



**Exampro A-level Biology
(7401/7402)**

Name:

Class:

Enzymes MS

Author:

Date:

Time: 97

Marks: 70

Comments:

These questions mix the different styles of questions. Short answers, practical techniques, experimental data analysis, extended answer and comprehension Work through these, the more you do the better you will become with your exam technique.

M1. (a) (i) Active site / enzyme not complementary;

Active site changes (shape) / is flexible;

(Change in enzyme allows) substrate to fit / E-S complex to form;

Active site becomes complementary / wraps around substrate = 2 marks

For mark point 2. allow 'binding site' but not 'enzyme'

For mark point 2. can only have enzyme changes (shape) if active site has been mentioned earlier

Final mark point must have context

Reject: active site on substrate for second marking point only

Accept: diagrams only if suitably labelled or annotated

2 max

(ii) Active site does not change (shape) / is fixed (shape) / is rigid / does not wrap around substrate / (already) fits the substrate / is complementary (before binding);

Assume that 'it' refers to lock and key

1

(b) Similar structure / shape (to PABA) / both complementary;

Competes for / binds to active site / competitive inhibitor;

Less PABA binds / less E-S complexes;

OR

Specific reference to different structure / shape (to PABA) using the diagram;

Binds to position other than active site / binds to allosteric site / binds to inhibitor site / non-competitive inhibitor;

Changes the active site so substrate cannot bind / less PABA binds / less E-S complexes;

Q *Reject: same structure / shape*

Note: competitive inhibitor binds to active site = 1 mark (same mark point)

Assume that 'it' refers to sulfanilamide

Accept: PABA / substrate cannot bind

Neutral: less product produced as in question stem

Neutral: different structure / shape to PABA

Reject: active site on substrate for second marking point only

3 max

[6]

- M2.** (a) (i) (Grinding) breaks open cells / increases surface area (of liver);
Releases catalase / enzyme / more catalase / allows more hydrogen peroxide
into liver; 2
- (ii) Heating causes bonds (maintaining tertiary structure) to break;
Denatures / changes tertiary structure so active site changed;
Substrate no longer fits / ES complex not formed; 3
- (b) (Control) to show that sand did not affect reaction (with ground liver); 1
- (c) (i) Lower activation energy / less energy required to bring about reaction; 1
- (ii) Energy in products / water and oxygen less than energy in substrate /
reactants / hydrogen peroxide;
(Difference) given out as heat / exothermic; 2

[9]

M3.(a) Any **two** of the following;

Concentration of enzyme

Volume of substrate solution

pH

Allow same concentration of substrate

1

(b) Ratio between 5.18:1 and 5.2:1;

Initial rates incorrect but correctly used = 1 mark

Allow 1 mark if rate at:

$60\text{ }^{\circ}\text{C} = 0.83\text{ g dm}^{-3}\text{ s}^{-1} / 49.8\text{ g dm}^{-3}\text{ minute}^{-1}$

OR

$37\text{ }^{\circ}\text{C} = 0.16\text{ g dm}^{-3}\text{ s}^{-1} / 9.6\text{ g dm}^{-3}\text{ minute}^{-1}$

(c) At 60 °C:

1. More kinetic energy;
2. More E–S complexes formed;
Allow converse for 37 °C

2

(d) Different times:

1. Higher temperature / 60 °C causes denaturation of all of enzyme;
Accept converse for 37 °C
2. Reaction stops (sooner) because shape of active site changed;
Reject if active site on substrate

Different concentrations of product (at 60 °C)

3. Substrate still available (when enzyme denatured);
4. But not converted to product;

4

[9]

- M4.(a)**
1. Enzyme hydrolyses / breaks down protein to amino acids;
 2. Products are soluble / can be washed away;

2

(b) **Arguments for biological washing powder:**

3 max if only arguments against biological washing powder are referred to

1. More effective with all stains;
Accept different ways of expressing 'effective' e.g. higher % of stain removed
2. Greater improvement with salad dressing / chocolate milkshake / chocolate pudding;

Arguments against biological washing powder:

3. Little / less improvement with raspberry sorbet / raspberry smoothie;

4. Only tested 5 / a small number of stains;
5. Only chose stains that would work / didn't select stains that wouldn't work;
6. Only included results that did work / didn't show results that didn't work;
7. Only one set of results / not repeated;
8. Only compared against one washing powder / may not be true for other washing powders;
Ignore references to unknown masses of powder, temperature of washes or other aspects of technique or different fabrics

4 max

- (c)
1. Enzyme **S** effective across a wider range of temperatures;
 2. Enzyme **S** more active above 50 °C / active up to 80 °C / active above 60 °C;
 3. Enzyme **S** more active below (about) 37 °C temperature;
 4. (Although) Enzyme **P** has higher rate of reaction at optimum / 40 – 50 °C;
 5. Enzyme **P** denatured above 50 °C;
*Answers should be in the context of choosing enzyme **S** but, if **P** is chosen, points 4 and 5 may still be awarded, if described*
In points 2 and 3, a temperature must be stated. Allow ± 5 degrees of values shown

3 max

- (d)
1. Stains caused by different substances;
 2. Enzymes are specific;
 3. Active site specific to substrate / other substrates cannot fit active site;
This could be expressed in other ways e.g. 'other substrates are not complementary to the active site'

3

[12]

- M5.(a)**
1. Tertiary structure / 3D shape of enzyme (means);
Accept references to active site
 2. Active site complementary to maltose / substrate / maltose fits into active

site / active site and substrate fit like a lock and key;
Idea of shapes fitting together

3. Description of induced fit;
4. Enzyme is a catalyst / lowers activation energy / energy required for reaction;
Accept "provides alternative pathway for the reaction at a lower energy level"
5. By forming enzyme-substrate complex;
Accept idea that binding stresses the bonds so more easily broken
Do not award point 5 simply for any reference to E-S complex

5

- (b) 1. Inhibitors reduce binding of enzyme to substrate / prevent formation of ES complex;
Max 3 if only one type of inhibition dealt with. Accept maltase and maltose as examples of enzyme and substrate (and others)
Only once, for either inhibitor

(Competitive inhibition),

2. Inhibitor similar shape (idea) to substrate;
3. (Binds) in to active site (of enzyme);
Accept allows max rate of reaction to be reached / max product will eventually be formed
Accept complementary to active site
4. (Inhibition) can be overcome by more substrate;

(Non-competitive inhibition),

5. Inhibitor binds to site on enzyme other than active site;
6. Prevents formation of active site / changes (shape of) active site;
Accept does not allow max rate of reaction to be reached / max product will not be formed
7. Cannot be overcome by adding more substrate;

5 max

[10]

- M6.** (a) Several / more than one polypeptide chain in molecule;
Evidence must only relate to 4^o structure

1

(b) Chemical bonds formed between sulphur-containing groups / R-groups / form stronger disulphide bonds; Bind chain(s) to each other; 2

(c) Different number / sequences of amino acids; Bonds in different places which gives different shape; 2

(d) Outer layer of skin cells are dead / do not respire Do not contain mitochondria / do not produce ATP / release energy; Cells do not have required proteins / carriers; 3

(e) Advantages:

- 1 Small objects can be seen;
- 2 TEM has high resolution as wavelength of electrons shorter;
Accept better

Limitations:

- 3 Cannot look at living cells as cells must be in a vacuum;
- 4 must cut section / thin specimen;
- 5 Preparation may create artefact
- 6 Does not produce colour image;

6
[14]

M7. (a) Hydrolysis (reaction);
Accept phonetic spelling

1

- (b)
1. Too big / wrong shape;
Wrong charge - neutral
Accept insoluble
 2. To fit / bind / pass through (membrane / into cell / through carrier / channel protein);
 3. Carrier / channel protein;
Accept carrier / channel protein not present

- (c) 1. Villi / microvilli damaged / destroyed;
2. Reduced surface area;
Accept fewer channel / carrier proteins
3. For (facilitated) diffusion / active transport;
Must be in correct context

3

- (d) Foreign / (act as) antigen / non-self;
Reject foreign cells

1

- (e) 1. Dose to be given;
Accept: interaction with other drugs
2. No (serious) side effects;
3. How effective;
4. Cost of drug;

2 max

[10]