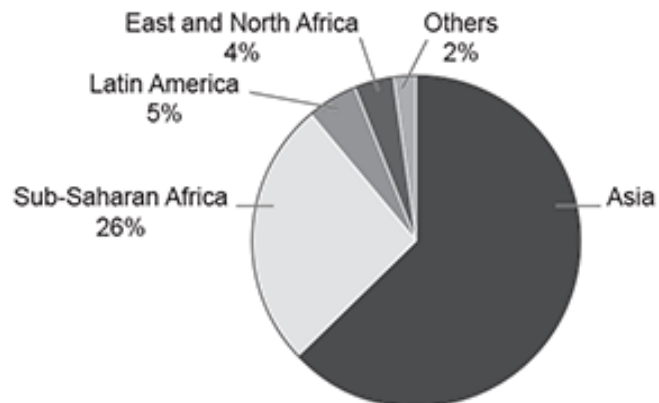
Describe the difference between this process and genetic engineering.

[1]

2. Lack of food security can lead to people being undernourished.

1×10^9 people in the world are undernourished.

The pie chart shows the percentage of undernourished people found in different parts of the world.



How many people are undernourished in Asia?

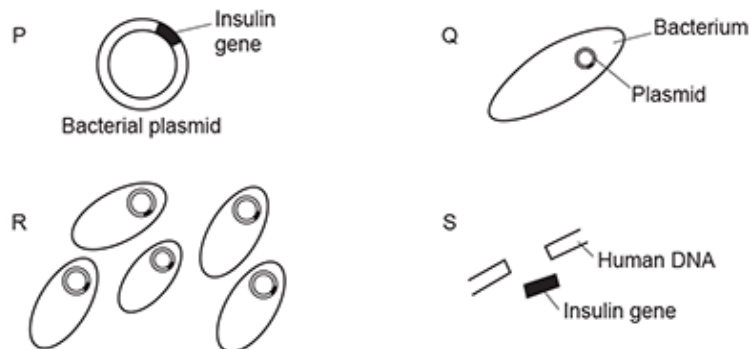
- A 1.75×10^8
- B 6.3×10^8
- C 1.75×10^9
- D 63×10^9

Your answer

[1]

3. Bacteria can be genetically engineered to make human insulin.

The diagrams show four stages in this process.



What is the order of these processes in insulin production?

- A P, S, Q, R
- B R, Q, P, S
- C R, Q, S, P
- D S, P, Q, R

Your answer

[1]

4(a). Sorghum is a crop plant grown in Africa for its seeds.



Sorghum produces a bitter chemical in its seeds.

Birds do not like the taste of this chemical. Some people also find the taste unpleasant.

Explain how sorghum could have evolved to produce the bitter chemical.

[3]

(b). In some areas in Africa, farmers have been growing varieties of sorghum that have lower levels of a bitter chemical.

These varieties have been produced by artificial selection.

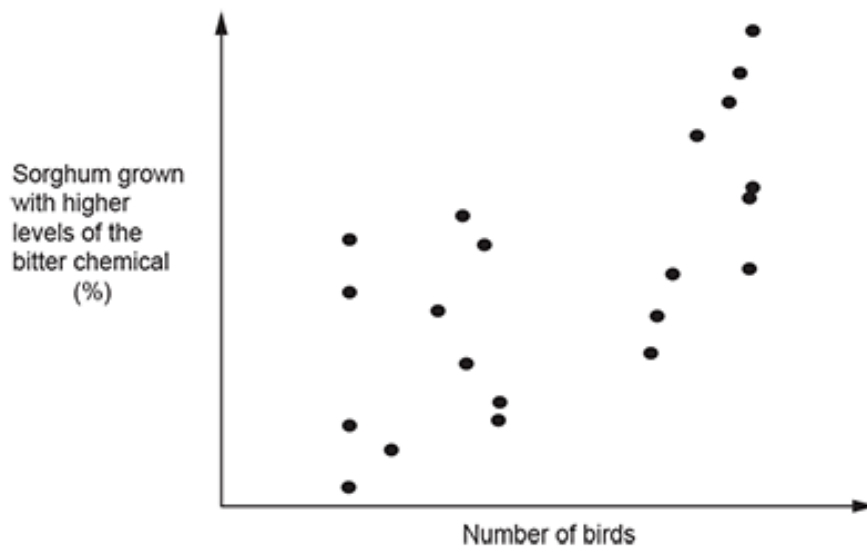
Describe how the process of artificial selection is carried out.

[2]

(c). Scientists recorded the types of sorghum grown in different areas of Africa that have higher levels of the bitter chemical.

They also recorded the number of birds that eat sorghum living in the same areas.

The graph shows their results.

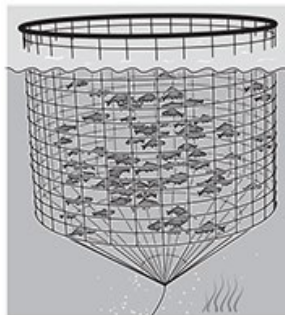


Suggest an explanation for the pattern of results shown in the graph.

[2]

5(a). The demand for food in the world is growing. One possible solution to this is the use of aquaculture.

This involves farming fish, such as salmon, in large cages in lakes or the sea as shown in the diagram. However, growing salmon in cages allows parasites on their body to spread easily from fish to fish.



Small fish called wrasse are often kept in the cage with the salmon. The wrasse act as a biological control mechanism. This results in an increased growth rate of the salmon.

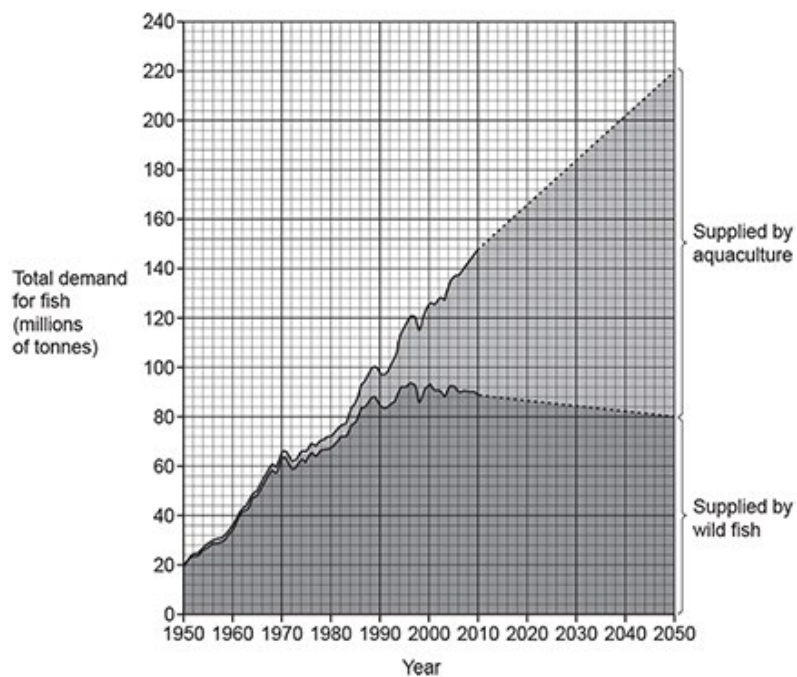
Suggest how putting wrasse in the cage results in an increased growth rate of the salmon.

[2]

(b). Many people in the world eat fish as their main source of protein.

Fish eaten by people can be caught directly from the sea (wild fish) or grown using aquaculture.

The graph shows how the world's total demand for fish has changed since 1950 and how it is expected to change up to 2050. It also shows how the total demand is met by the supply of wild fish and fish from aquaculture.



Describe the patterns in past and predicted fish use shown by the graph.

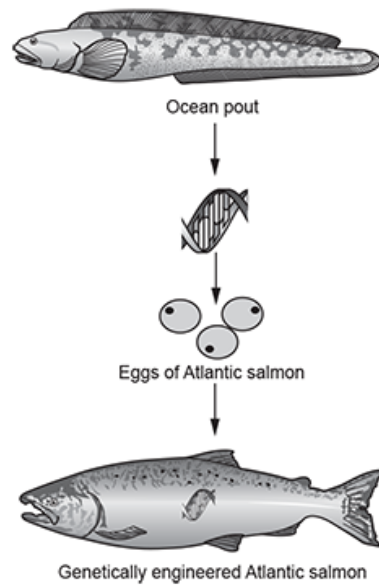
Include data.

(c). Scientists are trying to increase the mass of Atlantic salmon produced by aquaculture using genetic engineering and a fish called ocean pout.

The growth of fish is controlled by growth hormone.

Atlantic salmon only grow for part of the year but ocean pout grow throughout the year.

The diagram shows how scientists are producing genetically engineered Atlantic salmon.



- i. What is the name of the enzyme used to cut out the gene from the DNA of the ocean pout?

.....[1]

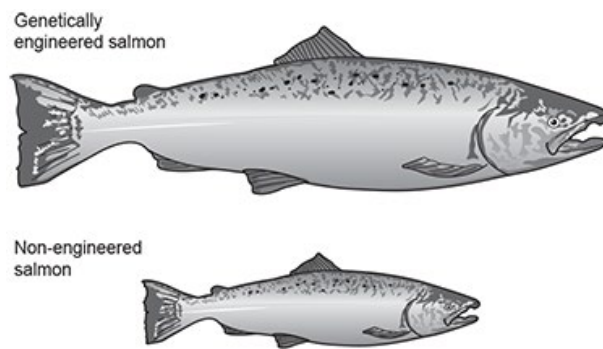
- ii. What is the name of the enzyme used to join the gene from the ocean pout into the DNA of the Atlantic salmon?

.....[1]

- iii. Explain how the addition of the gene from ocean pout can cause the Atlantic salmon to grow faster.

.....[2]

- iv. This diagram shows a genetically engineered salmon and a non-engineered salmon of the same age. The drawings are to the same scale.



Use a ruler to measure the length of each salmon.

Calculate the percentage increase in length caused by genetic engineering using your measurements.

Give your answer to **2** significant figures.

Percentage increase in length = % **[3]**

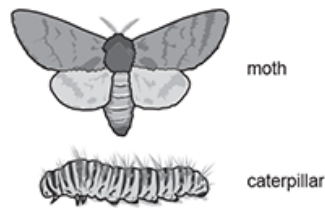
6. Why are antibiotic markers used in the process of genetic engineering?

- A** To act as a vector allowing the DNA into the cell.
- B** To identify which cells have taken up the genetic material.
- C** To make the engineered cells resistant to bacterial infections.
- D** To prevent the spread of antibiotic resistant bacteria.

Your answer

[1]

7. Pine processionary moths lay eggs that develop into larvae and then into caterpillars, as shown in the diagram.



The caterpillars are a major pest, eating and killing pine trees.

The caterpillars are fed on by birds such as cuckoos. The caterpillars are also parasitised by fungi.

Scientists are controlling the pine processionary moth to conserve pine trees.

They spray the caterpillar's eggs or larvae with fungal spores.

This has been successful when spraying different concentrations of spores:

- 1×10^6 spores / ml on the eggs
- 1×10^8 spores / ml on the larvae.

i. Name this type of control method.

.....[1]

ii. The concentration of spores used on the larvae is higher than the concentration used on the eggs.

By how many orders of magnitude is it higher?

.....[1]

8. Errors in experiments can be random or systematic.

- A student investigates the effect of fertilisers on the dry mass of seedlings.
- They use pots of seedlings, solutions of fertilisers and a mass balance.

Which of these would produce a systematic error in the student's results?

- A** Some of the seedlings receive more light than others.
- B** Some of the seedlings are infected by a fungus.
- C** The student's mass balance is not calibrated correctly.
- D** The temperature in the classroom changes during the experiment.

Your answer ☐

[1]

9. Genetic engineering involves the use of vectors.

Which is an example of a vector?

- A** A set of unpaired bases on the end of a DNA molecule.
- B** A small ring of DNA present in a bacterium.
- C** An enzyme that joins together two pieces of DNA at specific sites.
- D** An organism that has undergone genetic modification.

Your answer

[1]

END OF QUESTION PAPER