COMPONENT 1 – Basic Biochemistry and Cell Organisation

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statement. Award the middle mark in the level if most of the content statements are given and the communication statement is partially met. Award the lower mark if only the content statements are matched.

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Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			beta glycosidic bond (1)	1			1		0
	(b)			**similarity** alternative monosaccharides / sugars rotated by 180^{o} (1) **difference** -OH on C_2 of cellulose replaced by $-NHCOCH_2$ in chitin (1)	2			2		
	(c)			(in **cellulose** and **chitin)** hydrogen bonds form to cross-link adjacent polysaccharide chains (1) (in **starch)** hydrogen bonds will coil the polysaccharide to form an alpha helix. (1)	2			2		
	(d)			Main area of digestion and absorption is stomach and small intestine (1) In the cow cellulose digestion by bacteria takes place before stomach and small intestine so digested food can be absorbed. (1) In the rabbit cellulose digestion takes place after the stomach and small intestine so the rabbit has to eat the faeces so that digestion of materials can be completed and nutrients absorbed. (1)		3		3		
				Question 1 total	**5**	**3**	**0**	**8**	**0**	**0**

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Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		Stage A – telophase and Stage C – metaphase (1)	1			1		1
		(ii)		microtubules used to form the spindle apparatus (1) so spindle cannot form / separate / move chromatids (1)		2		2		
		(iii)		To separate each pair of chromatids/ to pull a copy of each chromosome to opposite poles(1) so that each resulting nucleus will be genetically identical(1)	2			2		
	(b)	(i)		Interphase (1)	1			1		
		(ii)		The quantity of DNA has <u>doubled/</u> returns to its initial value / (quantity of) DNA changes from 6 to 12 (1) NOT: increase		1		1		
		(iii)		Observe the cell for a longer period of time and if the DNA quantity doubles cell division is mitosis and if it halves it is meiosis(1)			1	1		1
	(c)	(i)		nitrogenous / organic bases (1)	1			1		
		(ii)		each strand of DNA used as a template to make a new DNA strand/ New DNA molecules are made of an old/ original strand and a new strand (1) G_0 – all DNA heavy due to ^{15}N (1) G_1 – all DNA is intermediate / lighter because each ^{15}N strand has acted as a template for the synthesis of a ^{14}N strand (1) G_2 – half DNA is light / lighter again due to ^{14}N strands acting as template but half is intermediate due to presence of original ^{15}N strands (1) G_3 – increasing amount of ^{14}N DNA as more ^{14}N strands acting as templates (1)	1	4		5		4
				Question 2 total	**6**	**7**	**1**	**14**	**0**	**6**

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Question				Marking details	Marks available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
3	(a)	(i)		E = (DNA) carries genetic code and is transcribed into mRNA (1) C=(ribosomes) translate mRNA to form polypeptide chain (1) D=(nucleolus) involved in production of ribosomes /rRNA (1) F=(RER) transports polypeptides to Golgi body (1) B= (Golgi body) processes/ modifies and packages protein (1)	5			5		
		(ii)		production / synthesis of ATP to provide the energy for eg peptide bond formation/ amino acid activation (1)		1		1		
	(b)	(i)		24 × 1 000 ÷ 12 000 (1) 2 µm (1)		2		2	2	2
		(ii)		Organelle A = mitochondrion +Two structural similarities for 1 mark from: a loop/ circle of DNA,70S ribosome, infolding of membranes, stalked particles (1) Mitochondria has two membranes, same as is if a bacterium had been {enclosed in a phagocytic vesicle/ engulfed by another cell}(1)			2	2		
				Question 3 total	**5**	**3**	**2**	**10**	**2**	**2**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		{Heads/ phosphates} are {hydrophilic/ polar} and are attracted to the water (1) {Tails/ fatty acids} are {hydrophobic/ non polar} and are {repelled by/ above/ avoid} water (1) NOT react/ dissolve with water		2		2		
		(ii)		The total surface area of red blood cell is half the area of the monofilm as phospholipids arrange themselves as a bilayer (1) With hydrophilic heads facing the polar/ ionic molecules on both sides of the membrane(1)			2	2		
	(b)	(i)		proteins are embedded in the phospholipid bilayer as well as being located outside phosphate head / there are extrinsic and intrinsic proteins not just extrinsic (1) many proteins present in the membrane but not linked together as in the diagram (1) channel / pore is formed from a single protein not lined with protein (1)		3		3		
		(ii)		Mosaic = protein molecules embedded in the membrane (1) Fluid = protein and phospholipid molecules free to move (1)	2			2		
	(c)	(i)		Change in temperature would change the kinetic energy of the molecules and therefore the rate(1) High temperature could denature proteins in the membrane(1) Change in pH could change the tertiary structure of the protein membranes(1)	3			3		3

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		(ii)		Concentration of phosphate ions inside cell must be 30a.u.(1) Because in the absence of oxygen and in concentrations less than 30a.u. there is no uptake of phosphate(1) Absence of oxygen uptake must be by facilitated diffusion/ diffusion(1) In the presence of oxygen and in concentrations less than 30a.u. must be active transport as phosphate uptake is against concentration gradient and ATP is present(1) At concentrations greater than 30 a.u. and oxygen present uptake is by both active transport and facilitated diffusion/ diffusion (1) At high concentration of phosphate all carrier proteins are in use and become a limiting factor(1)		2	4	6		
				Question 4 total	**5**	**7**	**6**	**18**	**0**	**3**

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		four polypeptide chains bonded together to produce functional protein (1)	1			1		
		(ii)		alpha helix and hydrogen bonds formed between polar H and O atoms / amino and hydroxyl groups (1)	1			1		
	(b)	(i)		4.7 (1)		1		1	1	
		(ii)		Axes correctly assigned with correct labels (1) Appropriate linear scales plus units (1) All points correctly plotted and joined with a curve or ruled straight lines (tolerance ½ small square) (1)		3		3	3	
		(iii)		Between 0.75% and 4.50% hydrogen peroxide concentration: As the concentration of hydrogen peroxide increases the rate of reaction increases (1) As the hydrogen peroxide concentration increases there are more enzyme-substrate complexes formed (per unit time) (1) The concentration of hydrogen peroxide is limiting the rate / hydrogen peroxide concentration is the limiting factor (1) Above 4.50% As the concentration increases the rate of reaction remains constant(1) all of the active sites (of catalase) are occupied/ catalase is saturated (1) The concentration of catalase is now limiting the rate / catalase concentration is a limiting factor (1)		4	2	6		

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Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(c)			Any two inaccuracies + two linked improvements The reaction is exothermic and this would affect the rate of reaction (1) Use of a water bath to control temperature (1) The concentration of catalase in the potato extract could vary (1) Use of catalase solution (1) pH could vary (1) Use a buffer (1) Time of disc in enzyme could vary (1) Leave disc in enzyme solution for a set time (1) By using same hydrogen peroxide solution each time, concentration would decrease(1) Use fresh solution each time (1)			4	4		4
				Question 5 total	**2**	**8**	**6**	**16**	**4**	**4**

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Question	Marking details	Marks available					
		AO1	AO2	AO3	Total	Maths	Prac
6	Indicative content Water is a polar molecule: ● it forms hydrogen bonds with other water molecules so it is liquid in the usual range of temperatures found on Earth ● it can also form H bonds with other ionic and polar molecules and so is able to dissolve and transport these molecules ● due to H bonds water molecules can move up through xylem vessels through a combination of cohesive and adhesive forces ● liquid water also has a high surface tension that provides a habitat for some organisms Water has a high specific heat capacity: ● as it requires a large amount of energy to raise its temperature. This helps to maintain body temperatures at a fairly constant temperature ● aquatic habitats also have a fairly stable temperature Water has a high latent heat of evaporation: ● as it requires a large amount of energy to evaporate it it can be used to cool bodies e.g. evaporation of sweat ● aquatic habitats do not disappear easily through evaporation Additional Points: ● as water is transparent light can pass through it and aquatic plants can photosynthesise ● ice is less dense than water so insulates the water beneath it as it forms thus stopping it from freezing ● due to its polar nature it is a reactant in many biochemical reactions e.g. hydrolysis /photosynthesis	4	5		9		

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				7-9 marks The importance of water as a polar molecule is explained in detail in terms of the interactions of water molecules with each other and with other molecules and structures. In addition, there is a clear understanding of how the thermal properties of water affect temperature control of habitats and organisms. Explanations of how other properties of water are important to life are also given. *The candidate constructs an articulate, integrated account, correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately.* **4-6 marks** The polar nature of water is described and is linked to how this property makes it important to life on earth. The thermal properties of water are explained in terms of how they affect temperature control of habitats and / or organisms and some explanations of how other properties of water are important to life are also given. *The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately.*						

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				1-3 marks A number of properties of water are described together with an attempt at explaining how these properties are important to life on earth. Reference to the polar nature of water molecules or the thermal properties of water are limited or incorrect. *The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate has limited use of scientific conventions and vocabulary.* **0 marks** *The candidate does not make any attempt or give a relevant answer worthy of credit.*						
				Question 6 total	**4**	**5**	**0**	**9**	**0**	**0**

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COMPONENT 1: BASIC BIOCHEMISTRY AND CELL ORGANISATION

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	5	3	0	8	0	0
2	6	7	1	14	0	6
3	5	3	2	10	2	2
4	5	7	6	18	0	3
5	2	8	6	16	4	4
6	4	5	0	9	0	0
TOTAL	**27**	**33**	**15**	**75**	**6**	**15**

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