

3 The *lac* operon is present in the genome of the bacterium *Escherichia coli*.

When glucose is **not** available, the presence of lactose in the extracellular environment leads to the expression of the genes of the *lac* operon. This leads to an increase in the uptake and metabolism of lactose.

When glucose **and** lactose are available in the extracellular medium, lactose is prevented from entering the bacterial cell.

Fig. 3.1 shows what happens when glucose enters a bacterial cell.

- Glucose enters the bacterial cell using a transport protein, **A**.
- **B** is an enzyme found in the cytoplasm of the bacterial cell.
- **B** catalyses the phosphorylation of glucose to produce glucose 6-phosphate.

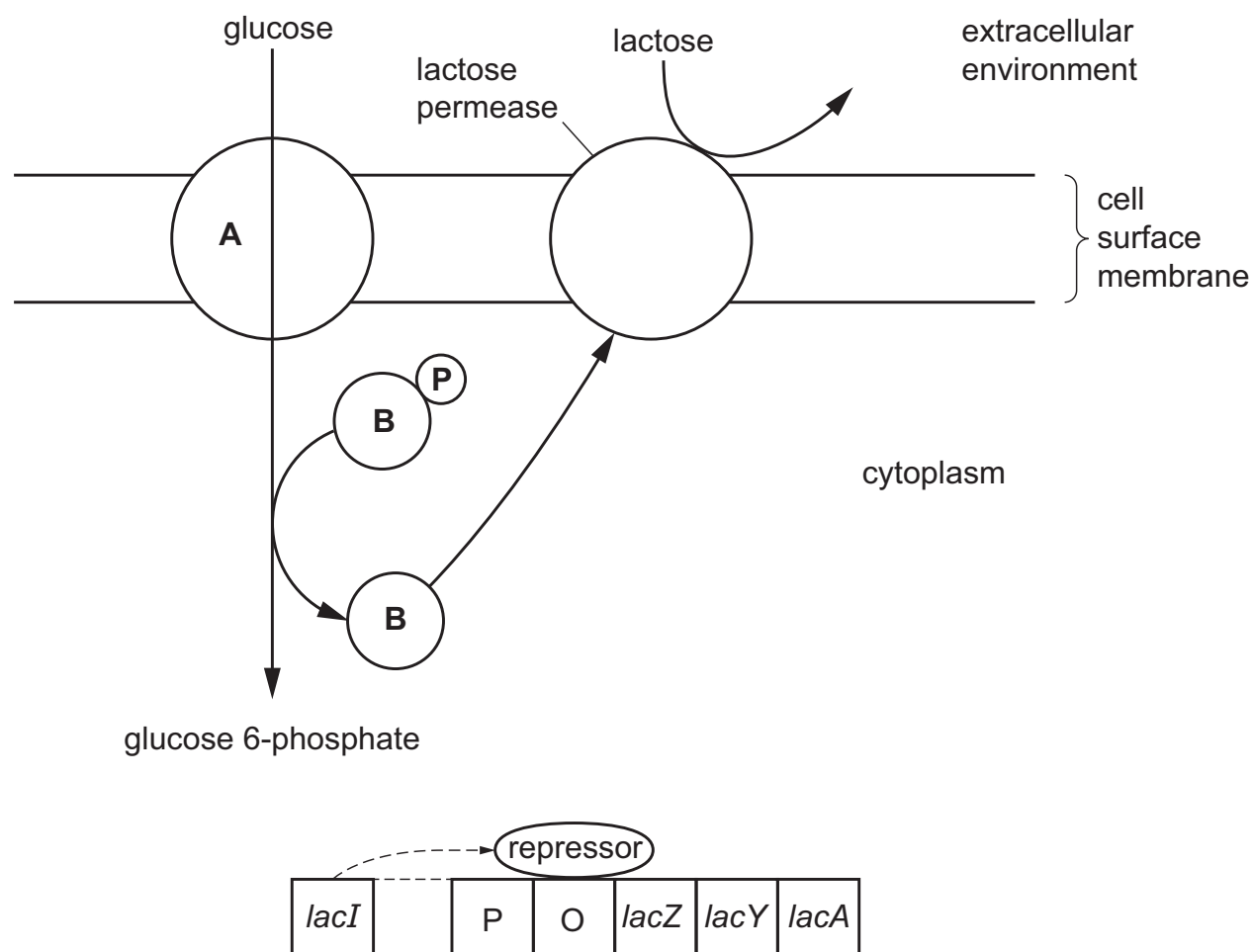


Fig. 3.1

(a) (i) With reference to Fig. 3.1, suggest **and** explain how the presence of glucose in the extracellular environment prevents lactose entering the bacterial cell.

.....

 [3]

(ii) Suggest the advantages for the bacterial cell in preventing the entry of lactose when glucose is present in the extracellular environment.

.....

 [2]

(iii) The glucose 6-phosphate in the cytoplasm of the bacterial cell is used to produce fructose 1,6-bisphosphate.

Fructose 1,6-bisphosphate is used in glycolysis.

Outline the events that occur in glycolysis following the production of fructose 1,6-bisphosphate.

.....

 [3]

(b) *E. coli* is present in the gut (intestines) of young mammals.

The diet of young mammals contains lactose which is present in the milk they consume.

Scientists carried out an experiment using *E. coli* with a *lac* operon (*lac*⁺ *E. coli*) and *E. coli* without a *lac* operon (*lac*⁻ *E. coli*).

The experiment was carried out to determine whether the presence of a *lac* operon gives *E. coli* a selective advantage.

- Equal numbers of *lac*⁺ *E. coli* and *lac*⁻ *E. coli* were given to 8 mice to allow the bacteria to colonise the gut.
- On day 0, 50% of the *E. coli* in the gut of each mouse were *lac*⁺ *E. coli*.
- 4 mice were fed a standard diet that included lactose.
- 4 mice were fed a standard diet without lactose.
- The percentage of *lac*⁺ *E. coli* that were in the gut of each mouse was determined every day for 6 days.

The results are shown in Fig. 3.2.

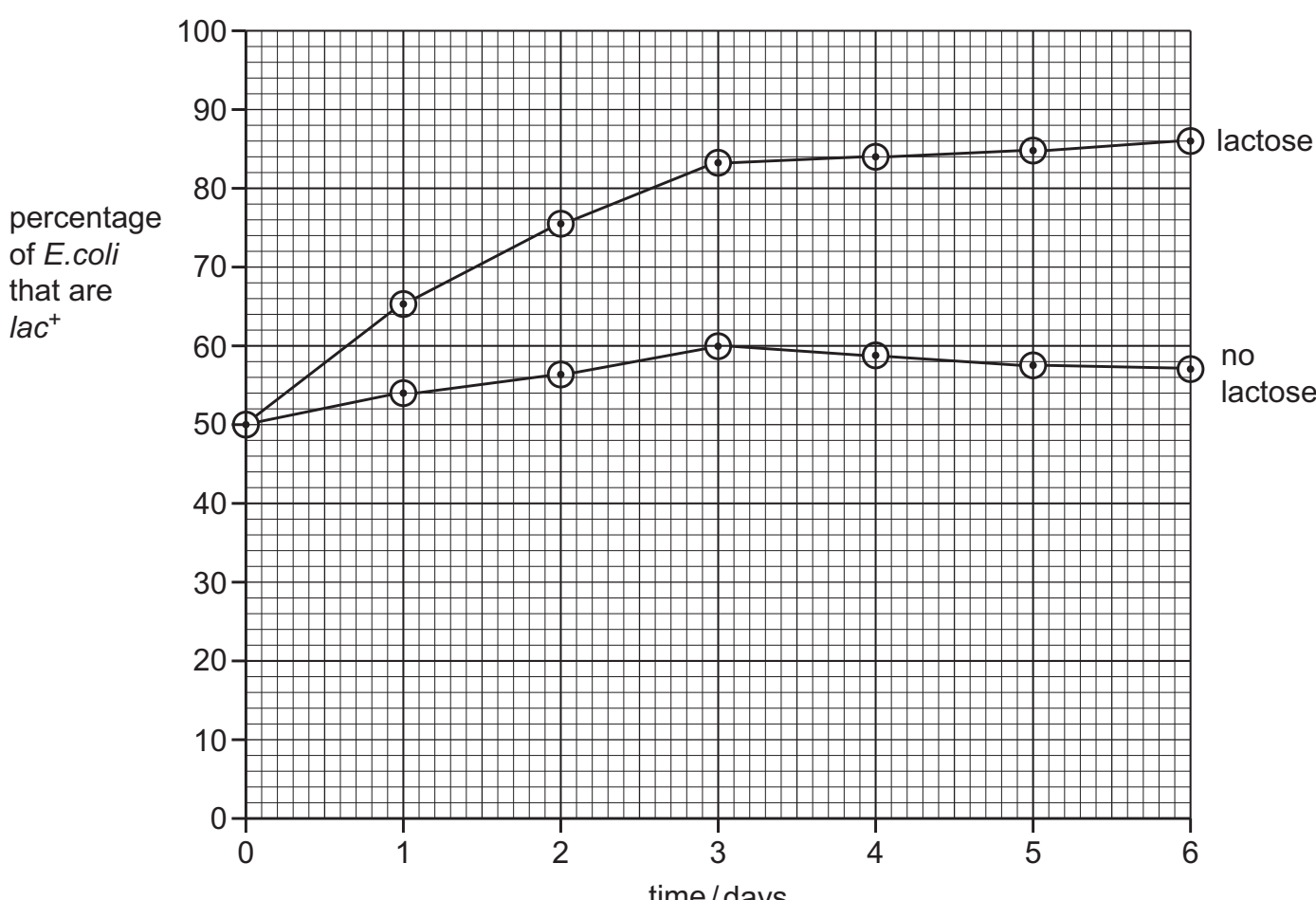


Fig. 3.2

(i) With reference to Fig. 3.2, describe the effect of the different diets on the percentage of *E. coli* that are *lac*⁺.

.....

 [2]

(ii) The scientists concluded that *lac*⁺ *E. coli* had a selective advantage when colonising the gut, but only in the presence of lactose.

Suggest why the presence of lactose caused *lac*⁺ *E. coli* to have a selective advantage.

.....

 [2]