Solutions

Each answer shows the steps, then the **result**.

2.1

- genes are cut out with **restriction enzymes**

2.2

- the gene is joined into a plasmid by **(DNA) ligase**

2.3

- changing the genetic material of an organism by removing, changing or inserting individual genes

2.4

- any one of: resistance to herbicides, resistance to insect pests, extra vitamins (such as vitamin A in Golden Rice)

3.1 A

- a plasmid carrying an inserted gene is a **recombinant plasmid**
- B is the cutting enzyme; C and D are not plasmids

3.2

(a)

- cut the human gene with **restriction enzymes**, leaving sticky ends
- cut a plasmid with the same enzyme and join with **ligase**
- put the recombinant plasmid into a bacterium, which **expresses the gene**

(b)

- any **one** of: concerns about **health** / effects on **wild species** / cost of GM seeds

3.3

- bacteria reproduce very quickly
- they have plasmids, and they use the same genetic code, so they make the human protein

3.4

- the enzyme cuts both at the same base sequence
- leaving matching sticky ends, so the gene fits into (pairs with) the plasmid

3.5

(a)

- higher yield, or less insecticide needs to be bought and sprayed

(b)

- any one of: seeds are expensive, less genetic variation (biodiversity), the gene may spread to wild plants, harmless insects that eat the crop may be killed