Cambridge International AS & A Level

BIOLOGY (9700) P1

TOPIC WISE QUESTIONS + ANSWERS | COMPLETE SYLLABUS

PapaCambridge

Chapter 3

Enzymes

3.1 Mode of action of enzymes

461. 9700_s20_qp_11 Q: 12

Protease enzymes are found in many locations inside and outside the cells. Four of these locations are listed.

1 lysosomes

2 lumen of the stomach

3 at a telophase spindle

4 mucus in the trachea

Which of these locations are sites of intracellular hydrolysis?

A 1, 2, 3 and 4

B 1, 2 and 4 only

C 1 and 3 only

D 2 and 4 only

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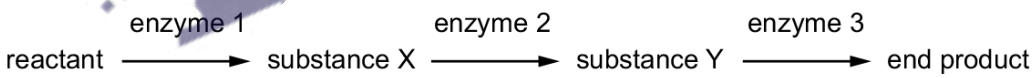
462. 9700_s20_qp_12 Q: 13

The diagram shows a metabolic pathway.



What would be the effect of adding a small amount of a non-competitive inhibitor of enzyme 2?

A Enzyme 2 would be partially denatured.

B Substance X would increase in concentration.

C Substance Y would no longer be formed.

D The initial reactant would no longer be metabolised.

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463. 9700_s20_qp_12 Q: 14

Two enzymes are added to a solution containing a low concentration of a substrate that they can both use.

Which statement is correct?

A Both enzymes will use equal amounts of the substrate.

B Neither enzyme will be able to use the substrate.

C The enzyme with the lower V_{max} will use less of the substrate than the other enzyme.

D The enzyme with the lower V_{max} will use more of the substrate than the other enzyme.

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464. 9700_w20_qp_11 Q: 13

Which enzyme is extracellular?

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

B ATP synthetase is an enzyme found in mitochondria that synthesises ATP.

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

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

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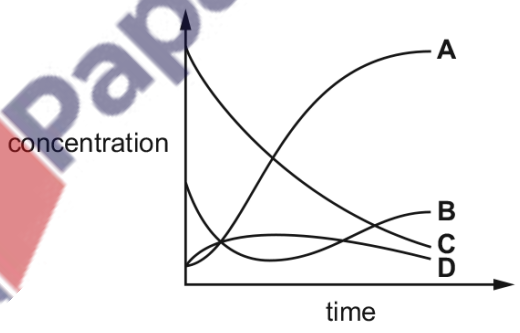
465. 9700_w20_qp_11 Q: 14

The graph shows how the concentration of components of an enzyme-catalysed reaction changes with time.

Which line represents enzymes with empty active sites?



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466. 9700_w20_qp_12 Q: 12

Which statements describe some enzyme actions?

1 Enzymes hold reacting molecules so that their reactive groups are close together.

2 In an enzyme-catalysed reaction, more molecules have sufficient energy to react than in the absence of the enzyme.

3 Reactions catalysed by enzymes take place at a lower temperature than they would without the enzyme.

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

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467. 9700_w20_qp_12 Q: 14

The painkiller ibuprofen reduces the activity of an enzyme involved in the production of prostaglandin.

Ibuprofen binds reversibly to the active site of the enzyme.

Which type of enzyme inhibition describes this example and why?

A competitive inhibition because ibuprofen alters the shape of the enzyme

B competitive inhibition because ibuprofen and the substrate cannot bind at the same time

C non-competitive inhibition because ibuprofen blocks the active site

D non-competitive inhibition because ibuprofen has the same shape as the substrate

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468. 9700_w20_qp_13 Q: 13

Lysozyme occurs in human tears, saliva, milk and mucus.

Lysozyme has a role in the immune system and hydrolyses peptidoglycan.

Which description of lysozyme is correct?

A It is an extracellular antibody.

B It is an intracellular antibody.

C It is an extracellular antibacterial protein.

D It is an intracellular antibacterial protein.

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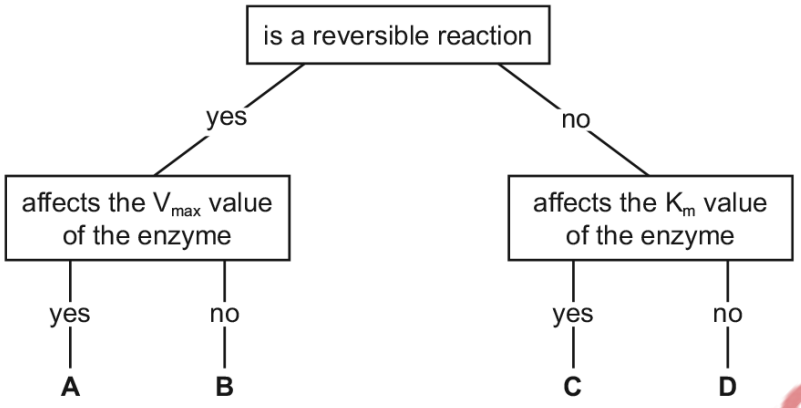
469. 9700_w20_qp_13 Q: 14

Which letter in the flow diagram shows the effect of adding a competitive inhibitor to an enzyme-catalysed reaction?



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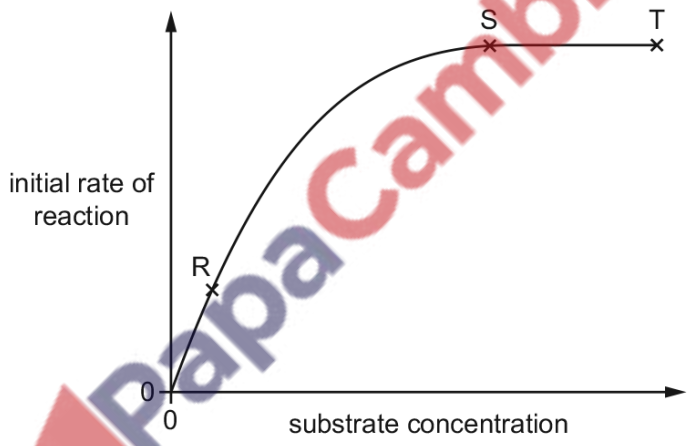
470. 9700_m19_qp_12 Q: 15

The graph shows the effect of substrate concentration on the initial rate of an enzyme-catalysed reaction. The enzyme concentration is constant.



Which statement about the graph is correct?

A Between R and S the number of enzyme molecules is limiting the rate of reaction.

B Between R and S the number of product molecules is limiting the rate of reaction.

C Between S and T the number of enzyme molecules is limiting the rate of reaction.

D Between S and T the number of substrate molecules is limiting the rate of reaction.

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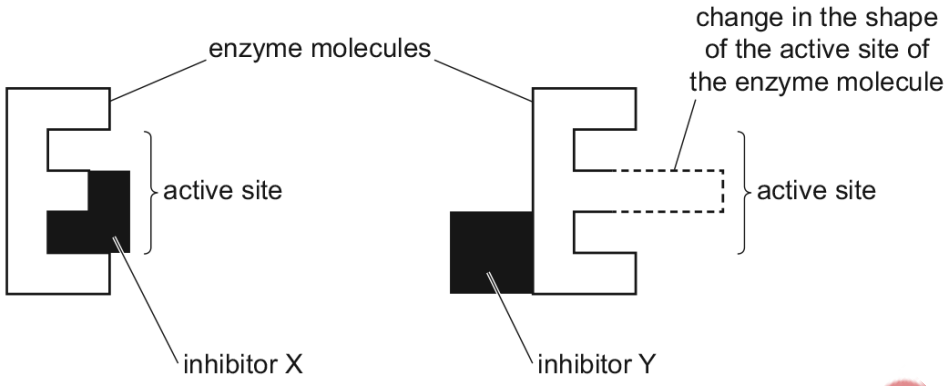
471. 9700_m19_qp_12 Q: 16

The diagram represents the reversible interaction between the active site of an enzyme and different inhibitors, X and Y.



Which row correctly identifies the type of inhibition shown by inhibitor X and inhibitor Y?

	X	Y
A	competitive	competitive
B	competitive	non-competitive
C	non-competitive	competitive
D	non-competitive	non-competitive

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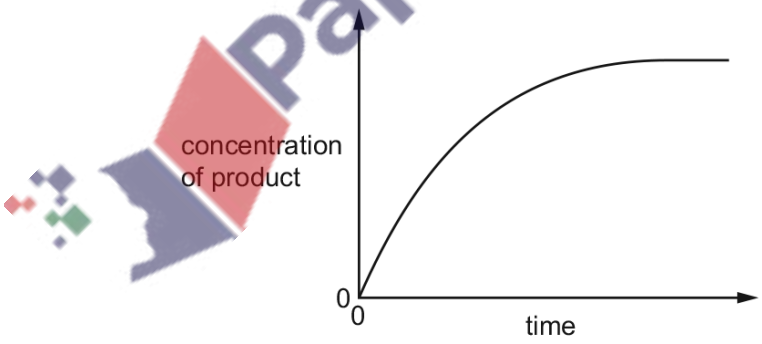
472. 9700_s19_qp_12 Q: 10

A fixed volume of the enzyme catalase was added to a fixed volume of hydrogen peroxide solution. The diagram shows how the concentration of product changed over the course of the reaction.



What explains the shape of this graph?

A The active sites become saturated.

B The enzyme was denatured.

C The hydrogen peroxide inhibited the reaction.

D The substrate molecules were used up.

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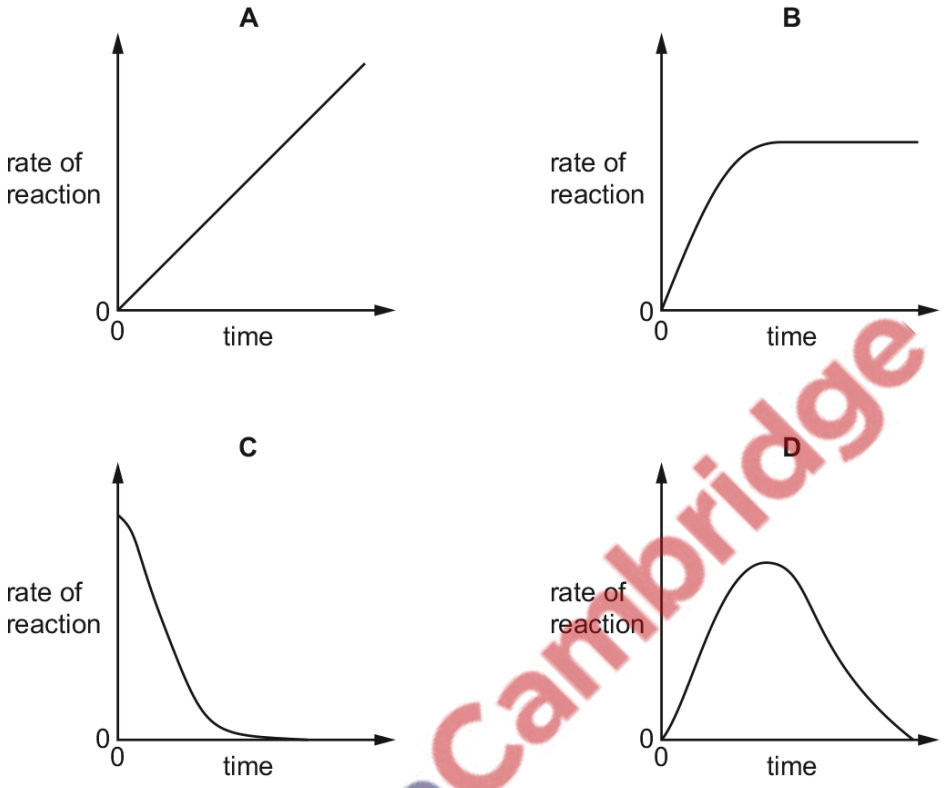
473. 9700_s19_qp_12 Q: 11

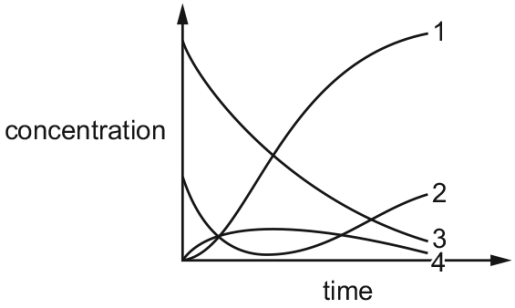
A fixed volume and concentration of substrate and enzyme were mixed. All other variables were kept constant. The enzyme-catalysed reaction was left until it was complete.

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



474. 9700_w19_qp_11 Q: 14

The graph shows how the concentration of components,1, 2, 3 and 4, of an enzyme-catalysed reaction changes with time.



Which row identifies the components of this reaction?

	component 1	component 2	component 3	component 4
A	enzyme–substrate complex	unbound enzyme	product	substrate
B	enzyme–substrate complex	product	substrate	unbound enzyme
C	product	enzyme–substrate complex	unbound enzyme	substrate
D	product	unbound enzyme	substrate	enzyme–substrate complex

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475. 9700_w19_qp_12 Q: 14

Which statement about the active site of an enzyme is correct?

A It always has a specific fixed shape.

B It reduces the total energy of the product.

C It does not form chemical bonds with its substrate.

D It is determined by the primary structure of the enzyme.

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476. 9700_m18_qp_12 Q: 13

Lysosomes contain many different hydrolytic enzymes that may act within cells (intracellular enzymes) or outside cells (extracellular enzymes).

Which process must occur in order for lysosomal enzymes to act outside the cell?

A active transport

B endocytosis

C exocytosis

D phagocytosis

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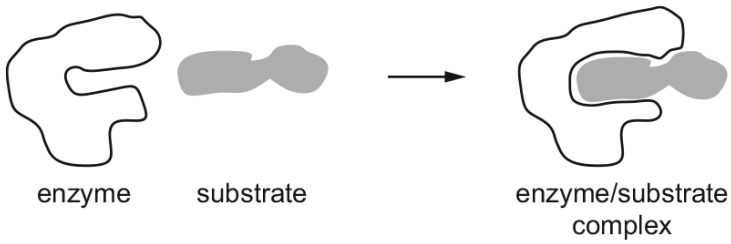
477. 9700_m18_qp_12 Q: 14

The diagram shows an enzyme, its substrate and an enzyme/substrate complex.



Which statement explains how the substrate is able to enter the active site of the enzyme?

A Contact between the substrate and the enzyme causes a change in the enzyme shape.

B The shape of the active site and the shape of the substrate are complementary.

C The substrate within the active site forms hydrogen bonds with amino acids.

D When the enzyme/substrate complex forms, the tertiary structure of the enzyme changes.

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478. 9700_m18_qp_12 Q: 15

What could be used to calculate the rate of an enzyme-catalysed reaction?

1 the appearance of product

2 the disappearance of substrate

3 the Michaelis-Menten constant (K_m)

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

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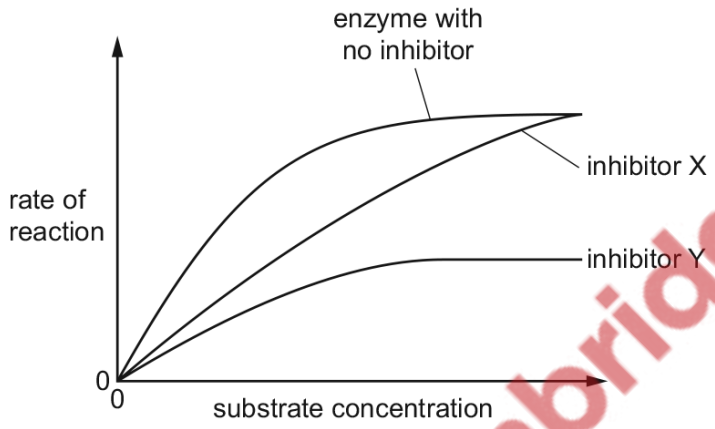
479. 9700_s18_qp_11 Q: 13

The effect of substrate concentration on an enzyme-catalysed reaction was measured in three different conditions:

- with no inhibitor
- with a competitive inhibitor
- with a non-competitive inhibitor.

The graph shows the results.



Which statement is correct?

A X is a competitive inhibitor which binds to a site other than the active site of the enzyme.

B X is a non-competitive inhibitor which has a similar shape to the active site of the enzyme.

C Y is a competitive inhibitor which has a similar shape to the active site of the enzyme.

D Y is a non-competitive inhibitor which binds to a site other than the active site of the enzyme.

480. 9700_s18_qp_13 Q: 14

Four students investigated the effect of catalase on hydrogen peroxide.

Each student started a digital clock at the beginning of the experiment and stopped the clock after 25 bubbles had been counted.

The time recorded on the digital clock is shown below.

hours	minutes	seconds	hundredths of a second
00	01	33	54

Which of the times recorded by the students is appropriate for this experiment?

A 1.34 minutes

B 1 minute 33.54 seconds

C 94 seconds

D 93.54 seconds

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481. 9700_s18_qp_13 Q: 15

What is the effect of an enzyme in an enzyme-catalysed reaction?

A decreases the activation energy and decreases the energy yield

B decreases the activation energy and has no effect on the energy yield

C increases the activation energy and increases the energy yield

D increases the energy yield and decreases the activation energy

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482. 9700_w18_qp_13 Q: 15

An investigation was carried out on the effect of temperature on an enzyme-catalysed reaction.

The enzyme and its substrate were initially placed into separate test-tubes and raised to the temperature required. They were then mixed and placed into four tubes **A**, **B**, **C** and **D**.

These tubes were incubated for the time and at the temperature stated. The mass of the product formed was then measured.

In which tube was the rate of reaction highest?

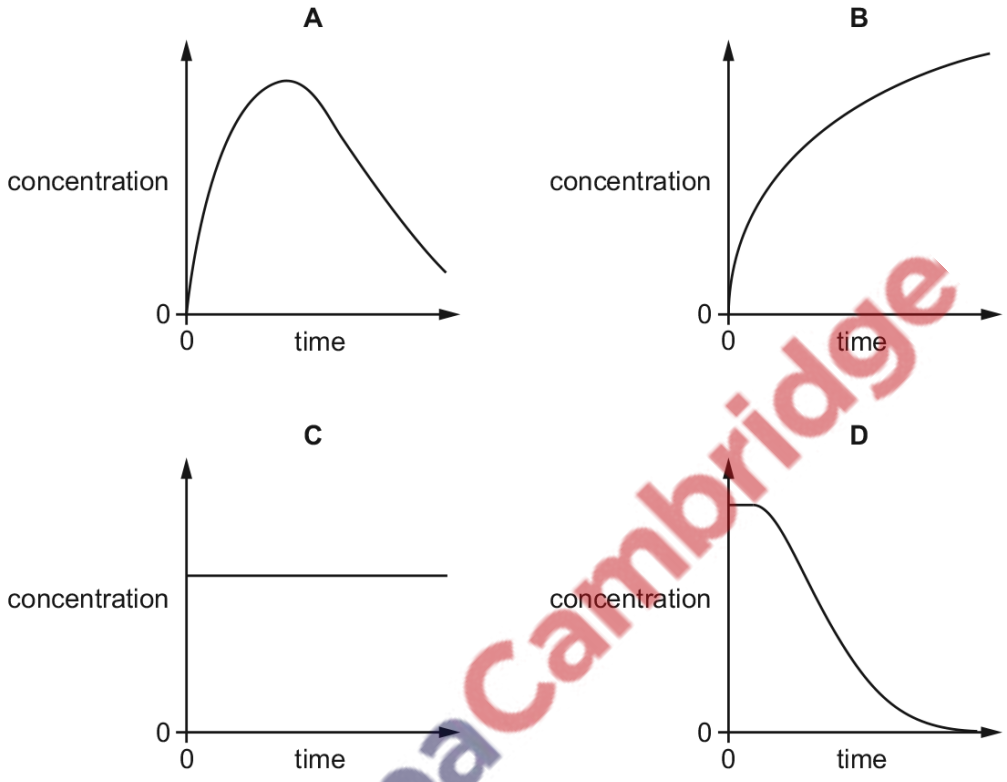
	incubation time / s	incubation temperature / °C	mass of product / μg
A	30	25	2.5
B	30	45	5.0
C	600	25	32.0
D	600	45	10.0

483. 9700_m17_qp_12 Q: 14

An enzyme was added to a small excess of its substrate. All variables were kept constant.

A student was asked to sketch a graph to show how the concentration of the enzyme-substrate complex changes over time.

Which graph shows this correctly?

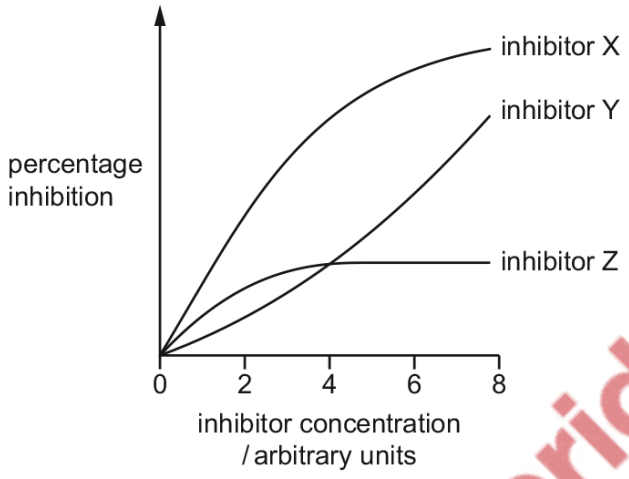


484. 9700_s17_qp_12 Q: 10

The enzyme invertase catalyses the breakdown of sucrose to glucose and fructose.

Three different enzyme inhibitors of invertase X, Y and Z were investigated. The percentage inhibition of invertase was measured at different concentrations of inhibitor.

The graph shows the result of the investigation.



Which are valid conclusions from these results?

1 The higher the concentration of inhibitor X, the less sucrose is broken down.

2 The production of glucose and fructose using inhibitor Y is higher than when inhibitor Z is used.

3 The production of glucose and fructose at an inhibitor concentration of 2 arbitrary units is lower than at an inhibitor concentration of 4 arbitrary units, for all inhibitors.

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

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485. 9700_s17_qp_12 Q: 11

The following statements are about enzymes.

1 Folding of an enzyme molecule causes the formation of the active site.

2 The shape of the active site changes to enable the substrate to bind.

3 Temporary bonds hold the substrate in the active site.

4 More enzyme-substrate complexes are formed at the optimum temperature.

Which statements are correct for the induced fit hypothesis?

A 1 and 2 **B** 1 and 3 **C** 2, 3 and 4 **D** 2 and 4 only

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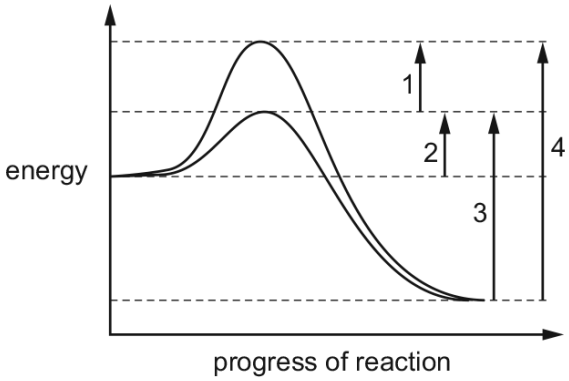
486. 9700_s17_qp_13 Q: 10

The graph shows energy changes in a chemical reaction.



What is the activation energy when an enzyme is added?

A 1 + 2 **B** 2 only **C** 3 – 2 **D** 4

---

487. 9700_w17_qp_11 Q: 11

Some RNA molecules, called ribozymes, can catalyse reactions in a similar way to protein enzymes.

Most of these ribozymes have other RNA molecules as their substrates and catalyse reactions that break specific sugar phosphate bonds in the substrate molecules.

Which statements about these ribozymes are correct?

1 Hydrogen, ionic and disulfide bonds will be involved in the ribozyme structure.

2 The active site of a ribozyme is formed from a specific sequence of nucleotides.

3 Ribozymes can form because RNA can have a specific secondary and tertiary structure.

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

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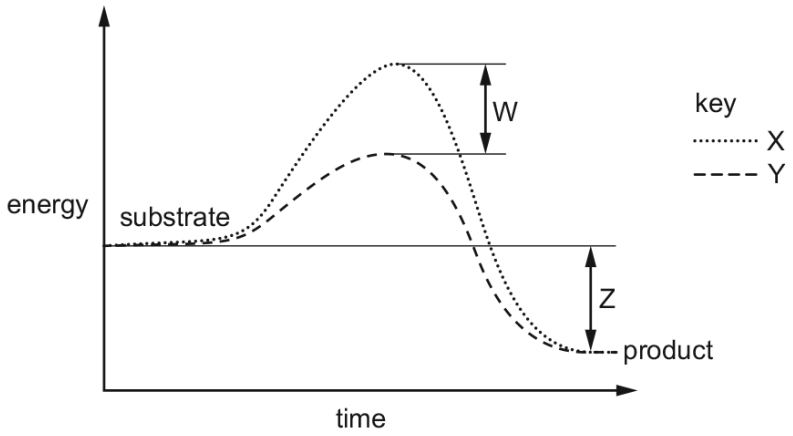
488. 9700_w17_qp_11 Q: 12

The graph shows the effect of an enzyme on a reaction.



Which labels are correct?

A X is the reaction without the enzyme, W is the activation energy.

B X is the reaction with the enzyme, Z is the overall energy change.

C Y is the reaction with the enzyme, W is the difference in activation energy.

D Z is the energy gained by the product, W is the activation energy with the enzyme.

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489. 9700_w17_qp_11 Q: 14

The following are all processes that allow movement into cells.

1 phagocytosis

2 active transport

3 facilitated diffusion

Which processes require ATP?

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

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490. 9700_w17_qp_12 Q: 14

Which of these statements describe the action of an extracellular enzyme?

1 synthesis of a polynucleotide in the nucleus during DNA replication

2 digestion of macromolecules in the lumen of the small intestine

3 synthesis of ATP molecules in the mitochondria

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

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491. 9700_w17_qp_12 Q: 16

Which statement about the effect of substrate concentration on the activity of an enzyme is correct?

A Above a certain concentration of substrate an enzyme reaches its maximum rate of reaction.

B At high concentration of competitive inhibitor increasing the substrate concentration has no effect.

C At high substrate concentration a non-competitive inhibitor no longer affects the enzyme activity.

D The higher the concentration of substrate the faster an enzyme can catalyse a reaction.

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492. 9700_w17_qp_13 Q: 14

An investigation was carried out into the effect of an increasing concentration of substrate molecules on the rate of an enzyme-catalysed reaction. All other variables were standardised.

Which statement is correct?

A The rate increases to a maximum and then levels off.

B The rate increases to an optimum and then decreases.

C The value of K_m will increase.

D The V_{max} will never be reached.

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493. 9700_w17_qp_13 Q: 15

Which features are correct for a competitive inhibitor of an enzyme-catalysed reaction?

	binds to active site	changes shape of enzyme	similar shape to substrate	rate of reaction affected by concentration of inhibitor
A	✓	✗	✓	✓
B	✓	✗	✗	✓
C	✗	✓	✓	✗
D	✗	✓	✗	✗

key
✓ = correct
✗ = incorrect

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494. 9700_m16_qp_12 Q: 11

The rate of enzyme-catalysed reactions in human cells is regulated.

What may be involved in such regulation?

1 a change in enzyme concentration

2 a change in substrate concentration

3 inhibition by the final product of the reaction

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

---

495. 9700_m16_qp_12 Q: 13

Which statement correctly describes the action of competitive enzyme inhibitors?

A They bind permanently to the active site.

B They change the shape of the active site.

C They limit the formation of enzyme-substrate complexes.

D They lower the activation energy of the reaction.

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496. 9700_s16_qp_11 Q: 12

Influenza virus has an enzyme called neuraminidase which breaks down glycoproteins in the membrane of the cell that the virus will infect. The glycoprotein binds to the active site of neuraminidase by induced fit.

Which statements about the induced fit hypothesis of enzyme action are correct?

1 The active site must have a complementary shape to the substrate for them to bind together.

2 This enzyme is less likely to be affected by non-competitive inhibitors than an enzyme working by the lock and key mechanism.

3 The substrate is converted to product by specific R-groups in the active site just like the lock and key mechanism.

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

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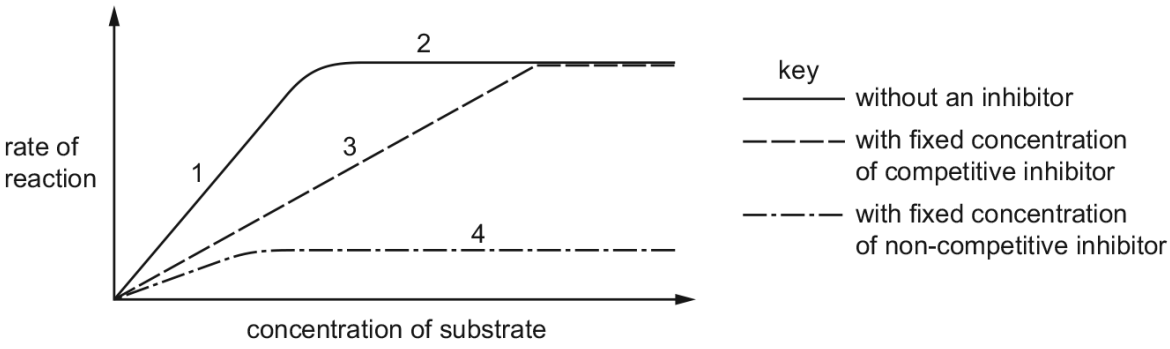
497. 9700_s16_qp_11 Q: 14

The graph shows the effect of increasing the concentration of substrate on the rate of an enzyme-catalysed reaction.



What is limiting the rate of the enzyme-catalysed reaction at 1, 2, 3 and 4 on the graph?

	1	2	3	4
A	enzyme concentration	substrate concentration	competitive inhibitor	non-competitive inhibitor
B	enzyme concentration	substrate concentration	non-competitive inhibitor	competitive inhibitor
C	substrate concentration	enzyme concentration	competitive inhibitor	non-competitive inhibitor
D	substrate concentration	enzyme concentration	non-competitive inhibitor	competitive inhibitor

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498. 9700_s16_qp_12 Q: 10

In two investigations, the rate of an enzyme-catalysed reaction was measured in the presence of either a competitive inhibitor or a non-competitive inhibitor.

What could be the effect of increasing the substrate concentration on each rate of reaction?

	rate of reaction	
	with competitive inhibitor	with non-competitive inhibitor
A	decreases	no change
B	increases	decreases
C	increases	no change
D	no change	decreases

---

499. 9700_s16_qp_13 Q: 11

Which statement is **only** true for the induced fit theory of enzyme action?

A A few amino acids give the active site a specific shape.

B An enzyme has a substrate with a specific shape.

C The enzyme changes shape in the presence of the substrate.

D The substrate molecules are complementary to the active site.

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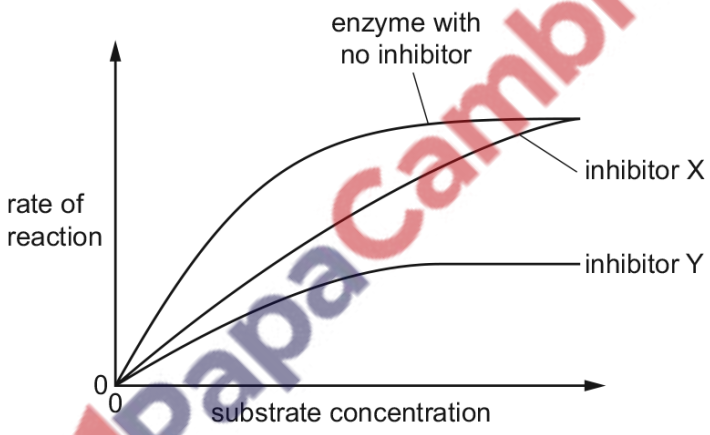
500. 9700_s16_qp_13 Q: 12

The effect of substrate concentration on an enzyme-catalysed reaction was measured in three different conditions:

- with no inhibitor
- with inhibitor X
- with inhibitor Y.

The graph shows the results.



Which statement is correct?

A X is a competitive inhibitor which binds away from the active site of the enzyme.

B X is a non-competitive inhibitor which has a similar shape to the substrate.

C Y is a competitive inhibitor which has a similar shape to the substrate.

D Y is a non-competitive inhibitor which binds away from the active site of the enzyme.

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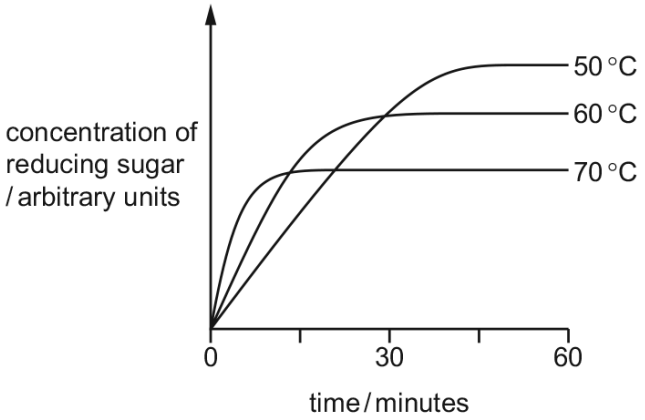
501. 9700_w16_qp_12 Q: 14

The graph shows the results of an investigation into the effect of amylase on starch at three different temperatures.



Which statements are correct conclusions using these results?

1 The optimum temperature is 50 °C.

2 The initial rate of reaction is highest at 70 °C.

3 The higher the temperature the more quickly the enzyme denatures.

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

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502. 9700_w16_qp_13 Q: 11

An investigation into the rate of an enzyme-catalysed reaction was carried out. During the investigation the concentration of the substrate was kept higher than the concentration of the enzyme.

During this investigation, which change in the variables would always lead to an increase in the rate of the reaction?

1 increase in enzyme concentration

2 increase in pH

3 increase in temperature

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

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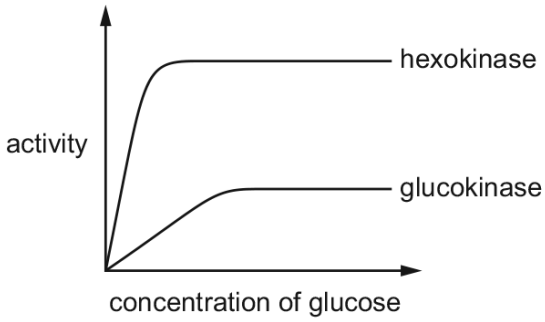
503. 9700_w16_qp_13 Q: 12

The enzymes glucokinase in the liver and hexokinase in the brain both catalyse the phosphorylation of glucose:

glucose + ATP → glucose phosphate + ADP

The activity of each enzyme was measured at different concentrations of glucose. The graph shows the results.



What describes the different activities of the two enzymes?

A Both enzymes hold glucose and ATP molecules together at the active site.

B Glucokinase becomes saturated with glucose at a lower concentration of glucose than hexokinase.

C Glucokinase phosphorylates more molecules of glucose per minute.

D The affinity of hexokinase for glucose is greater than that of glucokinase.

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504. 9700_s15_qp_11 Q: 13

Which statements about the effect of **all** enzyme inhibitors are correct?

1 change the shape of the active site

2 denature the enzyme

3 reduce the rate of the enzyme-catalysed reaction

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

---

505. 9700_s15_qp_11 Q: 14

The graphs show the rate of reaction of an enzyme-catalysed reaction.

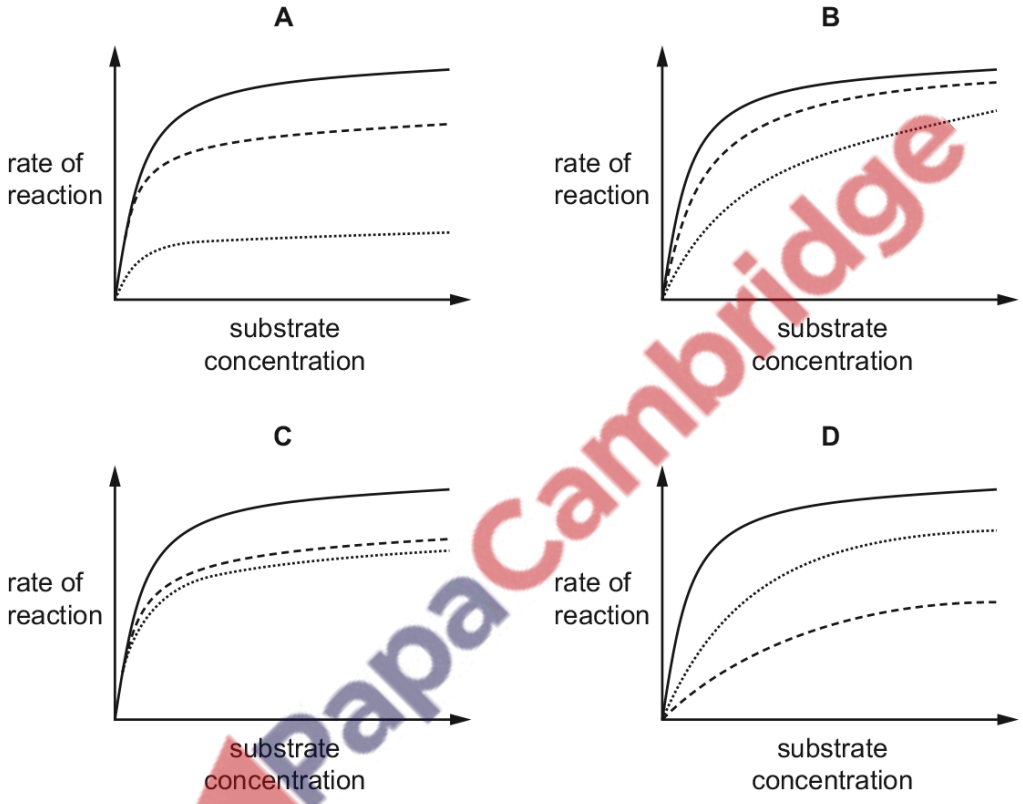
Which graph shows the effect of increasing the concentration of the substrate at two different concentrations of a competitive inhibitor?

key

——— no inhibitor

- - - - - - low concentration of inhibitor

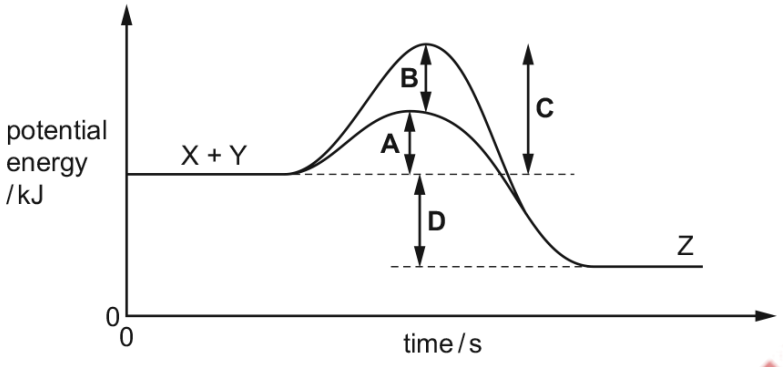
..... high concentration of inhibitor



506. 9700_w15_qp_11 Q: 12

The graph shows the energy levels involved in an enzyme-catalysed reaction. Substrate molecules X and Y combine to give product Z.

Which arrow shows the reduction in activation energy due to the enzyme?



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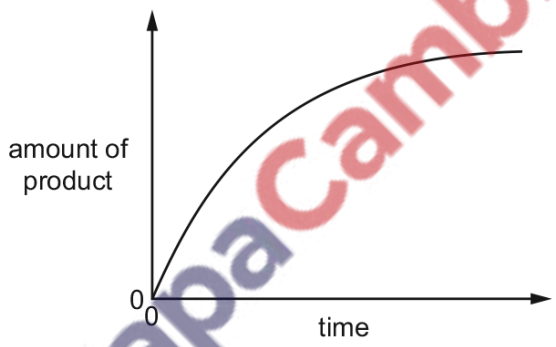
507. 9700_w15_qp_11 Q: 14

A fixed volume of the enzyme catalase was added to a fixed volume of hydrogen peroxide solution. The diagram shows how the amount of product changed over the course of the reaction.



What explains the shape of this graph?

A The active sites become saturated.

B The enzyme was denatured.

C The hydrogen peroxide inhibited the reaction.

D The substrate molecules were used up.

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508. 9700_w15_qp_11 Q: 15

Which descriptions are correct about transport across cell surface membranes?

	active processes	passive processes
A	endocytosis and exocytosis	diffusion and osmosis
B	exocytosis and facilitated diffusion	osmosis and endocytosis
C	facilitated diffusion	exocytosis and osmosis
D	facilitated diffusion and exocytosis	endocytosis and diffusion

---

509. 9700_w15_qp_12 Q: 12

Which statements describe some enzyme actions?

1 Enzymes hold reacting molecules in such a way that their reactive groups are brought close together.

2 In an enzyme-catalysed reaction, more molecules have sufficient energy to react than in the absence of the enzyme.

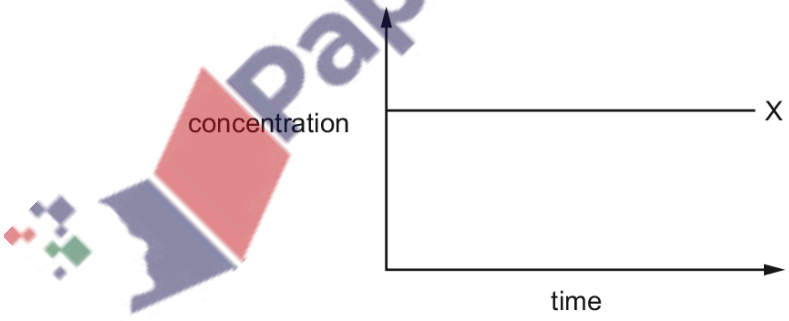
3 Reactions catalysed by enzymes take place at a lower temperature than they would without the enzyme.

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

---

510. 9700_w15_qp_13 Q: 12

The graph shows the concentration of one of the substances which is involved in an enzyme-catalysed reaction.



Which substance is shown by line X?

A enzyme

B enzyme-product complex

C enzyme-substrate complex

D substrate

---

511. 9700_w15_qp_13 Q: 13

What describes the induced fit mode of action of an enzyme?

A The binding of the active site to the substrate causes the enzyme to change shape.

B The substrate and active site have complementary shapes that form temporary bonds.

C The substrate causes a change in enzyme shape so the active site can bind.

D The substrate changes shape so it can bind to the active site.

3.2 Factors that affect enzyme action

512. 9700_m20_qp_12 Q: 13

What is the most appropriate set of controls to use in an investigation into the rate of an enzyme-catalysed reaction over a range of temperatures from 25 °C to 65 °C?

A enzyme and substrate at all temperatures tested

B enzyme and boiled substrate at all temperatures tested

C boiled enzyme only at all temperatures tested

D substrate only at all temperatures tested

---

513. 9700_m20_qp_12 Q: 14

An investigation is carried out with an enzyme at its optimum temperature and pH.

The rate of the enzyme reaction is measured at different substrate concentrations.

The investigation is repeated in the presence of a competitive inhibitor.

How will the results with the competitive inhibitor be different from the original results?

	K_m with competitive inhibitor	V_{max} with competitive inhibitor
A	higher	lower
B	higher	the same
C	the same	lower
D	the same	the same

---

514. 9700_s20_qp_11 Q: 13

An enzyme is modified for industrial use. It has a lower Michaelis-Menten constant (K_m) than the unmodified enzyme.

What is true of the modified enzyme?

A It is more specific.

B It has a higher affinity for its substrate.

C It has a lower maximum rate of reaction (V_{max}).

D It needs more substrate to become saturated.

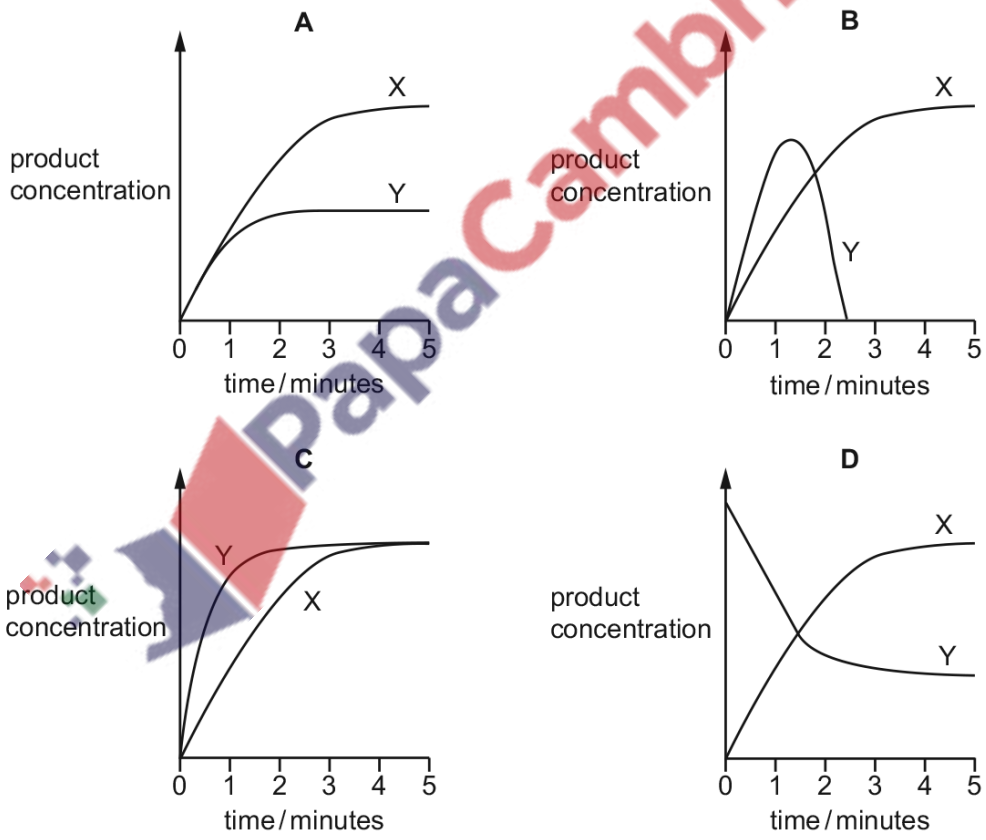
---

515. 9700_s20_qp_13 Q: 12

Two experiments, X and Y, were carried out using an enzyme from humans.

Experiment X was carried out at a constant temperature of 37 °C. During experiment Y, the temperature was increased from 37 °C to 80 °C. All other factors were kept the same.

Which graph shows the results?



---

516. 9700_s20_qp_13 Q: 13

What affects the rate of an enzyme-catalysed reaction when in the presence of a non-competitive inhibitor?

1 enzyme concentration

2 inhibitor concentration

3 substrate concentration

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

---

517. 9700_w20_qp_11 Q: 15

Which effects can non-competitive inhibitors have on enzyme-controlled reactions?

1 lower the K_m value

2 reduce the concentration of the product

3 reduce the rate of a metabolic pathway

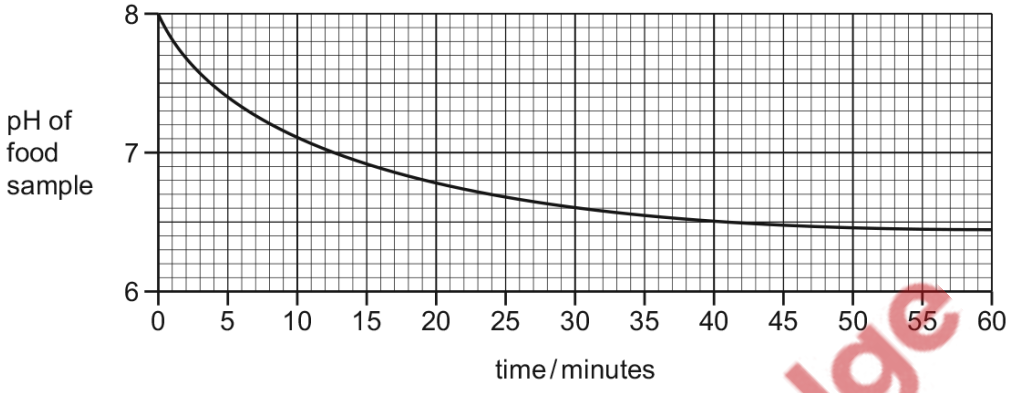
A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

---

518. 9700_w20_qp_12 Q: 13

Lipase is an enzyme that catalyses the hydrolysis of lipids. An experiment was carried out to investigate changes in pH when lipase is added to a food sample containing a high proportion of lipids.

The results are shown in the graph.



Which statements are possible explanations of the results of the experiment between 50 minutes and 60 minutes?

1 Enzyme concentration becomes the limiting factor.

2 Substrate concentration becomes the limiting factor.

3 All the enzyme active sites are occupied.

4 Denaturation of the enzyme by the products takes place.

5 Products are acting as competitive inhibitors.

A 1, 2 and 3 **B** 1, 4 and 5 **C** 2, 3 and 4 **D** 2, 4 and 5

---

519. 9700_s19_qp_11 Q: 14

What is the definition of the Michaelis-Menten constant, K_m, for an enzyme?

A V_{max}

B half V_{max}

C the substrate concentration that gives V_{max}

D the substrate concentration that gives half V_{max}

---

520. 9700_s19_qp_13 Q: 15

The enzyme β-galactosidase can catalyse the hydrolysis of four substrates, **A**, **B**, **C** and **D**, with similar structures.

Each substrate has a different K_m value.

For which substrate does β-galactosidase have the **lowest** affinity?

A $K_m = 4 \times 10^{-3}$ mol dm^{-3}

B $K_m = 1 \times 10^{-3}$ mol dm^{-3}

C $K_m = 2 \times 10^{-4}$ mol dm^{-3}

D $K_m = 1 \times 10^{-4}$ mol dm^{-3}

---

521. 9700_s19_qp_13 Q: 16

Which is correct for competitive inhibitors of enzymes?

1 They occupy the active site of an enzyme.

2 They have exactly the same shape as the substrate.

3 They can be used to control the rate of enzyme activity.

4 They can bind to a site on an enzyme other than the active site.

A 1, 2 and 3 **B** 1 and 3 only **C** 1 only **D** 2, 3 and 4

---

522. 9700_w19_qp_11 Q: 13

The V_{max} and K_m are determined for an enzyme-catalysed reaction.

What will be the effects on the V_{max} and K_m in the presence of a competitive inhibitor?

	V_{max}	K_m
A	decreases	increases
B	increases	decreases
C	stays the same	decreases
D	stays the same	increases

---

523. 9700_w19_qp_12 Q: 15

When investigating the rate of reaction of the enzyme lipase on the hydrolysis of triglycerides, the pH must be maintained at an optimum to prevent the lipase denaturing.

What is the reason for this?

A The addition of water molecules produced by hydrolysis increases the pH.

B The products of hydrolysis decrease the pH.

C The products of hydrolysis increase the pH.

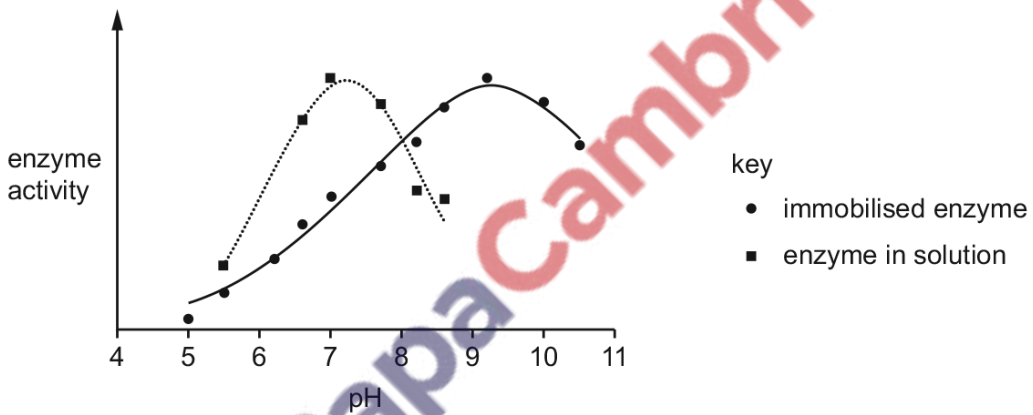
D The removal of water molecules used in hydrolysis decreases the pH.

---

524. 9700_w19_qp_12 Q: 16

An experiment was carried out to compare the effect of pH on the activity of an enzyme that was in solution and the same enzyme that had been immobilised on a gel. All other variables were kept the same.

The results are shown in the graph.



Which statement explains these results when the enzyme is immobilised?

A The primary structure has changed.

B The secondary structure has changed.

C The tertiary structure has changed.

D The quaternary structure has changed.

---

525. 9700_w19_qp_13 Q: 12

The Michaelis-Menten constant for an enzyme-catalysed reaction is referred to as K_m, and the maximum velocity of such a reaction is known as V_{max}.

Which statement about K_m and V_{max} is correct?

A An enzyme with a high value of K_m can reach its V_{max} at a low substrate concentration.

B An enzyme with a high value of K_m has a high affinity to its substrate.

C An enzyme with a low value of K_m can reach its V_{max} at a high substrate concentration.

D An enzyme with a low value of K_m has a high affinity to its substrate.

---

526. 9700_s18_qp_11 Q: 12

Which words from the table correctly complete the paragraph about enzymes?

When the pH of an environment is decreased below the optimum pH of an enzyme, ……1…… bonds between adjacent ……2…… groups, holding the ……3…… structure, are disrupted.

	1	2	3
A	hydrogen and ionic	R	tertiary
B	hydrogen	hydroxyl	secondary
C	ionic and peptide	R	primary and tertiary
D	peptide	amine	primary

---

527. 9700_s18_qp_12 Q: 12

A student investigated the hydrolysis of the lipid in high-fat milk, using the enzyme lipase.

- 1 cm^3 of enzyme solution was added to 10 cm^3 of high-fat milk.
- The temperature was kept constant.
- The pH of the reaction mixture was recorded at time 0 minutes and every minute for 20 minutes.

Which statements could be supported by the results of the investigation?

1 Less product is made as time proceeds because the substrate is decreasing.

2 The pH of the reaction mixture changes more rapidly in the first few minutes and then changes less rapidly.

3 The product gradually causes more lipase molecules to denature.

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

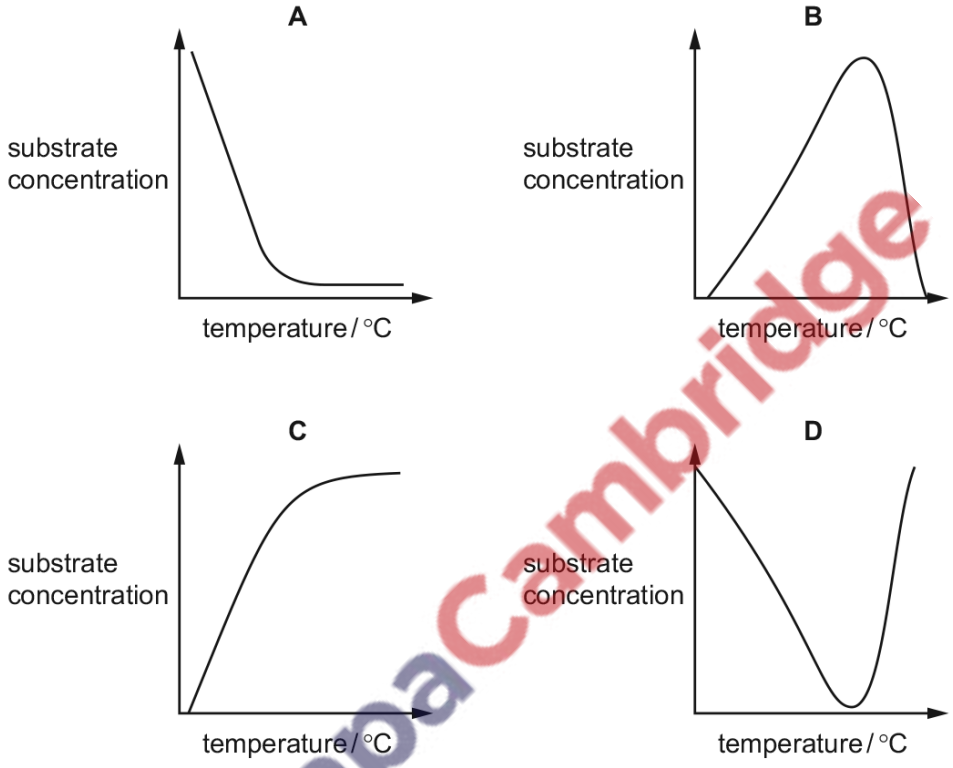
---

528. 9700_s18_qp_12 Q: 13

A student carried out an investigation into the effect of temperature on the rate of an enzyme-catalysed reaction.

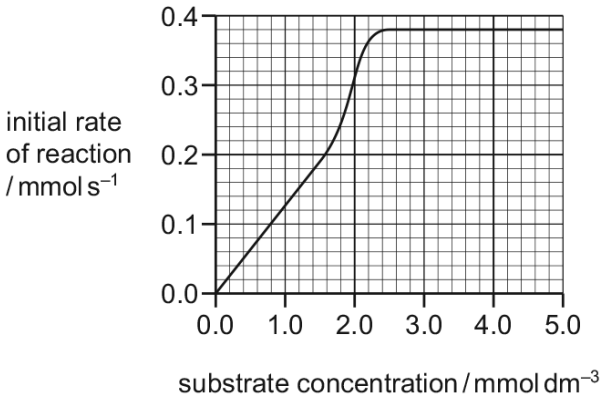
At each temperature, the substrate concentration was measured after 10 minutes. All the other variables were kept constant.

Which graph shows the effect of increasing temperature on the substrate concentration after 10 minutes?



529. 9700_s18_qp_12 Q: 14

The graph shows how the rate of an enzyme-catalysed reaction depends on the concentration of substrate.



What is the Michaelis-Menten constant (K_m) for this enzyme under these conditions?

A 0.19 mmol dm^{-3}

B 0.38 mmol dm^{-3}

C 1.5 mmol dm^{-3}

D 5.0 mmol dm^{-3}

---

530. 9700_s18_qp_13 Q: 13

Catechol is a chemical found in a number of fruits. Catechol can be oxidised to a quinone by the enzyme catechol oxidase.

Catechol oxidase is inhibited by parahyroxybenzoic acid (PHBA) which is structurally similar to catechol.

Catechol oxidase is also inhibited by phenylthiourea (PTU) which binds to a copper atom in the enzyme.

How do both these inhibitors reduce the enzyme activity?

1 altering the specificity of the enzyme

2 competing with substrates for the active site

3 decreasing the V_{max} of the reaction

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

---

531. 9700_w18_qp_11 Q: 14

Which row is correct for an enzyme with a low Michaelis-Menten constant?

	affinity of enzyme for substrate	substrate concentration at maximum reaction rate
A	high	high
B	high	low
C	low	high
D	low	low

---

532. 9700_w18_qp_12 Q: 14

Aspirin inhibits an enzyme by reacting with an amino acid that forms an essential part of the 3D structure of the enzyme. Part of the aspirin molecule binds firmly with the amino acid.

What describes this inhibition?

1 competitive inhibition

2 non-competitive inhibition

3 reversible inhibition

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

---

533. 9700_w18_qp_12 Q: 15

The table shows the Michaelis-Menten constant, K_m, for three enzymes.

enzyme	K_m / mmoldm^{-3}
C	1.5×10^{-2}
P	3.0×10^{-4}
F	5.0×10^{-6}

Which interpretation of the information is correct?

A Enzyme C has a V_{max} which is half that of enzyme P.

B Enzyme C will reach V_{max} in the shortest time interval.

C Enzyme F has the greatest affinity for its substrate.

D Enzyme P has a V_{max} of 6.0×10^{-3} mmoldm^{-3}.

---

534. 9700_w18_qp_13 Q: 13

Which statement about the typical modes of action of a competitive inhibitor and a non-competitive inhibitor is correct?

A Competitive inhibitors can bind to alternative (allosteric) sites of an enzyme, non-competitive inhibitors have an irreversible effect on the enzyme.

B Competitive inhibitors have exactly the same shape as the substrate, non-competitive inhibitors can have any shape.

C Competitive inhibitors may be used to regulate enzyme activity, non-competitive inhibitors have no functions in enzyme regulation.

D Competitive inhibitors will not alter V_{max}, non-competitive inhibitors will reduce V_{max}.

---

535. 9700_m17_qp_12 Q: 15

The table contains results recorded by a student from an investigation into the effect of temperature on an enzyme-catalysed reaction. All other variables were standardised.

temperature / °C	rate of reaction / arbitrary units
10	3
20	7
30	16
40	33
50	32
60	14

What is the correct conclusion?

A 40 °C was the optimum temperature.

B The data for 50 °C was anomalous.

C The optimum temperature was between 30 °C and 50 °C.

D The optimum temperature was between 40 °C and 50 °C.

---

536. 9700_s17_qp_11 Q: 14

A student carried out experiments to investigate the effect of enzyme concentration on the rate of hydrolysis (break down) of protein in milk.

When the enzyme and milk were mixed, the protein was hydrolysed and the mixture changed from cloudy to clear.

The student investigated five different enzyme concentrations and recorded the time taken to reach the end-point for each.

What is an appropriate control for this investigation?

A Carrying out a further experiment where the enzyme solution is replaced with water.

B Carrying out each experiment in a thermostatically regulated water-bath at 35 °C.

C Performing three repeat experiments for each of the five enzyme concentrations.

D Using the same volume of enzyme solution for each of the five experiments.

---

537. 9700_s17_qp_11 Q: 15

What determines the specificity of an enzyme?

1 the bonding between R groups of the polypeptide

2 the optimum pH of the enzyme

3 the peptide bonds between amino acids of the polypeptide

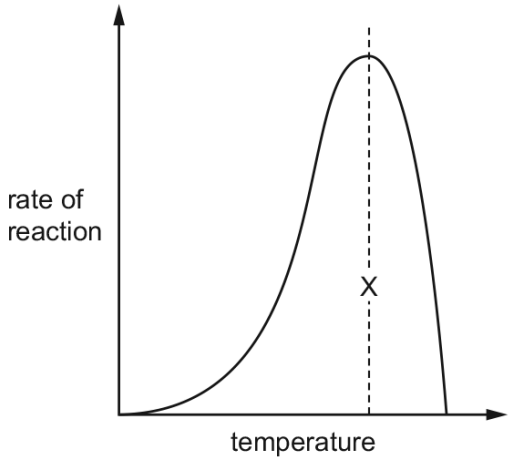
4 the shape of the substrate molecule

A 1, 2, 3 and 4 **B** 1 and 3 only **C** 1 only **D** 2, 3 and 4 only

---

538. 9700_s17_qp_11 Q: 16

The graph shows the effect of temperature on the rate at which the enzyme in a biological washing powder digests and removes fruit juice stains.



Which statements explain the shape of the graph at temperatures higher than X?

1 Bonds are broken between the R groups of the amino acids in the polypeptide chains of the enzyme.

2 There are more collisions between the enzyme and its substrate.

3 The tertiary structure of the enzyme is altered.

4 The shapes of the active site and the substrate are no longer complementary.

A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

---

539. 9700_s17_qp_12 Q: 12

How is the Michaelis-Menten constant (K_m) used?

A to assess the efficiency of an enzyme in catalysing a reaction

B to compare the affinity of enzymes for their substrate

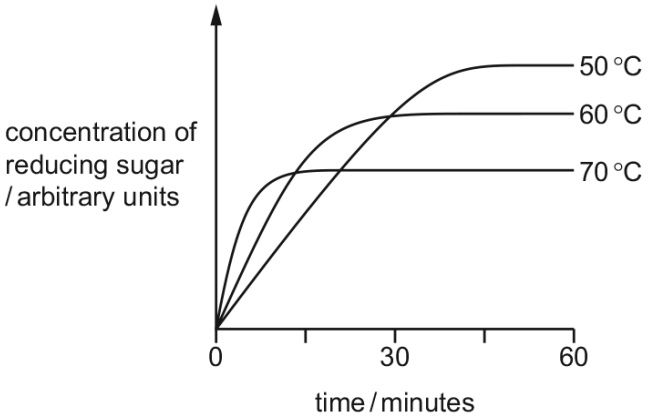
C to find the maximum velocity of an enzyme (V_{max})

D to find the rate at which substrate is loaded by an enzyme

---

540. 9700_s17_qp_13 Q: 11

The graph shows the results of investigations into the effect of amylase on the hydrolysis of starch at three different temperatures.



In each investigation the concentration and volume of the solutions was kept constant.

Which conclusion may be drawn?

A 50 °C is the optimum temperature of amylase.

B At 60 °C all the starch is hydrolysed after 30 minutes.

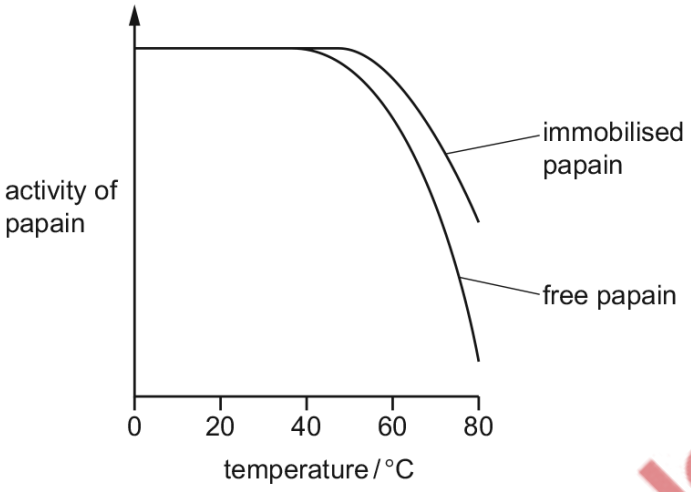
C At 70 °C the amylase is denatured before hydrolysis is complete.

D The rate of hydrolysis of starch is faster at 50 °C than at 70 °C.

---

541. 9700_s17_qp_13 Q: 12

The graph compares the effect of temperature on the activity of the protease enzyme, papain, when in solution (free) and when immobilised in alginate beads.



Which statement about the effect of immobilisation of papain is correct?

A It alters the shape of papain's active site at higher temperatures.

B It decreases the activity of papain at higher temperatures.

C It increases the stability of papain at higher temperatures.

D It reduces the number of collisions of papain with the substrate.

---

542. 9700_w17_qp_11 Q: 13

Which statements about non-competitive enzyme inhibitors are correct?

1 The inhibitor can bind to the enzyme whether or not the enzyme has its substrate bound in the active site.

2 The inhibitor may bind at an allosteric site.

3 The inhibitor may not prevent substrate binding at the active site, but will prevent product formation.

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

---

543. 9700_w17_qp_12 Q: 15

An experiment was carried out in which the enzyme lipase was used to hydrolyse a triglyceride.

The pH was recorded at regular intervals during the reaction.

The results are shown in the table.

time / minutes	pH
0	7.0
2	6.2
4	5.6
6	5.1
8	4.7
10	4.6
12	4.6
14	4.6

At 14 minutes unreacted triglyceride was still present.

What explains the results after 10 minutes?

A The end-products acted as competitive inhibitors.

B The end-products acted as non-competitive inhibitors.

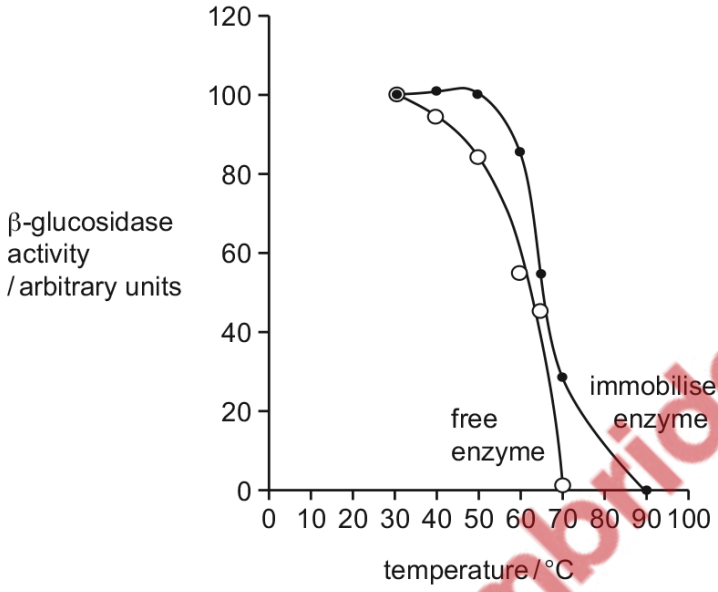
C The enzyme reaction had reached V_{max}.

D The tertiary structure of the enzyme had been lost.

544. 9700_w17_qp_13 Q: 13

An experiment was conducted to investigate the effect of temperature on the activity of the enzyme β-glucosidase. The enzyme was tested when in solution (free) and when immobilised in alginate beads.

The results are shown in the graph below.



Which statement about the effect of immobilisation of β-glucosidase is correct?

A It increases the kinetic energy of the enzyme.

B It inhibits the activity of the enzyme.

C It reduces the optimum temperature of the enzyme.

D It stabilises the enzyme against denaturation.

545. 9700_w17_qp_13 Q: 16

Liver cells contain membrane-bound organelles called peroxisomes, which contain the enzyme catalase. This enzyme hydrolyses hydrogen peroxide into water and oxygen gas.

A student cut two identical sized pieces of liver and placed one in a refrigerator at 5 °C and the other in a freezer at –18 °C.

After 12 hours both pieces were raised to room temperature and placed in equal volumes of hydrogen peroxide.

The liver that had been at –18°C produced bubbles of oxygen more rapidly than the liver that had been at 5 °C.

Which statement explains why the liver that had been at –18 °C produced bubbles of oxygen more rapidly than the liver that had been at 5 °C?

A At 5 °C the cell surface membrane allowed water to enter cells and dilute the catalase.

B Freezing at –18 °C made the cell walls more permeable to hydrogen peroxide.

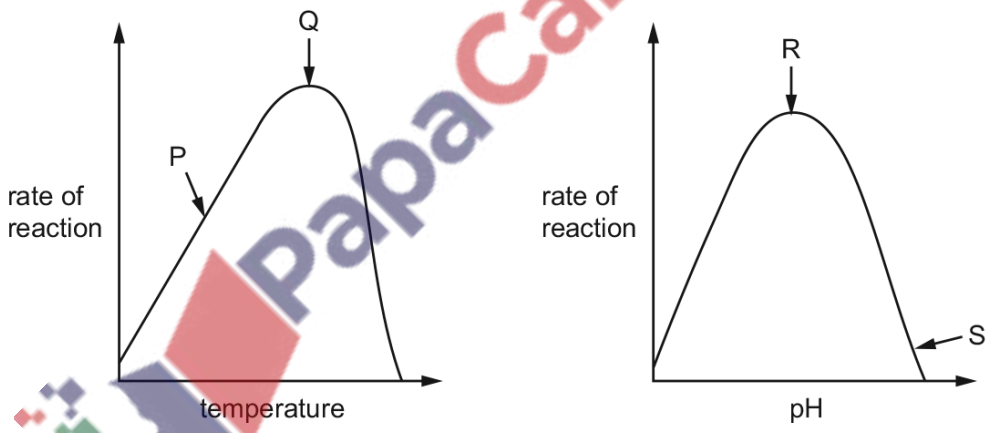
C Ice crystals damaged the cell membranes of the liver cells at –18 °C.

D The higher temperature had denatured some of the catalase.

---

546. 9700_m16_qp_12 Q: 12

The graphs show the effects of temperature and pH on enzyme activity.



Which statement is a correct explanation of the enzyme activity?

A At P, hydrogen bonds are formed between enzyme and substrate.

B At Q, the kinetic energy of enzyme and substrate is highest.

C At R, disulfide bonds in the enzyme begin to break.

D At S, the enzyme is completely denatured.

---

547. 9700_s16_qp_11 Q: 13

Which row about competitive inhibitors of enzymes is correct?

	bind to a site other than the active site	lower the activation energy needed for a reaction to occur
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key
✓ = true
✗ = false

---

548. 9700_s16_qp_12 Q: 11

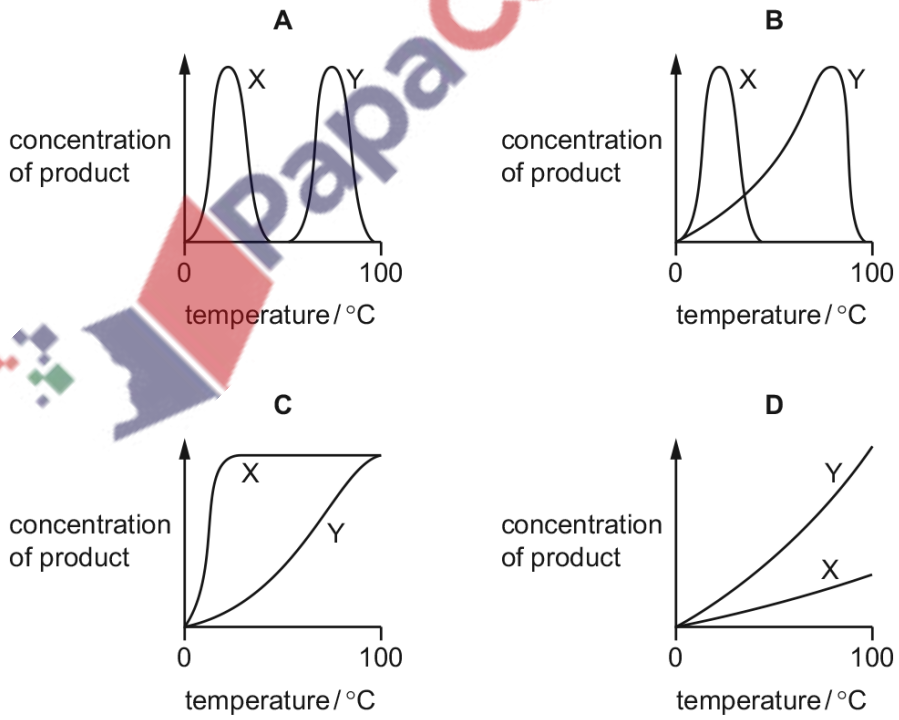
Two enzymes, X and Y, were used in an experiment.

Enzyme X was from bacteria that live in rivers and lakes at temperatures from 5 °C to 20 °C.

Enzyme Y was from bacteria that live in hot water springs at temperatures from 40 °C to 85 °C.

The experiment measured the concentration of product produced by each enzyme at temperatures between 0 °C and 100 °C after 5 minutes.

Which graph shows the results?



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549. 9700_s16_qp_13 Q: 10

Which of the bonds will be last to break as the temperature of an enzyme is increased?

A hydrogen

B hydrophobic interactions

C ionic

D peptide

---

550. 9700_w16_qp_11 Q: 12

Following a heart attack, the enzyme lactate dehydrogenase leaks into the blood plasma from damaged heart muscle.

Which steps are required to obtain an estimate of lactate dehydrogenase activity in a sample of blood plasma?

	sterilise blood plasma by heating	incubate with substrate for lactate dehydrogenase	incubate with lactate dehydrogenase inhibitor
A	✓	✓	✓
B	✗	✓	✓
C	✗	✓	✗
D	✗	✗	✓

key

✓ = step required

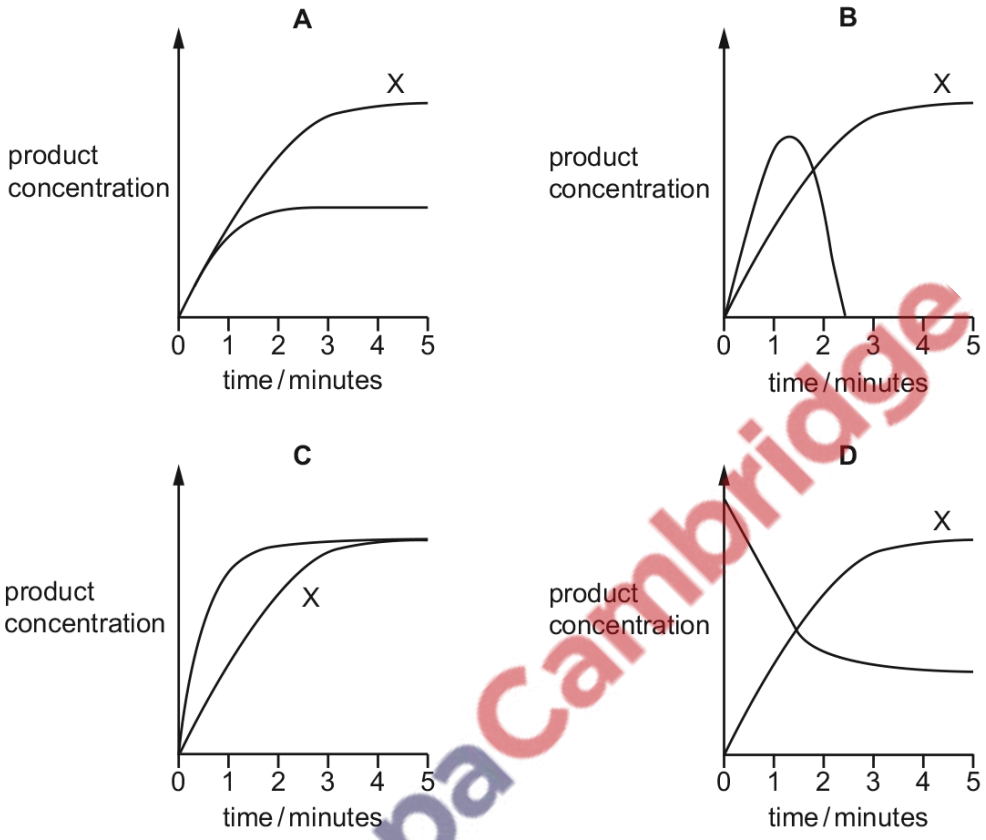
✗ = step not required

---

551. 9700_w16_qp_11 Q: 13

Two experiments were carried out using an enzyme from humans. The first experiment, X, was carried out at a constant temperature of 37 °C. During the second experiment, the temperature was increased from 37 °C to 80 °C. All other factors were kept the same.

Which graph shows the results?



552. 9700_w16_qp_12 Q: 15

Substances called furanocoumarins are found in some fruits, where they act as inhibitors of the enzyme CYP3A4. This enzyme is needed to break down toxins in the human digestive system, so dangerous levels of these toxins may develop if these fruits are eaten.

What does this information suggest about molecules of the enzyme CYP3A4?

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

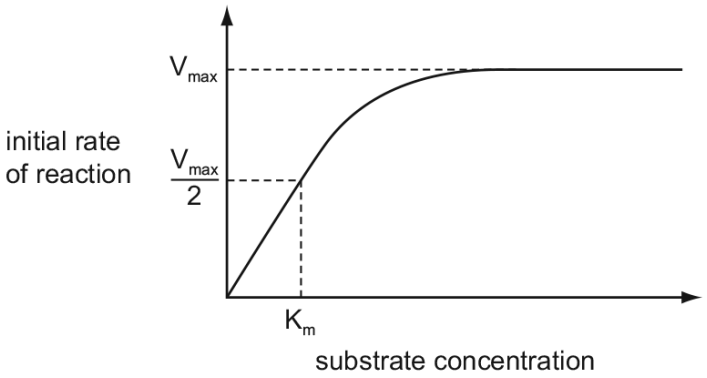
B They show specificity for a particular substrate found in fruits.

C They will change permanently when acted upon by furanocoumarin molecules.

D They will resume normal activity when levels of furanocoumarins decrease.

553. 9700_w16_qp_13 Q: 13

The value K_m is the substrate concentration at which the rate of an enzyme-catalysed reaction is half its maximum rate, $\frac{V_{max}}{2}$.



The K_m was measured in the presence of a competitive inhibitor and in the presence of a non-competitive inhibitor.

What could be the value of K_m with inhibitor compared to the value of K_m with no inhibitor?

	value of K_m in presence of	
	competitive inhibitor	non-competitive inhibitor
A	less	less
B	less	more
C	more	less
D	the same	more

---

554. 9700_s15_qp_12 Q: 13

Which levels of protein structure are always involved when competitive and non-competitive inhibitors bind to enzymes?

	competitive	non-competitive
A	primary, secondary and tertiary	secondary
B	quaternary and tertiary	quaternary and tertiary
C	secondary	primary and tertiary
D	tertiary	tertiary

---

555. 9700_s15_qp_13 Q: 13

Some inhibitors of enzyme reactions bind to the enzyme-substrate complex.

Which statements about this type of inhibition are correct?

1 The active site changes shape.

2 The inhibitor is non-competitive.

3 The initial rate of reaction is reduced.

4 The maximum rate of reaction (V_{max}) stays the same.

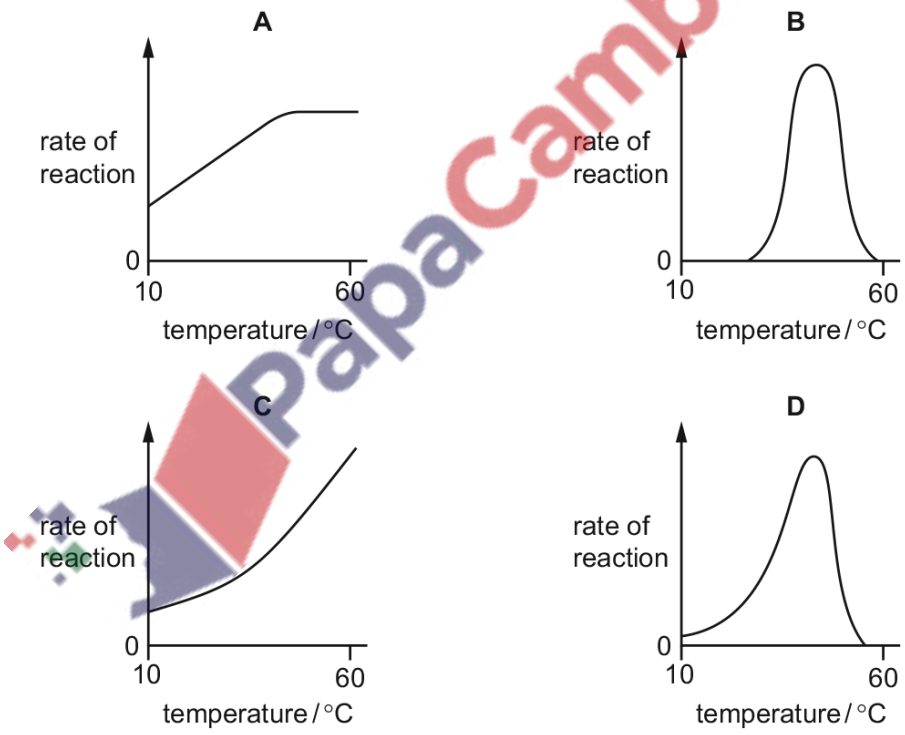
A 2, 3 and 4 **B** 1 and 2 **C** 1 and 3 **D** 2 and 3 only

---

556. 9700_s15_qp_13 Q: 14

The enzyme DNA polymerase is used in DNA replication. This enzyme was extracted from bacteria living in natural hot water springs where the water temperature is between 85 °C and 95 °C.

Which graph would represent the relationship between temperature and the rate of DNA replication when catalysed by the enzyme from these bacteria?



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557. 9700_w15_qp_11 Q: 13

Which statements about enzyme inhibitors are correct?

1 Competitive inhibitors may be similar shapes to the substrate.

2 Competitive inhibitors bind to the active site.

3 Non-competitive inhibitors alter the shape of the enzyme.

4 Non-competitive inhibitors bind to the substrate.

A 1, 2 and 3 **B** 2, 3 and 4 **C** 1 and 2 only **D** 3 and 4 only

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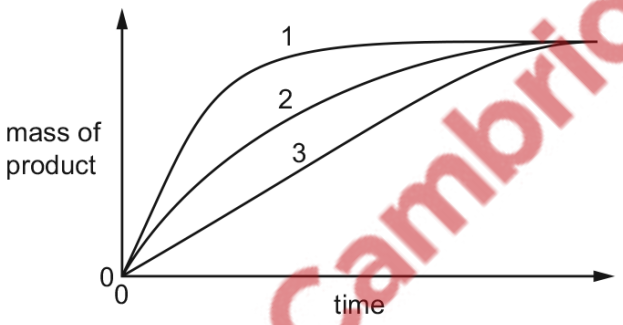
558. 9700_w15_qp_12 Q: 13

The diagram shows the mass of product formed over time in three reactions using the same substrate and enzyme.

The volumes of substrate, enzyme and temperature were kept constant in each reaction.



Which statement explains the difference in these reactions?

A The pH in reactions 2 and 3 has denatured the enzyme.

B There is a non-competitive inhibitor present in reaction 3.

C There is the highest concentration of enzyme in reaction 1.

D There is the highest concentration of substrate in reaction 1.

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559. 9700_w15_qp_12 Q: 14

Tyrosinase is an enzyme that catalyses the conversion of the amino acid tyrosine into the black pigment melanin. It is responsible for the black fur colour of some rabbits.

A group of rabbits kept at 30°C resulted in 90% of the rabbits with light fur colour. A second group of rabbits kept at 10°C resulted in 90% of the rabbits with black fur colour.

Which hypothesis is supported by these results?

A An inhibitor is present in rabbit skin cells that can bind strongly to tyrosinase when the external temperature is 30°C.

B At 10°C external temperature there are fewer tyrosinase-tyrosine complexes formed and less melanin is produced.

C Tyrosinase is an enzyme that is coded for by a gene that is switched off when the external temperature is 10°C.

D Tyrosinase is a temperature-sensitive molecule that is only activated when the external temperature is 30°C.

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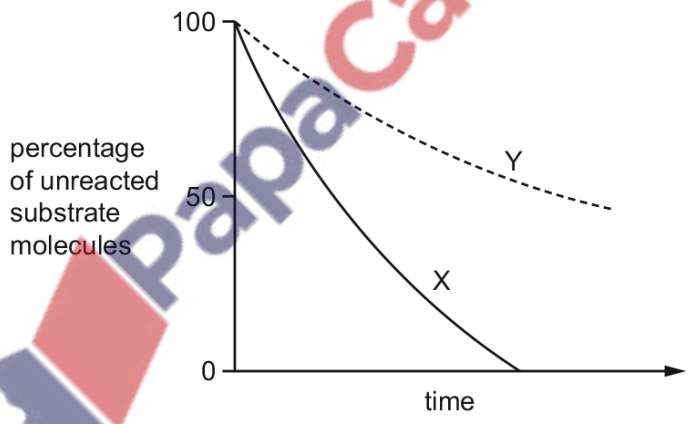
560. 9700_w15_qp_13 Q: 14

Line X represents the course of an enzyme-catalysed reaction under optimum conditions.

Line Y shows the action of the same enzyme on the same substrate but with one variable changed: substrate concentration or pH or temperature.



Which changes to the variables could give the results shown by line Y?

1 decreased substrate concentration

2 higher pH

3 lower temperature

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

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