EXAM PAPERS PRACTICE

Proteins and enzymes 4

Level: OCR AS H020
Subject: Biology
Exam Board: Suitable for all boards
Topic: Proteins and enzymes 4
Type: Mark Scheme

To be used by all students preparing for OCR AS Biology H020 foundation or higher tier but also suitable for students of other boards.

Mark schemes

1

(a) mutation changes the amino acid sequence / primary structure of Factor VIII protein;
changes the tertiary structure / 3D shape;

2

(b) (mutant) Factor VIII protein is non-functional / does not work with Factor IX;
so no conversion of Factor X to active form and pathway blocked;

2

(c) boy's blood contains (active) Factor VIII;
Factor VIII haemophiliac's blood contains (active) Factor IX;
the mixture has both Factors and so the pathway can complete / blood clots;

2 max

[6]

2

(a) membrane relatively impermeable / less permeable to sodium ions / gated channels are closed / fewer channels;
sodium ions pumped / actively transported out;
by sodium ion carrier / intrinsic proteins;
inside negative compared to outside / 3 sodium ions out for two potassium ions in;

(if sodium mentioned but not in context of ions, negate 1 mark)

4

(b) (i) 1.6;

1

(ii) 18 ÷ 1.6 = 11.25;
multiply by 1000 to convert from ms to s / 11 250;

(correct method = 1 mark, i.e. $\frac{distance}{time}$ *or × 1000)*
(correct answer based on (b)(i) = 2 marks)

2

(iii) time for transmission / diffusion across the neuromuscular junction / synapse;
time for muscle (fibrils) to contract;

1 max

(c) movement by diffusion;
binding to receptors on (post-synaptic) membrane;
causing sodium channels to open / sodium ions to move in to muscle (cell);

3

(d) (i) toxin binds to / competes for / blocks the acetylcholine receptors;
acetylcholine can not depolarise the membrane / the toxin does not cause depolarisation;

(allow references to generating action potentials instead of depolarisation, do not allow references to impulses in muscles)

2

(ii) acetylcholinesterase is unable to breakdown acetylcholine;
acetylcholine still available to depolarise the membrane / generate action potentials in the membrane;

2

[15]

3

(a) Protein;

Catalyst;

Accept speeds up a reaction (but is not changed by the reaction)

(For reaction involving a) specific substrate;

Lowers activation energy;

2 max

(b) Enzyme D binds/collides with substrate E;

Ignore lock and key references

Active site forms/changes shape to fit substrate/E;

Max 2 if no reference to letters

(By) induced fit;

(As) enzyme-substrate complex forms;

(Breaks down to give) products F and G;

Enzyme is unchanged (at end);

3 max

[5]

4

(a) (i) Changes shape of antitrypsin;
Reference to hydrogen/ionic/disulfide bonds;
No longer attaches to/interacts/ reacts with trypsin;

Accept protease

2

(ii) Higher the concentration of hydrogen peroxide, more amino acids/ proteins affected;
More antitrypsin molecules change shape;

2

(b) (Longterm smokers) inhale a lot of hydrogen peroxide;
Smokers have more active enzyme that damages lung tissue;
Reducing gas exchange surface;

2 max

[6]

5 (a) Digestion / hydrolysis / breakdown of a disaccharide into monosaccharides;
OR
(glucose and galactose form lactose) glucose is a monosaccharide;

max 1

(b) (i) Dipeptidase / disaccharidase / named disaccharidase;

1

(ii) Enzymes not lost (with gut contents) / more effective absorption of products formed by these enzymes;

1

(c) No ATP formed / no energy released by respiration;

[reject "making" energy]

Link ATP to active transport (of galactose) into cells;

2

[5]

6 (a) **A** <u>and</u> structure(of **A**) is complementary to that of the active site;

1

(b) idea that non-competitive inhibitor(**C**) binds at a site not the active site; binding causes a change in the shape of the active site;
substrate is no longer able to bind to the active site;

3

(c) (i) peptide;

1

(ii) idea that amino acid chain folds / tertiary structure;
named bond holding tertiary structure e.g. ionic disulphide hydrogen;

{reject peptide)

2

[7]

7

(a) (i) box drawn around R group (i.e. CH_2OH group)
(allow circle if labelled R);

1

(ii) circle drawn around either of the Hs on NH_2 group and circle drawn around the OH;

1

(b) (i) (di)peptide and water;

1

(ii) peptide;

1

(c) sequence of amino acids changes;
tertiary structure changes / folds in a different way;
bonds form in different places;
(*Reject peptide bonds*)

3

[7]

8

(a) (i) ammonia / ammonium ions / compound;

1

(ii) glucose;

1

(b) <u>final</u> acceptor for hydrogen:
to form water;

2

(c) glycolysis can continue;
NAD can accept more hydrogen;

2

(d) secondary / tertiary structure;
produces particular shape of active site;
or
(shape of) active site;
complementary to shape of substrate;

2

(e) sodium ions / non-competitive inhibitor binds to enzyme
at a site other than active site;
resulting in change of shape of active site / no longer complementary;
substrate can no longer bind with the enzyme / enzyme-substrate complexes no longer formed;

3

[11]

9

(a) (i) fructose;

1

(ii) correctly drawn (OH group at bottom left);

1

(b) hydrolysis;

1

(c) (i) heat with Benedict's solution (*disqualify if HCl added*);
orange / brown / brick red / green / yellow colour or precipitate;

2

(ii) biuret test / NaOH + $CuSO_4$;
purple / violet / lilac / mauve;

2

[7]

10

(a) (i) condensation;

1

(b) (i) **D**;

1

(ii) **C**;

1

(iii) **A**;

1

(c) absence of a double bond;
in the (hydrocarbon) chain;
unable to accept more hydrogen / saturated with hydrogen;

2 max

[6]

11

(a) specific 3D tertiary structure / shape;
substrate complementary shape;
(reject same shape)

substrate (can bind) to active site / can fit into each active site;

3

(b) (bacterial) active site / enzymes / proteins denatured /
tertiary 3D structure disrupted / changed;
(ionic) bonds broken;

(reject peptide bonds)
(ignore other bonds)

no enzyme substrate complex formed / substrate no longer fits;

3

[6]

12

(a) pioneers / suitable example colonise land;
example of change in environment;
enables change in species;
conditions change further / example to favour trees;

4

(b) stable community / no further succession / final community;

1

(c) roots unable to respire (aerobically);
active transport of minerals / other metabolic effect stops;

2

(d) action of bacteria / decomposers inhibited / fewer bacteria / decomposers;
acid conditions inhibits enzymes / enzymes denatured / changes active site;
H^+ ions affect active site;
anaerobic conditions;

3 max

[10]

13

(a) (i) number of bases = 4440

allow 4446 if they refer to start / stop

each amino acid coded for by triplet / three bases
(so three times more bases than amino acids);

2

(ii) deletion;
(deletion) of three bases;
because substitution / addition would change amino acid(s);

2 max

(b) codon on mRNA;
specific / complementary base pairing with;
anti-codon on tRNA;
specific tRNA for each amino acid;
protein formed by condensation reactions /
peptide bonds formed;

4 max

[8]

14 (a) diagram showing molecule **A** fitting in inhibition site; distortion of active site;

2

(b) molecules moving less / slower; reduces chance of collision (between enzyme and substrate) / of enzyme-substrate complexes being formed; *(reject converse)*

2

(c) these bonds hold / maintain tertiary / globular structure (of enzyme);
enzyme denatured / tertiary structures destroyed; (shape of) active site distorted / changes;
substrate no longer fits / enzyme-substrate complex not formed;

3 max

[7]

15 (a) (i) Biuret / alkali + copper sulphate;
Lilac / purple / mauve / violet;

Do not give credit for blue or pink. Ignore references to heating.

2

(b) R group of phenylalanine copied accurately;

1

(c) (i) Bond shown linking carbon and nitrogen;
OH and H removed, =O and –H remaining;

2

(ii) Peptide bond;

1

(d) Addition of hydroxyl / OH group;

Candidate must distinguish clearly between hydroxylation and hydrolysis

1

[7]

16 (a) Structure resulting from aggregation of several polypeptide chanins / tertiary structures / eq:

1

(b) Low pH / (more)H^+ ; due to (increased) CO_2 (increased) respiration;
(ignore refs to buffering action of haemoglobin)
(increased) dissociation of haemoglobin;
Oxygen diffuses from r.b.c. to tissues;

3

(c) Deaminated for use in respiration / used in protein synthesis / suitable e.g.;

1

[5]

17 **Quality of Communication**

The answers to all sections of this question require the use of continuous prose.
Quality of language should be considered in crediting points in the scheme. In order to gain credit, answers should be expressed logically and unambiguously, using scientific terminology where appropriate.

(a)
1. Deviation of a value from norm initiates corrective mechanisms;
2. fluctuations in plasma glucose concentration detected by hypothalmus / islet cells in pancreas;
3. initial decrease, no food given (in plasma glucose) stimulates (increased) secretion of glucagon;
4. increases (in plasma glucose) stimulate (increased) secretion of insulin from β cells as secretors;
5. correct ref. to interconversion of glycogen / glucose / increased / decreased uptake of glucose by cells (as appropriate) / correct ref to change in membrane permeability;

5

(b)
1. Body temp. / 37 °C is optimum temp for enzymes;
2. excess heat denatures enzymes / alters tertiary structure / alters shape of active site / enzyme so substrate cannot bind / eq;
3. reactions cease / slowed;
4. too little reduces kinetic energy of molecules / moleculesmove more slowly;
5. fewer collisions / fewer ES complexes formed'

5

[10]