

Enzymes

Mark Scheme 4

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Enzymes
Sub Topic	Enzymes
Booklet	Theory
Paper Type	Mark Scheme 4

Time Allowed : 69 minutes

Score : / 57

Percentage : /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

- 1 (a) 1 mitochondrion ; **A** mitochondria
A outer mitochondrial membrane
- 2 produces/synthesises /AW, ATP ; **A** release/supply, ATP/energy
R produces energy
R ATP energy
- or**
for outer mitochondrial membrane allows exit of (synthesised) ATP to cell
- 3 example of use of ATP in liver cells ;
e.g. for synthesis of, cholesterol/glycogen/protein/biological molecules/polymers/
AW
intracellular movement of vesicles
exocytosis/endocytosis/bulk transport
active transport [3]
- (b) (i) lipoproteins are soluble ;
cholesterol is not water-soluble ;
cholesterol surrounded by/lipoproteins have, phospholipid heads/proteins, that are
hydrophilic ; AW
allows transport in blood ; [max 1]
- (ii) *cholesterol needed for*
making/components of, membranes ;
membrane stability ;
regulating the fluidity of, membranes/phospholipid bilayer ;
production of, steroid hormones/named steroid hormone ;
AVP ; e.g. helps prevent entry of, ions/polar molecules [max 2]
- (c) vesicles travel to cell surface membrane ; **A** travels through cytoplasm towards space
between cells
exocytosis ;
vesicle/membrane, fusion (with cell surface membrane) ;
contents/cholesterol, released ; [max 2]
- (d) glycosylation/adding sugar molecules to proteins/making glycoproteins ;
A modifying proteins
phosphorylating proteins ;
cutting/folding, proteins ;
assembly of polypeptides into proteins (with quaternary structure) ;
AVP ; e.g. lipid synthesis
ref. lysosome formation [max 1]

[Total: 9]

2 (a)

<p><i>Keratin and chitin have structural functions</i></p> <p>cellulose ; collagen ;</p> <p><i>allow <u>only one</u> incorrect molecule to be listed for max 1</i></p>	<p><i>Keratin is a fibrous protein</i></p> <p>collagen ;</p> <p><i>no marks if other molecules given</i></p>
<p><i>The monomers of chitin have β-1,4 linkages between them</i></p> <p>cellulose ;</p> <p><i>no marks if other molecules given</i></p>	<p><i>Keratin and chitin contain nitrogen</i></p> <p>collagen / haemoglobin ; 1st mark mRNA ; 2nd mark</p> <p><i>allow <u>only one</u> incorrect molecule to be listed for max 1</i></p>

[max 5]

(b) (i) 47.5 °C ;

[1]

(ii) *accept activity for relative activity throughout*
accept manipulated data quotes and penalise once for, incorrect / no, units

Fig. 2.2 (relative activity of enzyme at different temperatures)

- 1 as temperature increases, activity increases up to, optimum / 47.5 °C (*allow ecf from (i), then decreases ;*
A peaks (*for increase then decrease*))
- 2 activity increases from 30 °C to 47.5 °C, then decreases to 70 °C ; *also mp 1*
or
increase or decrease, described with comparative data (activity and temperature compared with another activity and temperature)
- 3 at higher temperatures (compared to most others) enzyme still active ;
- 4 high optimum temperature (compared to most other enzymes) ;

Fig. 2.3 (stability over time for enzyme maintained at different temperatures)

- 5 enzyme becomes less stable over time ;
A activity decreases over time
A description if at least two temperatures described
- 6 data quote to support ; *activity at two times for any one temperature if time 0 or 'start', then assume 100% relative activity if 100%, assume time 0*

3 (a) mark both parts together to a maximum of four marks

- 1 (polymer / polysaccharide of) β -glucose ; *allow glucose if β given for bond*
- 2 (1-4, β) glycosidic, bonds / linkages ; **A** glucosidic
R if 1-6 also given
- 3 ref. to (β) glucose units, linked at 180° to each other / alternately orientated / AW ;
- 4 many -OH groups projecting out (in different directions) ;
- 5 unbranched (polymer) / straight chain / linear ;
- 6 many hydrogen bonds between molecules ;
- 7 (straight chain allows) molecules lie parallel to each other ;
- 8 (form) microfibrils ;
- 9 many microfibrils form (cellulose) fibres ;
- 10 ref. to fibres at angles / criss-cross / AW ;
- 11 (cellulose) cell wall is permeable ;
A idea of many gaps, in wall / between fibres, allowing passage of water / (named) substances
- 12 ref. to strength to, prevent cell bursting / withstanding (turgor) pressure / AW ; [max 4]

(b) *data quote may help to decide if mp2 is matched*
units must be used at least once in the answer to award mp3

- 1 as retention time increases percentage of cell wall material digested increases / positive correlation ;
A 'time for digestion' / reverse relationship
R directly proportional
- 2 results scattered / not all animals fit the pattern / varying percentages for the same retention time ; *not just a data quote*
- 3 data quote with units (% and h) using both axes ;
e.g. (highest percentage) 65% at 78 hou
(lowest percentage) $35.5 \pm 0.5\%$, 35 hours
- 4 no retention time shorter than 35 hours and none longer than 88 hours ;
A lowest / shortest and highest / longest
A reverse relationship **A** 'time for digestion'
- 5 none of the (24) herbivores can digest the cell wall material completely ;
A no more than 65% is digested
not just a data quote [max 3]

(ii) more digestion means that there is more energy available to the animal ;
ora = undigested material means less energy to the animal

- 2 more digested material means more energy for, secondary consumers / carnivores / next trophic level / for the food chain ; ora
- 3 more digested material means more trophic levels ; ora
- 4 more undigested material provides more energy to decomposers / AW ;
- 5 AVP ; e.g. ref. to (named) animal productivity
A secondary, production / productivity [max 2]

(c) *one mark per line*

similarities

use, membrane / integral / intrinsic / transmembrane / transport / carrier, proteins ;

R channel proteins

are specific / have specific binding site ;

involve conformational / shape, change of protein ;

(movement of (named)), ions / polar molecules / water soluble molecules / hydrophilic molecules / lipid insoluble molecules ;

I large molecules **A** charged

(movement) across membranes / into *or* out of the cell ;

[max 2]

differences **A** *ora*

facilitated diffusion is (movement from), high(er) to low(er) concentration /
down concentration gradient ; *ora* **A** diffusion gradient

I 'along a concentration gradient'

facilitated diffusion, is passive process / does not require energy *and* / *or* ATP (from the cell) ;

R ATP energy

R the cell makes energy for active transport

[max 2]

[Total: 13]

CHEMISTRY ONLINE
— TUITION —

- 4 (a) (i) tangent drawn on the graph as close as possible to time 0 e.g. 1.6 / 6 ;
0.27 ;

accept

correct volume of gas

stated time, up to and including 20 secs

or

tangent drawn on the graph before 20 secs

$$\left. \begin{array}{l} \text{e.g. } \frac{2.5}{10} \quad \frac{4.3}{20} \\ \frac{5.8}{20} \end{array} \right\} ;$$

correct calculation ; e.g. $0.25 \text{ (cm}^3 \text{ s}^{-1}\text{)}$, $0.22 \text{ (cm}^3 \text{ s}^{-1}\text{)}$ **A** 0.215
e.g. 0.29

award one mark if the time is 21–40 s but the calculation is completed correctly

[2]

- (ii) *accept hydrogen peroxide or reactant for substrate*

initially high concentration of substrate so, rate of reaction high / enzyme activity at
a maximum / AW ;

(rate slows as) concentration of substrate decreases ; **A** substrate being used up
no further change in volume / AW, reaction has stopped ;

correct data quote to support explanation(s) ;

correct ref. to number of (successful) collisions;

correct ref. to enzyme-substrate complexes / active sites occupied;

[max 3]

- (b) 1 (copper ions act as enzyme) inhibitor ; **R** competitive inhibitor
2 non-competitive (inhibition) ;
3 (non-competitive) inhibitor / Cu^{2+} , combines with enzyme at site other than active
site ;
4 active site shape / tertiary structure / 3D shape, changes ;
5 active site no longer accepts substrate / enzyme-substrate complex not formed /
AW ;
6 independent of substrate concentration / increase in substrate concentration has
no effect / AW ;
7 comparative rates quoted from Fig. 2.2 ;
e.g. max, $3.25 \text{ cm}^3 \text{ s}^{-1}$ v $0.22\text{--}0.25 \text{ cm}^3 \text{ s}^{-1}$
8 AVP ; e.g. actual rate depends on the relative concentration of inhibitor / AW
 V_{max} not reached
effect of ion presence on tertiary structure

[max 4]

- (c) enzymes are proteins ;

ref. transcription ; *accept description* } *in correct context*
ref. to mRNA ;
ref. translation ; *accept description*

ref. to further folding / glycosylation / modifying, in, RER / Golgi body ;

[max 3]

[Total: 12]

5 (a) (i) active, transport / uptake ;

max 2

movement, against the concentration gradient / from low to high concentration ;

A diffusion gradient

requires energy (from ATP) ;

specificity / specific binding site ; **A** complementary shape

conformational change / change in 3-D shape ; **A** ref. to, 'flip-flop' / 'kissing gate' mechanism [max 3]

(ii) (70S) ribosomes ; *ignore size* [1]

(iii) ammonia / ammonium / ammonium ions ; **A** NH_3 / NH_4^+ [1]

(b) (i) *two marks for correct answer*
35(%) ;;

1 mark if correct working but not to whole number

$90 / 255 \times 100 = 35.29 / 35.3$ [2]

(ii) idea that nitrogen removed is replaced by nitrogen added ;
denitrification / denitrifying bacteria ; **A** named bacteria e.g. *Pseudomonas aeruginosa* / *Thiobacillus denitrificans*
convert / AW, nitrate / nitrite (to nitrogen gas) ;
AVP ; e.g. occurs, when oxygen depleted / waterlogged soils
volcanic action adds nitrogen [max 2]

(c) 1 increase / maintain, nitrogen content of soil ; **A** add, ammonium / nitrates, to soil
2 increase / maintain, soil fertility ;
3 uptake / absorption, of, ammonium ions / nitrates / fixed nitrogen (by plants) ;
4 (plants use) for, amino acid / protein, production ;
5 increased, growth / yield, of (crop) plants ;
6 ref. feeding, livestock / human populations ;
7 reduced need for fertilisers ;
8 example of environmental benefit of reduced fertilisers ;
9 cost saving from reduced use of fertilisers ;
10 qualified ref. to, *Rhizobium* / legumes ; [max 3]

[Total: 12]