

**Model Answers: Easy**

1a

(a) Region **X** and enzyme **Y** are...

- **X** = Promoter (region); [1 mark]
- **Y** = RNA polymerase; [1 mark]

**[Total: 2 marks]**

1b

(b) The following events take place during stages **2** and **3**...

- Stage **2** = RNA polymerase binds to the start of the gene; [1 mark]
- Stage **3** = Transcription is initiated / the RNA polymerase begins to transcribe the DNA; [1 mark]

**[Total: 2 marks]**

1c

(c) A mutation in the gene coding for the transcription factor in Fig. 1 might cause...

- No/reduced expression/transcription (of the gene); [1 mark]

Because...

- The tertiary structure of the transcription factor would be different/altered/changed **OR** the transcription factor would no longer be complementary to the promoter region / the transcription factor would not be able to bind to the promoter region; [1 mark]

**[Total: 2 marks]**

This question requires you to apply your knowledge of both protein structure and mutations to a situation involving transcription factors. You don't need to understand a great deal about transcription factors to be able to answer the question; just the effect of a mutation on protein structure and function.

1d

(d) A transcription factor could act as a repressor by...

- Preventing/blocking RNA polymerase from binding to the start of the gene (by binding to the promoter region); [1 mark]
- (This results in the) inhibition of transcription / a slower rate of transcription; [1 mark]

**[Total: 2 marks]**

2a

(a)(i) The genes of the *lac* operon can be identified as...

- Structural; [1 mark]

(a)(ii) The reason for this is...

- (These genes) code for a protein/lactase that has a function within the (bacterial) cells; [1 mark]

**[Total: 2 marks]**

Ensure that you are familiar with the terminology found within this topic as this will provide the foundation from which to build an understanding of gene control mechanisms.

2b

(b) An inducible enzyme...

- Is only synthesised in the presence of their substrate/lactose; [1 mark]

**[Total: 1 mark]**

Producing an enzyme only when its substrate is present prevents materials and energy from being wasted by the cell.

2c

(c) The purpose of lactase in some bacterial cells include...

- To break down (the substrate) lactose (into glucose and galactose); [1 mark]
- (So that it can be) used as an energy source (in bacterial cells); [1 mark]

**[Total: 2 marks]**

This is a useful mechanism by which some bacterial cells can utilise lactose as an energy source, especially when their preferred substrate (glucose) is in short supply.

2d

(d)(i) The name of the protein that *lacI* codes for is...

- *lac* repressor (protein); [1 mark]

(d)(ii) The role of this protein is...

Any **two** of the following:

- It binds to the operator region upstream of *lacZ* (when lactose is absent); [1 mark]
- (This means that) RNA polymerase is unable to bind to the promoter region; [1 mark]
- No transcription of the structural genes take place / no lactase is synthesised; [1 mark]

**[Total: 3 marks]**

3a

(a) Molecules **A** and **B** can be identified as follows...

- **A** = Gibberellin; [1 mark]
- **B** = DELLA (repressor protein); [1 mark]

**[Total: 2 marks]**

3b

(b) The effect of molecule **A** binding to its receptor on molecule **B** is...

- Molecule **B**/DELLA will be broken down; [1 mark]

**[Total: 1 mark]**

3c

(c) A transcription factor is...

- A protein that controls the transcription of genes; [1 mark]
- By binding to a specific region of DNA; [1 mark]

**[Total: 2 marks]**

Some transcription factors will bind to the promoter region of a gene where it will affect the rate of transcription.

3d

(d) The importance of **PIF** binding to the promoter region (**P**) includes...

- It initiates transcription of the amylase gene; [1 mark]
- Amylase is produced (to facilitate germination of seeds); [1 mark]

**[Total: 2 marks]**

Amylase is responsible for breaking down stored starch within the seeds so that it can be utilised as an energy source for growth and other cellular processes.