Enzymes – AS 9700 Biology June 2022

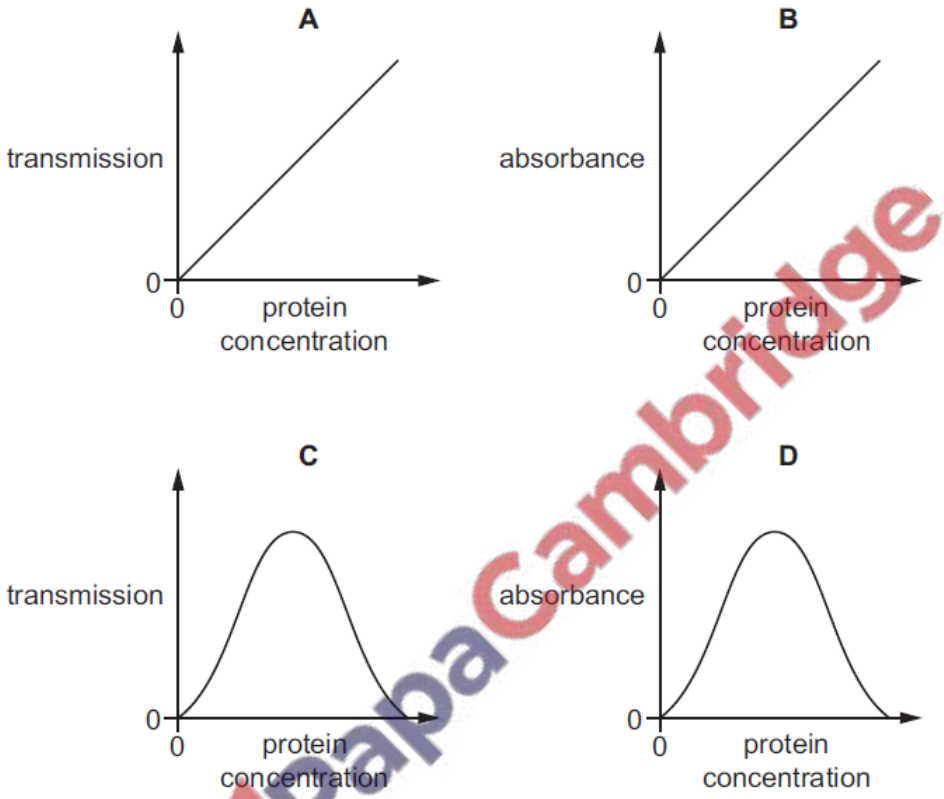
1. June/2022/Paper_11/No.12

A student used colorimetry to monitor the hydrolysis of a protein by a protease enzyme.

The student used biuret solution to determine the concentration of protein in the hydrolysis reaction.

The student produced a calibration curve using known concentrations of protein.

Which diagram shows the calibration curve?



2. June/2022/Paper_11/No.13

A student completed an experiment to measure how increasing concentrations of substrate affects the rate of an enzyme-controlled reaction.

The student then repeated the experiment after adding a fixed quantity of a reversible competitive inhibitor.

Which row describes the effect of a reversible competitive inhibitor on enzyme activity?

	attachment of inhibitor at active site	effect of increasing substrate concentration on rate of enzyme-controlled reaction
A	no	little effect on the rate
B	yes	rate increases
C	no	rate increases
D	yes	little effect on the rate

3. June/2022/Paper_11/No.20

Telomerase is an enzyme that adds nucleotides to telomeres.

Which statement about telomerase is correct?

A A high concentration of telomerase in a cell damages genes during DNA replication.

B A high concentration of telomerase in cancerous cells limits the rate of tumour growth.

C The low concentration of telomerase in stem cells means that these cells can divide an unlimited number of times.

D The low concentration of telomerase in body cells means that these cells can divide a limited number of times.

4. June/2022/Paper_12/No.11

Typical enzymes are large globular proteins with a specific tertiary shape.

Which molecular interactions are directly involved in maintaining the tertiary shape?

1 hydrogen bonding

2 disulfide bridges

3 hydrophobic interactions

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

5. June/2022/Paper_12/No.12

Which statement about the Michaelis–Menten constant (K_m) is correct for an enzyme with a low affinity for its substrate?

A It has a high K_m and reaches V_{max} at a high substrate concentration.

B It has a high K_m and reaches V_{max} at a low substrate concentration.

C It has a low K_m and reaches V_{max} at a high substrate concentration.

D It has a low K_m and reaches V_{max} at a low substrate concentration.

6. June/2022/Paper_12/No.13

Long chain, saturated fatty acids change from solid to liquid at higher temperatures compared with short chain, unsaturated fatty acids.

Which fatty acids would be more likely to form triglycerides in mammals that live in cold climates?

A long chain saturated

B long chain unsaturated

C short chain saturated

D short chain unsaturated

7. June/2022/Paper_13/No.13

What is a feature of competitive enzyme inhibition?

A The inhibitor binds permanently to the active site.

B Inhibition can be reversed by increasing the concentration of the substrate.

C The inhibitor molecule changes the secondary structure of the enzyme.

D The substrate and the inhibitor are the same shape.

8. June/2022/Paper_22/No.4

The enzyme carbonic anhydrase has been found in a wide range of organisms and acts as a catalyst in many tissues.

Studies have shown that there are differences in the protein structure of the enzyme and differences in the number and organisation of introns and exons of the gene coding for the enzyme.

All carbonic anhydrase enzymes catalyse the same reversible reaction, shown in Fig. 4.1.

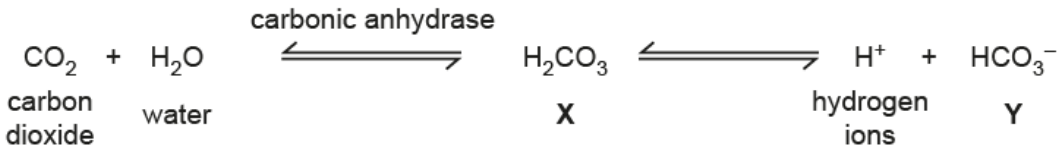


Fig. 4.1

(a) With reference to Fig. 4.1, name **X** and **Y**.

X .....

Y .....

[2]

(b) Carbonic anhydrase enzymes can have different primary structures.

Suggest how all carbonic anhydrase enzymes can catalyse the same reaction, even though they have different primary structures.

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..... [1]

(c) Genes coding for proteins in eukaryotes consist of introns and exons.

Outline the similarities and differences between the introns and the exons of genes coding for proteins such as carbonic anhydrase.

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..... [3]

All mammals have the same type of carbonic anhydrase, known as α-carbonic anhydrase. Many different forms, or isoforms, of α-carbonic anhydrase have been identified in mammals.

There are 15 isoforms of α-carbonic anhydrase (CA) in humans. Cells of different tissues have one or more isoforms. Within cells the isoforms may be in different locations.

(d) Red blood cells contain two isoforms, CA1 and CA2.

Suggest the location of CA1 and CA2 in red blood cells **and** give a reason for your answer.

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..... [2]

(e) Isoform CA6 forms part of human breast milk. Mammary gland cells package CA6 in Golgi vesicles for release from the cells.

Name the transport mechanism associated with CA6 secretion.

..... [1]

(f) Human CA isoforms in some epithelial cells in the eye have a role in the formation of the clear fluid of the eye known as aqueous humour. Overactivity of the enzyme may lead to a harmful increase of pressure within the eye and cause a condition known as glaucoma.

Acetazolamide is a therapeutic drug that can be used in the treatment of glaucoma. It acts as a reversible non-competitive inhibitor.

Describe the mechanism of action of acetazolamide as a reversible non-competitive inhibitor of carbonic anhydrase.

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..... [3]

[Total: 12]

9. June/2022/Paper_22/No.5

Arachidonic acid is a fatty acid that is a common component of phospholipids.

Phospholipids can be used as a source of arachidonic acid when it is metabolised within cells in an enzyme-catalysed pathway known as the cyclooxygenase (COX) pathway.

The final products of the COX pathway can be different in different cell types, causing a range of responses. In some cells, the products are involved in the inflammatory response, which is a response by the body to infection. In other cells, cell division is stimulated.

Fig. 5.1 shows the **first reaction** in the COX pathway. This reaction is catalysed by an enzyme known as COX-2.

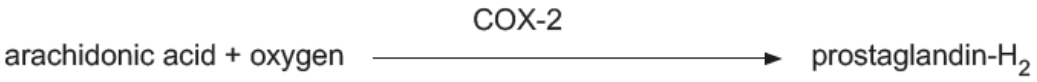

Fig. 5.1

(a) The enzymes involved in the COX pathway are located in the membrane of rough endoplasmic reticulum.

Suggest the advantages to the cell of enzyme pathways being located in cell membranes, rather than in the cytosol of the cell (fluid portion of cytoplasm).

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(b) During an inflammatory response, compounds produced by the COX pathway cause an increased sensitivity to pain.

Some anti-inflammatory drugs are reversible competitive inhibitors of COX-2.

Fig. 5.2 shows how increasing arachidonic acid concentration affects COX-2 activity.

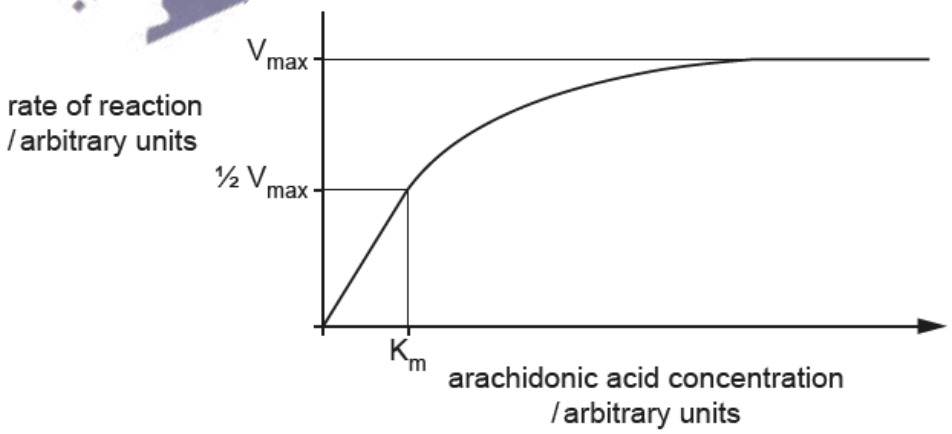

Fig. 5.2

(i) Sketch on Fig. 5.2 the curve obtained if an anti-inflammatory drug, which is a **competitive** inhibitor, is present with arachidonic acid. [1]

(ii) Complete the statements to show whether the maximum rate of reaction (V_{max}) and the Michaelis-Menten constant (K_m) of COX-2 **increases**, **decreases**, or **stays the same** in the presence of a competitive inhibitor.

In the presence of a competitive inhibitor:

V_{max} of COX-2 .....

K_m of COX-2 ..... . [2]

(c) COX-2 is composed of two identical polypeptides. The enzyme is produced when a gene, *PTGS2*, located on chromosome 1, is switched on and transcription begins.

(i) Using gene *PTGS2* and enzyme COX-2 as examples, explain what is meant by a gene.

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..... [2]

(ii) Some mutations in *PTGS2* lead to an increased rate of transcription. These mutations have been linked to an increased risk of certain types of cancer.

Suggest why mutations in *PTGS2* may increase the risk of cancer.

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..... [2]

(d) Fig. 5.3 shows the molecular structure of arachidonic acid. Not all hydrogen atoms are shown.

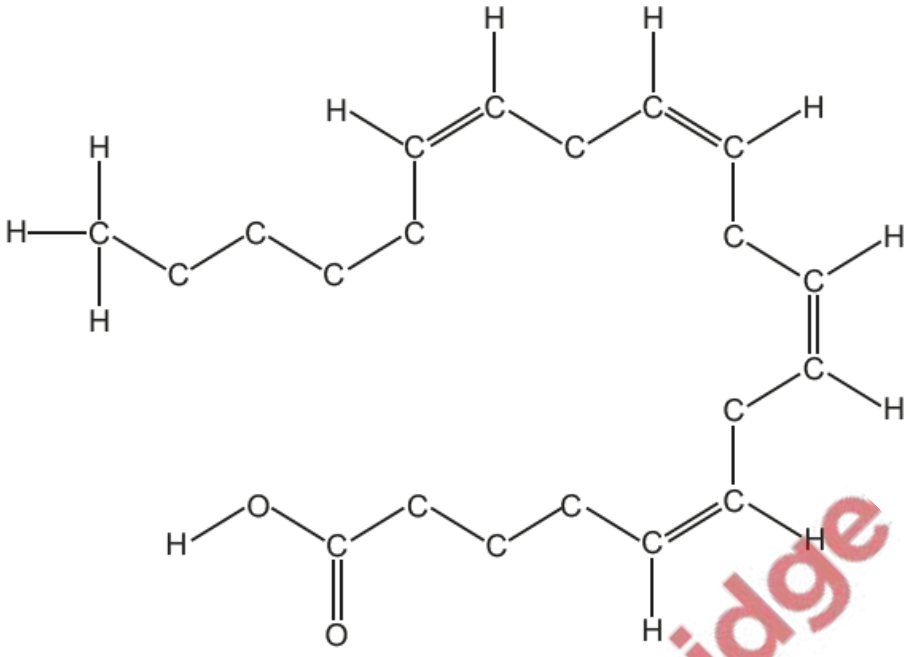

Fig. 5.3

With reference to Fig. 5.3, explain why increasing the proportion of phospholipids with arachidonic acid in a cell will increase the fluidity of the cell surface membrane of the cell.

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[Total: 12]