

# 8.1 Metabolism

## Question Paper

Course	DP IB Biology
Section	8. Metabolism, Cell Respiration & Photosynthesis (HL Only)
Topic	8.1 Metabolism
Difficulty	Medium

**Time allowed:** 60  
**Score:** /46  
**Percentage:** /100

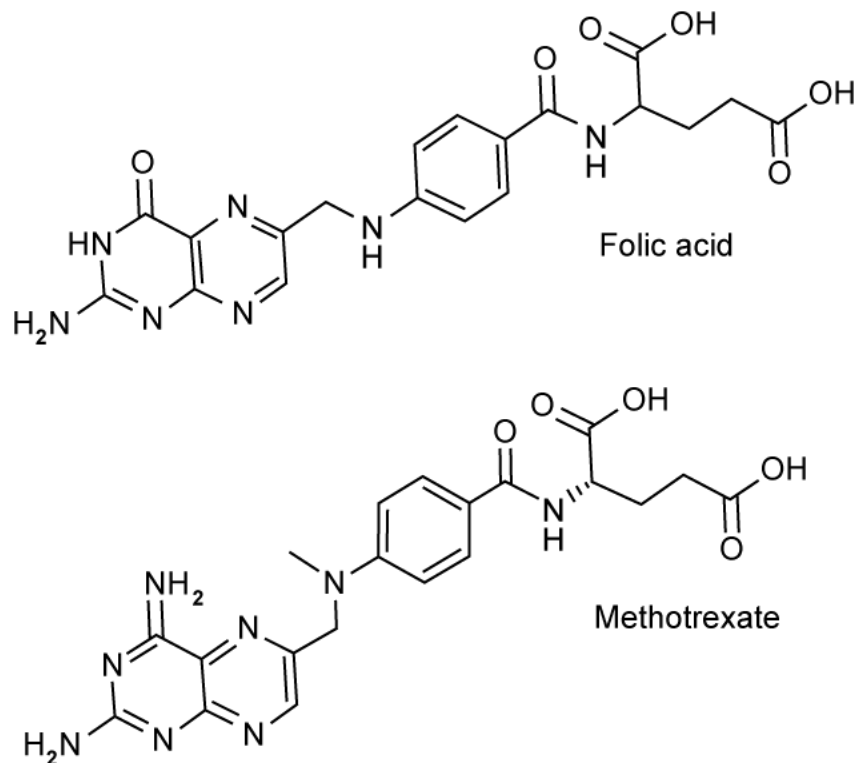
### Question 1a

a)

Folate is a chemical used by cancer cells to make DNA during cell division. Folate is produced through the conversion of folic acid catalysed by the enzyme dihydrofolate reductase.

Methotrexate is a medicinal drug given to people with cancer, and other autoimmune diseases, as it acts as an inhibitor for the enzyme dihydrofolate reductase.

The image below shows the chemical structure for the enzyme's normal substrate, folic acid, as well as the structure of its inhibitor, methotrexate.



Using the images, suggest the method of inhibition used by methotrexate. Explain your answer.

[2 marks]

### Question 1b

b)

Folate is not just used by cancer cells during replication, but by any cells of the human body that replicate quickly.

Methotrexate is commonly used as part of chemotherapy treatment for cancer sufferers.

Using this information, suggest why people that undergo chemotherapy lose their hair.

**[3 marks]**

### Question 1c

c)

There are many enzymes that are unique to cancer cells. Designing drugs to specifically target those enzymes could remove many difficult side-effects for the patients.

Reference to databases of information detailing the action and chemical structure of different chemicals could aid scientists in identifying a suitable chemical to tackle cancer cells without the same impact on other body cells seen in the use of methotrexate.

State the name given to this method of chemical identification and suggest how it might be used to identify suitable cancer drugs.

**[2 marks]**

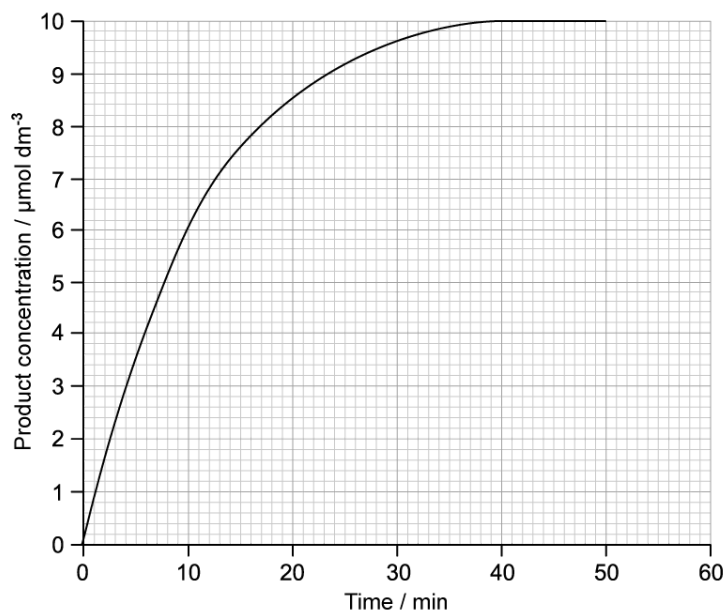
### Question 2a

a)

Trypsin is an enzyme produced by the pancreas that hydrolyses proteins in the small intestine.

The activity of trypsin was investigated by placing a small amount of the enzyme with a known concentration of protein.

The graph below shows the progress of this reaction when it is carried out at 25 °C.



Calculate the initial rate of the reaction in the graph. Show your working.

[2 marks]

### Question 2b

b)

The procedure was repeated at the same temperature in the presence of a competitive inhibitor of trypsin.

Predict the results that will be obtained using the competitive inhibitor.

[2 marks]

### Question 2c

c)

Describe how your prediction for part b) would be different if a non-competitive inhibitor was used rather than a competitive inhibitor.

[2 marks]

### Question 2d

d)

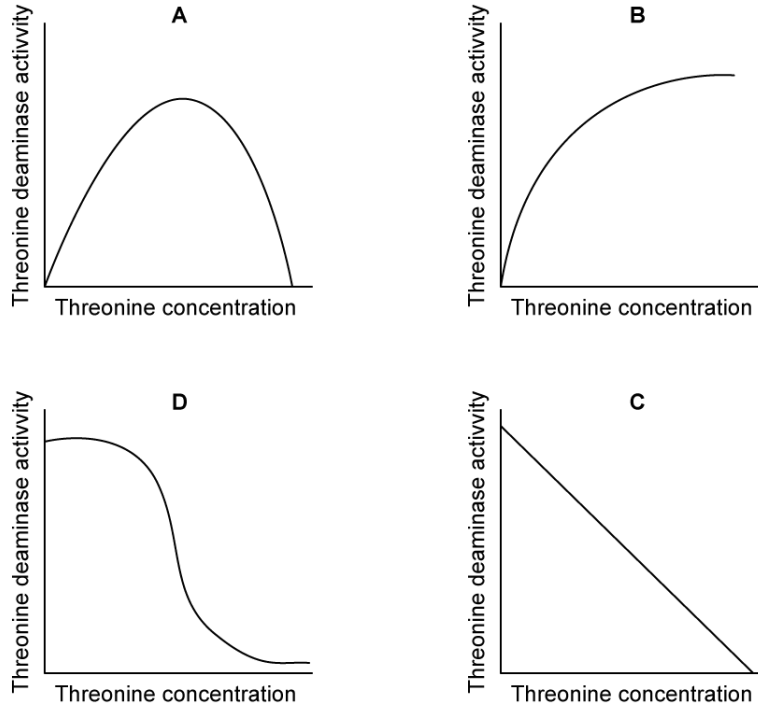
The investigation was extended to compare the initial reaction rates of trypsin obtained from different species of animal.

Suggest **two** advantages of calculating the **initial** reaction rates of enzyme catalysed reactions here rather than the reaction rates at another point during the experiment.

[2 marks]

### Question 3a

a)  
Threonine deaminase catalyses the conversion of threonine into an intermediate substrate, before producing the end product of isoleucine.



State which graph represents the relationship between threonine concentration and threonine deaminase concentration.

[1 mark]

### Question 3b

b)  
Explain the effect a build up of isoleucine concentration would have on the activity of threonine deaminase.

[3 marks]

**Question 3c**

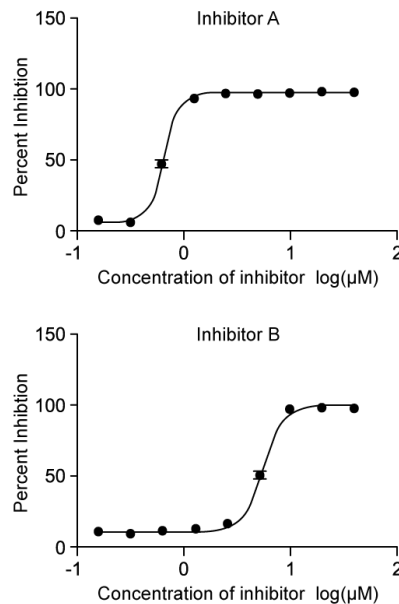
c)  
Explain how end product inhibition is an example of negative feedback.

[3 marks]

**Question 4a**

a)  
*Plasmodium falciparum* is a protozoan parasite of humans that causes malaria. Scientists have sequenced the proteome of this parasite and have determined a number of enzymes involved in its metabolic pathways. One such enzyme is hexokinase which is involved in the phosphorylation of glucose within the parasite.

The scientists tested two potential enzyme inhibitors, Inhibitor A and Inhibitor B, on the activity of hexokinase. The results are shown in the graphs below.



Compare and contrast the effect of the two inhibitors on the percentage inhibition.

[2 marks]

### Question 4b

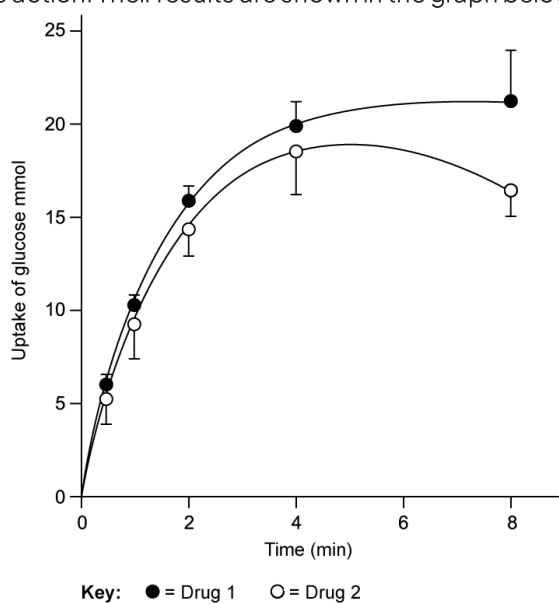
b)  
Deduce, with reasons, whether the inhibitors act as competitive or non-competitive inhibitors.

[2 marks]

### Question 4c

c)  
The *Plasmodium falciparum* parasite depends on glycolysis for its survival, particularly the uptake of glucose from its host cells which is mediated by hexokinase.

The scientists investigated the action of hexokinase within *Plasmodium falciparum*. They tagged hexokinase with two different potential drugs that inhibit its action. Their results are shown in the graph below.



Describe how to calculate the rate of reaction from the graph.

[2 marks]



**Question 4d**

d)

The scientists concluded that drug 1 was less effective than drug 2.

Evaluate this conclusion.

**[3 marks]****Question 5a**

*One mark is available for clarity of communication throughout this question.*

a)

Explain the effect of inhibitors on the activity of enzymes.

**[8 marks]**

**Question 5b**

b)

Outline how bioinformatics has been used to identify anti-malarial drugs.

**[4 marks]****Question 5c**

c)

Distinguish between an enzyme catalysed reaction and a non enzymatic reaction.

**[3 marks]**