Enzymes (2.1.4): OCR A Level Biology Exam Questions by Topic

18 questions · 33 marks · about 40 minutes. Answer in the spaces, then check the mark schemes at the end.

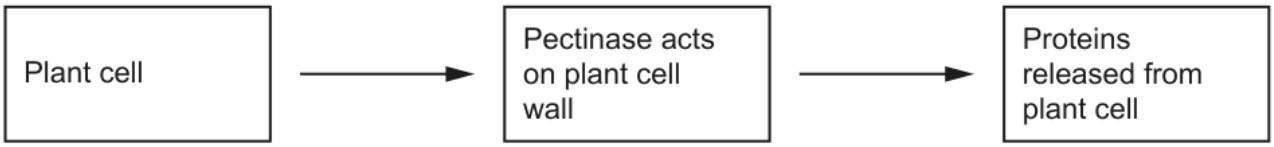
Question 1 · AS Paper 2 · June 2025 · Q3(a)(i) · 2 marks

3

(a)

(i) Enzymes can be used to extract proteins from plant cells. These proteins can be used for food products.

The diagram shows how the enzyme pectinase can be used to extract some plant proteins.



Complete the sentences using the most appropriate term(s).

Use the diagram and your knowledge of enzymes.

In living organisms, enzymes usually speed up reactions involved in the

..... of the cells.

From the location of the enzyme pectinase shown in the diagram, the action of pectinase can be

described as ..... .

[2]

Question 2 · AS Paper 1 · June 2023 · Q27(a)(i) · 2 marks

27 Enzymes that catalyse the removal of CH_3 groups from cytosine bases in DNA are called TET enzymes. The rate of transcription increases when CH_3 groups are removed from DNA.

During embryo development, TET enzymes remove CH_3 from a large number of genes. This TET activity is essential for the development of embryos.

(a) (i) Suggest how the activity of TET enzymes affects metabolism at both the cellular and whole organism level.

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..... **[2]**

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Question 3 · AS Paper 1 · June 2023 · Q27(a)(iii) · 1 mark

(iii) Intracellular and extracellular reactions are catalysed by enzymes.

The table lists three enzymes, including TET.

Complete the table to indicate whether the enzyme catalyses an intracellular reaction or an extracellular reaction.

Tick (✓) **one** box in each row.

Enzyme	Type of reaction catalysed	
	Intracellular	Extracellular
TET		
Catalase		
Trypsin		

[1]

Question 4 · A level Paper 1 · June 2018 · Q18(c) · 1 mark

(c) Cellulose cannot be digested by animals. Some mammals have bacteria in their stomachs that produce enzymes that can digest cellulose.

Explain whether the action of these enzymes is intracellular or extracellular.

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.....

..... **[1]**

Question 5 · AS Paper 2 · June 2018 · Q4(b)(i) · 2 marks

(b) Copper (II) ions act as irreversible non-competitive inhibitors of the enzyme catalase.

(i) Describe how a non-competitive inhibitor works to inhibit the activity of an enzyme.

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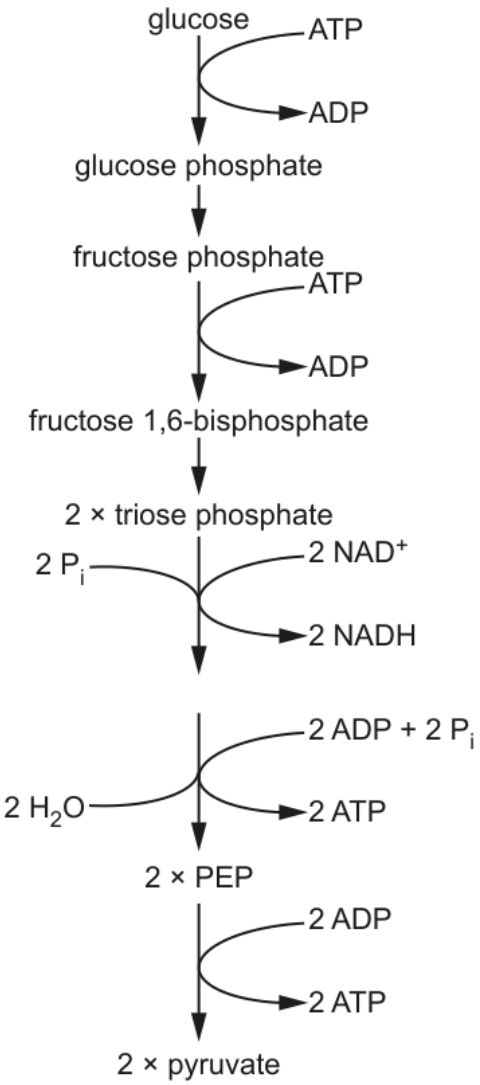
..... **[2]**

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Question 6 · information from earlier in the question

17

(a) The diagram shows some of the steps in glycolysis.



The enzyme phosphofructokinase (PFK) catalyses the conversion of fructose phosphate to fructose 1,6-bisphosphate (hexose bisphosphate).

(i) State the type of reaction that is catalysed by PFK.

..... **[1]**

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Question 6 · A level Paper 1 · June 2025 · Q17(a)(iv) · 1 mark

(iv) Inhibition of PFK by ATP and PEP is an example of a negative feedback control mechanism.

State the name of this type of inhibition in metabolic pathways such as glycolysis.

..... **[1]**

Turn over

Question 7 · information from earlier in the question

22 Fungal pathogens such as black sigatoka infect plants.

Many plants produce the enzyme chitinase as a defence against fungal pathogens. Chitinase catalyses the breakdown of chitin in the cell walls of fungi.

(a) Scientists have discovered that when chitin binds to chitinase:

- two amino acids in chitinase move closer together to form a hydrophobic region around the chitin substrate
- other amino acid interactions cause the active site of the enzyme to partially cover the chitin substrate.

(i) Name the hypothesis of enzyme action that is supported by the mechanism observed in chitinase.

..... **[1]**

Question 7 · AS Paper 1 · June 2023 · Q22(a)(ii) · 2 marks

(ii) Explain how the mechanism of enzyme action observed in chitinase increases the rate of chitin breakdown.

.....

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..... **[2]**

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Question 8 · A level Paper 3 · November 2020 · Q2(c) · 1 mark

(c) Creatine kinase (CK) is an enzyme that catalyses reactions in heart muscle. High levels of CK in the blood indicate that a person may have had a heart attack.

Suggest why high levels of CK in the blood indicate that a person may have had a heart attack.

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.....

..... **[1]**

Question 9 · A level Paper 3 · June 2019 · Q3(b) · 2 marks

(b) One example of a cold-tolerant molecule present in icefish is a modified form of the protease enzyme trypsin.

Fig. 3 shows how trypsin is converted from a molecule called trypsinogen. This conversion occurs in the lumen of the small intestine.

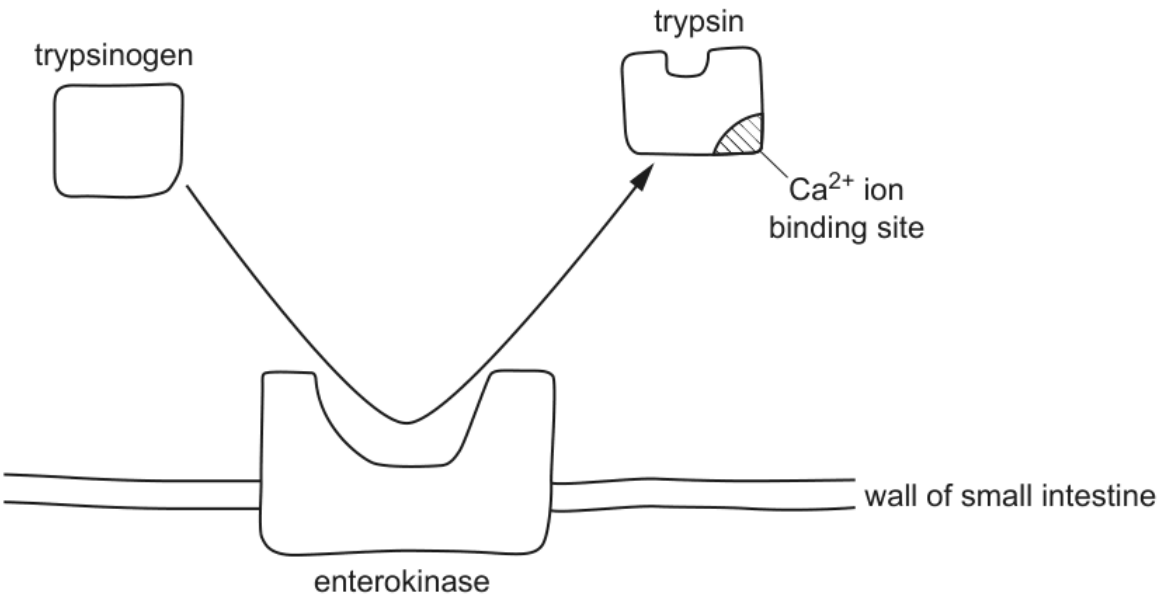


Fig. 3

State **two** conclusions that can be drawn from Fig. 3 about the roles of the molecules and ions that affect how trypsin functions.

1 .....

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2 .....

..... **[2]**

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

Question 10 · A level Paper 3 · June 2023 · Q2(d)(i) · 2 marks

(d) Vitamin C affects the activity of enzymes in different ways.

(i) Vitamin C acts as a coenzyme for several enzymes in the synthesis of collagen.

Outline the role of coenzymes in biological reactions.

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..... **[2]**

Turn over

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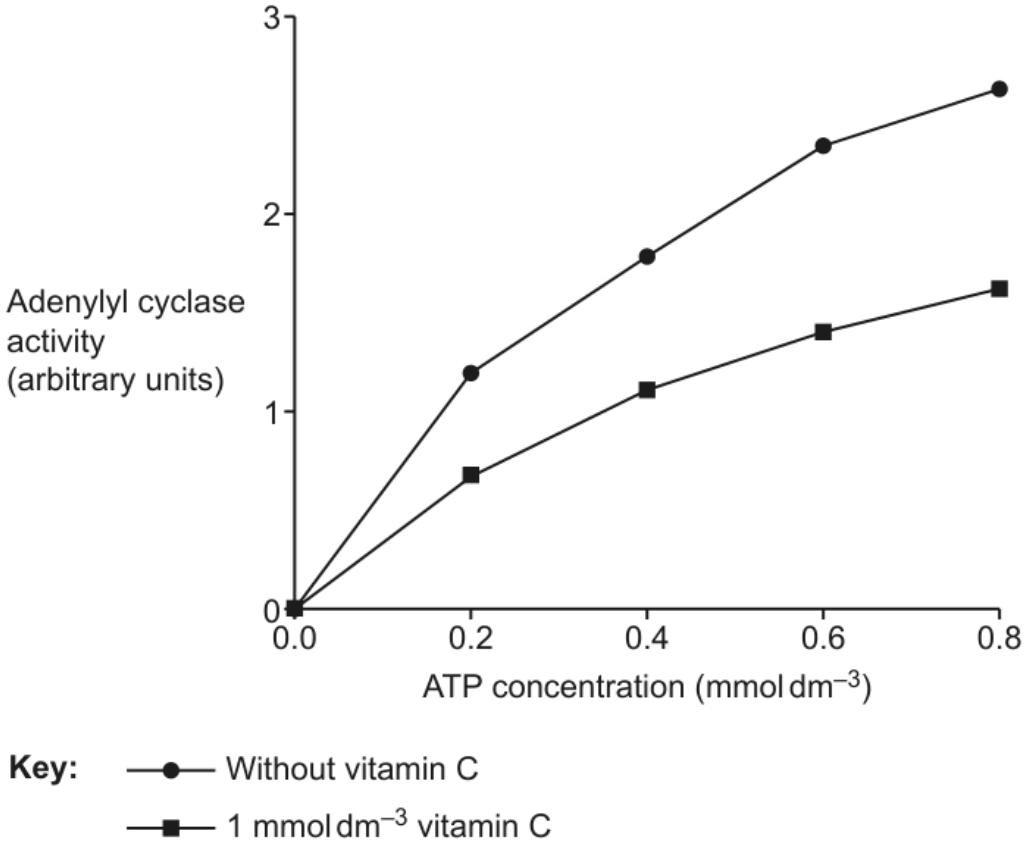
(ii) A scientist investigates the effect of vitamin C on the activity of the enzyme adenylyl cyclase.

Adenylyl cyclase catalyses the conversion of ATP to cAMP.

The scientist measures the activity of adenylyl cyclase without vitamin C and with 1 mmol dm^{-3} of vitamin C.

The scientist's results are shown in **Fig. 2.4**.

Fig. 2.4



Explain what can be concluded from the results in **Fig. 2.4** about the effect of vitamin C on the activity of adenylyl cyclase.

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..... **[2]**

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(c) Enzymes are affected by temperature. Fig. 25.2 shows the time course of a mammalian enzyme reaction at different temperatures.

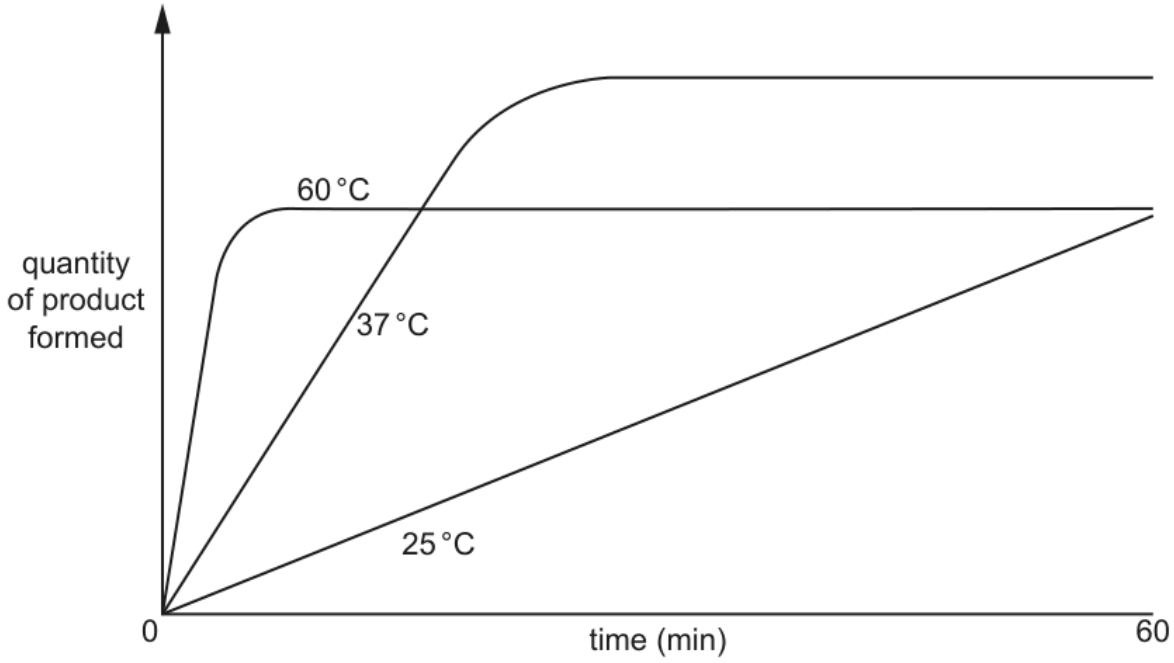


Fig. 25.2

(i) Explain why there is a difference in the shapes of the curves at 37 °C and 60 °C.

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..... **[2]**

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Question 13 · AS Paper 1 · June 2019 · Q25(c)(ii) · 2 marks

(ii) Explain why there is a difference in the shapes of the curves at 25 °C and 37 °C.

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..... **[2]**

Turn over

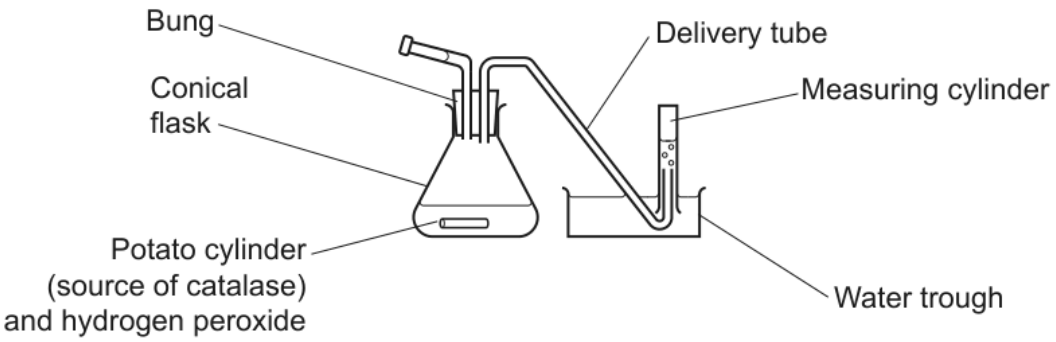
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Question 14 · information from earlier in the question

17 Catalase is found in many tissues. It is an enzyme that breaks down hydrogen peroxide into oxygen and water.

Some students do an experiment to investigate the effect of hydrogen peroxide concentration on the rate of this reaction using the apparatus shown in **Fig. 17.1**.

Fig. 17.1



This is the method the students use.

1. Use a stock solution of 250 cm^3 of 20 a.u. hydrogen peroxide, to make solutions of 8 a.u. and 2 a.u.
2. Cut 15 cylinders of potato of equal diameter, using a cork borer, and use a ruler to ensure that each one is 5 cm long.
3. Set up the apparatus as shown in **Fig. 17.1**.
4. Record the starting position of the water in the measuring cylinder.
5. Place one cylinder of potato into the conical flask.
6. Pour 50 cm^3 of 2 a.u. hydrogen peroxide into the flask, immediately secure the bung and start the stopwatch.
7. Record the volume of gas given off every 30 s for 3 min.
8. Repeat steps 3 to 7 twice.
9. Repeat steps 3 to 8 using 8 a.u. and 20 a.u. hydrogen peroxide.

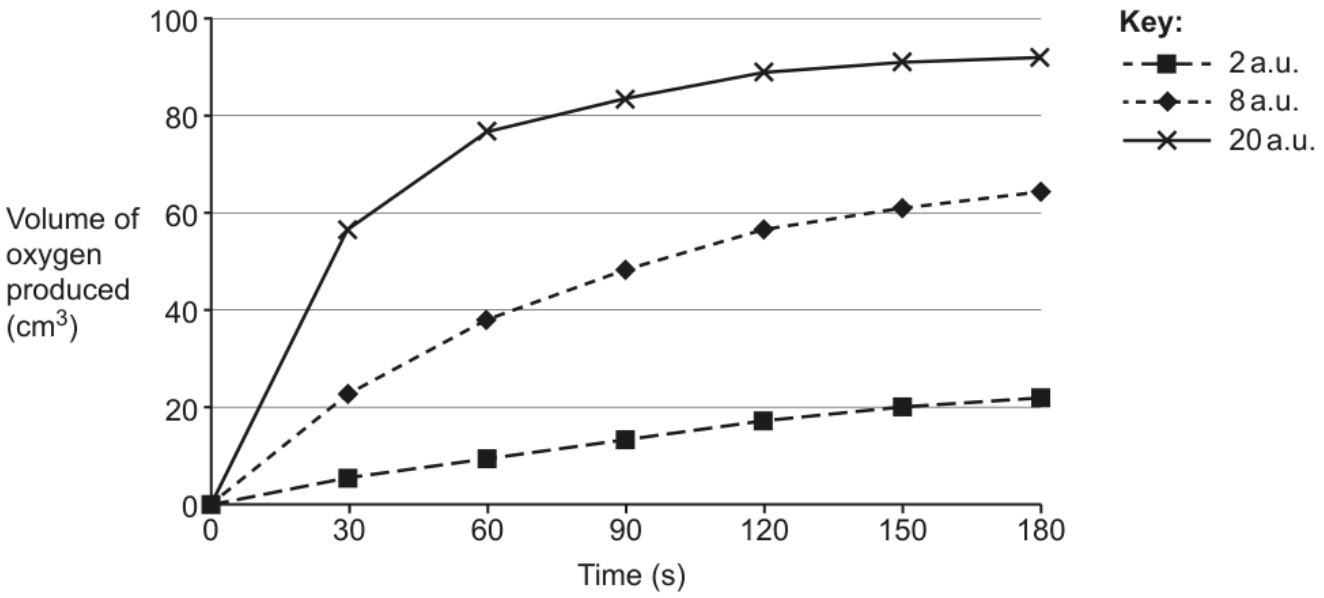
(a) (i) State the independent variable in this investigation.

..... **[1]**

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(c) **Fig. 17.2** shows a graph of the students' results.

Fig. 17.2



Explain the results for 20 a.u. hydrogen peroxide.

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..... **[3]**

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

Question 15 · A level Paper 2 · June 2022 · Q21(b)(i) · 2 marks

(b) Yoghurt is a food produced from milk using microorganisms.

Yoghurt production involves two bacteria: *Lactobacillus delbrueckii* and *Streptococcus thermophilus*.

(i) The bacteria convert the lactose present in milk into lactic acid.

Lactic acid is an important contributor to the flavour of yoghurt. Lactic acid also helps to give yoghurt a longer shelf life than milk.

Suggest how lactic acid helps to extend the shelf life of yoghurt.

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..... **[2]**

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(b) The scientists studied the effect of living at different temperatures on respiration in young fish at different stages of growth.

High oxygen consumption in fish is associated with a fast growth rate.

Their results are shown in **Fig. 20.2**.

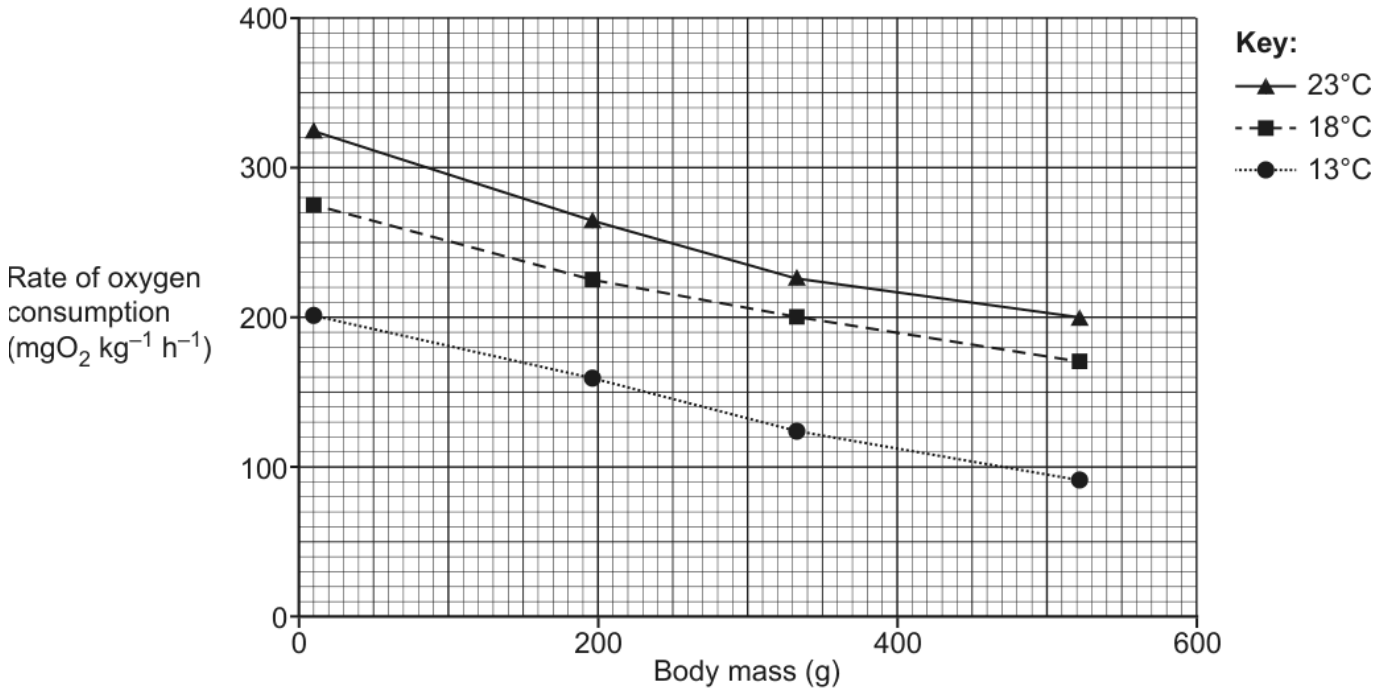


Fig. 20.2

(i) Calculate the Q_{10} for respiration in the largest fish.

Give your answer to **3** significant figures.

Q_{10} = ... **[2]**

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

Question 17 · AS Paper 2 · June 2025 · Q3(b)(i) · 3 marks

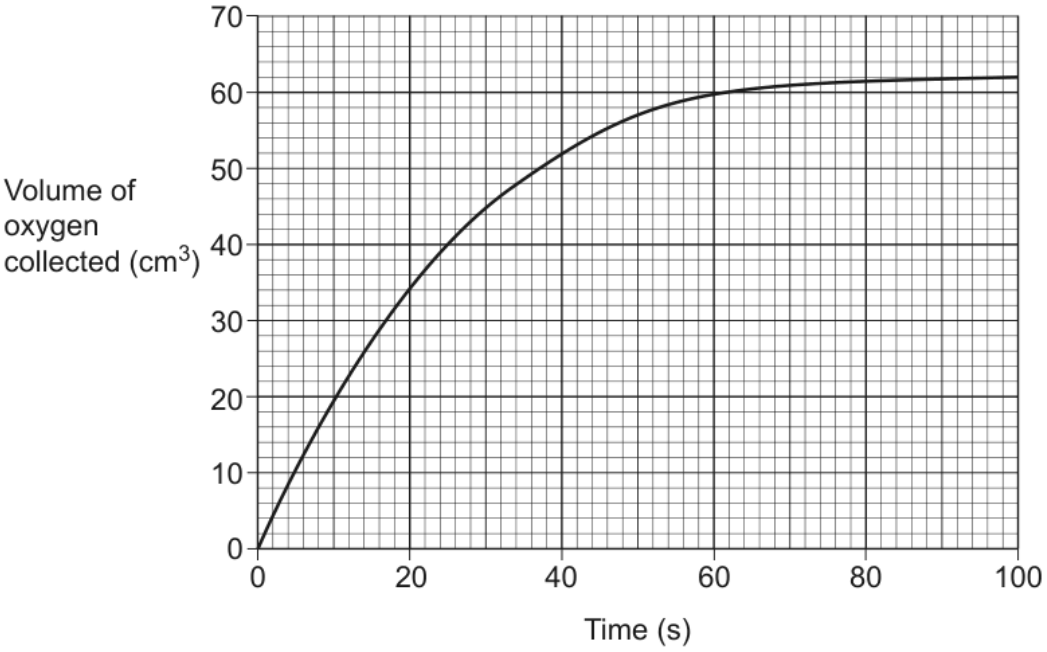
(b) Peas can be used in experiments as a source of catalase.

Catalase is an enzyme that catalyses the breakdown of hydrogen peroxide to water and oxygen gas.

A student mashes some peas in distilled water to release the catalase.

They investigate the effect of temperature on the rate of the enzyme reaction.

The graph shows the results they obtain at 20 °C.



(i) Use the graph to calculate the initial rate of the reaction.

Give your answer to **2** significant figures.

Initial rate of the reaction = ... $cm^3 s^{-1}$ **[3]**

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Question 18 · AS Paper 2 · June 2025 · Q3(b)(ii) · 1 mark

(ii) The student repeats this experiment at 30 °C and finds the initial rate of reaction to be 4.34 $cm^3 s^{-1}$.

Calculate the Q_{10} for catalase.

Give your answer to **2** significant figures.

Q_{10} for catalase = ... **[1]**

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Mark schemes

Question 1 · AS Paper 2 · June 2025 · Q3(a)(i) · 2 marks

3	(a)	(i)	metabolism ✓ extracellular ✓	2	1.1	**ALLOW** metabolic reactions **ALLOW** hydrolytic / catabolic / carbohydrase

Question 2 · AS Paper 1 · June 2023 · Q27(a)(i) · 2 marks

27	(a)	(i)	*idea of* changes protein production (inside cells) ✓ (some of these) proteins are secreted to affect, other cells / growth / embryo development ✓ increased protein synthesis requires more energy ✓ rate of respiration increases (to supply ATP) ✓

2 max	e.g. 'TET enzymes cause new proteins to be made in the cell' / proteins to be made at a higher rate / more proteins made **ALLOW** proteins are secreted to cause faster growth **DO NOT ALLOW** ref to excretion of proteins
1	

Question 3 · AS Paper 1 · June 2023 · Q27(a)(iii) · 1 mark

(iii)	<table><tr><th rowspan="2">Enzyme</th><th colspan="2">Type of reaction catalysed</th></tr><tr><th>Intracellular</th><th>Extracellular</th></tr><tr><td>TET</td><td>✓</td><td></td></tr><tr><td>catalase</td><td>✓</td><td></td></tr><tr><td>trypsin</td><td></td><td>✓</td></tr></table> ✓	1	✓ **IGNORE** crosses

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

Question 4 · A level Paper 1 · June 2018 · Q18(c) · 1 mark

	(c)	extracellular **AND** (it) takes place outside of cells / cellulose cannot enter (bacterial) cells ✓
		Total

1 max	**ALLOW** enzymes must , leave / be secreted from , (bacterial) cells **IGNORE** 'excrete'
10	

Question 5 · AS Paper 2 · June 2018 · Q4(b)(i) · 2 marks

4(b)(i)	2 **1** inhibitor binds to, allosteric site / enzyme away from active site ✓ **2** changes, tertiary / 3D, structure of, enzyme / active site / protein **OR** active site no longer complementary to substrate **OR** substrate and, enzyme / active site, cannot, bind / fit (together) **OR** E-S compex cannot form ✓

ALLOW catalase for 'enzyme' throughout
ALLOW hydrogen peroxide / H_20_2, for 'substrate' throughout

ALLOW joins / fits into, for 'binds'
ALLOW shown on diagram

ALLOW conformation / shape for 'structure'
IGNORE denatures

Question 6 · A level Paper 1 · June 2025 · Q17(a)(iv) · 1 mark

17	**(a)**	**(iv)**	end-product (inhibition) ✓	**1**	1.2

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Question 7 · AS Paper 1 · June 2023 · Q22(a)(ii) · 2 marks

		(ii)	(changes to active site cause formation of) stronger bonds between chitin and chitinase ✓ bonds in chitin are, weakened / put under strain ✓ lower activation energy ✓	2 max

Question 8 · A level Paper 3 · November 2020 · Q2(c) · 1 mark

c	(creatine kinase is an) intracellular (enzyme)/AW ✓ (presence in the blood indicates) damage to heart (cells / tissue / muscle)✓	1 max

2.1	e.g. 'creatine kinase should be within cells'

Question 9 · A level Paper 3 · June 2019 · Q3(b) · 2 marks

b	enterokinase, is an enzyme / converts trypsinogen to trypsin / described ✓ calcium ion / Ca^{2+}, is a cofactor (to trypsin)✓	2

mark as prose
ALLOW enterokinase**,** modifies / activates / changes tertiary structure, of trypsinogen
ALLOW calcium ion binding site formed by enterokinase
ALLOW enterokinase is a catalyst

ALLOW a description of a cofactor
ALLOW calcium ion / Ca^{2+}, is a non-competitive inhibitor

DO NOT ALLOW Ca^{2+} is a, prosthetic group / coenzyme

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Question 10 · A level Paper 3 · June 2023 · Q2(d)(i) · 2 marks

2	**(d)**	**(i)**	assists enzymes / AW ✓ without being permanently bound to enzymes / AW ✓ example of mechanism ✓

2 max	1.1	e.g. 'activates enzymes / helps enzyme (carry out its function)' e.g. 'temporarily attached to enzyme' e.g. 'reduces activation energy required for reaction' / 'involved with binding of substrate to active site' / 'allows substrate to bind more easily' / 'allows more ESCs to form' / 'binds to active site of enzyme' / 'changes structure of binding site' / 'helps transport reactant into active site'

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Question 11 · A level Paper 3 · June 2023 · Q2(d)(ii) · 2 marks

Question			Answer
2	(d)	(ii)	acts as inhibitor / reduces enzyme activity / enzyme activity is (always) lower in the presence of vitamin C / reduces amount of cAMP produced ✓ *idea of* (possibly) non-competitive because increasing ATP concentration does not allow enzyme activity to reach level without vitamin C ✓ *idea of* cannot decide whether it is competitive or non-competitive because enzyme activity has not plateaued (at the ATP concentrations shown) ✓

Mark	AO Element	Guidance
2 max	3.1	**ALLOW** 'without vitamin C enzyme activity is (always) higher ' **ALLOW** 'non-competitive because V_{max} not reached' **Note** : if state 'it is a non-competitive inhibitor because increasing ATP concentration does not allow enzyme activity to reach level without vitamin C' = mp1 and 2

Question 12 · AS Paper 1 · June 2019 · Q25(c)(i) · 2 marks

(c)	(i)	*At higher temperature / 60°C* more kinetic energy therefore more, successful collisions / ESC formed ✓ initial rate (of reaction) faster ✓ enzyme (eventually) denatured and, less product formed / reaction stopped earlier / not all substrate reacted ✓

max 2	**ORA** for 37°C **ALLOW** description of denatured

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Question 13 · AS Paper 1 · June 2019 · Q25(c)(ii) · 2 marks

	(ii)	*At lower temperature / 25 °C* less kinetic energy therefore less, successful collisions / ESC formed ✓ rate (of reaction) slower / taking more time for product to be formed ✓ not all substrate reacted (after 60 min) ✓
		Total

max 2	**ORA** for 37°C **ALLOW** reaction not complete (in 60 min) **ALLOW** substrate (concentration) does not become limiting (in 60 min) **IGNORE** Ref to amount of product formed
10	

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Question 14 · A level Paper 2 · June 2023 · Q17(c) · 3 marks

(c)	**1**	more frequent collisions at the start ✓ **ora**
	2	substrate / H_2O_2 (collides with) , active site (of catalase) ✓
	3	rate of , product / oxygen , formation decreases (with time or substrate concentration) ✓
	4	substrate / H_2O_2 , concentration decreases (with time) ✓

3 max	2.8	**1 ALLOW** (rate) depends on frequency of collisions / more collisions over first 30 s **2 ALLOW** formation of ESC **3 ALLOW** e.g., more oxygen produced per second at the beginning **4 ALLOW** substrate concentration initially higher **4 ALLOW** substrate concentration becomes limiting factor **4 DO NOT CREDIT** enzyme concentration **DO NOT AWARD 1**, **3** or **4** for answers that do not address changes over time

Question 15 · A level Paper 2 · June 2022 · Q21(b)(i) · 2 marks

(b)	**(i)**	pH below optimum ✓ (for) bacterial enzymes ✓	**2**	2.5

ALLOW low(er) pH denatures (enzymes)

ALLOW enzymes in (named) microorganisms

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Question 16 · A level Paper 1 · June 2022 · Q20(b)(i) · 2 marks

20	**(b)**	**(i)**	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer is 2.22 / 2.20 award 2 marks** $Q_{10} = \frac{R_2}{R_1}$ 200 / 90 = 2.22222 correct values for O_2 consumption at 23 ºC **AND** 13 ºC ✓ correct calculation of Q_{10} based on values from graph ✓

2	3.1, 3.2	**If answer incorrect then:** **ALLOW** 1 mark if answer not given to 3 sig. fig. e.g. 2.22222 **OR** **ALLOW** 1 mark if you see 200 and 90 or 91 as the two correct readings from Fig. 20.2 **DO NOT ALLOW** if 170 is also given as this is the incorrect reading for 18ºC

Question 17 · AS Paper 2 · June 2025 · Q3(b)(i) · 3 marks

(b)	**(i)**	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.0 cm^3 s^{-1} award 3 marks** Initial rate = 16/8 = 2.0 cm^3 s^{-1} appropriately drawn tangent between 0 to 8s **OR** single data point used between 0 to 8s ✓ correct working: difference in *y* axis readings divided by difference in *x* axis ✓ correct answer to two significant figures ✓	**3**	**2.4**

ALLOW a range of 2.0 to 2.2 with supporting tangent line drawn **ALLOW** ECF for tangent drawn at incorrect position

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(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.1 award 1 mark.** 4.34 / 2.1 = 2.06666 = 2.1 ✓	**1**	**2.4**

ALLOW ECF from **(i)**
DO NOT ALLOW if answer not given to 2 sig. figs.

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