



Q3.

- (a) In humans, the enzyme maltase breaks down maltose to glucose.
This takes place at normal body temperature.

Explain why maltase:

- only breaks down maltose
- allows this reaction to take place at normal body temperature.

(Extra space)

(5)



- (b) NMO is a disease that leads to damage to nerve cells in the spinal cord.
A person with NMO produces anti-AQP4 antibody that attacks only these nerve cells.

Explain why the anti-AQP4 antibody only damages these cells.

(4)

- (c) Each type of antibody binds specifically to one of the antigen proteins.

Explain why.

(3)

- (d) HIV attaches to a specific protein receptor on helper T cells. A low percentage of people have a mutation of the *CCR5* gene which codes for this protein receptor. This mutation results in a non-functional protein receptor.

Explain how this mutation can result in the production of a non-functional protein receptor.

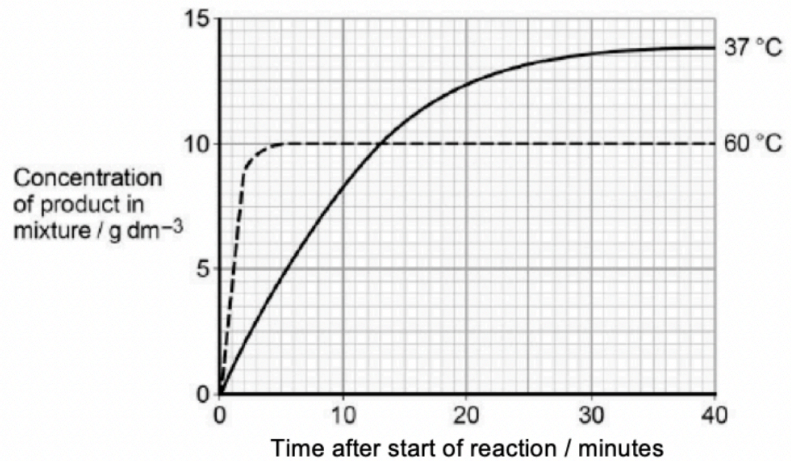
(4)

(Total 16 marks)



Q5.

A technician investigated the effect of temperature on the rate of an enzyme-controlled reaction. At each temperature, he started the reaction using the same concentration of substrate.



(a) Give **two** other factors the technician would have controlled.

1.

2.

(1)

(b) Draw a tangent on each curve to find the initial rates of reaction.

Use these values to calculate the ratio of the initial rates of reaction at 60 °C : 37 °C.

Ratio = :1
(2)

(c) Explain the difference in the initial rate of reaction at 60 °C and 37 °C.

.....
.....
.....

(2)

(d) Explain the difference in the rates of reaction at 60 °C and 37 °C between 20 and 40 minutes.

.....
.....
.....
.....
.....

(4)
(Total 9 marks)



Q1.

- (b)
1. Polymer of amino acids;
 2. Joined by peptide bonds;
 3. Formed by condensation;
 4. Primary structure is order of amino acids;
 5. Secondary structure is folding of polypeptide chain due to hydrogen bonding;
Accept alpha helix / pleated sheet
 6. Tertiary structure is 3-D folding due to hydrogen bonding **and** ionic / disulfide bonds;
 7. Quaternary structure is two or more polypeptide chains.

5 max
[11]

Q3.

- (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. (Anti-AQP4) antibody has a (specific) tertiary structure;
 2. Has binding site / variable region that only binds to / complementary to one antigen;
 3. Antigen to this antibody (only) found on these nerve cells;
 4. So, antibody (only) binds to / forms antigen-antibody complex with these nerve cells (causing damage);
Reject "active site" (only penalise once if it occurs throughout)
3. / 4. Accept 'receptor' for antigen

4

- (c)
1. Each antigen protein has a different tertiary structure;
 2. (Each) antibody has a specific antigen / binding / variable region / site;
 3. So, (each antibody) forms different antigen-antibody complex
OR
(each antibody) only binds to complementary (protein);

3

- (d)
1. Change in DNA base/nucleotide (sequence);
Accept: mutation in DNA base (sequence).
Accept: deletion/substitution/addition of a DNA base/nucleotide.
 2. Change in amino acid (sequence)/primary structure;
Reject: different amino acid formed.
Ignore: change in code for amino acid.
 3. Alters (position of) hydrogen/ionic/disulfide bonds;
 4. Change in tertiary structure (of receptor);
Reject: any reference to active site.
Ignore: 3°.

4

[16]



Q5.

- (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:

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

OR

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

2

- (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]