Enzymes

Mark Scheme 6

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Enzymes
Sub Topic	Enzymes
Booklet	Theory
Paper Type	Mark Scheme 6

Time Allowed : **53 minutes**

Score : **/ 44**

Percentage : **/100**

Grade Boundaries:

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

1 **(a)** denature, sucrase / enzyme **;** **A** deactivate
stop the reaction (in each tube at the same time) **;**

idea that Benedict's test requires a high temperature **;**
ref to reducing sugars **;** [2 max]

(b) starts at, the origin / 5 g dm^{-3}, increases to 45–55 g dm^{-3} **;**
constant from 80 to 100 g dm^{-3} **;** [2]

(c)

description	*rate**
5	0.0036
10	0.0069
15	0.0105
20	0.0133
50	0.0213
100	0.0222

penalise lack of units once only

1 increase in rate of hydrolysis to approx 50 g dm^{-3} **;**
A decrease in time taken to approx 50 g dm^{-3} / correct rate calculations* to show an increase
2 remains constant / plateaus / levels out / AW, from approx 50 g dm^{-3} to 100 g dm^{-3} **;**

explanation to max 4
3 (sucrase / enzyme) hydrolyses / breaks , glycosidic bonds **;**
4 forming, reducing sugars / glucose / fructose **;**

5 *idea that* concentration is the limiting factor, at low concentration of, sucrose / substrate **;**

6 (at low concentrations) active sites, unoccupied / available **;**
A as concentration increases, more active sites are occupied / more enzyme-substrate complexes formed / AW

7 at higher concentrations all active sites, occupied / saturated / AW **;**
R enzymes for 'active sites'
8 substrate, in excess / AW **;**
9 V_{max} reached / working at maximum rate **;**

idea that
10 at higher concentrations, enzyme / sucrase, is the limiting factor **;** [5 max]

[Total: 9]

2 **(a)** parents, carriers / heterozygous ;

child homozygous recessive ;

¼ / 0.25 / 25%, chance ;

mutation ; [3 max]

(b) **(i)** gene technology / genetic engineering / description ; [1]

(ii) glucagon ; [1]

(iii) low blood glucose concentration / during or after exercise ;
R sugar [1]

(c) foreign / non-self / cell recognition ;

stimulates immune response / AW ; [1 max]

(d) *parental genotypes* L^ML^N x L^ML^N

gametes L^M or L^N L^M or L^N ;

parental genotypes and gametes for one mark

offspring genotypes L^ML^M L^ML^N L^ML^N L^NL^N ;

offspring phenotypes MM MN MN NN ; [3]

*penalise once for omission of **L***

(e) Canadian Inuit, allele frequencies / L^ML^N ratio, different from others ;

high frequency of L^M / low frequency of L^N , compared to other populations ;

R just highest L^M / lowest L^N

less outbreeding / more inbreeding ;

AVP; e.g. L^M has selective advantage in Inuit environment [3 max]

[Total: 13]

3 **(a)** *measure*

disappearance of substrate; **A** measure conc. of substrate

appearance of product; **A** measure conc. of products **2**

(b) active over a wide range of pH/AW e.g. whole range/pH 1-9;

increasing activity as pH increases to, optimum/pH 5;

decreasing activity as pH increases, above optimum/> pH 5;

optimum is, between pH 4 to 5.5/pH 5; **A** any figure between 4-5.5 **3**

(c) (idea of) some enzymes active/all enzymes partly active; **1**

low pH equivalent to high H^+ ion concentration;

(so) enzymes (partly) denatured;

reference to tertiary structure affected;

reference to hydrogen/ionic bonds, disrupted/broken;

(so) active sites changed e.g. no longer complementary to substrate;

(detail) affect on R groups of amino acids (in active site);

(therefore) (few) enzyme-substrate complexes formed; **3 max**

(c) curve same shape with same optimum (at pH 5 - between 2.0 and 3.0 units on y axis);

lower (starting at pH 1 and finishing at pH 9 without touching x axis); **2**

(e) similar/same shape to, substrate/organic phosphates;
R similar structure

occupies/binds/combines/fits into, active site; **R** inhibitor competes with substrate for active site

so blocking/preventing, entry of substrate; (therefore) decreased rate of product/ e-s complex/phosphate, formation (at low substrate concentrations

inhibitor molecules, not permanently bound to active site/bind briefly;

reference effect of concentration of substrate e.g. inhibitor less effective at high concentrations of substrate

A from sketch graph if given **3 max**

[Total 14]

Question	Expected Answers	Marks
4 (a)	active site; specific shape / configuration / conformation (in ref to active site); complementary to substrate / exact / perfect fit (between substrate and active site); combine to form enzyme-substrate / ES complex; mould around substrate / substrate alters shape of active site (induced fit); R. induced fit unqualified ref to temporary bonds / named bond;	**3 max**
(b) (i)	EcoR1;	**1**
(ii)	sticky ends;	**1**
(c)	plasmid DNA cut with same restriction enzyme / endonuclease; DNA and plasmid mixed together / AW; R. inserted ref complementary / base pairing / C and G on sticky ends pair up; ref to hydrogen bonding; ligase forms bonds between sugar and phosphate / phosphodiester bonds;	**3 max**
		[Total : 8]