

16.3 Gene Control

Question Paper

Course	CIEA Level Biology
Section	16. Inheritance
Topic	16.3 Gene Control
Difficulty	Medium

Time allowed: 40
Score: /33
Percentage: /100

Question 1a

The enzyme lactase is an example of an inducible enzyme.

(i)

State why lactase can be described as an inducible enzyme.

[1]

(ii)

Explain the importance of inducible enzymes.

[1]

[2 marks]

Question 1b

In certain species of bacteria, such as *Escherichia coli*, transcription of the structural genes of the lac operon enables the production of lactase. This process only occurs in the presence of lactose, and is also affected by the presence or absence of glucose.

In the absence of glucose, *E. coli* cells produce the molecule cAMP. cAMP binds to a catabolite activator protein (CAP), activating it and allowing it to bind to a region of the lac operon known as the CAP site. The presence of the CAP protein makes it easier for RNA polymerase to bind and greatly increases the transcription rate of the structural genes. RNA polymerase does not bind well to the promoter in the absence of CAP.

Fig. 1 illustrates the effect of CAP on the transcription rate of the structural genes.

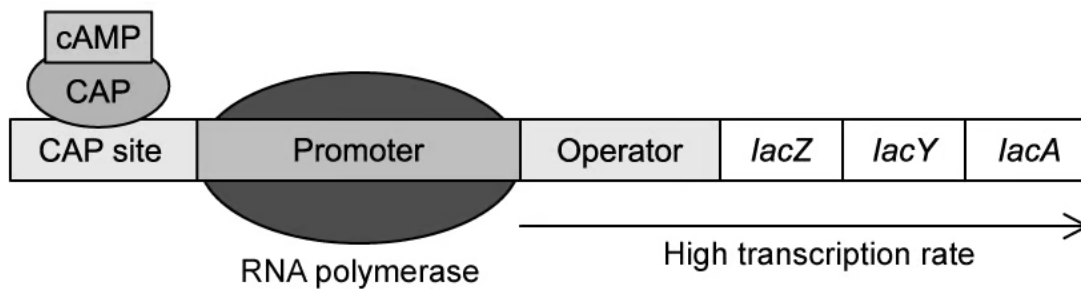


Fig. 1

(i)

Explain why the structural genes are transcribed in the presence of lactose.

[3]

(ii)

Suggest how the transcription of the structural genes would be affected if *E. coli* was grown in a medium that contained both glucose **and** lactose.

[3]

[6 marks]

Question 1c

In the absence of lactose *E. coli* will not produce lactase.

State the role of the operator region in preventing the production of lactase.

[1 mark]

Question 2a

Gibberellin is a plant hormone that plays an important role in controlling seed germination.

Describe how gibberellin influences gene expression in a germinating seed.

[5 marks]

Question 2b

Scientists will often analyse the RNA that is produced when studying gene expression in cells.

Explain the importance of RNA analysis in the study of gene expression in an organism.

[2 marks]

Question 2c

Suggest why it is important for gibberellin to control the germination of seeds.

[2 marks]

Question 3

Explain genetic control of protein production in a prokaryote using the lac operon.

[7 marks]

Question 4a

The *lac* operon is a section of DNA present in the genome of *Escherichia coli*. The structural genes of the *lac* operon are only fully expressed when the bacteria are exposed to high lactose concentrations.

Fig.1 is a diagram showing the *lac* operon and a nearby region of the *E. coli* genome.

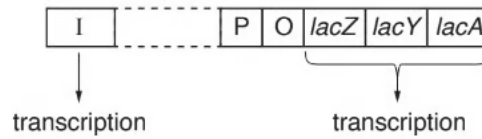


Fig. 1

(i)

Fig.1 shows how the *lac* operon consists of structural genes and regulatory sequences.

Use Fig. 1 to identify two structural genes.

Complete Table 1 to name each structural gene and its product.

Table 1

structural gene	name of gene product

[2]

(ii)

Gene I is transcribed all the time to produce its protein. This is constitutive expression.

Explain why some genes show constitutive expression.

[1]

(iii)

Describe the effect of the product of gene I on the functioning of the *lac* operon.

[2]

[5 marks]

Question 4b

If *E. coli* is put into a nutrient medium containing lactose, some new enzymes are synthesised. These are described as inducible enzymes.

(i)

Explain what is meant by an *inducible enzyme*.

[2]

(ii)

The structural genes of the *lac* operon are **not** expressed when lactose is absent.

Suggest **one** reason why this is beneficial to *E. coli*.

[1]

[3 marks]