Enzymes

Mark Scheme 3

Level	IGCSE
Subject	Biology
Exam Board	CIE
Topic	Enzymes
Paper Type	(Extended) Theory Paper
Booklet	Mark Scheme 3

Time Allowed: **68 minutes**

Score: **/56**

Percentage: **/100**

Question	E	Answers	Marks	Additional Guidance
1 (a)		broad leaves / *Ranunculus* does not have narrow leaves / AW **;** branched veins / not parallel veins **;** flower parts, in 5s / not in 3s **;** **R** 'flowers in fives'	[max 2]	**A** wide / large surface area **A** net(work) of veins / reticulate **I** two cotyledons
(b)	**1**	(cells of **W** were) in, the winter / cold / low light / short days / AW **;** **I** refs. to water		*assume answers refer to **W** unless told otherwise – accept ORA for **S***
	2	starch, has been used / converted to glucose *or* sugar / broken down **;**		
	3	to provide energy **;** **R** 'produce'		**1** (cells of **S** were) in summer / warm / high light / AW **;** **I** refs. to water
	4	in respiration **;**		**2** starch has been, stored / produced **;**
	5	to keep the, plant / cells, alive **;** **I** for growth, etc.		**8** result of (more) photosynthesis **;**
	6	root has become a source (not a sink) **;**		**6** root is a sink (not a source) **;**
	7	when there has been, no / few, leaves **;**		**7** many leaves **;**
	8	so there has been, no / little / less, photosynthesis **;**		
	9	ref. to, light / temperature / cold, as limiting factor(s) **;**	[max 3]	
(c)	**1**	sucrose / sugar, transported / translocated **;** **A** travels / in phloem		*if given breakdown of starch award MP6 to 9 only*
	2	glucose / monosaccharide **;**		
	3	joined together (by chemical bonds) **;** **R** if refers to joining sucrose		**A** 'join together to make maltose'
	4	condensation reaction / described **;**		
	5	glucose added to growing chain / AW **;**		
	6	(starch is a) long / chain, molecule **;** **A** is a polysaccharide		**A** polymer / polymerisation
	7	enzyme provides active site for reaction **;**		
	8	enzyme, catalyses / speeds up, the reaction **;**		**A** enzyme(s) is/are (biological) catalyst(s)
	9	ref. to lock and key (model) **;**	[max 3]	

Question	E	Answers	Marks	Additional Guidance
1 (d)	1 2 3 4 5	increase in (kinetic) energy ; more, collisions / AW ; between, enzyme / active site, and, substrate / AW ; ref. to optimum temperature / works best at ≈ 30 °C ; denatured, at high temperature / above 30 °C / above optimum ;	[max 2]	**I** particles, movement **R** 'destroyed' / 'killed' / 'damaged'
			[Total: 10]	

Question	E	Answers	Marks	Additional Guidance
2 (a)	1 2 3 4 5 6 7	substrate / sucrose, fits into enzyme ; active site ; ref to shape of molecules, fitting together / matching / AW ; lock and key ; sucrose and water / molecules, close together within enzyme ; glucose and fructose produced + enzyme, unchanged / reused ; lowers energy needed for reaction ;	[max 3]	**R** similar/same shape **A** form, enzyme substrate complex / ESC
(b) (i)		temperature constant so not another variable / AW ; (near) optimum temperature ; denatures at higher temperatures / less or not active at lower temperature ;	[max 2]	**R** denatures at lower temperatures
(ii)	1 2 3 4	increase in activity from pH 3 to pH 7 / ORA; optimum pH / peak activity, pH 7 ; decrease in activity from pH 7 to pH 11 / ORA; any rate of activity quoted ;	[max 3]	**A** pH 6.8 – 7.2 **A** neutral pH **R** 6 – 7 **A** correct ref. to no activity below pH 3 or above pH 11
(iii)		**P** – pepsin / protease ; **Q** – amylase / carbohydrase ; **R** – lipase / trypsin / protease / amylase / carbohydrase / maltase / sucrase / lactase ;	[3]	
(c)	 1 2 3 4 5 6	*marking points **not** linked – allow ecf* amylase, breaks down starch ; starch → maltose / glucose / sugar(s) ; (named) protease, breaks down protein ; protein → polypeptides / peptides / amino acids ; lipase, breaks down fats ; fat → fatty acids and glycerol ;	[max 4]	**alternatives for MP1**: (named) carbohydrase breaks down (correctly named) carbohydrate **alternatives for MP2:** maltose → glucose / sucrose →glucose and fructose / carbohydrates → sugars
			[Total: 15]	

3 **(a** *description required not an explanation, so ignore collisions / denaturation*
MP3 may be awarded for comments within the range 50 °C to 90 °C

1 no activity, at / below, 10 °C **;**
2 increased activity between 10 °C and 90 °C **;**
3 steep(est) increase / exponential increase, between 50 *or* 60 °C and 90 °C **;**
4 optimum / peak / maximum, at 90 °C **;** **A** 'works best at' / most active at
5 above 90 °C activity decreases **;** **[3 max]**

(b) *ignore details of genetically modified bacteria*

1 (bacteria grown in) fermenter / bioreactor / vat **;** **R** tanks
2 (bacteria provided with) substrate / feedstock / food substances / glucose / sugars / starch / minerals / whey / waste substances / nutrients / amino acids / AW **;**
R food / raw materials
3 oxygen / aerobic conditions **;** **A** air bubbled through / aerated
4 optimum conditions / 26 °C / pH 5–6 / sterile **;**
5 stirred to, prevent settling / mix bacteria with nutrients **;**
6 (bacteria) grow / reproduce / divide / multiply, rapidly **;**
7 (extracellular) enzymes, secreted / released / AW **;** **R** production
8 enzymes, extracted / harvested / separated / collected / removed (from, bacteria / mixture) **;**
A ref to filtration / crushing bacteria **R** crushing enzymes **[4 max]**

(c) *enzymes must be in the correct context*
do not award MP9 if there are no other points made

1 protein digested to, amino acids / (poly)peptides **;** **A** broken down / hydrolysed
2 (by) protease(s) **;**
3 fats digested to fatty acids (and glycerol) **;**
4 (by) lipase(s) **;** **R** ligase
5 (by) amylase **;**
6 starch to, sugar, maltose, glucose **;**
7 (by) cellulase **;**
8 breaksdown cellulose (fibres) to release stains **;** **A** reduces pilling
9 *idea that* products are, soluble / washed away (in the water) **;** **[4 max]**

(d) **1** thrombin / protease **;**
2 fibrinogen converted to fibrin **;**
3 soluble (protein) converted to insoluble (protein) **;**
4 fibrin, traps blood cells / forms mesh / forms 'nets' **;** **[3 max]**

[Total: 14]

4 **(a) (i)** excretion **;** [1]

(ii) biological **;** **A** made by, cells / organisms
catalyst / described **;**
(made of) protein / AW **;**

bio-catalyst = 2 marks [max 2]

(b) (i) pH **;** **A** ph / PH / Ph [1]

(ii) temperature **;** **R** heat *ignore* room
size / mass / quantity / amount / surface area / type, of potato **;**

volume of hydrogen peroxide **;**
concentration of hydrogen peroxide **;**

A 'amount' with respect to hydrogen peroxide
R refs to catalase / enzyme [max 2]

(c) *award two marks if correct answer (0.56 / 0.57 / 0.58) is given – may be in white space below the table*

if no answer or incorrect answer award one mark for correct working

if 0.5 or 0.6 award one mark

10 divided by 17.4

0.56 / 0.57 / 0.58 **;;** [2]

(d) *graph* [2]

1 *x-axis labelled* pH **;**
2 *y-axis labelled – must have units*
rate (of oxygen production / of reaction), $cm^3\ min^{-1}$ / cm^3 per min ;
3 points all correct **;** use the overlay, but **A** *ecf from* ***(c)***
4 continuous and clear line , which may be either a curve which may not go through all the points or straight lines between points
R if line goes beyond plotted points [4]

(e) (i) increase in rate to (pH) 6 then decrease / reaches a peak at (pH) 6 **;**
any rate given as a data quote, **with $cm^3\ min^{-1}$ / cm^3 per min ;** [2]

(ii) pH 6 is, optimum / when enzyme 'works best' **;**

following points may refer to optimum or sub-optimum
ref to shape of enzyme **;**
ref to active site **;**
ref to denaturation **;** **A** destroyed **R** 'killed'
ref to substrate / hydrogen peroxide, fitting into, enzyme / active site **;** [max 3]

[Total: 17]