

C2 Species, selection and genetic engineering

1. a) i) If members of two different species interbreed their offspring are usually sterile or are so biologically weak that they rarely produce offspring. (2)
- ii) Speciation (1)
- iii) A river started flowing through the forest, creating a valley that separated the two groups of trees and stopped the flow of genes between them. Genetic differences gradually developed and a point was reached where members of the groups could no longer successfully interbreed. (3)
- iv) *Any one of the following:*
If two groups of organisms of the same species inhabit the same region but become adapted to different habitats in that region, this reduces gene flow so the groups become different species. If animals exhibit elaborate courtship behaviours before mating and small differences occur in any of the stimuli involved it can prevent mating, which prevents gene flow. (3)
- b) i) All the organisms in the species die, such that the species no longer exists. (1)
- ii) *Any three of the following:*
Loss of habitat
Spread of disease
Predation by species that have been introduced into the habitat
Competition with species that have been introduced into the habitat
Overexploitation by humans (3)
- iii) Caribbean monk seal (1)
2. a) i) Natural selection is the process by which populations change over time, or evolve, so they remain well adapted to their environment. (1)
- ii) A dominant mutation (1)
- iii) Variety Y was well camouflaged against the tree trunks, which were blackened with soot in industrialised areas. This gave the variety Y a selective advantage in these areas and its numbers gradually increased. Variety X was no longer well camouflaged and was at a selective disadvantage and its numbers gradually decreased. (3)
- iv) As a result of mutations, bacteria have developed that are resistant to all antibiotics used to treat gonorrhoea. When exposed to antibiotics, these resistant mutants survive, reproduce and pass on their resistant mutant alleles to their offspring, creating populations of resistant bacteria. (3)
- b) i) Artificial selection is the process by which humans select and breed organisms showing characteristics that are desirable to suit human needs. (1)

- ii) *Any three of the following:*
Increased yields
Increased quality of the product
Faster growth rates
Increased resistance to pests and disease
Increased number of offspring
Shorter time to reach maturity
Increased suitability to the environment (3)
- iii) Hybrid vigour (1)
- iv) 1. They are tolerant to heat.
2. They have a high resistance to ticks and tick-borne diseases.
3. They produce high yields of milk when grazing on poor pastureslands. (3)
- v) *Any one of the following:*
It reduces variation, which makes individuals more vulnerable if environmental conditions change. Inbreeding reduces the gene pool, which increases the frequency of undesirable genes. (1)
3. a) i) Genetic engineering involves changing the traits of one organism by inserting genetic material from a different organism into its DNA. (1)
- ii) A genetically modified organism or a transgenic organism (1)
- iii) Golden rice: Two genes, one from maize and one from a soil bacterium, are introduced into rice plants. The genes cause the endosperm of the rice grains to produce beta-carotene. The human body then converts the beta-carotene to vitamin A. Insulin: The gene that controls the production of insulin in humans is transferred into bacteria. The bacteria then produce human insulin. (4)
- b) i) *Any three of the following:*
It can be used to increase yields, which should then increase the world food supply and reduce food shortages.
It can be used to increase the nutritional value of foods, which should then reduce deficiency diseases worldwide.
Vaccines produced by genetic engineering are generally safer than vaccines containing live and weakened, or dead pathogens.
It can be used to produce larger quantities of drugs in a safer and purer form than previously produced from animal sources so more people worldwide have access to these drugs.
It overcomes ethical concerns of obtaining certain drugs from animals.
Crops genetically engineered to be resistant to pests reduce the need for chemical pesticides, which harm the environment. (3)
- ii) *Any three of the following:*
Plants genetically engineered to be toxic to a pest may also be toxic to useful organisms. This could negatively affect wild plants, reduce reproduction in crops and reduce food production.

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