

F212: Module 1: Biological Molecules
From June 2009-January 2013
Mark schemes

- | |
|---|
| (a) describe how hydrogen bonding occurs between water molecules, and relate this, and other properties of water, to the roles of water in living organisms |
| (b) describe, with the aid of diagrams, the structure of an amino acid; |
| (c) describe, with the aid of diagrams, the formation and breakage of peptide bonds in the synthesis and hydrolysis of dipeptides and polypeptides; |
| (d) explain, with the aid of diagrams, the term <i>primary structure</i> ; |
| (e) explain, with the aid of diagrams, the term <i>secondary structure</i> with reference to hydrogen bonding |
| (f) explain, with the aid of diagrams, the term <i>tertiary structure</i> , with reference to hydrophobic and hydrophilic interactions, disulfide bonds and ionic interactions; |
| (g) explain, with the aid of diagrams, the term <i>quaternary structure</i> , with reference to the structure of haemoglobin; |
| (h) describe, with the aid of diagrams, the structure of a collagen molecule; |
| (i) compare the structure and function of haemoglobin (as an example of a globular protein) and collagen (as an example of a fibrous protein); |
| (j) describe, with the aid of diagrams, the molecular structure of alpha-glucose as an example of a monosaccharide carbohydrate; |
| (k) state the structural difference between alpha- and beta-glucose; |
| (l) describe, with the aid of diagrams, the formation and breakage of glycosidic bonds in the synthesis and hydrolysis of a disaccharide (maltose) and a polysaccharide (amylose); |
| (m) compare and contrast the structure and functions of starch (amylose) and cellulose; |
| (n) describe, with the aid of diagrams, the structure of glycogen; |
| (o) explain how the structures of glucose, starch (amylose), glycogen and cellulose molecules relate to their functions in living organisms; |
| (p) compare, with the aid of diagrams, the structure of a triglyceride and a phospholipid; |
| (q) explain how the structures of triglyceride, phospholipid and cholesterol molecules relate to their functions in living organisms; |
| (r) describe how to carry out chemical tests to identify the presence of the following molecules: protein (biuret test), reducing and non-reducing sugars (Benedict's test), starch (iodine solution) and lipids (emulsion test); |
| (s) describe how the concentration of glucose in a solution may be determined using colorimetry |

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Question	Answer	Marks	Guidance
4 (a)	<p>(contains) <u>all of the / every / each</u>, nutrient(s) / food groups / components / constituents</p> <p>or</p> <p>(contains the), nutrients / food groups / components / constituents, <u>needed for health</u></p> <p>or</p> <p>(contains) fat and protein and carbohydrate and minerals and vitamins (and , fibre / roughage , and water) ;</p> <p>in correct / right / suitable, proportions / amount / quantity / level ;</p>	2	<p>IGNORE factors / things , as AW for nutrients</p> <p>IGNORE refs to energy</p> <p>IGNORE 'adequate / sufficient / enough' as this implies minimum</p> <p>IGNORE 'balanced' as this is part of the term they are defining</p> <p>IGNORE 'match consumption with use'</p>

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Mark Scheme

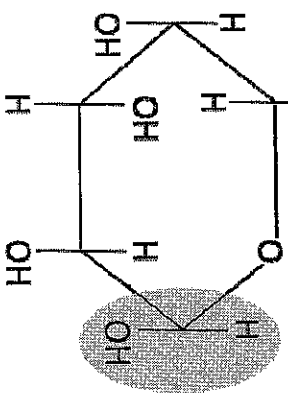
January 2013

Question	Answer	Marks	Guidance
4 (b) (i)	<p>1 membranes ;</p> <p>2 absorption of fat soluble vitamins ;</p> <p>3 electrical <u>insulation</u> / insulation of , neurones / nerve cells / axons ;</p> <p>4 (thermal) <u>insulation</u> ;</p> <p>5 protection of organs ;</p> <p>6 (source of) (steroid) hormones / named steroid hormone / named group of steroid hormones ;</p> <p>7 (source of) cholesterol / LDL / HDL ;</p> <p>8 waterproofing / skin suppleness / sebum ;</p> <p>9 source of vitamin D ;</p> <p>10 buoyancy ;</p>	3	<p>Mark the first answer on each prompt line. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>IGNORE 'energy source'</p> <p>1 ACCEPT 'phospholipid bilayer'</p> <p>3 ACCEPT insulation in context of myelin / Schwann cells</p> <p>4 IGNORE refs to thermoregulation</p> <p>5 IGNORE 'protect cells / padding'</p> <p>6 e.g. testosterone, oestrogen, progesterone, aldosterone , glucocorticoids, androgens</p> <p>8 ACCEPT ear wax</p>

Question	Answer	Marks	Guidance
4 (b) (ii)	1 (leads to) increased / AW, cholesterol / LDL ;	3	1 IGNORE 'low density lipid' 1 IGNORE cholesterol unqualified. Answers must imply that the level of cholesterol (in the body) is raised
2	cholesterol / fat, deposited, <u>in</u> arterial walls / <u>under</u> endothelium ;		2 ACCEPT 'LDL deposited in arterial wall' 2 ACCEPT epithelium / lining , as AW for endothelium
3	increase risk of / leads to, <u>atherosclerosis</u> / <u>atheroma</u> / plaque formation ;		3 ACCEPT 'causes atherosclerosis'
4	narrowing / blocking , of artery <u>lumen</u> ;		4 ACCEPT 'sticking out into artery lumen'
5	increased risk of / leads to , CHD / angina / stroke / hypertension / high blood pressure / heart attack / myocardial infarction / gallstones ;		5 DO NOT CREDIT if candidates think the C stands for 'chronic' 5 ACCEPT mis-spellings of 'coronary' which cannot be confused with chronic 5 ACCEPT 'causes heart disease' 5 IGNORE diabetes / arthritis as directly related to obesity

Question	Answer	Marks	Guidance																				
4 (c)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;"></td> <td style="width: 25%; text-align: center;"><i>triglyceride</i></td> <td style="width: 25%; text-align: center;"><i>phospholipid</i></td> </tr> <tr> <td style="text-align: center;"><i>difference</i></td> <td style="text-align: center;">3 fatty acids</td> <td style="text-align: center;">2 fatty acids</td> </tr> <tr> <td style="text-align: center;"><i>difference</i></td> <td style="text-align: center;">3 ester bonds</td> <td style="text-align: center;">2 ester bonds</td> </tr> <tr> <td style="text-align: center;"><i>difference</i></td> <td style="text-align: center;">absence of phosphate</td> <td style="text-align: center;">presence of phosphate</td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center;"><i>similarity</i></td> <td style="width: 50%; text-align: center;">(contain) glycerol</td> </tr> <tr> <td style="text-align: center;"><i>similarity</i></td> <td style="text-align: center;">(contain) fatty acids</td> </tr> <tr> <td style="text-align: center;"><i>similarity</i></td> <td style="text-align: center;">(contain) ester bonds</td> </tr> <tr> <td style="text-align: center;"><i>similarity</i></td> <td style="text-align: center;">(contain elements) C,H and O</td> </tr> </table>		<i>triglyceride</i>	<i>phospholipid</i>	<i>difference</i>	3 fatty acids	2 fatty acids	<i>difference</i>	3 ester bonds	2 ester bonds	<i>difference</i>	absence of phosphate	presence of phosphate	<i>similarity</i>	(contain) glycerol	<i>similarity</i>	(contain) fatty acids	<i>similarity</i>	(contain) ester bonds	<i>similarity</i>	(contain elements) C,H and O	4	<p>Award one mark per correct row. CREDIT any correct (pair of) statement(s) in each row regardless of other information</p> <p>2 max for differences</p> <p>2 max for similarities</p> <p>IGNORE molecule / group</p> <p>IGNORE 'hydrocarbon / hydrophobic / lipid , tail' the first time it is seen but ECF if used as a synonym for 'fatty acid' in both difference and similarity</p> <p>IGNORE molecule / group</p> <p>DO NOT CREDIT if an incorrect element stated</p> <p>ACCEPT 'C, H and O atom'</p> <p>DO NOT CREDIT molecule / group</p>
	<i>triglyceride</i>	<i>phospholipid</i>																					
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4 (d)	(i) emulsion (test) ;	1	<p>ACCEPT 'emulsification / white emulsion / Sudan III'</p> <p>IGNORE refs to translucent grease mark test'</p>																				

Question	Answer	Marks	Guidance
4 (d) (ii)	<p><i>emulsion test</i></p> <p>1 add , ethanol / alcohol , (to sample) ;</p> <p>2 shake / stir / agitate / mix thoroughly / AW ;</p> <p>3 add (to) water ;</p> <p><i>If candidate is clearly describing Sudan III test</i></p> <p>5 mix sample with water ;</p> <p>6 add Sudan III (stain) ;</p> <p>7 shake / stir / agitate / mix thoroughly / AW ;</p> <p><i>If candidate is describing translucent grease mark test</i></p> <p>AWARD one mark only ;</p>	3	<p>Max 2 if step 1, 2 3 are in different sense order but IGNORE any ref to shaking after adding water, i.e. 1, 2, 3, 2.</p> <p>2 IGNORE 'mix' unqualified</p> <p>2 not dependent on correct chemical in mp 1</p> <p>3 not dependent on correct chemical in mp 1</p>
4 (d) (iii)	<p>(mixture) turns, cloudy / milky / white ;</p>	1	<p>DO NOT CREDIT 'precipitate'</p> <p>ACCEPT 'red layer floating to top' if Sudan III test has been described in part (ii)</p> <p>ACCEPT 'translucent stain is permanent / AW'</p>
Total		17	

Question	Answer	Marks	Guidance
6 (a)	monosaccharide(s) ;	1	ACCEPT phonetic spelling
6 (b)	identical to diagram of β -glucose with inversion of OH and H on any one carbon atom ; correct inversion of OH and H on 1 st C ;	2	A correct diagram as shown below = 2 marks  <p>ACCEPT displayed formula for CH_2OH etc If the candidate has drawn α-glucose upside down = 0 marks</p>

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Question	Answer	Marks	Guidance
6 (b) (ii)	<ol style="list-style-type: none"> 1 soluble so can be (easily), transported / carried (around organism) ; 2 small (molecule) so can , be transported / diffuse , across (cell) membranes ; 3 easily / quickly , respired / oxidised / broken down , to , release energy / produce ATP ; 4 molecules can , join / AW , to produce , (named) disaccharides / (named) polysaccharides ; 	2	<p>Answers need a feature plus an explanation of how the feature helps the function</p> <p>1 ACCEPT soluble so is able to , react / AW</p> <p>1 ACCEPT description of solubility in terms of chemical properties linked to transport or reactivity</p> <p>3 DO NOT CREDIT 'hydrolysed'</p> <p>3 DO NOT CREDIT 'easily broken down to provide energy for respiration'</p> <p>3 DO NOT CREDIT 'easily broken down to produce energy'</p> <p>4 IGNORE 'used to form glycogen' without idea of molecules , bonding / joining / condensation</p>
6 (c)	<ol style="list-style-type: none"> 1 part of nucleotide ; 2 bonded / joined / attached , to (named) base and phosphate ; 3 phosphate (joined) to C5 (and C3) / base (joined) to C1 ; 4 (deoxy)ribose is part of) backbone (of DNA) ; 5 idea of linking with (second) phosphate on adjacent nucleotide ; 6 nucleotide is , monomer / repeating unit , of DNA / polynucleotide ; 	3	<p>AWARD making points from suitably labelled diagram</p> <p>2 IGNORE 'made up of'</p> <p>2 DO NOT CREDIT answers which state incorrect bond</p> <p>2 IGNORE 'phosphate molecule'</p> <p>6 ACCEPT 'DNA formed from a chain of nucleotides'</p>

Question	Answer	Marks	Guidance
6 (d) (i)	<p>1 α-glucose / β-glucose ;</p> <p>2 some / no, 1–6 bonds or only 1–4 bonds ;</p> <p>3 condensation / hydrolysis ;</p> <p>4 branches / straight chain ;</p>	3	<p>Mark the first answer on each prompt line. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p><i>Candidates may identify the error or correct the error</i> If nothing is written on the answer lines, ACCEPT a clear indication on the boxed list of which statements are incorrect</p> <p>1 ACCEPT b / B for 'p'</p>
6 (d) (ii)	<p>glycogen / amylopectin ;</p>	1	<p>Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>IGNORE starch DO NOT CREDIT if spelling could be confused with another molecule, e.g. glucagon</p>
Total		12	

Question	Answer	Marks	Guidance
4 (a) (i)	polysaccharide ;	1	<p>Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>ACCEPT phonetic spelling IGNORE polymer IGNORE oligosaccharide</p>
(ii)	<p><i>similarity</i> chain / unbranched / glycosidic bonds / (contain) hexose / hex ring / O in each ring / CHO ;</p> <p><i>difference</i> <i>agarose has:</i></p> <p>two types of (glycosidic) bond</p> <p>or</p> <p>two different, sugars / sugar residues / monosaccharides</p> <p>or</p> <p>disaccharide, monomer / subunit / AW</p> <p>or</p> <p>(residues) are alternately rotated / AW</p> <p>or</p> <p>straight chain ;</p>	2	<p>IGNORE polysaccharides IGNORE 6-carbon ring ACCEPT 5-carbon ring</p> <p>Assume answer refers to agarose unless otherwise stated ACCEPT ora for any point</p> <p>DO NOT CREDIT references to any incorrect bond ACCEPT any suggestion of bonding to different numbered carbon atoms (as numbers are not given in diagram) ACCEPT 'alternating bonds'</p> <p>IGNORE refs to glucose</p> <p>ACCEPT 'flipped' / 'reflected'</p> <p>ACCEPT 'amylose is coiled'</p>

Question	Answer	Marks	Guidance
4 (b)	<p>(bacteria) do not, make / have, correct <u>enzyme</u> (to digest agarose) ;</p> <p>agarose, does not fit / not complementary to, <u>active site</u> (of bacterial enzymes) ;</p> <p>bacteria unable to transport , substrate / enzyme , across membrane ;</p>	1 max	<p>DO NOT CREDIT in incorrect context e.g. 'bacteria do not have amylase' or 'bacterial enzyme cannot break down amylose'</p>
(c)	<p>(i) <u>control</u> ;</p> <p>compare with tube A / see what happened when there was no bacteria / show it was bacteria doing it / to show it does not break down on its own / to show that the nutrient solution does not break it down ;</p>	2	<p>ACCEPT 'compare it with the other tube' IGNORE 'compare the tubes'</p>

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Question	Answer	Marks	Guidance
4 (c) (ii)	<p><i>idea that</i></p> <p>some, starch / other polysaccharide / (reducing) sugar present in , nutrient solution / culture solution / bacteria (at start) ;</p> <p>presence of some mutated , <i>E. coli</i> / bacteria , (that can break it down) ;</p> <p>presence of (other) microorganism that can break it down ;</p>	1 max	<p>IGNORE experimental error unqualified</p> <p>IGNORE any reference to temperature</p> <p>IGNORE other carbohydrate</p>
(iii)	<p>replicate(s) / repeat(s) ;</p> <p>more than one sample tested from each tube / sample each tube twice ;</p>	2	<p>Mark the first answer on each prompt line. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>IGNORE 'do more tests'</p> <p>IGNORE 'disregard anomalous results'</p> <p>IGNORE 'compare with other results'</p> <p>IGNORE 'calculate mean'</p>

Question	Answer	Marks	Guidance
4 (d)	1 add, Benedict's (reagent) / $\text{CuSO}_4 + \text{NaOH}$ / alkaline copper sulphate ;	5 max	1 ACCEPT 'do Benedict's test' 1 DO NOT CREDIT if adding acid / hydrolysing
	2 heat ;		2 ALLOW boil 2 IGNORE warm
	3 (forms) <u>precipitate</u> ;		2 ACCEPT any temperature between 80°C and 100°C 2 ACCEPT gently heat
	4 (colour changes from blue to), green / yellow / orange / brown / (brick) red ; <i>concentration estimated from</i> EITHER		Read as prose and mark the best suggestions
	5a degree of colour change / use different colours ;		5/6 DO NOT AWARD if candidate is using a colorimeter
	6a comparison (of final colour) with , standard / known, solution ; OR		5a ACCEPT 'the darker / redder , the more reducing sugar' 5a ACCEPT in context of precipitate or supernatant
	5b filter / centrifuge , and weigh precipitate ; 6b greater mass = more sugar present / use of a standard curve ; OR		6a Answers must include the idea of comparison 6a ACCEPT ref to calibration curve as long as not in context of colorimeter
	5c centrifuge ; 6c size , of pellet / colour of supernatant (liquid), indicates concentration ;		6b ACCEPT weight 6b ACCEPT amount 6c ACCEPT mass

Question	Answer	Marks	Guidance
(ii)	<p>1 add (hydrochloric) acid and boil ;</p> <p>2 add, (named) alkali / (sodium) carbonate / (sodium) hydrogencarbonate ;</p> <p>3 then carry out reducing sugar test (again) / described ;</p>	3 max	<p>Max 2 if any point out of sequence</p> <p>1 CREDIT add hydrolytic enzyme</p> <p>1 ACCEPT heat</p> <p>2 CREDIT 'neutralise' if not contradicted by named chemical</p>
	Total	17	

Question	Answer	Marks	Guidance
1 (a) (i)	<u>N</u> ;	1	IGNORE nitrogen DO NOT CREDIT n or N ₂
1 (a) (ii)	polypeptide / protein ;	1	Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks IGNORE peptide
1 (a) (iii)	<p>name <u>peptide</u> (bond / link) ;</p> <p>plus any two from ... <i>description of formation</i></p> <p>between, amine group (of one amino acid) and carboxyl group (of another) ;</p> <p>H (from amine) combines with OH (from carboxyl) ;</p> <p>condensation (reaction)</p> <p>OR</p> <p>water, lost / eliminated / produced / created / AW ;</p>	3 max	<p>Maximum two marks for description. Name must be given to award 3 marks.</p> <p>ACCEPT marking points from diagram where amine and carboxyl groups are clearly labelled.</p> <p>Mark writing first then look at diagram.</p> <p>If diagram contradicts creditable text award maximum one mark for description.</p> <p>DO NOT CREDIT dipeptide</p> <p>ACCEPT phonetic spellings of amine and carboxyl</p> <p>ACCEPT 'carboxylic acid' and 'amino'</p> <p>DO NOT CREDIT amide / carbonyl</p>

Question	Answer	Marks	Guidance
1 (b) (i)	<p>V1 <u>high latent heat of vaporisation</u> / large amount of energy required to change from liquid to gas / AW ;</p> <p>V2 <u>evaporation</u> is (efficient) cooling mechanism / AW ;</p> <p>V3 example of cooling in living organism ;</p> <p>H1 high specific heat capacity / large amount of energy needed to, raise / change, temperature ;</p> <p>H2 (thermally) stable environment for, aquatic / named aquatic, organisms ;</p> <p>H3 (aquatic) organisms use less <u>energy</u> on temperature control ;</p> <p>H4 (internal) temperature of organisms changes only slowly ;</p> <p>H5 (biological) reactions / enzymes / metabolism, function(s) correctly ;</p> <p>F1 ice, is less dense than water / floats ;</p> <p>F2 (surface of) ice provides habitat for, organisms / named organism ;</p>	8 max	<p>Annotate property (number 1) marks with <input checked="" type="checkbox"/> 1 symbol to help distinguish marks for QWC</p> <p>All marks are stand alone</p> <p>V1 ACCEPT 'large amount of heat needed...'</p> <p>V1 ACCEPT 'high latent heat of evaporation'</p> <p>V2 ACCEPT 'evaporation removes heat from body'</p> <p>V3 e.g. sweating, panting, transpiration (as cooling)</p> <p>'high latent heat of evaporation means sweat cools you down' = 3 marks</p> <p>H1 ACCEPT 'water / it, is thermally stable'</p> <p>H1 ACCEPT 'water is slow to change temperature'</p> <p>H1 CREDIT 'the temperature of the sea does not change much'</p> <p>H2 'thermally' can be inferred from previous statement</p> <p>H5 IGNORE 'organisms function correctly'</p> <p>F1 ACCEPT 'maximum density is at 4 °C'</p> <p>F2 e.g. 'polar bears on ice'</p>

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Question	Answer	Marks	Guidance
	<p>I1 water (beneath ice), insulated / remains liquid / doesn't freeze ;</p> <p>I2 (aquatic) organisms, do not freeze / can still swim ;</p> <p>S1 (effective) solvent ;</p> <p>S2 medium for reactions / (internal) transport medium / able to dilute toxic substances ;</p> <p>C1 cohesion / adhesion ;</p> <p>C2 example of cohesion / adhesion, in living organism ;</p> <p>T1 surface tension ;</p> <p>T2 habitat for (named) invertebrates ;</p> <p>P1 transparent ;</p> <p>P2 allows underwater photosynthesis ;</p> <p>D1 idea of high density ;</p> <p>D2 allows flotation / support ;</p> <p>U organisms can still obtain, oxygen / (named) minerals / food / carbon dioxide, from water ;</p>		<p>I2 IGNORE unqualified references to survival</p> <p>I2 ACCEPT gametes / AW, can be dispersed</p> <p>C2 e.g. transpiration stream / apoplast movement</p> <p>C2 ACCEPT descriptions</p> <p>T2 ACCEPT insects IGNORE animals</p> <p>P2 ACCEPT other example of transparency linked to survival, e.g. eyes</p> <p>D1 IGNORE references to viscosity</p> <p>U not linked to a single property and so cannot contribute to QWC</p> <p>U IGNORE nutrients / nutrition</p>

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Mark Scheme

January 2012

Question	Answer	Marks	Guidance
	QWC: a property mark (with number 1) and a survival mark with the same letter seen twice.	1	e.g. H1 and H3 and S1 and S2

Question	Answer	Marks	Guidance
1	(b)	3 max	Mark the first answer on each prompt line.
	1 protein <u>secondary</u> structure / α -helix / β -pleated sheet ;		3 e.g. between adjacent chains in collagen
	2 (protein) <u>tertiary</u> structure ;		CREDIT 'protein / named protein / enzyme' OR 'between amino acid R-groups' once ONLY if <u>none</u> of mps 1-3 have been awarded
	3 between polypeptide chains in (named) quaternary structure ;		4 IGNORE microfibrils
	4 (between chains of) cellulose ;		6 e.g. between mRNA and tRNA binding between enzyme and substrate (coiling of) amylose
	5 (between, strands of / bases in) DNA ;		between DNA and mRNA during transcription
	6 AVP ; ; ;		
	Total	17	

Question	Expected Answers	Mark	Additional Guidance
3 (a) (i)	D; A; F;	3	Mark the first answer for each letter. If an additional answer is given then = 0 mark
3 (a) (ii)	B; E; F; F;	4	Mark the first answer for each letter. If an additional answer is given then = 0 marks
3 (b)	<p>1 insoluble ;</p> <p>2 does not , change / affect , water potential / ψ , of cell ;</p> <p>3 can be , broken down / hydrolysed / built up , quickly / easily ;</p> <p>4 lots of branches for enzymes to attach ;</p> <p>5 compact ;</p> <p>6 (therefore) high energy content for mass / energy dense / AW ;</p>	3 max	<p>2 ACCEPT osmotically inactive / AW</p> <p>3 Answers must contain the idea of ease or speed of breakdown IGNORE broken up</p> <p>Answers must imply density, e.g. 'it is compact and so stores a lot of energy' = 2 marks</p>

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June 2011

Question	Expected Answers	Mark	Additional Guidance
3	(c) (i)		<p>Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>ACCEPT 'd'</p>
		1	<p>Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>DO NOT CREDIT any answer that clearly states that glucose is energy, makes energy, produces energy or creates energy</p> <p>1 ACCEPT used in respiration ACCEPT 'releases energy for respiration'</p> <p>2 IGNORE used for energy</p> <p>4 e.g. starch / cellulose / polysaccharide / disaccharide / glycogen / protein / lipid / sucrose / maltose / fructose / fat</p>
3	(c) (ii)		<p>1 respiratory substrate / used for respiration ;</p> <p>2 source of / releases / provides, energy ;</p> <p>3 formation of ATP ;</p> <p>4 conversion into named compound ;</p>
		1 max	
3	(c) (iii)		<p>Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>ACCEPT F IGNORE triglyceride / fat / lipid / haemoglobin</p>
		1	
	D ;		

Question	Expected Answers	Mark	Additional Guidance																				
3 (d)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center;">glycogen <i>no hydrogen bonding</i></td> <td style="width: 50%; text-align: center;">cellulose <i>hydrogen bonding</i></td> </tr> <tr> <td>α / alpha , glucose</td> <td>β / beta , glucose</td> </tr> <tr> <td>1,4 <u>and</u> 1,6-glycosidic bonds</td> <td>1,4-glycosidic bonds (only)</td> </tr> <tr> <td>or</td> <td>or</td> </tr> <tr> <td>1,6-glycosidic bonds present</td> <td>1,6-glycosidic bonds not present</td> </tr> <tr> <td>branched</td> <td>not branched / linear / straight</td> </tr> <tr> <td>no , fibres / fibrils</td> <td>fibres / fibrils</td> </tr> <tr> <td>granules</td> <td>no granules</td> </tr> <tr> <td>all glucose units in same orientation</td> <td>adjacent glucose units in opposite orientation</td> </tr> </table>	glycogen <i>no hydrogen bonding</i>	cellulose <i>hydrogen bonding</i>	α / alpha , glucose	β / beta , glucose	1,4 <u>and</u> 1,6-glycosidic bonds	1,4-glycosidic bonds (only)	or	or	1,6-glycosidic bonds present	1,6-glycosidic bonds not present	branched	not branched / linear / straight	no , fibres / fibrils	fibres / fibrils	granules	no granules	all glucose units in same orientation	adjacent glucose units in opposite orientation	3 max	<p>Comparative statements must be made on the same line Award 1 mark for each correct side by side comparison. ALLOW two valid comparisons in the same pair of boxes, e.g</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center;">α-glucose in a branched chain</td> <td style="width: 50%; text-align: center;">β-glucose in a straight chain</td> </tr> </table> <p>= 2 marks</p> <p>ACCEPT 'a' and 'b'</p> <p>ACCEPT helical / spiral / coiled vs linear / straight DO NOT CREDIT α-helix</p>	α -glucose in a branched chain	β -glucose in a straight chain
glycogen <i>no hydrogen bonding</i>	cellulose <i>hydrogen bonding</i>																						
α / alpha , glucose	β / beta , glucose																						
1,4 <u>and</u> 1,6-glycosidic bonds	1,4-glycosidic bonds (only)																						
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Total		[16]																					

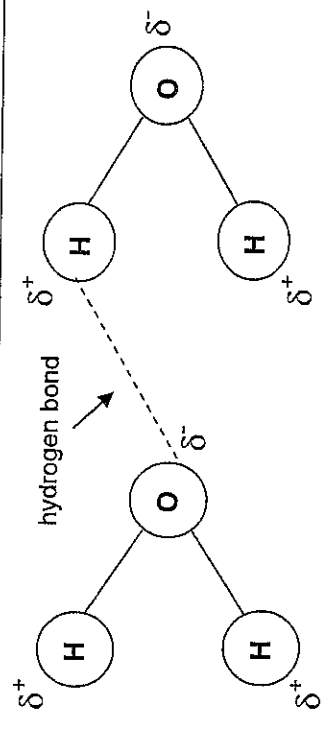
Question	Expected Answer	Mark	Additional Guidance
7 (a)			<p>CREDIT marking points from a clearly labelled diagram 1 IGNORE polypeptide</p>
1	sequence / chain, of amino acids ;		
2	(amino acids) joined by peptide bonds ;		
S1	secondary		
S2	alpha / α , helix ;		
S3	small regions of, beta / β , pleated sheet / fold ; hydrogen / H, bonds ;		S3 Must be in context of secondary structure
T1	tertiary secondary structure / helix / polypeptide chain, undergoes further, coiling / folding ;		T1 ACCEPT polypeptide chain folds further
T2	3 bonds / interactions from: disulfide / ionic / hydrogen / hydrophobic or hydrophilic ;		T2 IGNORE if clearly in context of secondary or quaternary structures T2 H bond must be in context of tertiary structure
T3	hydrophilic R groups on outside (of molecule) / hydrophobic R groups on inside (of molecule) ;		
Q1	quaternary 4, polypeptides / subunits ;		
Q2	2, alpha / α , chains and 2, beta / β , chains ;		'contains 2 α and 2 β polypeptides' = 2 marks (Q1 and Q2) Q3 IGNORE protein in ref to 1 haem (group) per polypeptide
Q3	1 haem (group) per polypeptide / 4 haems (per molecule) ;		
3	prosthetic group (is) haem, (which) contains Fe ²⁺ ;	6 max	3 ACCEPT iron ion / Fe ⁺ / Fe ³⁺ 3 DO NOT CREDIT iron / Fe unqualified
	QWC - correct refs to secondary, tertiary and quaternary structure ;	1	1 S mark and 1 T mark and 1 Q mark

Question	Expected Answer	Mark	Additional Guidance
7 (b)	(collagen has) amino acid, <u>chain</u> / <u>sequence</u> ; 1 peptide bonds ; 2 helical / helix ; 3 <i>3 bonds / interactions from: disulfide / ionic / hydrogen / hydrophobic or hydrophilic ;</i> 4 quaternary structure ; 5 more than one polypeptide / subunit ; 6	4 max	Assume answer refers to collagen unless stated if the answer mentions only collagen, assume that the candidate thinks any features mentioned also apply to haemoglobin. 1 IGNORE polypeptide 1 IGNORE repeating units 3 DO NOT CREDIT if candidate refers to collagen having an α helix 5 IGNORE primary /secondary / tertiary 6 ACCEPT polypeptides but DO NOT CREDIT 3 polypeptides if number in haemoglobin not specified
Total		11	

Question	Expected Answer	Mark	Additional Guidance
8	1 antibodies ; 2 natural ; 3 artificial ; 4 natural ; 5 antigen ; 6 vaccination ;	6	ACCEPT minor mis-spellings so long as word can not be confused with another word in the list
Total		6	

Question	Expected Answer	Mark	Additional Guidance																				
1 (a) (i)	<table border="1"> <thead> <tr> <th>reagent</th> <th>observation</th> <th>molecule</th> <th>present or absent</th> </tr> </thead> <tbody> <tr> <td>ethanol and water</td> <td>white emulsion</td> <td>lipid</td> <td>present</td> </tr> <tr> <td>Benedict's solution</td> <td>brick-red precipitate</td> <td>reducing sugar / lactose / glucose / galactose / monosaccharides</td> <td>present ;</td> </tr> <tr> <td>biuret / and II</td> <td>lilac colour</td> <td>protein / named milk protein</td> <td>present ;</td> </tr> <tr> <td>iodine solution</td> <td>yellow / brown</td> <td>starch / amylose</td> <td>absent ;</td> </tr> </tbody> </table>	reagent	observation	molecule	present or absent	ethanol and water	white emulsion	lipid	present	Benedict's solution	brick-red precipitate	reducing sugar / lactose / glucose / galactose / monosaccharides	present ;	biuret / and II	lilac colour	protein / named milk protein	present ;	iodine solution	yellow / brown	starch / amylose	absent ;	3	<p>One mark per correct row. IGNORE 'yes', 'no' and ticks and crosses DO NOT CREDIT if anything incorrect is written in any box in the molecule column. e.g. 'starch or cellulose' = 0 mark</p> <p>ACCEPT maltose DO NOT CREDIT sucrose</p> <p>ACCEPT casein / lactoglobulin / lactalbumin / polypeptide IGNORE amylopectin</p>
reagent	observation	molecule	present or absent																				
ethanol and water	white emulsion	lipid	present																				
Benedict's solution	brick-red precipitate	reducing sugar / lactose / glucose / galactose / monosaccharides	present ;																				
biuret / and II	lilac colour	protein / named milk protein	present ;																				
iodine solution	yellow / brown	starch / amylose	absent ;																				
1 (a) (ii)	milk is already, cloudy / an emulsion / white / AW ;	1	ACCEPT idea of difficulty in detecting change because of the appearance of milk																				
1 (a) (iii)	(one) glycerol / glyceride ; 3 fatty acids ; ester bond (between glycerol and fatty acid) ;	3	<p>ACCEPT marking points from clearly labelled diagram but DO NOT CREDIT if contradicted in text. IGNORE individual atoms on diagram and look for correct position of labels MAX 2 if phosphate group included (as could be confused with phospholipid)</p> <p>ACCEPT on diagram if 3 shown and at least one labelled ACCEPT triglycerides are esters</p>																				

Question	Expected Answer	Mark	Additional Guidance
1 (b)	<p>1 (thermal) insulation ; energy, store / source / release ;</p> <p>2</p> <p>3 protection ; membranes / phospholipid bilayer / control entry and exit into cells ;</p> <p>4 (steroid) hormones / named steroid hormone ;</p> <p>5 buoyancy ;</p> <p>6 waterproofing ;</p> <p>7 source of water (from respiration) ;</p> <p>8 (electrical insulation) in myelin / around neurones / around axons / around dendrons ;</p> <p>9 aid, absorption / storage / production, of, fat soluble / A / D / E / K, vitamins ;</p> <p>10</p>	3	<p>MARK THE FIRST RESPONSE ON EACH NUMBERED LINE</p> <p>1 ALLOW 'warmth'</p> <p>2 CREDIT answers that refer to the idea of lipid as a respiratory substrate but DO NOT CREDIT 'for respiration' unqualified</p> <p>IGNORE 'fat contains energy' without further qualification</p> <p>DO NOT CREDIT refs to producing energy or to quick energy release</p> <p>ACCEPT 'provides energy'</p> <p>4 CREDIT ref to cholesterol in membranes</p> <p>9 CREDIT nerve fibres / saltatory conduction</p> <p>IGNORE nerves</p>
1 (c) (i)	<p>saturated ; (fatty acids have) no / fewer, double bonds ; solid at room temperature ;</p>	1 max	<p>Assume answers refer to animal fats unless otherwise stated</p> <p>ACCEPT reverse argument</p> <p>IGNORE ref to fats and oils (as stated in question)</p> <p>ACCEPT 'fatty acids are not kinked'</p> <p>ACCEPT reasonable temperature quoted</p>

Question	Expected Answers	Marks	Additional Guidance
2 (a)	<p>1 hydrogen bond represented as, horizontal / vertical, dashed line between O on one molecule and H on the adjacent molecule ;</p> <p>2 hydrogen / H, bond label (on any drawn bond between 2 molecules) ;</p> <p>3 (delta positive) δ^+ on each drawn H <u>and</u> (delta negative) (2) δ^- on each drawn O ;</p>	3	 <p>1 DO NOT CREDIT if >1 H bond is drawn between the same two molecules</p> <p>3 if both molecules drawn, δ^+ and δ^- on all atoms.</p> <p>ACCEPT d (lower case) for δ</p>

Question	Expected Answers	Marks	Additional Guidance
2	<p>(b)</p> <p>P1 <i>ice floats</i> (ice less dense because) molecules spread out ; P2 molecules form, crystal structure / lattice / AW ; P3 ice forms insulating layer / clearly described ; P4 water (below ice), does not freeze / still liquid / remains water / kept at higher temperature ;</p> <p>S1 organisms do not freeze ; S2 animals / organisms, can still, swim / move ; S3 allows, currents / nutrients, to circulate ;</p> <p><i>solubility</i> P5 ions / named ion, polar / charged ; P6 ions / named ion, attracted to / bind to / interact with, water ;</p> <p>S4 (named) organisms / plants / animals, uptake / AW, minerals / named mineral / nutrients ;</p> <p>S5 correct use of named, mineral / nutrient, in organism ;</p>		<p>P3 e.g. acts as a barrier to the cold</p> <p>S1 DO NOT ACCEPT die (because 'survival' stated in stem)</p> <p>S4 ACCEPT obtain / enters / goes in / gets</p> <p>S5 needs to be more specific than 'for growth / metabolism' suitable examples include but are not limited to: nitrates for amino acids / protein / (named) nucleic acid / phosphate for ATP / phospholipids / plasma membrane / magnesium for chlorophyll etc</p>

		<p><i>temperature stability</i></p> <p>many / stable, (hydrogen) bonds between molecules ;</p> <p>at lot of energy to, force apart molecules / break bonds ;</p> <p>high (specific) <u>heat capacity</u> ;</p> <p>temperature does not change much / small variation in temperature ;</p> <p>effect of temperature on , enzymes / metabolic rate ;</p> <p>gases remain soluble ;</p> <p><i>Award once in any section</i></p> <p>hydrogen bonds ;</p>			<p>P7 Many hydrogen bonds between molecules = 2 marks (gets P7 and H)</p> <p>P8 ACCEPT heat as alternative to energy</p> <p>P9 DO NOT CREDIT latent heat capacity</p> <p>S6 could refer to organisms or surrounding water ACCEPT stays cool in summer / stays warm in winter DO NOT CREDIT constant alone</p> <p>S7 ACCEPT any reference to temperature affecting enzyme activity / metabolic rate</p> <p>DO NOT CREDIT if in incorrect context (e.g. they are strong bonds)</p>
				7 max	
				1	
2 (c)		<p>QWC - Award if you see a P mark and an S mark within the same section ;</p> <p>hydrolysis / hydrolytic ;</p> <p>hydrophilic ;</p>		2	<p>ACCEPT phonetic spelling throughout</p> <p>IGNORE head</p>
			Total	13	

Question	Expected Answers	Marks	Additional Guidance
4 (a) (i)	L ; M ; J ;	3	If 2 nd letter given, no mark
4 (a) (ii)	1 peptide bond ; 2 between, amine / J group (of one amino acid) and carboxyl / L group (of another) ; 3 H (from amine group) combines with OH (from carboxyl group) ; 4 condensation reaction OR water, lost / eliminated / produced / created / AW ; 5 covalent ;	3 max	CREDIT answers from clearly drawn diagrams with bonds labelled 1 ACCEPT peptide link
4 (b)	1 some R groups, attract / repel ; 2 <u>disulfide</u> , bridges / bond ; 3 between, cysteine / SH / S (atoms) ; 4 hydrogen / H, bonds ; 5 ionic bonds between, oppositely charged / + and -, R groups ; 6 hydrophilic R groups, on outside of molecule / in contact with water (molecules) ; 7 hydrophobic R groups, on inside of molecule / shielded from water (molecules) ;	4 max	4 DO NOT CREDIT in context of secondary structure

Question	Expected Answers	Marks	Additional Guidance																				
4 (c) (i)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center;">glycogen</td> <td style="width: 50%; text-align: center;">collagen</td> </tr> <tr> <td style="text-align: center;">1 carbohydrate / polysaccharide</td> <td style="text-align: center;">protein / polypeptide ;</td> </tr> <tr> <td style="text-align: center;">2 (alpha) glucose (units)</td> <td style="text-align: center;">amino acid (units) ;</td> </tr> <tr> <td style="text-align: center;">3 identical units</td> <td style="text-align: center;">different amino acid units ;</td> </tr> <tr> <td style="text-align: center;">4 glycosidic, bonds / links</td> <td style="text-align: center;">peptide, bonds / links ;</td> </tr> <tr> <td style="text-align: center;">5 branched</td> <td style="text-align: center;">unbranched / linear ;</td> </tr> <tr> <td style="text-align: center;">6 non-helical</td> <td style="text-align: center;">helical ;</td> </tr> <tr> <td style="text-align: center;">7 one chain (per molecule)</td> <td style="text-align: center;">three chains (per molecule) ;</td> </tr> <tr> <td style="text-align: center;">8 no cross links</td> <td style="text-align: center;">cross links (between chains) ;</td> </tr> <tr> <td style="text-align: center;">9 contains C H O</td> <td style="text-align: center;">contains C H O N ;</td> </tr> </table>	glycogen	collagen	1 carbohydrate / polysaccharide	protein / polypeptide ;	2 (alpha) glucose (units)	amino acid (units) ;	3 identical units	different amino acid units ;	4 glycosidic, bonds / links	peptide, bonds / links ;	5 branched	unbranched / linear ;	6 non-helical	helical ;	7 one chain (per molecule)	three chains (per molecule) ;	8 no cross links	cross links (between chains) ;	9 contains C H O	contains C H O N ;	3 max	<p>AWARD 1 mark per correct row Comparative statements must be made in a row</p> <p>2 DO NOT CREDIT beta</p> <p>5 ALLOW straight</p> <p>7 DO NOT CREDIT strands</p> <p>9 IGNORE S (for collagen)</p>
glycogen	collagen																						
1 carbohydrate / polysaccharide	protein / polypeptide ;																						
2 (alpha) glucose (units)	amino acid (units) ;																						
3 identical units	different amino acid units ;																						
4 glycosidic, bonds / links	peptide, bonds / links ;																						
5 branched	unbranched / linear ;																						
6 non-helical	helical ;																						
7 one chain (per molecule)	three chains (per molecule) ;																						
8 no cross links	cross links (between chains) ;																						
9 contains C H O	contains C H O N ;																						
4 (c) (ii)	<p>(high tensile) strength / strong ; does not stretch / is not elastic ; insoluble ; flexible ;</p>	2 max	<p>Mark the 1st answer on each numbered line IGNORE fibrous / tough</p>																				
Total		15																					

Question	Expected Answers	Marks	Additional Guidance
3 (a) (i)	A hydrogen ; B glycosidic ;	2	DO NOT CREDIT 'H bond' as this is not a name Correct spelling only. IGNORE α or β or numbers
3 (a) (ii)	hydrolysis / addition of water ;	1	
3 (a) (iii)	β / <u>beta</u> , glucose ;	1	Must be qualified as β or beta or B or b
3 (b)	enzymes are <u>specific</u> ; the , carbohydrate molecules / substrates , are different <u>shapes</u> ; <u>active site</u> and substrate are complementary ; so that substrate will fit / formation of ESC ; lock and key / induced fit ;	3 max	

Question	Expected Answers	Marks	Additional Guidance
3 (c) (i)	<p>pH <u>much</u> , higher / less acidic , than optimum (for enzyme 2) ;</p> <p>change in charge of active site ;</p> <p>hydrogen / ionic , bonds <u>break</u> ;</p> <p>tertiary structure / 3D shape / active site shape , altered ;</p> <p>enzyme / tertiary structure , <u>denatured</u> ;</p> <p>substrate no longer fits active site / ESC does not form ;</p>	3 max	<p>Needs idea of <u>much</u> greater or <u>too</u> high</p> <p>DO NOT CREDIT just 'higher than' or 'above'</p> <p>DO NOT CREDIT too / more , alkaline</p> <p>DO NOT CREDIT peptide / disulphide , bonds break</p> <p>DO NOT CREDIT in context of heat / vibration</p> <p>IGNORE ref to denaturing active site</p> <p>IGNORE ref to denaturing active site</p> <p>DO NOT CREDIT kill / die</p> <p>'substrate doesn't bind to enzyme' is not quite enough</p>
3 (c) (ii)	<p><i>Mark 1st response on each numbered line unless no answer on one line, then mark 1st 2 answers</i></p> <p>temperature ;</p> <p>substrate <u>concentration</u> ;</p> <p>enzyme <u>concentration</u> ;</p>	2 max	<p>IGNORE ref to time</p>

Question	Expected Answers	Marks	Additional Guidance
3 (d)	<p>Marking points 2 – 6 can be applied to the standard solutions or the sample</p> <p>1 using , standard / known , concentrations (of reducing sugar) ;</p> <p>2 <u>heat</u> with , Benedicts (solution) / $\text{CuSO}_4 + \text{NaOH}$;</p> <p>3 (use of) same volumes of solutions (each time) ;</p> <p>4 (use of) excess Benedicts ;</p> <p>5 changes to , green / yellow / orange / brown / (brick) red ;</p> <p>6 remove precipitate / obtain filtrate ;</p> <p>7 calibrate / zero , colorimeter ;</p> <p>8 using , a blank / water / unreacted Benedicts ;</p> <p>9 use (red) filter ;</p> <p>10 reading of , transmission / absorbance ;</p> <p>11 more transmission / less absorbance , of filtrate = more sugar present ; ora</p> <p>12 (obtain) <u>calibration</u> curve ;</p> <p>13 <u>plotting</u> , transmission / absorbance , against (reducing) sugar concentration ;</p> <p>14 use reading of unknown sugar solution and read off graph to find conc. ;</p>	6 max	<p>e.g. serial dilutions</p> <p>ALLOW boil / > 80°C DO NOT CREDIT warm DO NOT CREDIT amount / quantify</p> <p>CREDIT description of method e.g. filtering / centrifuging & decanting</p> <p>ACCEPT 'measure how much light , does / does not , pass through' If precipitate is clearly indicated as being present in sample, ALLOW 'less transmission / more absorbance , = more sugar present'</p>
	Total	18	