3. Enzymes

1.

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

Ans: B

2.

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.

Ans: A

3.

RNA polymerase and peptidyl transferase are both enzymes involved in protein synthesis.

Which statements describe similarities between these two enzymes?

1 They are both globular proteins.

2 They both have the same tertiary structure.

3 They are both intracellular enzymes.

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

Ans: B

4.

Which statement describes an example of an extracellular enzyme?

A Amylase in saliva is an enzyme that catalyses the breakdown of starch in the mouth.

B Carbonic anhydrase is an enzyme that helps in the transport of carbon dioxide in blood.

C DNA polymerase is an enzyme that helps build DNA molecules from nucleotides.

D RNA polymerase is an enzyme involved in the process of gene transcription.

Ans: A

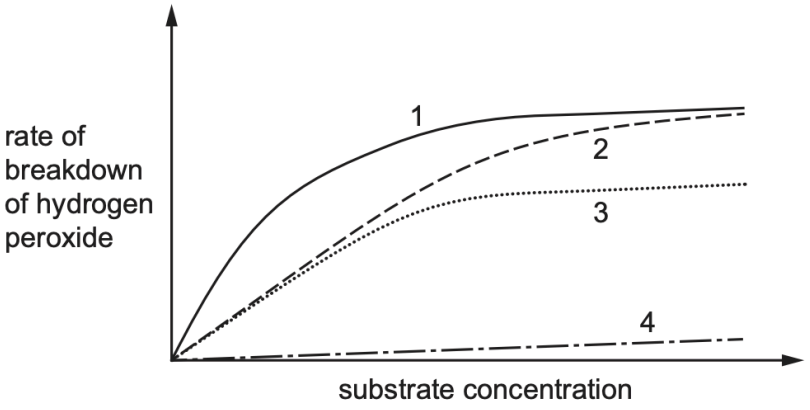
5.

A scientist investigated the rate of breakdown of hydrogen peroxide.

Four experiments were carried out using different mixtures.

- substrate only
- substrate + enzyme
- substrate + enzyme + competitive inhibitor
- substrate + enzyme + non-competitive inhibitor

The results are sketched in the graph.



Which row shows the correct lines for two of the experimental mixtures?

	substrate only	substrate + enzyme + competitive inhibitor
A	1	2
B	4	2
C	1	3
D	4	3

Ans: B

NOTE: curve 1 is for substrate + enzyme. For only substrate, reaction rate is too low to sustain, so it should be 4!!

6. in

Ans: D

7. Ans: C
   - Hydrolysis of fat = fatty acids, which decreases the pH!

8.

What is the correct order of locations in the cell for the production of an extracellular enzyme?

A nucleus → ribosome → rough endoplasmic reticulum → Golgi body

B ribosome → nucleus → Golgi body → rough endoplasmic reticulum

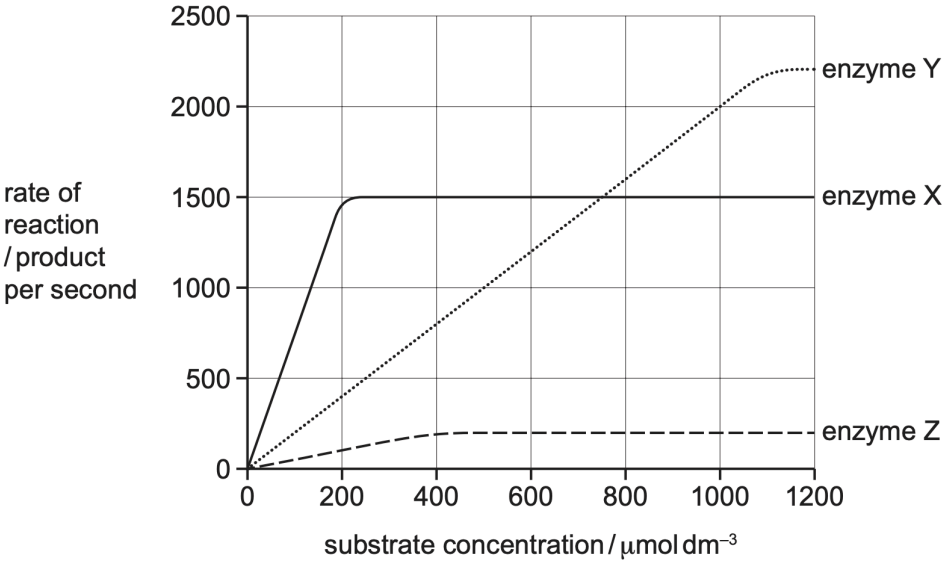
C ribosome → rough endoplasmic reticulum → nucleus → Golgi body

D rough endoplasmic reticulum → nucleus → Golgi body → ribosome

Ans: A

9.

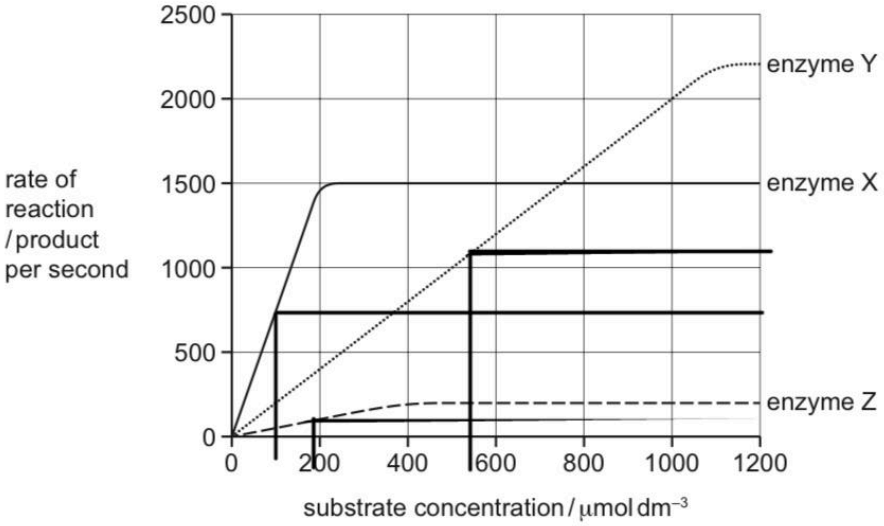
The graph shows the effect of substrate concentration on the rates of reaction of three enzymes, X, Y, and Z.



What is the correct order of affinity of these enzymes for their substrates, starting with the enzyme with the highest affinity?

A X → Y → Z **B** X → Z → Y **C** Y → X → Z **D** Z → X → Y

Ans: B



- Km: Y > Z > X
- Thus affinity: X > Z > Y

10.

Which aspect of enzyme activity can be compared by the Michaelis–Menten constant?

A activation energy of a reaction with or without an enzyme

B affinity of different enzymes for their substrates

C affinity of an enzyme at different substrate concentrations

D maximum rate of reaction (V_{max}) at different temperatures

Ans: B

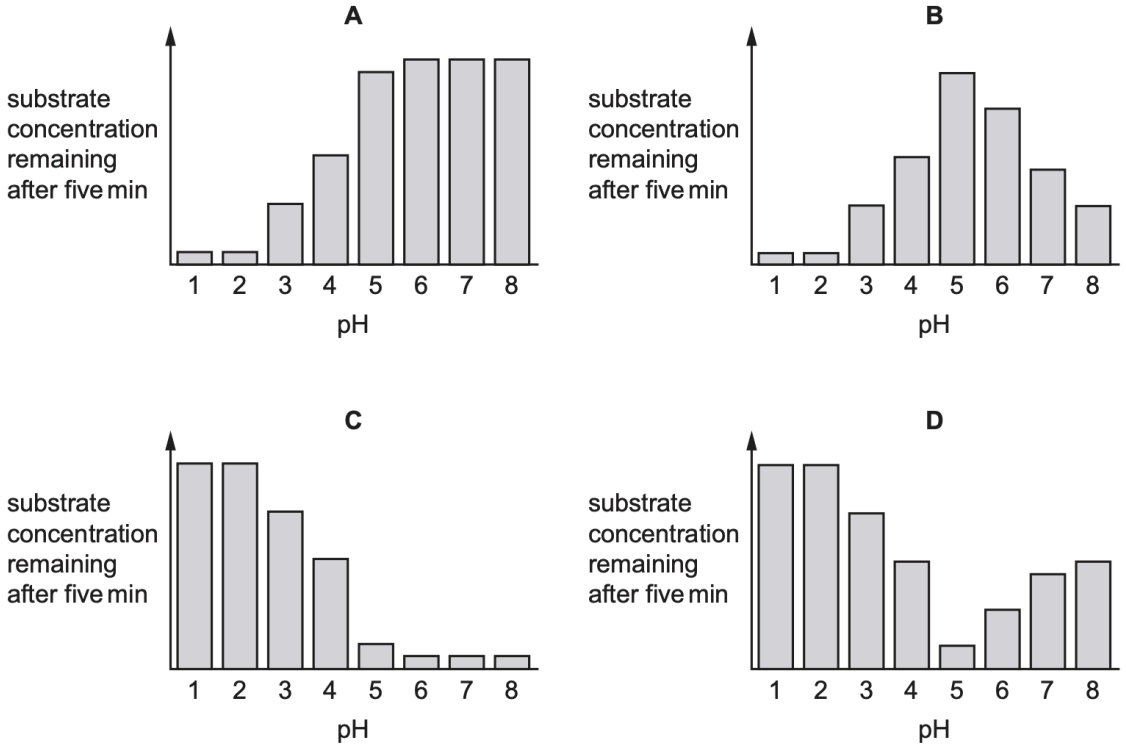
11.

12 A student carried out investigations at pH 1–8 to look at the effect of pH on an enzyme-catalysed reaction.

The optimum condition for this enzyme is the acidic environment of the stomach at pH 1–2.

The remaining substrate concentration was measured after five minutes at each different pH.

Which graph shows the effect of increasing pH on substrate concentration remaining after five minutes?



Ans: A

12.

Proteases are a group of enzymes that digest proteins.

Which statements about proteases are correct?

1 A bacterial protease that is secreted from a disease-causing bacterium could act as an antibody and cause the production of antigens against it.

2 Non-competitive inhibition of a protease that has an optimum condition of pH 2 can be overcome by increasing the substrate concentration and increasing the pH.

3 Water molecules are required when peptide bonds that link the monomers together are broken by the action of proteases in hydrolysis reactions.

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

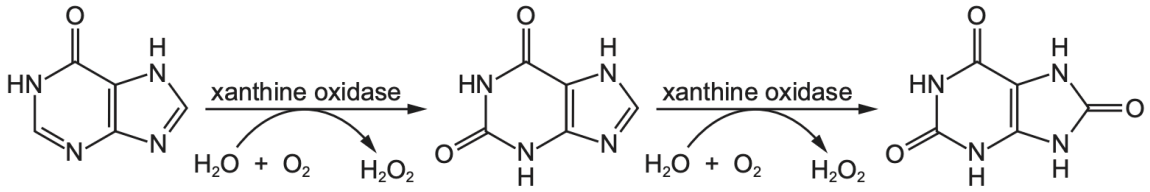
Ans: D

- 2 cannot be right as non-competitive inhibition cannot be overcome by increasing substrate concentration, as shape of active site is altered

13.

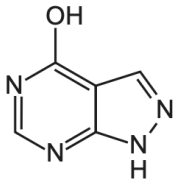
13 Gout is a type of arthritis in which small uric acid crystals form inside and around the joints. It causes sudden attacks of severe pain and swelling.

The diagram shows how uric acid is formed from hypoxanthine catalysed by the enzyme xanthine oxidase.



hypoxanthine xanthine uric acid

Gout can be treated using a drug called allopurinol which has a similar shape to hypoxanthine.



allopurinol

What can be concluded from this information about how allopurinol prevents the formation of uric acid?

A It binds to the active site of xanthine oxidase instead of hypoxanthine, resulting in reduced production of uric acid.

B It binds to another part of xanthine oxidase and this changes the shape of the active site.

C It disrupts the hydrogen bonds within xanthine oxidase so it denatures and the active site is no longer complementary to hypoxanthine and xanthine.

D It hydrolyses the peptide bonds within xanthine oxidase to change the shape of the active site.

Ans: A

Question specifies that they have similar shape, so it must fit into the active site.

14.

HIV-1 protease is an enzyme produced by the HIV virus.

Two identical chains of 99 amino acids form the enzyme. In each chain, amino acids 25, 26 and 27 in the sequence form part of the active site.

Which orders of protein structure control the shape of the active site?

A primary, secondary, tertiary and quaternary

B primary, secondary and tertiary only

C primary and quaternary only

D quaternary only

Ans: A

15.

CYP3A4 is an important enzyme in the human digestive system where it is needed to break down a range of different toxins. The activity of CYP3A4 has been shown to be reduced by substances called furanocoumarins. Furanocoumarins are found in some fruits and so dangerous concentrations of toxins may develop in the human digestive system when fruits containing furanocoumarins are eaten.

From the information provided, what can be concluded about molecules of the enzyme CYP3A4?

A They lower the activation energy of the toxin breakdown reactions.

B They bind specifically through the active site to a substrate found in some fruits.

C They change permanently when acted upon by furanocoumarin molecules.

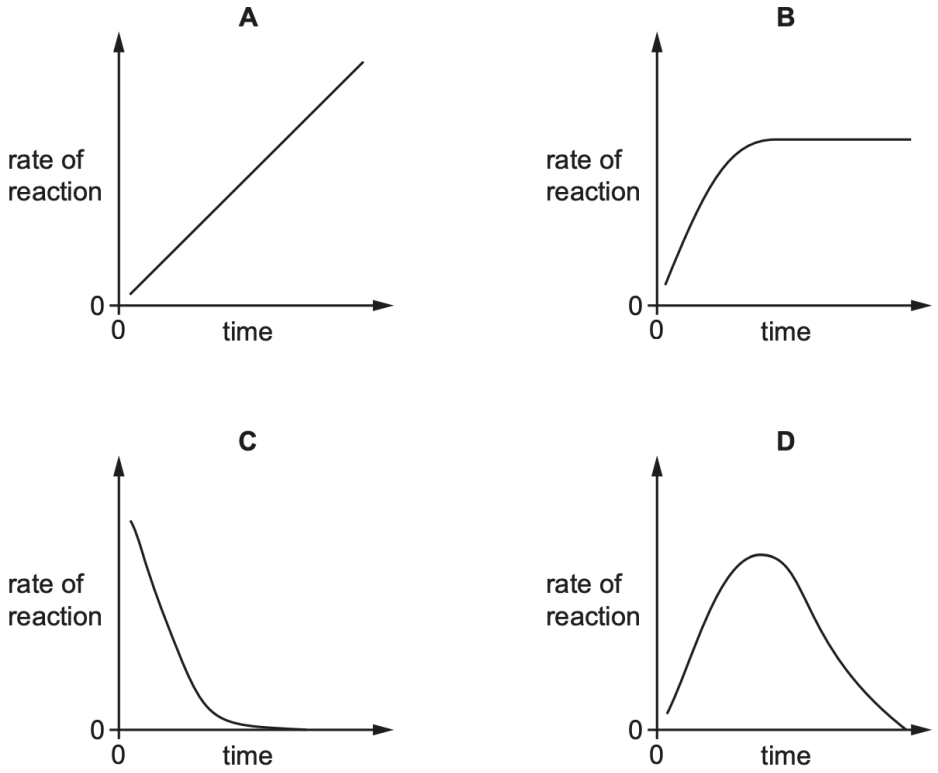
D They resume normal activity when concentrations of furanocoumarins decrease.

Ans: A

16.

A fixed volume and concentration of substrate and enzyme were mixed. All other variables were kept constant. The enzyme-catalysed reaction was left until it was complete.

Which graph shows how the rate of reaction changes with time?



Ans: C

- Rate is highest at beginning
- As time passes, substrate concentration decreases or more active sites become occupied, so rate of reaction decreases
- Eventually, rate becomes constant and 0 as all active sites are saturated/ all substrate is used up