

# A Level OCR Biology

## 5 Enzymes – answers

Question	Answers	Extra information	Mark	AO Spec reference																
1(a)(i)	non-protein substance ✓ required for protein / enzyme to function ✓		2	AO1 2.1.4(e)																
1(a)(ii)	<table border="1"> <thead> <tr> <th>Cofactor</th> <th>Enzyme with which it is associated</th> <th>Is the cofactor organic or inorganic?</th> <th>Is the cofactor a prosthetic group?</th> </tr> </thead> <tbody> <tr> <td>Zn<sup>2+</sup></td> <td>carbonic anhydrase</td> <td>inorganic</td> <td>yes</td> </tr> <tr> <td>Cl<sup>-</sup></td> <td>amylase</td> <td>inorganic</td> <td>no</td> </tr> <tr> <td>coenzyme A</td> <td>pyruvate dehydrogenase</td> <td>organic</td> <td>no</td> </tr> </tbody> </table>	Cofactor	Enzyme with which it is associated	Is the cofactor organic or inorganic?	Is the cofactor a prosthetic group?	Zn <sup>2+</sup>	carbonic anhydrase	inorganic	yes	Cl <sup>-</sup>	amylase	inorganic	no	coenzyme A	pyruvate dehydrogenase	organic	no	Award one mark per correct row	3	AO1 2.1.4(e) 5.2.2(f)
Cofactor	Enzyme with which it is associated	Is the cofactor organic or inorganic?	Is the cofactor a prosthetic group?																	
Zn <sup>2+</sup>	carbonic anhydrase	inorganic	yes																	
Cl <sup>-</sup>	amylase	inorganic	no																	
coenzyme A	pyruvate dehydrogenase	organic	no																	
1(b)(i)	(end) product inhibition ✓		1	AO2 2.1.4(f)																
1(b)(ii)	<i>idea of</i> regulates production rate ✓	Accept negative feedback	1	AO2 2.1.4(f)																
2(a)	Any five from: active site (of amylase) complementary to substrate / starch ✓ substrate / starch binds to active site ✓ induced fit ✓ (forms) enzyme–substrate complex ✓ lowers activation energy ✓ (forms) enzyme–product complex ✓		5 max	AO1 2.1.4(c)																
2(b)(i)	Any two from: temperature ✓ amylase (solution) concentration / volume ✓ starch (solution) concentration / volume ✓		2 max	AO2 2.1.4(d)(i) 2.1.4(d)(ii)																

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2(b)(ii)	iodine (test) ✓ <i>idea that</i> hydrolysis is complete when blue / black colour no longer appears ✓		2	AO2 2.1.4(d)(ii) 2.1.2(q)
2(b)(iii)	Any two from: <i>idea that</i> more intermediate temperatures need to be tested ✓ the number of repeats is unknown / more repeats are needed ✓ 6.5 <b>and</b> 7.0 <b>and</b> 7.5 are similar ✓		2 max	AO3 2.1.4(d)(i) 2.1.4(d)(ii)
2(b)(iv)	<i>idea of</i> change in charges in active site ✓		1	AO2 2.1.4(d)(i) 2.1.4(d)(ii)
3(a)	transfer 1% solution to distilled water ✓ 1:9 ratio of solution : water ✓  use pipette / volumetric flask ✓	e.g., ‘add 1 cm <sup>3</sup> of the solution to 9 cm <sup>3</sup> of water’	3	AO2 2.1.4(d)(ii)
3(b)(i)	1.3 ✓ ✓ ✓ ✓	Q <sub>10</sub> between 20 and 30 °C = 0.39/0.20 = 0.95 Q <sub>10</sub> between 30 and 40 °C = 0.66/0.39 = 1.69 (mean =) 1.32  Accept errors carried forward throughout Correct answer scores full marks even without working	4	AO2 2.1.4(d)(i) 2.1.4(d)(ii)
3(b)(ii)	more kinetic energy ✓ <i>idea of</i> greater rate of enzyme–substrate complex formation ✓ <i>idea of</i> greater rate of product formation ✓	Accept alternative wording for more	3	AO2 2.1.4(d)(i) 2.1.4(d)(ii)

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Question	Answers	Extra information	Mark	AO Spec reference
4(a)	$1.58 \times 10^{-7}$ (mol dm <sup>-3</sup> ) ✓ ✓	Accept one mark for 0.000 000 158 (not in standard form)	2	AO2 2.1.4(d)(i)
4(b)	Any four from:  <i>temperature</i> more kinetic energy ✓ hydrogen bonds break ✓  <i>pH</i> change in charges ✓ hydrogen and ionic bonds break ✓  <i>general</i> active site changes shape ✓		4 max	AO1 2.1.4(d)(i)
4(c)	competitive inhibitor binds to active site and non-competitive inhibitor binds to allosteric site ✓ non-competitive inhibitor changes tertiary structure ✓ non-competitive inhibitor lowers the maximum rate of reaction / $V_{\max}$ ✓	Allow 'site other than active site' for 'allosteric site' Accept reverse argument Accept reverse argument Do not allow reversible / irreversible because these terms can apply to either inhibitor	3	AO1 2.1.4(f)
5(a)	curved line below the original line ✓ new line labelled as 'lower activation energy with enzyme' ✓	Accept alternative wording	2	AO2 2.1.4(c)
5(b)	(original model was) lock and key ✓ active site and substrate(s) have specific and complementary shapes ✓ (new model is) induced fit ✓ substrate binds and changes the shape of the active site ✓ providing a better fit ✓		4 max	AO1 2.1.4(c)

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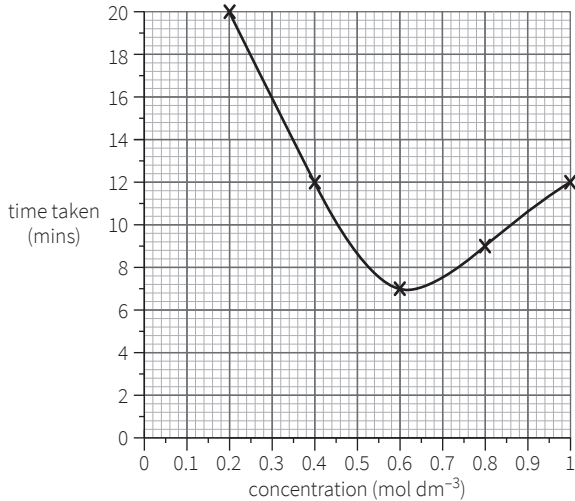
## 5 Enzymes – answers

Question	Answers	Extra information	Mark	AO Spec reference
6	<p><b>Level 3 (5–6 marks)</b>            Outlines reactions <b>and</b> details for all three enzymes.  <i>There is a well-developed line of reasoning, which is clear and logically-structured and uses scientific terminology at an appropriate level. All the information presented is relevant and forms a continuous narrative.</i></p> <p><b>Level 2 (3–4 marks)</b>            Outlines reactions <b>and</b> details for two enzymes <b>OR</b> Outlines reactions for all three enzymes <b>and</b> details for at least one enzyme.  <i>There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.</i></p> <p><b>Level 1 (1–2 marks)</b>            Outlines reaction of an enzyme <b>and</b> details for an enzyme.  <i>The information is communicated with only a little structure. Communication is hampered by the inappropriate use of technical terms.</i></p> <p><b>0 marks</b>            No response or no response worthy of credit.</p>	<p><b>Indicative content:</b></p> <p><i>amylase</i></p> <ul style="list-style-type: none"> <li>• Breaks down starch / amylose / amylopectin</li> <li>• forms maltose</li> <li>• extracellular / digestive</li> <li>• cofactor is <math>\text{Cl}^-</math></li> <li>• optimum pH is 6.7–7.0</li> </ul> <p><i>carbonic anhydrase</i></p> <ul style="list-style-type: none"> <li>• converts water and carbon dioxide</li> <li>• to carbonic acid / <math>\text{H}^+</math> and <math>\text{HCO}_3^-</math></li> <li>• in red blood cells</li> <li>• prosthetic group is <math>\text{Zn}^{2+}</math></li> </ul> <p><i>ATP synthase</i></p> <ul style="list-style-type: none"> <li>• converts ADP and inorganic phosphate</li> <li>• to ATP</li> <li>• on thylakoid / mitochondrial membranes requires flow of <math>\text{H}^+</math> ions</li> </ul>	6	AO1 2.1.4(b) 2.1.4(e) 3.1.2(i) 5.2.2(h)

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### Skills box answers

Question	Answer
<p><b>1</b></p>	 <p>time taken (mins)</p> <p>concentration (mol dm<sup>-3</sup>)</p> <p>Things to look out for:</p> <ul style="list-style-type: none"> <li>• a line graph should be drawn with pH on the <i>x</i>-axis and volume of apple juice on the <i>y</i>-axis</li> <li>• the scaling and tick marks should be regular</li> <li>• a curve of best fit</li> </ul>
<p><b>2</b></p>	<p>5</p>
<p><b>3</b></p>	<p>use more pH values between pH 2–6</p>