24 Applied genetics - answers

1 (a) The plant breeder would pollinate plant A with pollen from plant B (or vice versa).
The gametes would be (A) **HsHs**, (B) **hShS**.
When the gametes combined in the zygote, the seeds would all have the **HhSs** genotype.
Since **H** and **S** are the dominant alleles, the plants would all be high-yielding, short-stemmed varieties (the F_1 variety).
(b) When the **HhSs** variety produces gametes, these could be **HS**, **Hs**, **hS** or **hs** which, when combined in the zygote, could produce four varieties of offspring; some of which might be short-stemmed / high yield; short-stemmed / low yield; long-stemmed / low yield, or long-stemmed / low yield.

2 In genetic engineering, a *gene* (A) from one organism is introduced into the *genome* (B) of an unrelated organism.

3 An enzyme which is used to cut DNA at specific sites is called a *restriction enzyme*.

4 The cells structures in bacteria which carry genes intended for genetic engineering are called *plasmids*.

5 Useful producs of genetic engineering are *chymosin, Alpha-anti-trypsin, hepatitis B vaccine, and insulin* (any three)

6 The gene for insulin is 'cut' from the appropriate strand of DNA using restriction enzymes. Plasmids are extracted from bacterial cells and 'opened up' using the same restriction enzymes and the insulin gene is inserted in the gap. The recombinant plasmids are inserted into bacteria which then produce insulin.

7 Genetic engineering of crop plants can improve resistance to pests, retard ripening, improve uptake of ions from the soil, increase the vitamin content of the crop. In the future, genetic engineering might improve drought resistance and salt tolerance.

8 (a) DNA fragments, in solution, are placed at one end of a sheet of gel and an electric current is applied which separates the fragments.
(b) The size of the fragments determines how rapidly they move through the gel. Smaller fragments travel faster and further than larger fragments.

9 (a) Suspect S3 is the most likely to be guilty
(b) The greatest correspondence in the position of the bands at the crime scene is with those of suspect 3.
(not all the relevant lines are drawn here)

Applied genetics - answers (continued)

10 (a) Stem cells can continue to divide throughout their life.
(b)The special characteristic of embryonic stem cells is that they can develop into any kind of cell and in some animals (e.g. amphibia) into complete organism.

11 Embryonic stem cells can be derived from individual cells of an early embryo, from blood cells in the umbilical cord of mammals and from cultures of stem cells.

12 The advantage of using stem cells from the patient being treated is that they will not be rejected by the patient's immune system.

24 Applied genetics

1 A strain of barley (A) has a high yield of seeds but a long stem which is subject to 'lodging' (a flattening of areas of the crop). Another strain (B) has a short, sturdy stem but a lower yield. The genotype of variety A is **HHss** (high yield, long stem) and the genotype of B is **hhSS** (low yield, short stem)

(a) Show how a plant breeder would cross these varieties to produce a high yielding, short stemmed variety.

(b) Explain why this variety would not breed true.

2 Choose from the list of words below, to complete the following sentence.
In genetic engineering, a …..A …..from one organism is introduced into the ….. B …..
of an unrelated organism.

chromosome, nucleus, gene, protein, genome

3 What name is given to an enzyme which is used to cut a DNA molecule at specific sites?

4 What bacterial cell structures are used to carry the genes intended for genetic engineering?

5 Name three useful products that can be obtained by genetic engineering.

6 Outline the steps involved in using bacteria to produce human insulin.

7 Give three examples of genetic engineering that are intended to improve crop plants.

8 DNA can be split into fragments using restriction enzymes.

(a) Outline the technique used to separate these fragments.

(b) What property of the DNA fragments allows this separation?

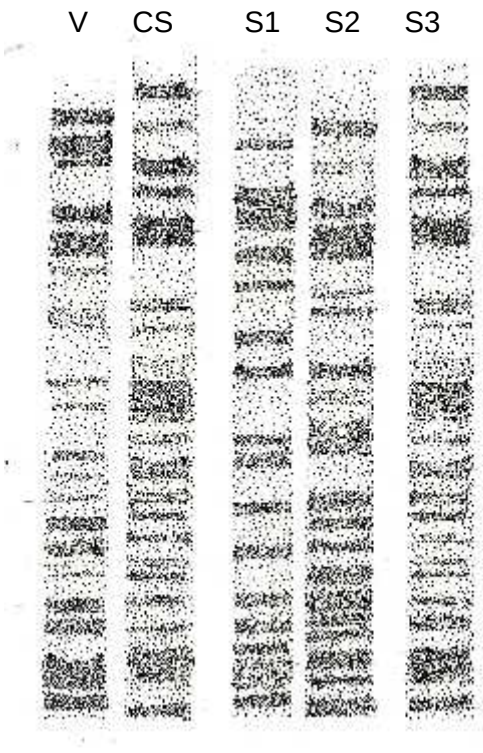
9 The illustration shows the separation of DNA fragments produced from blood samples taken at the scene of a crime, plus those of three suspects.

Rule horizontal lines through the DNA bands from the crime scene, to cross the three suspects profiles.

(a)Which suspect is most likely to be guilty?

(b) Explain why you think so.

V Victim
CS Sample taken from crime scene
S1 Suspect 1
S2 Suspect 2
S3 Suspect 3



Applied genetics (continued)

10 What is the special characteristic of (a) stem cells, (b) embryonic stem cells?

11 What are the possible sources of human embryonic stem cells?

12 What would be the advantage of using a patient's own stem cells e.g. blood stem cells, to treat his or her illness?