Test Name: carbohydrates

Marking Guides

Question: 1 (298033)

Question			Answer	Marks	Guidance
	(a)	(i)	polysaccharide ;	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** **ACCEPT** phonetic spelling **IGNORE** polymer **IGNORE** oligosaccharide
		(ii)	*similarity* chain / unbranched / glycosidic bonds / (contain) hexose / hex ring / O in each ring / CHO ; *difference* *agarose has:* two types of (glycosidic) bond **or** two different, sugars / sugar residues / monosaccharides **or** disaccharide, monomer / subunit / AW **or** (residues) are alternately rotated / AW **or** straight chain ;	**2**	**IGNORE** polysaccharides **IGNORE** 6-carbon ring **ACCEPT** 5-carbon ring Assume answer refers to agarose unless otherwise stated **ACCEPT** ora for any point **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' **IGNORE** refs to glucose **ACCEPT** 'flipped' / 'reflected' **ACCEPT** 'amylose is coiled'

Question			Answer	Marks	Guidance
	(b)		(bacteria) do not, make / have, correct <u>enzyme</u> (to digest agarose) ; agarose, does not fit / not complementary to, <u>active site</u> (of bacterial enzymes) ; bacteria unable to transport , substrate / enzyme , across membrane ;	**1 max**	**DO NOT CREDIT** in incorrect context e.g. 'bacteria do not have amylase' or 'bacterial enzyme cannot break down amylose'
	(c)	(i)	<u>control</u> ; 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 ;	**2**	**ACCEPT** 'compare it with the other tube' **IGNORE** 'compare the tubes'

Question			Answer	Marks	Guidance
	(c)	(ii)	*idea that* some, starch / other polysaccharide / (reducing) sugar present in , nutrient solution / culture solution / bacteria (at start) ; presence of some mutated , *E. coli* / bacteria , (that can break it down) ; presence of (other) microorganism that can break it down ;	**1 max**	**IGNORE** experimental error unqualified **IGNORE** any reference to temperature **IGNORE** other carbohydrate
		(iii)	replicate(s) / repeat(s) ; more than one sample tested from each tube / sample each tube twice ;	**2**	**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** **IGNORE** 'do more tests' **IGNORE** 'disregard anomalous results' **IGNORE** 'compare with other results' **IGNORE** 'calculate mean'

Question				Answer	Marks	Guidance
	(d)	(i)	**1**	add, Benedict's (reagent) / $CuSO_4$ + 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 **2 ACCEPT** any temperature between 80°C and 100°C **2 ACCEPT** gently heat
			3	(forms) precipitate ;		
			4	(colour changes from blue to), green / yellow / orange / brown / (brick) red ;		
				concentration estimated from		Read as prose and mark the best suggestions
				EITHER		**5/6 DO NOT AWARD** if candidate is using a colorimeter
			5a	degree of colour change / use different colours ;		**5a ACCEPT** 'the darker / redder , the more reducing sugar' **5a ACCEPT** in context of precipitate or supernatant
			6a	comparison (of final colour) with , standard / known, solution ;		**6a** Answers must include the idea of comparison **6a ACCEPT** ref to calibration curve as long as not in context of colorimeter
				OR		
			5b	filter / centrifuge , **and** weigh precipitate ;		
			6b	greater mass = more sugar present / use of a standard curve ;		**6b ACCEPT** weight **6b ACCEPT** amount
				OR		
			5c	centrifuge ;		
			6c	size , of pellet / colour of supernatant (liquid), indicates concentration ;		**6c ACCEPT** mass

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

Question: 2 (298143)

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

Question			Expected Answers	Mark	Additional Guidance
	(c)	(i)	<u>α</u> /<u>alpha</u> , glucose ;	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** **ACCEPT** 'α'
	(c)	(ii)	**1** respiratory substrate / used for respiration ; **2** source of / releases / provides, energy ; **3** formation of ATP ; **4** conversion into named compound ;	1 max	**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** **DO NOT CREDIT** any answer that clearly states that glucose **is** energy, **makes** energy, **produces** energy or **creates** energy **1** **ACCEPT** used in respiration **ACCEPT** 'releases energy for respiration' **2** **IGNORE** used for energy **4** e.g. starch / cellulose / polysaccharide / disaccharide / glycogen / protein / lipid / sucrose / maltose / fructose / fat
	(c)	(iii)	D ;	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** **ACCEPT** F **IGNORE** triglyceride / fat / lipid / haemoglobin

Question			Expected Answers	Mark	Additional Guidance
	(d)		glycogen / *no hydrogen bonding* ; cellulose / *hydrogen bonding* ; α / alpha , glucose ; β / beta , glucose ; 1,4 <u>and</u> 1,6-glycosidic bonds **or** 1,6-glycosidic bonds present ; 1,4-glycosidic bonds (only) **or** 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	**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** α-glucose in a branched chain | β-glucose in a straight chain **= 2 marks** **ACCEPT** 'α' and 'b' **ACCEPT** helical / spiral / coiled vs linear / straight **DO NOT CREDIT** α-helix
			Total	**[16]**	

Question: 3 (297648)

Question			Expected Answer	Mark	Additional Guidance
	(a)	(i)	blue-black / black / dark blue ;	1	**ACCEPT** dark purple / purplish-blue **DO NOT CREDIT** blue or purple unqualified by darkness **ACCEPT** acceptable colour change
	(a)	(ii)		2	**CREDIT** marking points from clearly labelled diagram max 1 if incorrect charges are on atoms
		1	between oxygen and hydrogen (atoms) ;		**1 DO NOT CREDIT** molecules / ions
		2	(between) electronegative / δ^-, and electropositive / δ^+ ;		**2 DO NOT CREDIT** ions / + and – **2 ACCEPT** slight / partial (negative / positive), charge
	(a)	(iii)		2 max	**IGNORE** refs to denaturation
		1	hydrogen / H, bonds break ;		
		2	helix, lost / unravels / AW ;		**2 ACCEPT** spiral / coil
		3	iodine, released / no longer in complex / AW ;		**3 ACCEPT** no longer contained in helix

Question			Expected Answer	Mark	Additional Guidance
	(b)	1	take samples at a range of times / AW ;		
		B2	same volumes (of solutions) added / removed (each time) ;		**B2** must be in context of Benedict's test rather than reaction mixture
		B3	heat with, Benedict's (solution) / $CuSO_4$ and NaOH ;		**B3 DO NOT CREDIT** boil **/** warm **B3 DO NOT CREDIT** if Benedict's added to the mixture at the beginning
		B4	(use of) excess Benedict's ;		
		B5	changes to, green / yellow / orange / brown / (brick) red ;		
		C6	remove precipitate / obtain filtrate ;		**C6 CREDIT** description of method e.g. filtering / centrifuging / decanting
		C7	colorimeter ;		
		8	calibrate / zero, using, a blank / water / (unreacted) Benedict's ;		**8 IGNORE** 'control'
		9	use (red / orange) filter ;		**9 DO NOT CREDIT** if colour of filter is incorrect
		T10	reading of, transmission / absorbance **OR** mass of precipitate ;		**T10 ACCEPT** 'measure how much light, does / does not, pass through'
		11	more transmission / less absorbance, of filtrate, **OR** greater mass ppt, = more maltose present ; **ora**		**11** if unfiltered Benedict's / precipitate is **clearly indicated** as being present **in sample**, **ACCEPT** 'less transmission / more absorbance, = more maltose present' **11 DO NOT CREDIT** if precipitate is added to colorimeter
		12	using, standard / known, concentrations (of maltose) ;		**12 CREDIT** 'serial dilutions'
		13	(obtain) calibration curve ;		
		14	plot, transmission / absorbance / mass of ppt, against (reducing sugar) concentration ;		
		15	use graph to read off concentration of maltose / AW ;	6 max	
			QWC – correct sequence ;	1	1 of mps **B2 to B5**, *then* mp **C6 or C7**, *then* mp **T10**

Question			Expected Answer	Mark	Additional Guidance
	(c)	(i)			
		1	increases / greater / faster ;		1 **ACCEPT** any time between 3.45 and 3.55 min.
		2	reaction completed in / plateaus after / concentration is 100% after, 3.5 minutes ;		
		3	figures with units to support mp 1 ;		3 two maltose concentrations (+ or – chloride) for a given time or two times (+ or – chloride) for given maltose concentration. 3 **ACCEPT** calculated difference 3 **DO NOT CREDIT** if '%' and 'min.' not given 3 **ACCEPT** any concentration within ± 1 % and time within ± 0.05 min.
				2 max	

Presence or absence of chloride ions	The percentage concentration of maltose (%) present every half a minute								
	0.0 min	0.5 min	1.0 min	1.5 min	2.0 min	2.5 min	3.0 min	3.5 min	4.0 min
Chloride ions present	0	24	54	70	80	88	95	100	100
Chloride ions absent	0	12	20	29	36	40	45	48	50
Difference in maltose concentration When chloride ions are either present or absent	0	12	34	41	44	48	50	52	50

Allow a + /- 1% for any concentration of maltose and a +/- 2% for the difference in maltose concentrations

	(c)	(ii)			
		1	(acts as a) cofactor ;		1 **IGNORE** 'coenzyme'
		2	(Cl^-) binds to, enzyme / amylase / amylose / substrate ;		2 **ACCEPT** binds to, active site
		3	enzyme substrate complex / ESC, forms more, easily / quickly ;	2 max	3 **ACCEPT** description

Question			Expected Answer	Mark	Additional Guidance
	(c)	(iii)			**Mark the first three answers only regardless of which line they are on** **DO NOT CREDIT** refs to, time
		1	temperature ;		
		2	pH ;		
		3	enzyme / amylase / chloride, concentration ;		3 **IGNORE** 'amount' or 'volume' 3 **DO NOT CREDIT** 'concentration' unqualified
		4	substrate / starch / amylose, concentration ;		4 **IGNORE** 'amount' or 'volume' 4 **DO NOT CREDIT** 'concentration' unqualified
		5	constant / regular, stirring ;		
		6	(fixed) volume of solution (removed each time for sampling) ;	3 max	
			Total	**19**	

Question: 4 (298566)

Question			Expected Answers	Marks	Additional Guidance
	(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
	(a)	(ii)	hydrolysis / addition of water ;	1	
	(a)	(iii)	β / beta , glucose ;	1	Must be qualified as β or beta or B or b
	(b)		enzymes are specific ; the , carbohydrate molecules / substrates , are different shapes ; active site 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
	(c)	(i)	pH much , higher / less acidic , than optimum (for enzyme 2) ; change in charge of active site ; hydrogen / ionic , bonds break ; tertiary structure / 3D shape / active site shape , altered ; enzyme / tertiary structure , denatured ; substrate no longer fits active site / ESC does not form ;	3 max	Needs idea of much greater or too high **DO NOT CREDIT** just 'higher than' or 'above' **DO NOT CREDIT** too / more , alkaline **DO NOT CREDIT** peptide / disulphide , bonds break **DO NOT CREDIT** in context of heat / vibration **IGNORE** ref to denaturing active site **IGNORE** ref to denaturing active site **DO NOT CREDIT** kill / die 'substrate doesn't bind to enzyme' is not quite enough
	(c)	(ii)	*Mark 1st response on each numbered line unless no answer on one line, then mark 1st 2 answers* temperature ; substrate concentration ; enzyme concentration ;	2 max	**IGNORE** ref to time

Question			Expected Answers	Marks	Additional Guidance
	(d)		***Marking points 2 – 6 can be applied to the standard solutions or the sample***		
		1	using , standard / known , concentrations (of reducing sugar) ;		e.g. serial dilutions
		2	heat with , Benedicts (solution) / $CuSO_4$ + NaOH ;		**ALLOW** boil / > 80°C **DO NOT CREDIT** warm
		3	(use of) same volumes of solutions (each time) ;		**DO NOT CREDIT** amount / quantity
		4	(use of) excess Benedicts ;		
		5	changes to , green / yellow / orange / brown / (brick) red ;		
		6	remove precipitate / obtain filtrate ;		**CREDIT** description of method e.g. filtering / centrifuging & decanting
		7	calibrate / zero , colorimeter ;		
		8	using , a blank / water / unreacted Benedicts ;		
		9	use (red) filter ;		
		10	reading of , transmission / absorbance ;		**ACCEPT** 'measure how much light , does / does not , pass through'
		11	more transmission / less absorbance , of filtrate = more sugar present ; **ora**		If precipitate is **clearly indicated** as being present in sample, **ALLOW** 'less transmission / more absorbance , = more sugar present'
		12	(obtain) calibration curve ;		
		13	plotting , transmission / absorbance , against (reducing) sugar concentration ;		
		14	use reading of unknown sugar solution and read off graph to find conc. ;	6 max	
			Total	**18**	

Question: 5 (5467774)

Question Number	Answer	Max Mark
(a)	breaking (glycosidic) bond; **R** if incorrect named bond glycosidic / correct bond drawn; treat 'covalent' = neutral addition of water / H_2O;	max[2]
(b)	*accept ✓ = yes x = no* *each correct row = 1 mark*	[4]

	gum arabic	amylose	cellulose	glycogen
branched structure		no;		yes;
heteropolysaccharide		no;		no;
found in animals/plants		plants;		animals;
function in organism		storage / reserve; **R** 'energy' alone	structural / strength / stops bursting / cell wall / support / gives cell shape; **R** protects rigid = neutral	

(c)(i)	crush (small amount of) seed pod; add (small volume of) biuret, A / NaOH, <u>and</u> biuret, B / $CuSO_4$; positive = colour change from blue to, mauve/purple;	**max[2]**
(c)(ii)	*preparation - allow 2 marks max:* 1 crush, samples / leaves and seed pods, separately with water; 2 use same mass of each / AW and use same volume of water; 3 filter; *method - allow 4 marks max:* 4 add benedict's reagent to filtrate; **A** $CuSO_4$ in alkaline solution 5 <u>excess</u> reagent used / stated volume; 6 same volume added; 7 heat in a water bath/ at near boiling; 8 for stated time (up to 5 min); *analysis - allow 2 marks max:* *<u>either</u>* 9 colour change from blue to green / yellow / orange / red; 10 shows increasing concentration of reducing sugar; *<u>or</u>* 11 use of centrifuge to remove precipitate; 12 use of colorimeter to compare intensity of blue colour in liquid portion; 13 red filter used in colorimeter;	**[8]**
(d)	humans eat only the seeds so do not gain, nutrition / energy, from, leaves / pods; seeds maybe deficient in (some) essential amino acids; cattle better at digesting, plant matter / seeds / leaves / pods, than humans / AW; meat (from cattle) provides more essential amino acids for humans (than plant material)/AW; cattle also produce milk; AVP; e.g. cattle naturally roam to find food / intensive labour needed for human collection of plant material;	**max [3]**
		Total: [19]