

Proteins & Water

Mark Scheme 3

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Biological Molecules
Sub Topic	Proteins & Water
Booklet	Theory
Paper Type	Mark Scheme 3

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) (i) **A** transcription; (ignore mRNA synthesis)
B translation;
C exocytosis; **R** secretion [max 3]
- (ii) **D** (sub unit of) ribosome
E Golgi apparatus/body; [2]
- (iii) **F** mRNA; [1]
- (b) active site;
(is) specific shape; **A** complementary/other amino acids are the wrong shape to fit, **R** same shape
only accepts R groups of these two amino acids; **R** accepts peptide bond [2]
- (c) correct bond broken (between C-N);
involvement of water molecule in breaking the peptide bond shown clearly;
two amino acids with free groups as follows
-COOH/-COO⁻ and -NH₂/-NH₃⁺;
A from diagram(s). [3]
- [Total: 11]

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- 2 (a) blood is in vessels / blood is in heart, arteries, veins, capillaries ;
any three

pulmonary and systemic circulations / described

or

blood passes through heart twice for one circuit round the body / **AW** ;

[2]

- (b) 1 globular (shape) ; **A** rounded / spherical **R** circular

- 2 hydrophilic, amino acids / R-groups, face cytosol

or

hydrophobic, amino acids / R-groups, to the interior ; **AW**

- 3 (so) soluble **or** dissolved in cytoplasm / cytosol ;

- 4 *ref. to* haem / prosthetic (group) / porphyrin (ring) / Fe^{2+} ferrous ion / iron (ion), binding oxygen ; **R** forms bonds with

- 5 four polypeptides / haems / **AW**, so 4 oxygen molecules / 8 oxygen atoms ;
A four polypeptides, each carrying an oxygen molecule / O_2

- 6 cooperative binding / allostery / described ;

- 7 **AVP** ; e.g. tertiary structure allows association of prosthetic group

[max 4]

- (c) 13–15% ;;

one mark for correct data extraction

96/97% at sea level and 82/83% at altitude

[2]

- (d) 1 more haemoglobin (molecules) / Hb ;

- 2 *idea of* compensation ; e.g. for decreased saturation of haemoglobin as less oxygen available so more can be taken up / transported so tissues receive same / sufficient concentration of oxygen

[2]

- (e) 1 reduces (rate of enzyme activity) ;
- 2 binds at a site on the enzyme other than at the active site/allosteric site ;
- 3 change in tertiary structure ;
- 4 change in shape/conformation/configuration of active site ;
- 5 substrate unable to bind/product unable to form/ES complexes do not form/fewer ESC ;
- 6 **AVP** ; e.g. V_{\max} not reached/increasing substrate concentration no effect [max 3]
- (f) *accept Hb for haemoglobin throughout*
- 1 carbon monoxide binds to Hb/Hb has higher affinity for CO than O₂ ;
A carboxyhaemoglobin forms (heavy smoker)
- 2 (with CO) Hb reaches lower % saturation/lower percentage saturation (after 3.6–, 4.0–4.2 kPa) ;
A correct figures quoted
R lower saturation at all partial pressures of oxygen
- 3 less oxygen taken up, in lungs/at higher partial pressures
or
reduces the volume of oxygen transported ; **AW**
- 4 below 3.6–4.2 kPa (with CO), curve shifts to left/Hb has (relatively) higher saturation ;
- 5 less oxygen unloaded at lower partial pressures/in tissues ;
- 6 heart rate increases to deliver sufficient oxygen ;
- 7 *ref. to* insufficient oxygen to heart muscle and effect on people with CHD ; [max 3]

[Total: 16]

- 3 (a) (i) variable region / antigen binding site ; **A** antigen binding region
A light, polypeptide / chain **R** antigen receptor [1]
- (ii) disulfide ; **I** bridge
A disulphide **R** disulfite / covalent [1]
- (iii) two or more / more than one , polypeptide(s) / tertiary structure(s) ;
R any specific number of polypeptide on its own
R more than one type of polypeptide / many polypeptides
R more than two / several, polypeptides
I ref to prosthetic group [1]
- (b) 1 antigen recognised as / AW, non-self / foreign ;
accept once for macrophage, B-lymphocyte or T-lymphocyte
A non-self / foreign, antigen leads to immune response
2 *idea of* phagocytosis leading to antigen presentation ;
3 antigen (on pathogen or APC) binding to, receptor / membrane, of B-cell(s) /
B-lymphocyte(s) ; **A** clonal selection of B-lymphocytes occurs
4 (helper) T-cell / T-lymphocyte, activate B-cells ; **I** killer T-cells
A release cytokines to stimulate B-cells
5 B-cells / B-lymphocytes, divide by mitosis ; **A** replicates / proliferates by mitosis
A clonal expansion of B-cells
6 plasma cells, formed / AW ;
7 plasma cells / B-cells / B-lymphocytes, produce / secrete / AW, antibody /
immunoglobulin / Ig ; [max 4]
- (c) *parasite / Plasmodium / pathogen / protoctist / protist / protozoan must be mentioned at least once somewhere in the answer to gain any marks*
e.g. 'malaria / disease has many antigens' =
- if malaria is caused by a virus / bacterium penalise once only*
- 1 (malarial) parasite / pathogen / *Plasmodium*, (is eukaryotic) has many genes ;
A has greater genetic complexity cf smallpox / AW
2 different (malarial) parasite, species / strains / AW, have different antigens ;
R 'strands'
3 (malarial) parasite has different antigens in different stages of its life cycle ;
4 (malarial) parasite / *Plasmodium*, switches antigens / idea of antigens changing during infection / different genes coding for antigens switching on / AW ;
R 'active sites' of antigens changing
R 'antigens mutate'
5 parasite / antigen / stages of the life cycle, inside (host / liver / red blood) cells ; [max 2]

[Total: 9]

- 4 (a) (i) 1. gene isolated ;
2. inserted into plasmid / AW
3. correct ref. sticky ends
4. plasmid taken up by *E. coli* / bacterium ; **R** plasmid inserted into bacterium
5. detail ; e.g. use of restriction enzyme / cDNA produced [3 max]
- (ii) 1. marker gene linked to gene for wanted protein ;
2. with promoter
3. GFP gene is, transcribed / expressed
4. producing GFP which fluoresces [3 max]
- (b) *disadvantage*
1. may not fluoresce very brightly / may be difficult to detect ;
- explanation*
2. only a few molecules of GFP produced ;
3. each enzyme molecule produces more fluorescent substance /
idea of enzymes can be re-used ; [2 max]
- [Total: 8]

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