

Question 40 (Answer: C)

- Restriction enzymes *cut* DNA, opening the plasmid and cutting out the gene.
- DNA ligase *joins* DNA, sealing the gene into the cut plasmid.
- So ligase is used at the stage where the insulin gene is inserted into the plasmid.

Question 40 (Answer: B)

- The gene must be cut out and the plasmid opened, both with restriction enzymes.
- Ligase then seals the gene into the plasmid, and the plasmid is taken up by the bacterium.
- Only after that can the bacteria be grown in a fermenter and the insulin extracted.

Question 40 (Answer: A)

- First the gene wanted is cut out and the plasmid is cut open, both with restriction enzymes.
- The gene is joined into the plasmid with ligase, and the plasmid is put into a bacterium.
- The bacterium then expresses the gene, so cutting comes before expression.

Question 40 (Answer: C)

- The human gene must first be inserted into the cut plasmid, and joined with ligase.
- The plasmid then goes into the bacterium.
- Only then can the bacteria be grown and made to express the gene, so insertion comes first.

3(a)	310 (%) ;;;
3(b)(i)	DNA ;

3(b)(ii)	<i>any two from:</i> 1 to check (that the GM crops) inherit / have / express, <u>gene</u> / <u>allele</u> (to produce insect resistance) ; 2 to check (that the GM crops) have the same / a high enough yield / good (described) quality product / AW ; 3 to check (that the GM crops) can grow in, intended / different environments / AW ; 4 to check the gene / allele / GM / crop / plant, does not cause any unexpected / unwanted, effects / AW ; 5 <i>idea</i> of building up a large quantity of, seed / plants / crops (to sell to farmers) ;
3(b)(iii)	<i>any six from:</i> 1 section of DNA / gene / allele, is isolated / cut / AW (from one organism's chromosome / DNA) ; 2 <u>restriction</u> enzymes used (to cut / isolate, gene / DNA / plasmid) ; 3 bacterial plasmid DNA and section of (one organism's) DNA / gene, cut with the <u>same</u> (restriction) enzyme ; 4 sticky ends formed (when restriction enzymes are used) ; 5 (sticky) ends / base pairs (of bacterial plasmid DNA and other organism DNA) are complementary ; 6 section of (one organism's) DNA / gene / allele, is inserted into (bacterial) plasmid (DNA) ; 7 (DNA) <u>ligase</u> used (to insert, gene / DNA, into plasmid) ; 8 <u>recombinant</u>, plasmid / DNA, is formed (when, gene / DNA, and plasmid are joined) ; 9 (recombinant / plasmid, DNA) inserted into, bacteria / another cell / organism ; 10 AVP; multiplication / reproduction / division / growth, of (GM) bacteria OR use of a fermenter for (GM) (for multiplication of bacteria) OR protein from (one organism's) gene / allele, made / expressed, in (GM) bacteria

3(c)(i)	<i>any one from:</i> 1 isolate / separate, (GM) crops and wild plants ; 2 grow (GM) crops in glasshouses ; 3 cover flowers (of GM crop) ; 4 remove, stamens / anthers / pollen (of GM crop) ; 5 plant another species around the (GM) crop ;
3(c)(ii)	<i>any two from:</i> 1,2 confer resistance to, herbicides / pesticides / disease / salinity / cold / hot / drought / wind (e.g. thicker stems) / heavy metals ;; 3 provide additional, nutrients / AW (to humans) ; 4 improved, yield / shelf life (of product) / flavour / quantity / appearance / AW ; 5 reduced pollution OR less / no, use of, fertiliser / pesticides ;

Question 40 (Answer: B)

- Genetic modification needs a small circle of DNA that can be cut open and have a gene inserted.
- That is the plasmid, which bacteria carry in addition to their main chromosome.
- It can then be taken back up by the bacterium, which expresses the new gene.