Enzymes

Mark Scheme 3

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Enzymes
Sub Topic	Enzymes
Booklet	Theory
Paper Type	Mark Scheme 3

Time Allowed : **54 minutes**

Score : **/ 45**

Percentage : **/100**

Grade Boundaries:

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

1 **(a** (bacterial urease converts) urea → ammonia;

ammonia → nitrite;
Nitrosomonas;
nitrite → to nitrate;
Nitrobacter;

nitrification;
oxidation / chemosynthesis; **[max 3]**

(b) **6** ; **[1]**
(ii) ; **[1]**
(iii) ; **[1]**

(c) curve starting at 0;
but lower;
reaches same plateau but at higher concentration of urea; **[2]**

(d) inhibition is reversible;
enzyme is still active;
inhibitor fits into active site temporarily;
substrate is broken down (reaction does proceed);
same end point;
just takes longer / reaction is slower with inhibitor; **[max 2]**

[Total: 10]

2 **(a)** *Two correct letters required for a mark for each column if list given; mark first 2 letters.*

Alcohol	Caffeine	Nicotine	Heroin
U V Y Z	S T Z	S T W X Z	U Y W

4

(b) decrease in response to drug/effect of drug becomes less (intense);
decrease in sensitivity of receptors/more receptors are made;
drug is metabolised/becomes part of body's metabolism; more drug necessary to achieve the same effect/sensation/euphoria; **max 2**

(c) *award marks from any annotated diagrams*
Either
inhibitor fits site other than active site/allosteric site; tertiary/3D structure or shape changes/any two bonds mentioned break; (ionic, van der Waals, hydrophobic, hydrogen, disulphide, covalent)
active site changes shape;
substrate no longer fits/binds/active site no longer complementary to substrate/E.S. complex not formed;

or
inhibitor fits permanently/irreversibly into active site;
substrate can no longer bind/substrate blocked/no E.S. complex formed;
increasing substrate has no effect; **max 3**

Either mark scheme as appropriate – do not mix marking points from both mark schemes

[Total 9]

3 **(a 1** glucose / substrate, is not complementary / is partially complementary, to active site **;**

2 enzyme / active site, changes shape / moulds around / fits around, when substrate, enters / binds **; R** if substrate / glucose changes

3 stronger binding of substrate to active site **;**

4 further detail **;** e.g. becomes complementary to / fits more tightly to, glucose / substrate
interaction of, functional groups / R–groups / side-chains
formation of (named) bond but not disulfide *or* peptide bond [max 3]

(b) 1 (competitive) inhibitor has, same / similar, shape to substrate **;**

2 inhibitor does not induce the same change in, 3D shape / tertiary structure / active site (as the substrate) **;**

3 (so inhibitor) less likely to bind (successfully) in active site **;**

4 *idea that* because it does not have same functional groups (in same positions) / AW **;**

5 in lock and key the inhibitor, fits directly into / is complementary to / binds to, active site **;** [max 2]

(c) enzymes / hexokinase, denatured **;**
all enzymes molecules are partially denatured / some enzyme molecules are denatured **;**

changes / disrupts / loss of (specific shape / structure) active site **;**
A no longer complementary to, glucose / substrate
breakage of, ionic / hydrogen, bonds **; R** disulfide / peptide bonds

idea that loss of structure makes E–S complex formation more difficult / fewer E–S complexes are formed / substrate does not fit into active site **;** [max 3]

(d) (i) *accept* ***ora***
active transport requires, ATP / energy (whereas facilitated diffusion does not) **;**
active transport moves substances against the concentration gradient (whereas facilitated diffusion moves substances down the concentration gradient) **;**
active transport uses only carrier proteins (whereas facilitated diffusion uses both carrier and channel proteins) **;**
A active transport can involve cotransport but facilitated diffusion does not [max 2]

(ii) too large / too big **; R** 'it is a big molecule' unqualified

polar / charged, so cannot pass through hydrophobic region of membrane **;**
A fatty acid tails for hydrophobic
no, specific / AW, protein, in membrane / carrier / channel **;**
e.g. AW = no protein for G–6
AVP **;** e.g. gated channels are closed [max 2]

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

(ii) B / C ; [1]

(iii) A / F ; [1]

(iv) B ; [1]

(v) D ; [1]

(b) 1 nitrogen and hydrogen / substrates, bind to / AW, active site **;**
2 enzyme-substrate complex (forms) **;**

3 ref. lock and key / induced fit, mechanism **;**

4 activation energy of reaction is lowered **;**
5 example of how activation energy lowered **;**
e.g. strain on (triple) bond of, N_2 / (di)nitrogen
A bond broken between nitrogen (atoms)
nitrogen and hydrogen ions held close together for bond formation
transfer of electrons
alternative pathway

6 product / NH_4^+, leaves active site **;**

7 ATP, required / used / provided from respiration **;**
8 ref. anaerobic conditions for enzyme action **;**

9 suggestion as to use of, vanadium / molybdenum, in active site **;**
e.g. act as cofactor / coenzyme
transfer of, electrons / protons 4]

(c) 1 concentration of all the ions is greater in the root tissue than in the solution **;** ora
A roots

2 comparative data quote **;**

according to these data

3 (so) ions will not diffuse into the root tissue **;**
A if (facilitated) diffusion only, initially / till equilibrium reached

4 (so) active transport **; A** active, uptake / pumping **I** facilitated diffusion

5 use ATP **;** **A** energy
R ATP energy

6 move ions, against concentration gradient / from low to high concentration**;**
A diffusion gradient

7 use, membrane / integral / intrinsic / transmembrane / transport / carrier, proteins **;**
R channel proteins

8 are specific / have specific binding sites **;**

9 involve, conformational / shape, change **;**

10 comparative data quote to suggest that some ions are pumped more than others **;**
e.g. steepest gradients for K^+ and SO_4^-

11 phospholipid bilayer / hydrophobic core (of cell surface membrane) is impermeable to ions **;**

12 so ions cannot diffuse out / (membrane) proteins only allow inward flow of ions **;**

13 AVP **;** e.g. suggestion of differing numbers of specific membrane proteins to explain observation of mp 10 [max 5]

[Total: 14]