

# Proteins & Water

## Mark Scheme 1

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Biological Molecules
Sub Topic	Proteins & Water
Booklet	Theory
Paper Type	Mark Scheme 1

Time Allowed : 69 minutes

Score : / 57

Percentage : /100

Grade Boundaries:

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

- 1 (a) (i) (describes the) sequence of amino acids (in a polypeptide chain) ; **A** order/arrangement [1]
- (ii) H<sub>2</sub>O/water, released ;  
 (correct) bond formation between (lysine) carboxyl group and (valine) amino group ;  
 dipeptide (of lysine and valine) and formed with correct structural formula ; [3]
- (b) (i) *secondary*  
 1 regular order/pattern, based on H-bonds ;  
 2 between CO– group of one amino acid and NH– group of another ;  
 3 alpha-helix and β-pleated sheet ;
- tertiary to max 4*  
 1 folding coiling ;  
 2 interactions between, R groups side chains ;  
 3 two correctly named bonds ; e.g. hydrogen bonds, disulfide, bonds/bridges, ionic bonds, hydrophobic interactions  
 4 further description of bonds ; e.g. *disulfide* between cysteine (S–H) groups  
*hydrogen* between polar groups (NH– and CO–)  
*ionic* between ionised amine and carboxylic acid groups  
*hydrophobic interactions* between non-polar side chains  
 5 ref. active site, specific/precise, shape ;  
 6 ref. globular/AW, shape ; **A** spherical/ball  
 7 ref. amino acids with, hydrophilic/polar, R groups facing to outside ; ora [5 max]
- (ii) enables (protein to) function/AW ; **A** enables antimicrobial action/AW  
**A** biological catalyst, qualified  
 provides active site ;  
 qualified ref. to specificity ; [1 max]
- (c) altered, (mRNA) codon(s)/triplet(s) ; **A** named type of mutation  
 changed/AW, amino acid(s) ;  
 ref. to effects of stop codon ; e.g. shortened polypeptide chain  
 different, primary structure/described ;  
**A** ref. to differences in, transcription/translation  
 ref. to different properties of, R group/side chain (of normal v replaced amino acid) ;  
 altered tertiary structure/AW ; **A** different R group interactions  
**A** change/loss of, active site  
 idea of globular to fibrous change/hydrophilic R groups no longer to outside ; [3 max]
- [Total: 13]**

- 2 (a) (i) primary ;      **A** first  
              quaternary ;    **A** fourth      [2]
- (ii) disulfide (bonds/bridges) ;      [1]
- (b) peptide bond broken ;  
      correct involvement of water ;  
      free  $\text{-COOH/-COO}^-$  and free  $\text{-NH}_2\text{-NH}_3^+$  shown ;      [3]

**[Total: 6]**



- 3 (a) (i) haem; R. incorrect spelling  
combines/binds with/carries/holds/takes up/transport oxygen; **2**
- (ii) soluble/polar/hydrophilic (on outside)/compact/spherical/curled/  
coiled/folded (into a ball)/metabolically active;  
4 polypeptides; **2**
- (b) iron needed for haem/haem contains iron;  
less haemoglobin (made); R. less RBCs  
less oxygen transported/supplied/delivered (to cells/tissues);  
less respiration/respiration rate decreased;  
R.respiration less efficient/effective **max 3**
- (c) muscle; A. cardiac/skeletal/involuntary muscle **1**  
R. named muscle, e.g. biceps musc
- (d) (i) 90%;  
25%; A. within range 23-25% R. 23-26%, 22-25%  
(N.B. Both % need to be correct for one mark) **1**
- (ii) haemoglobin unloads/releases oxygen/dissociates,  
easily/readily/at higher ppO<sub>2</sub> (in tissues/cells);  
(whilst) myoglobin holds on to oxygen/is very stable/does  
not dissociate easily/has a higher affinity for oxygen;  
(so) providing a store/reservoir/reserve of oxygen;  
(so will not) release oxygen until the pp/conc./tension of oxygen  
is low/during strenuous exercise;  
so delaying anaerobic respiration; **max 3**
- (e) S-shaped curve to the right of **H**;  
(N.B. curve should be S-shaped, start at 0, plateau out at  
between 90-98% saturation, show 50% plus saturation at pp  
of 6kpa) **1**

**[Total 13]**

4 (a)



[3]

- (b) 1 protein higher in whole grain flour **because** protein is in aleurone layer ;  
2 parts containing protein / aleurone layer, not removed (as in white flour) ;  
3 dietary fibre higher in whole grain flour **because** (most) fibre is in, pericarp / testa ;  
4 pericarp / testa, has not been removed (as in white flour) ;  
5 carbohydrate content lower in whole grain flour **because** outer parts not removed ;  
*accept ora throughout* [3 max]

- (c) (i) starch must be digested (to glucose) before it is absorbed / digestion of starch takes time ; [1]

- (ii) 1 amylose has 1–4 bonds / amylopectin has 1–4 bonds plus 1–6 bonds ;  
2 amylose, digested / broken down to glucose / acted on by amylase, more slowly ;  
3 because fewer sites for enzyme to work on / AW ;  
*accept ora for mp2 and mp3* [2 max]

- (d) (i) 1 increasing intake (of whole cereal grains) decreases risk (of developing type II diabetes) ;  
2 use of figures supporting this relationship ;  
3 not all values fit the trend / reference to this not being a linear effect ;  
4 reference to higher risk at 19.0 – 24.5 intake ; [3 max]
- (ii) 1 idea that the risk of 1.00 for each food group is not the same risk ;  
2 no info on size of servings / no indications that same units used for each group ;  
3 intervals of range of intake not consistent – different intervals may give different results ; [2 max]
- (iii) 1 fruits contain, sugars / glucose / fructose ; [2]  
2 sugar has a high GI ;
- [Total: 16]**

CHEMISTRY ONLINE  
— TUITION —

- 5 (a) *primary*  
sequence / arrangement / order / AW, of amino acids ;
- secondary*  
 $\alpha$ , helix / helices ; **A** description *ignore any ref to  $\beta$  / pleated, sheet*
- tertiary*  
folding of, one / each, polypeptide / globin ; **A** coiling  
(shape) held in place by interactions between, R-groups / side chains ;  
**A** three or more named interactions
- quaternary*  
(arrangement / interaction, of) four polypeptides / four globins / two  $\alpha$  and two  $\beta$  globins ; **A** chains **A** ref. to more than one polypeptide if specific ref. to  $\alpha$  and  $\beta$  chains  
haem / prosthetic group ; **A** porphyrin [max 4]
- (b) six / first five and seventh, amino acids are the same ; ora amino acid at position 6 is different  
both are 1. val-2.his-3.leu-4.thr-5.pro....7.glu ; *take from diagram*  
variant 1 is, glutamic acid / glu (whereas), variant 2 is, valine / val ; [3]
- (c) (i) withstands pressure ;  
prevents, overstretching / AW ;  
prevents, bursting / rupture / AW ; [max 1]
- (ii) *assume answer is about collagen unless told otherwise*
- 1 polypeptides are not identical (v. 2 identical,  $\alpha$  /  $\beta$ , polypeptides) ;
  - 2 triple helix or three, polypeptides / helices (v. 4 polypeptides) ;
  - 3 only composed of amino acids or no, prosthetic group / haem / iron ;  
(fibrous so) not globular ;
  - 5 no complex folding / AW (v. complex folding) ; **A** no tertiary structure
  - 6 glycine is repeated every 3rd position / more glycine ;
  - 7 repeating triplets of amino acids / large number repeating amino acid sequences (v. greater variety) ;
  - 8 AVP ; e.g. different primary structure / AW  
variation in amino acid sequences (v specific sequences)  
all polypeptides, helical / AW (v.  $\alpha$  different to  $\beta$ , polypeptides)  
hydrogen bonds between polypeptides (v. Van der Waals)  
covalent bonds between molecules (to form fibrils) (v. none)  
300nm long polypeptides (v 5–10nm)  
each polypeptide over 1000 amino acids (each 141 / 146 amino acids) [max 1]

[Total: 9]