REVISION (3)
GRADE 9
CHAPTER # 21
BIOTECHNOLOGY
PAPER (3)

1 **(a)** Define the term *genetic engineering*.

ANS) <u>Taking a gene from one species and inserting it into another organism.</u>

(b) Fig. 6.1 is a flow diagram that shows how insulin can be produced using genetic engineering.

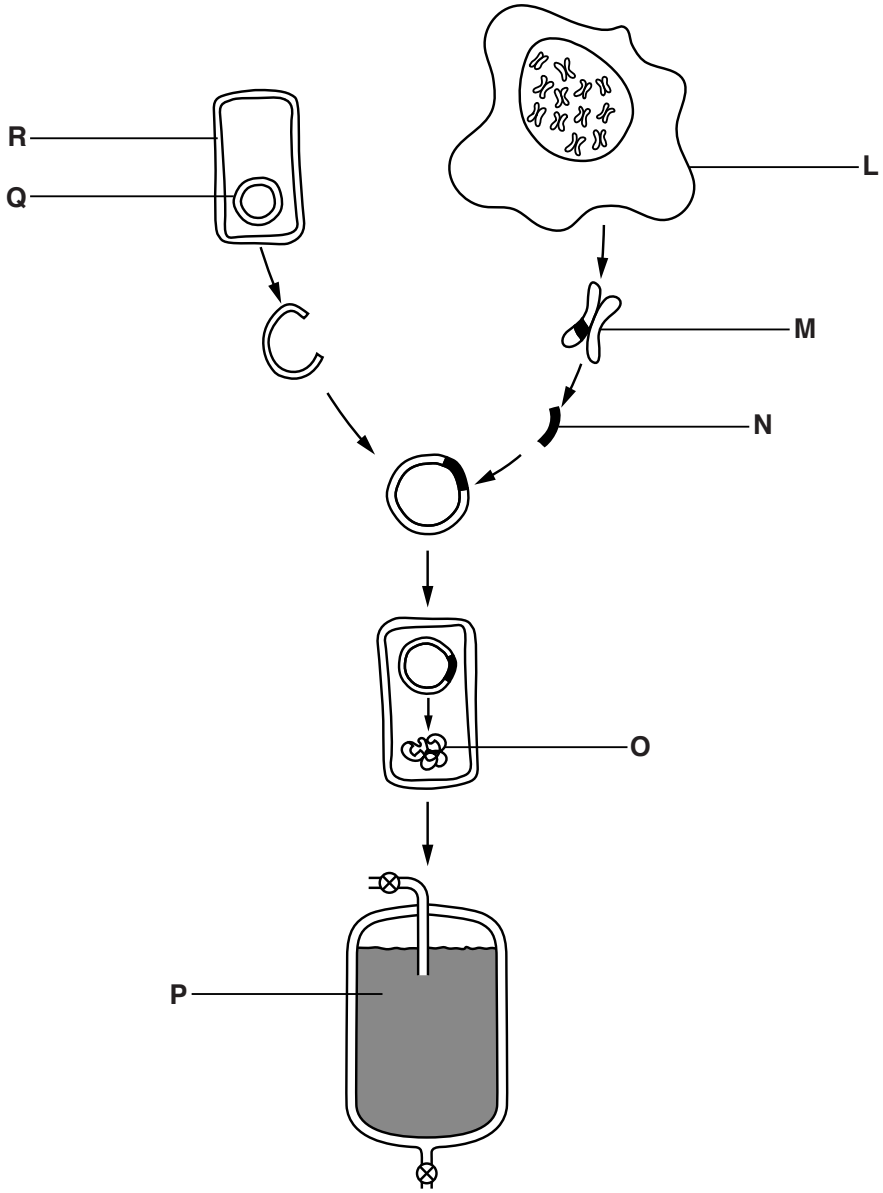

Fig. 6.1

Table 6.1 shows stages in the production of insulin by genetic engineering.

Complete Table 6.1. The first row has been done for you.

Table 6.1

letter from Fig. 6.1	name	description
M	chromosomes	threads of DNA found in the nucleus
		section of DNA removed from human cell
	plasmid	
		type of cell that is genetically engineered
		specific chain of amino acids coded by the section of DNA removed from the human cell
	fermenter	

[5]

ANS)

Letter from fig	Name	Descrip
M	chromosomes	threads of DNA found in the nucleus
N	gene / allele ;	section of DNA removed from human cell
Q	plasmid	vector / loop / circle, of DNA (that can carry a foreign section of DNA) / separate piece of DNA (from chromosome) ;
R	bacterial (cell) ; **A** yeast	type of cell that is genetically engineered
O	insulin / protein ;	specific chain of amino acids coded by the section of DNA removed from the human cell
P	fermenter	(container in which) bacteria / microorganisms / cells, reproduce / grow / produce insulin ;

(c) The genetically engineered cells in Fig. 6.1 reproduce asexually.

Explain the advantages of asexual reproduction for insulin production by genetic engineering.

ANS)

1) <u>They are genetically identical.</u>

<u>2) Less energy to reproduce (asexually) because only one parent is required no gametes are involved.</u>

<u>3) Large quantity of insulin produced.</u>

<u>4) All bacteria have the insulin gene & same insulin produced ;</u>

<u>5) Once cells are engineered does not have to be repeated e.g. no ethical or religious reasons & less allergic.</u>

<u>6) No immune rejection & no risk of disease (transmission).</u>

(d) Hormones are used to treat a variety of conditions.

The most common hormonal treatment is the use of insulin to treat diabetes. Most of the insulin is produced using cells that are grown in large fermenters. These cells have been genetically engineered to produce human insulin.

Fig. 2.2 shows the stages involved in transferring the gene for insulin from human cells to bacterial cells.

P	gene from human cell removed from chromosome 11
Q	bacterium produces human insulin
R	plasmid vector enters bacterium
S	gene for human insulin found to be on chromosome 11
T	bacterium divides by binary fission
V	gene for human insulin inserted into a plasmid vector

Fig. 2.2

(i) Put the stages into the correct sequence. Two have been done for you.

S					**Q**

[1]

ANS)

S	**P**	**V**	**R**	**T**	**Q**

(ii) Diabetes is often treated with human insulin that has been produced by genetically modified cells. In most countries this type of insulin has replaced the insulin that was prepared from animals.

Suggest the advantages of providing human insulin to people with diabetes rather than insulin obtained from animals.

ANS)

1) Easier & quicker to supply the demand.
2) More cost effective .
3) Less rejection or allergies & side effects .
4) Human insulin more effective (than animal insulin) .
5) It can be individually modified .
6) No risk of transmission of disease from animals .
7) No ethical or religious issues .

Q2)

Bovine somatotropin (BST) is a protein hormone that stimulates growth in cows.

(a) Name the small molecules that are joined together to make proteins.

ANS) Amino acids

(ii) Define the term *growth*.

ANS) Growth is a permanent increase in size and complexity of an organism.

(b) Genetic engineering techniques similar to those used for producing human insulin were used to make bacteria produce BST.

Outline the way in which genetic engineering was used to produce BST.

ANS)

1) Identify the position of gene in bovine genome.
2) Cutting chromosome/DNA/plasmid using restriction enzyme.
3) Insert gene into a plasmid (vector) .using ligase enzyme.
4) plasmid (vector) enters the bacterium cell.
5) Reproduction of (GM) bacteria in fermenters.
6) Bacteria produce, the protein BST .
7) Protein (BST) harvested/purified.

(c) The effects of BST on milk production and the food energy intake of cows were investigated.
The milk yield and food energy intake were recorded each day for each cow in two groups, **A** and **B**.

- Group **A** received BST treatment at week 10.
- Group **B** did not receive any BST.

The results are shown in Fig. 2.1.

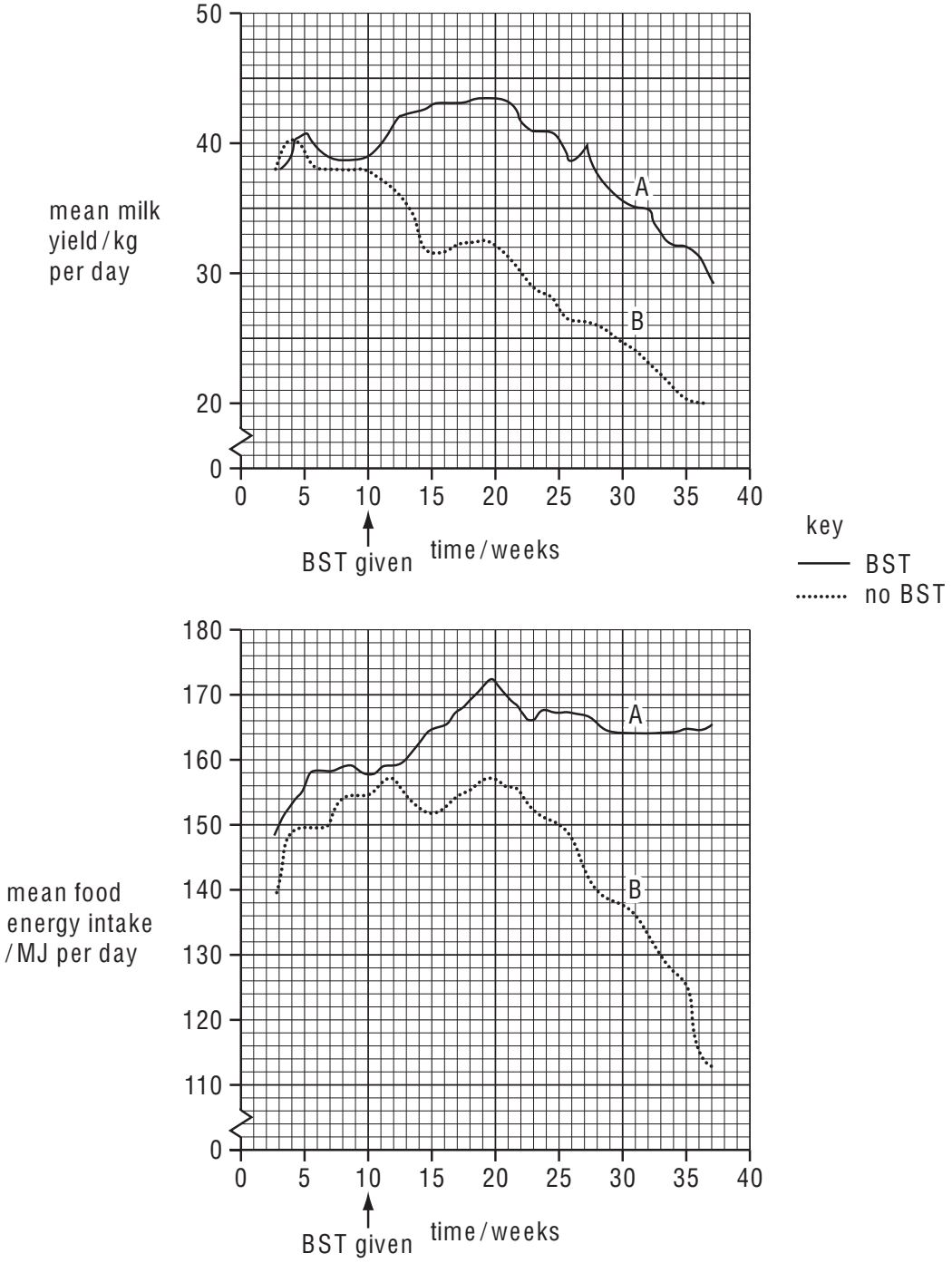

Fig. 2.1

(i) Use Fig. 2.1 to describe the effect of BST treatment on mean milk yield and mean food energy intake. You will gain credit if you use data from Fig. 2.1 in your answer.

ANS)
MEAN MILK YIELD:

1) Immediate increase after treatment at week 10.
2) Increases and decreases after 20 weeks (43.3 – 43.7 kg per day).
3) BST(A) yield always higher than no BST (B)(from 10 week/treatment).
4) 29 kg per day milk yield at 36–37 weeks.

MEAN FOOD ENERGY INTAKE:

1) Increase and decreases at 10 weeks & at start of treatment then levels off.
2) BST (A) energy always higher than no BST (B) from 10 week/treatment.
3) 158 MJ per day at 10 weeks or start of treatment
4) 164 MJ per day from week 29 – 34.

(ii) Various studies have shown that there is little economic benefit from using BST.

Use the results from Fig. 2.1 to explain why this might be so.

ANS)
1) Milk yield does not increase much in initial yield .
2) Increases only for 10 weeks or for short period.
3) Increase in food (energy) intake .
4) Cattle feed adds extra costs .
5) Milk yield decreases but food (energy) intake remains high in cows from 20 week.
7) After 20 weeks of treatment the differences in milk yield 10±2 kg (per day).

(d) The US Food and Drug Administration certifies that milk from cows treated with BST is as safe as milk from cows not treated with the hormone.

It is impossible to test milk to detect the use of BST, but some milk producers in the US label their milk to indicate that it is BST-free.

Discuss the reasons for labelling milk to show whether it has come from cattle treated with BST or not.

ANS)

1) Labelling provides information to the consumer.

2) Confusion in consumer minds about GM food results in loss in sales because consumer concerns about hormones 'in the milk' .

3) Possible effects on human health e.g. allergies.

4) Health of cattle expected to produce more milk.

5) There is no difference in the milk because this is not a GM food, but GM technology is used in the production of BST.

6) There is no reason to label the milk.

3 Fig. 1.1 shows a diagram of a bacterial cell.

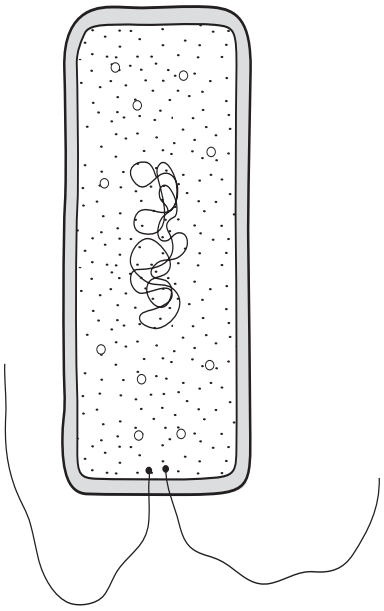

Fig. 1.1

(a) (i) State four structural features, present in a photosynthesising plant cell, that make it different from the bacterial cell in Fig. 1.1.

ANS)
1) It contain chloroplasts.
2) Photosynthesizing cell contain cellulose cell wall while bacterial cell wall is made of murein .
3) Photosynthesizing cell contain large permanent vacuole.
4) Nuclear membrane present in photosynthesizing cell .

(ii) State two structural features present in both the bacterial cell in Fig 1.1 and in an animal cell, such as a liver cell.

ANS)
1) Cell membrane
2) Cytoplasm
3) Ribosomes
4) Chromosomes

(b) Bacteria are examples of microorganisms. State two different types of food manufactured using microorganisms.

ANS)
cheese
yoghurt
sour milk

(c) Many bacterial diseases can no longer be treated with antibiotics. Outline how antibiotic-resistant strains of bacteria can develop.

ANS)
1) mutation / mutant
2) Less permeable wall to breakdown by antibiotics.
3) Antibiotic kills bacteria except those that are resistant to antibiotic.
4) Natural selection resistant bacteria reproduce and increase their population.

(d) Explain why bacteria, in particular, are very useful organisms in the process of genetic engineering.

ANS)

1) Fast reproduction rate.

2) Identical offsprings are produced .

3) Small number of genes.

4) It is easy to put gene in bacteria.

5) No ethical issues that might arise while using animals.

6) Bacteria have plasmids that can easily transfer from one bacterium to another.