Enzymes: AQA A Level Biology Exam Questions by Topic

18 questions · 44 marks · about 57 minutes. Answer in the spaces, then check the mark schemes at the end.

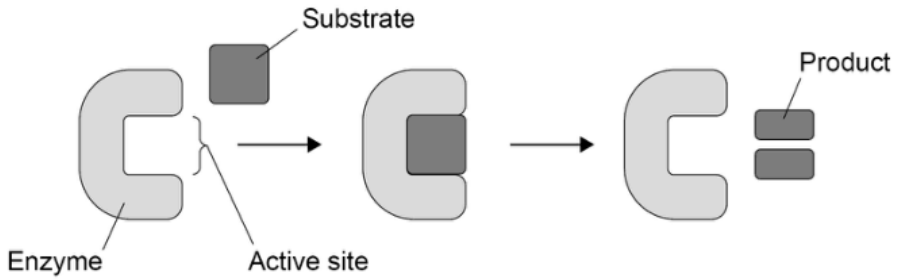
Question 1 · AS Paper 1 · June 2022 · Q05.2 · 2 marks

0 5 . 2 Many proteins are enzymes.

In 1894, a scientist suggested the lock and key model of enzyme action.

Figure 5 shows the lock and key model.

Figure 5



Describe **one** similarity and **one** difference between the induced-fit model of enzyme action and the lock and key model of enzyme action.

[2 marks]

Similarity _____

_____

Difference _____

_____

Question 2 · AS Paper 1 · June 2022 · Q05.3 · 1 mark

0 5 . 3 State how enzymes help reactions to proceed quickly at lower temperatures.

Do **not** write about active sites in your answer.

[1 mark]

_____

_____

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Question 3 · A level Paper 1 · June 2018 · Q04.1 · 2 marks

0 4 . 1 Formation of an enzyme-substrate complex increases the rate of reaction.

Explain how.

[2 marks]

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Question 4 · AS Paper 2 · June 2025 · Q06.1 · 3 marks

0 6 The reaction catalysed by the enzyme catalase is shown below.

$$\text{hydrogen peroxide} \xrightarrow{\text{catalase}} \text{water + oxygen}$$

0 6 . 1 Use your knowledge of the induced-fit model to explain how catalase breaks down hydrogen peroxide.

[3 marks]

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0 2 . 4 In 1914, a group of scientists investigated enzyme action.

After studying their results, the scientists reached the following conclusions:

> An enzyme is a substance which causes a reaction to occur at "ordinary" temperatures by being present, but **not** by its ability to combine with another substance. An enzyme changes the rate of a reaction without itself being changed by that reaction.

Our current understanding of enzyme action is based on the induced-fit model.

Describe similarities **and** differences between the conclusions from 1914 and our current understanding of enzyme action.

[4 marks]

Similarities

Differences

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Question 6 · A level Paper 1 · June 2017 · Q04.3 · 2 marks

0 4 . 3 Some proteases are secreted as extracellular enzymes by bacteria.

Suggest **one** advantage to a bacterium of secreting an extracellular protease in its natural environment.

Explain your answer.

[2 marks]

Question 7 · A level Paper 3 · June 2017 · Q05.2 · 2 marks

0 5 . 2 Sometimes, damage occurs during DNA replication. One enzyme involved in repairing damage to DNA is called ATR.

ATR works as follows.

- ATR phosphorylates other enzymes involved in repairing DNA.
- ATR **also** phosphorylates substrates required to repair DNA.

When ATR phosphorylates other enzymes, these enzymes become able to bind to their substrates.

Use your knowledge of enzyme structure to suggest why.

[2 marks]

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Question 8 · information from earlier in the question

0 5 Two enzymes, **P** and **Q**, are proteins with quaternary structure which catalyse the same reaction, but they have different amino acid sequences.

Question 8 · A level Paper 1 · June 2022 · Q05.2 · 2 marks

0 5 . 2 Explain how two enzymes with different amino acid sequences can catalyse the same reaction.

[2 marks]

Question 9 · information from earlier in the question

0 3 Galacto-oligosaccharides (GOS) are polymers of galactose.

Question 9 · AS Paper 2 · June 2023 · Q03.3 · 2 marks

0 3 . 3 Explain why amylase produced in the human digestive system does not digest GOS.

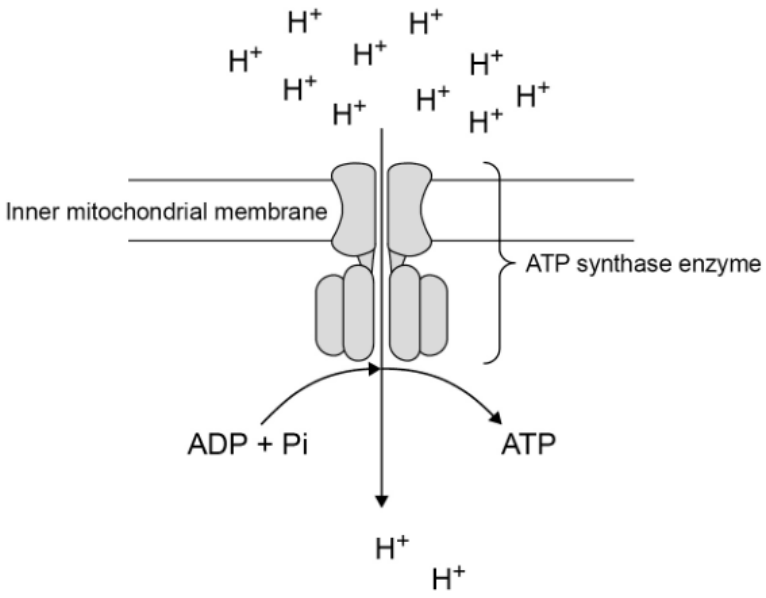
[2 marks]

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Question 10 · information from earlier in the question

0 2 . 1 **Figure 1** shows an ATP synthase enzyme in the inner mitochondrial membrane.

Figure 1



Complete the passage with the appropriate terms.

[2 marks]

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0 2 . 2 As shown in **Figure 1**, ATP synthase has two functions.

- It catalyses the synthesis of ATP.
- It allows the movement of H^+ ions.

Suggest how the shape of the ATP synthase allows it to have these two functions.

Explain your answers.

[4 marks]

Catalyses the synthesis of ATP _____

_____

_____

_____

_____

_____

Allows the movement of H^+ ions _____

_____

_____

_____

_____

_____

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Question 11 · information from earlier in the question

0 2 To study lipid digestion, a scientist placed a tube into the gut of a healthy 20-year-old man. The end of the tube passed through the stomach but did not reach as far as the ileum.

The scientist fed the man a meal containing triglycerides through the tube.
The scientist also used the tube to remove samples from the man's gut at intervals after the meal.

The scientist measured the type of lipid found in the samples. Some of her results are shown in **Table 1**.

Table 1

Sample	Time of collection after meal / min	Concentration of fatty acids / mg cm^{-3}	Concentration of triglycerides / mg cm^{-3}
A	45	2.7	0.6
B	75	3.3	0.0

Question 11 · A level Paper 1 · November 2020 · Q02.2 · 2 marks

0 2 . 2 After collecting the samples, the scientist immediately heated them to 70 °C for 10 minutes.

Explain why.

[2 marks]

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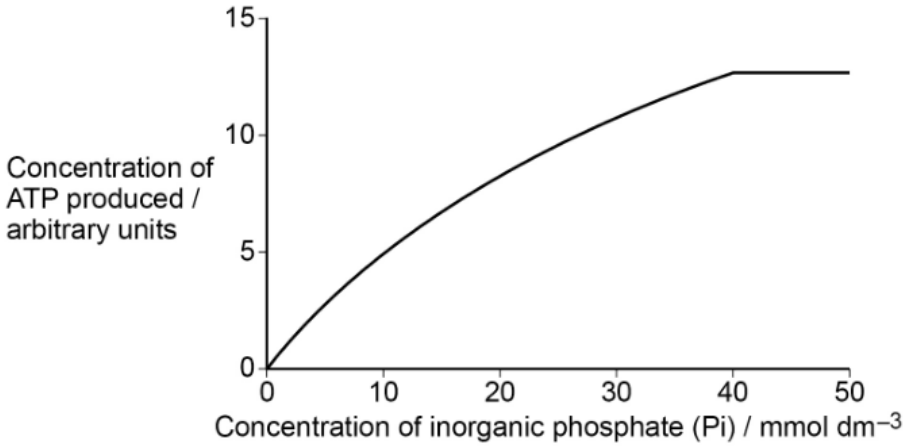
Question 12 · information from earlier in the question

0 1 . 3 The scientists investigated the effect of concentration of inorganic phosphate (Pi) on ATP synthase activity.

After 2 minutes, they stopped each reaction and then measured the concentration of ATP.

Figure 1 shows the scientists' results.

Figure 1



Suggest and explain a procedure the scientists could have used to stop each reaction.

[2 marks]

Question 12 · A level Paper 1 · November 2021 · Q01.4 · 2 marks

0 1 . 4 Explain the change in ATP concentration with increasing inorganic phosphate concentration.

[2 marks]

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Question 13 · AS Paper 2 · November 2020 · Q05.3 · 3 marks

0 5 . 3 A competitive inhibitor decreases the rate of an enzyme-controlled reaction. Explain how.

[3 marks]

Question 14 · A level Paper 1 · June 2023 · Q08.2 · 3 marks

0 8 . 2 MiTMAB acts as a non-competitive inhibitor of an enzyme called dynamin.

Suggest how MiTMAB can cause dynamin to become inactive.

[3 marks]

Questions, mark schemes and examiners' report extracts © AQA.

Question 15 · information from earlier in the question

0 3 . 2 Lactase catalyses the hydrolysis of lactose.

A student investigated the effect of galactose on lactase activity.

The student used the following method.

1. Mix together (in tube **X**) solutions of lactose, galactose and lactase in a 15 : 3 : 1 volume ratio so that the total volume is 90 cm^3
2. Leave the mixture at 30 °C for 10 minutes.
3. Measure the glucose concentration in the mixture.
4. Repeat steps 1 to 3 with two different mixtures.

Calculate the volume of **galactose** solution used in tube **X**.

[1 mark]

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Table 2 shows the student's results.

Table 2

Tube	Mixture	Glucose concentration after 10 minutes / mg dm^{-3}
X	Lactose, galactose, lactase	100
Y	Lactose, water, lactase	180
Z	Galactose, water, lactase	0

0 3 . 3 Galactose is a competitive inhibitor of lactase.

Use this information and your knowledge of enzymes to explain the results obtained in **Table 2**.

[4 marks]

Tube **X** _____

Tube **Y** _____

Tube **Z** _____

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Question 16 · A level Paper 1 · June 2025 · Q03.4 · 2 marks

0 3 . 4 Give:

- **one** change the student could make in tube **X** to confirm that galactose is a **competitive** inhibitor
- the result you would expect.

[2 marks]

Change _____

_____

_____

Result _____

_____

_____

Question 17 · AS Paper 2 · November 2020 · Q05.4 · 3 marks

0 5 . 4 When bread becomes stale, the structure of some of the starch is changed. This changed starch is called retrograded starch.

Scientists have suggested retrograded starch is a competitive inhibitor of amylase in the small intestine.

Assuming the scientists are correct, suggest how eating stale bread could help to reduce weight gain.

[3 marks]

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Question 18 · information from earlier in the question

0 6 The reaction catalysed by the enzyme catalase is shown below.

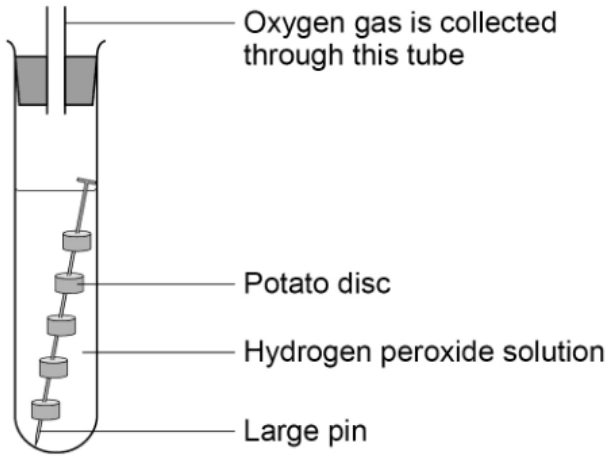
$$\text{hydrogen peroxide} \xrightarrow{\text{catalase}} \text{water + oxygen}$$

The student uses the following method.

1. Cut a 75 mm long cylinder of potato into 5 discs of equal size.
2. Arrange the discs on a large pin in a boiling tube.
3. Add 40 cm^3 of 1.0 mol dm^{-3} hydrogen peroxide.
4. Record the volume of oxygen collected in 2 minutes.
5. Repeat steps 1 to 4 with an uncut cylinder of potato 75 mm long.

Figure 10 shows the equipment the student uses.

Figure 10



Question 18 · AS Paper 2 · June 2025 · Q06.5 · 1 mark

0 6 . 5 The rate of reaction is faster with the five discs of potato than with the uncut potato cylinder.

Explain why.

[1 mark]

Questions, mark schemes and examiners' report extracts © AQA.

Mark schemes

Question 1 · AS Paper 1 · June 2022 · Q05.2 · 2 marks

05.2	(Similarity) 1. Substrate fits/binds to active site **OR** Enzyme-substrate complex (formed); (Difference) 2. Active site changes shape, but does not change in lock and key **OR** (Initially) active site not complementary to substrate with induced-fit, but is complementary in lock and key;	2 (2 x AO2)

2. Reject 'substrate changes shape'

2. Accept 'flexible' for changes shape and 'rigid' for does not change

Question 2 · AS Paper 1 · June 2022 · Q05.3 · 1 mark

05.3	Lower/reduce activation energy (needed to start a reaction);	1 (AO1)

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04.1	1. Reduces activation energy; 2. Due to bending bonds OR Without enzyme, very few substrates have sufficient energy for reaction;	2

1. Accept ‘reduces E_a’. 2. Accept ‘Due to stress/pressure/tension on bonds’ OR ‘Due to weakening bonds’. 2. Ignore references to ‘breaking bonds’.

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Question 4 · AS Paper 2 · June 2025 · Q06.1 · 3 marks

06.1	1. The shape of the active site becomes <u>complementary</u> (to the hydrogen peroxide/ substrate); 2. (So) tension/strain/twisting/bending of the bond(s) (in hydrogen peroxide); 3. (So) less energy needed to break the bond(s) **OR** Lowers activation energy;	3 (3 x AO1)

1. Reject catalase has similar/same shape as hydrogen peroxide

2. Ignore 'weakens bonds'

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Question 5 · A level Paper 1 · June 2025 · Q02.4 · 4 marks

02.4	**Similarities** 1. Enzymes are not changed/can be reused (in reactions); 2. Increase rate of reaction at low/ordinary/ normal/room temperature **OR** (Causes/allows) reaction(s) at low/ordinary/normal/room temperature **OR** (Both) lower activation energy; **Differences** 3. Active site changes shape (in induced fit model); 4. Enzyme-substrate complex forms **OR** Enzyme/active site and substrate bind/touch;	4 (4 x AO2)

4. Accept 'E-S complex'

4. Ignore 'ESC'

Question 6 · A level Paper 1 · June 2017 · Q04.3 · 2 marks

4.3	1. To digest protein; 2. (So) they can absorb amino acids for growth/reproduction/protein synthesis/synthesis of named cell component; **OR** (So) they can destroy a toxic substance/protein;	2	1. For 'digest' accept 'break down' here. 2. Accept '(so) they can destroy antibodies/antibiotics/ viral antigens/bacterial antigens'

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Question 7 · A level Paper 3 · June 2017 · Q05.2 · 2 marks

05.2	1. Changes tertiary structure of the enzyme; 2. (Enzyme) active site formed/able to be formed/active site becomes complementary;	2	1. Accept tertiary symbol 3^{o} 1. Ignore 3D 2. Reject refs to inhibition/inhibitors 2. Ignore refs to E-S complexes form 2. Ignore refs to substrate phosphorylation

Question 8 · A level Paper 1 · June 2022 · Q05.2 · 2 marks

05.2	1. (Both) active sites have similar/identical tertiary structures **OR** (Both) active sites have identical amino acid sequences; 2. (So) form enzyme-substrate complexes (with the same substrate);	2 (2 x AO1)

1. Ignore shape for tertiary structure 1. Accept (both) have active sites that are complementary to different parts of the substrate; 1. Accept attach/bind for complementary 2 Accept E-S for enzyme-substrate

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Question 9 · AS Paper 2 · June 2023 · Q03.3 · 2 marks

03.3	1. Active site (only) complementary to starch **OR** Active site not complementary to GOS; 2. (Due to) tertiary structure;	2 (2 x AO1)	1. Ignore 'hydrolysis'

Question 10 · AS Paper 2 · June 2023 · Q02.2 · 4 marks

02.2	(Catalyses the synthesis of ATP) 1. Active site complementary to ADP + Pi; 2. Enzyme-substrate complex forms; (Allows the movement of H^+ ions) 3. Channel (in membrane/protein/enzyme); 4. Allows facilitated diffusion of H^+ **OR** (Channel) has tertiary structure specific for (only) H^+;	4 (4 x AO2)	2. 'E-S' alone is insufficient Accept 'pore'

Question 11 · A level Paper 1 · November 2020 · Q02.2 · 2 marks

02.2	1. To denature the enzymes/lipase; 2. So no further digestion/hydrolysis/catalysis occurred;	2	1. Accept description of denaturation in terms of change in tertiary structure. 2. Accept 'break down' for digestion.

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Question 12 · A level Paper 1 · November 2021 · Q01.4 · 2 marks

01.4	1. (With) increasing Pi concentration, more enzyme-substrate complexes are formed; 2. At or above 40 (mmol dm^{-3}) all active sites occupied **OR** At or above 40 (mmol dm^{-3}) enzyme concentration is a limiting factor;	2

Question 13 · AS Paper 2 · November 2020 · Q05.3 · 3 marks

05.3	1. Inhibitor similar shape to substrate; 2. Fits/binds to active site; 3. Prevents/reduces <u>enzyme-substrate</u> complex forming;	3	1. Reject same shape 1. Accept 'complementary to active site'

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08.2	1. (MiTMAB) binds (to dynamin) other than the active site; 2. Changes the shape of (dynamin) active site **OR** Changes the tertiary structure (of dynamin/ enzyme); 3. Not <u>complementary</u> so substrate does not bind (to active site) **OR** Not <u>complementary</u> so no/fewer enzyme-substrate complexes (form);

3 (1 x AO1, 2 x AO2)	1. Accept (MiTMAB) binds to dynamin at an allosteric OR inhibitor site 2. Accept denature for 'change in shape' 3. Accept ES complex in this instance 3. Ignore ESC 3. Accept fit OR attach for bind

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03.3	1. (**X**) Galactose/inhibitor binds to active site; 2. (**X** so) slows/reduces/inhibits lactose hydrolysis; 3. (**Y**) **all**/**more** lactose/substrate is hydrolysed **OR** (**Y**) (more) lactose hydrolysed so **more** glucose/>100 (produced); 4. (**Z**) no lactose/substrate (so no product) **OR** (**Z**) Galactose is not hydrolysed by lactase **OR** (**Z**) Galactose is not a (lactase) substrate;	4 (4 x AO2)

2, 3 and 4 Accept digest/breakdown for hydrolysis

2. Reject 'stops' hydrolysis

3. Accept faster substrate hydrolysis for 'all/more'

4. Accept (Z) (only) lactose is the substrate

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Question 16 · A level Paper 1 · June 2025 · Q03.4 · 2 marks

03.4	1. Increase lactose/substrate (concentration); 2. More product/glucose (is formed) **OR** Increased rate of reaction;	2 (2 x AO3)

Question 17 · AS Paper 2 · November 2020 · Q05.4 · 3 marks

05.4	1. Less hydrolysis of starch; 2. (To) maltose; 3. (So) less absorption (of glucose) **OR** (So) more egested (starch/carbohydrate);	3	1. Accept no hydrolysis 3. Accept description of egestion, eg lost in faeces
TOTAL		**9**	

Question 18 · AS Paper 2 · June 2025 · Q06.5 · 1 mark

06.5	(Total surface area greater so) more enzyme-substrate complexes;	1 (1 x AO2)	Accept E-S complexes

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