Question			Answer	Marks	Guidance
1	(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)	(i	*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) <u>precipitate</u> **;**		
			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			Answer		Marks	Guidance
2	(a)				2 max	**Mark the first answer on each prompt line.** **ACCEPT** ora throughout
			1	nucleus / nuclei **;**		**1 ACCEPT** 'DNA not free'
			2	other named organelle / membrane bound organelles **;**		**2** e.g. mitochondria / Golgi / etc **2 ACCEPT** compartmentalized organelles **2 ACCEPT** don't have a mesosome
			3	linear chromosomes **;**		
			4	DNA, associated with / AW, histones / protein **;**		**4 ACCEPT** 'DNA not naked'
			5	80S / 22nm / large, ribosomes **;**		
			6	large cells / AW **;**		
			7	no cell wall **;**		
	(b)		capital letter on, specific name / Vivax **;** not italicised / not underlined **;**		1 max	**Mark the first answer** **ACCEPT** ora for what student should have typed **ACCEPT** 'the parasite is Plasmodium falciparum / malariae / ovale' if candidate uses capital 'P' and lower case 'f / m / o'
	(c)	(i)			3 max	**IGNORE** references to stages of life-cycle **Max 2 if virus / bacterium appears anywhere**
			1	(mosquito), is <u>vector</u> **;**		
			2	*Plasmodium* / parasite, present in (mosquito), saliva / salivary gland **;**		
			3	*idea that* infected mosquito, feeds on / bites, human **;**		**3 IGNORE** case of initial 'P' **3** Must be in context of transmission from mosquito **to** human
			4	*Plasmodium* / parasite, passes (from saliva) to blood **;**		**4** 'blood' can be inferred, e.g. from refs to anticoagulant **4 IGNORE** ref to parasite in blood after liver

Question			Answer	Marks	Guidance
	(c)	(ii)	destruction of a species is, morally / ethically, wrong **;** might cause unintended health problems in humans **;** might harm, other / unintended, species **;** *idea of* bioaccumulation / biomagnification **;**	1 max	**Mark the first suggestion** **IGNORE** 'might enter human food' unqualified Answers must imply idea of harm

Question			Answer		Marks	Guidance
	(c)	(iii)		5 max		Award marks for either a field or laboratory investigation – **must read whole answer before beginning to mark to decide if field or laboratory.** If candidates answer in terms of incidence of malaria award no marks as question states population of mosquitoes but read whole question in case mosquito study described in addition. If the investigation is in the both field and laboratory mark the investigation which gives candidate most marks.
			Field investigation			
			F1 (sampling) before and after insecticide treatment **;**			**F1 IGNORE** refs to treated and untreated areas as stem refers to 'a population'
			F2 *idea of* , unbiased / random, sampling of population **;**			
			F3 example of sampling technique **;**			**F3** e.g. sweep net, pond net, light trap **F3 ACCEPT** insect net **F3 IGNORE** 'net' **or** 'trap' unqualified
			F4 (sampling in) different, times / weather **;**			**F4 IGNORE** intervals unqualified. Answers must refer to time or weather
			F5 large number of samples taken **;**			**F5** Must imply large number or state five or more
			F6 *idea of* standardised sampling procedure **;**			**F6 ACCEPT** idea of counting by the same method
			F7 *idea of* preventing counting same individual more than once **;**			
			F8 *idea of* capture – recapture **;**			
			F9 calculate mean / calculate standard deviation / apply statistical test **;**			

Continued……..

Question			Answer		Marks	Guidance
				OR		
				Laboratory investigation		Laboratory investigation could be done outside
				idea of:		
			L1	with and without insecticide exposure **;**		**L1** is for changing the independent variable
			L2	measuring mosquito survival / count surviving mosquitoes **;**		**L2** is for measuring the dependent variable **ACCEPT** count the number of dead ones
			L3	controlling one named key variable **;**		**L3 and L4** *award up to 2 marks for* exposure time species of mosquito stage of mosquito life cycle sex of mosquito number of mosquitos insecticide type insecticide concentration volume of insecticide temperature
			L4	controlling second named key variable **;**		
			L5	*idea of* using a range of insecticide concentrations **;**		
			L6	replicates **;**		**L6** Minimum of 3 in total, i.e. original plus two
			L7	calculate mean / calculate standard deviation / apply statistical test **;**		**L7 IGNORE** average
				Total	**12**	

Question			Expected Answers	Marks	Additional Guidance
3	(a)	(i)	**1** sweep netting / sweep vegetation with a net **;** **2** beating / beat trees and bushes **;** **3** pooter / pooting / described **;**	**1 max**	**2** **ACCEPT** fogging **3** **ACCEPT** pitfall traps / described
	(a)	(ii)	*idea of* ladybirds not evenly distributed / some parts of hill different / more representative **;** lets <u>reliability</u> be assessed / anomalies identified **;**	**1 max**	**ACCEPT** description e.g. could be more ladybirds one side than another **ACCEPT** increases reliability **IGNORE** accuracy / precision / removes anomalies
	(b)	(i)	**M1** (calculate) % / proportion / ratio **;** **E1** as different total numbers at each site **;** **or** **M2** (draw) bar chart / kite diagram **;** **E2** pictorial data easier to understand **;**	**2 max**	**M1** **IGNORE** χ^2 **M2** **IGNORE** histogram / line graph

Question			Expected Answers	Marks	Additional Guidance
	(b)	(ii)	*yes (for first statement)* **1** first statement true / correlation exists **;** **2** number of black ladybirds increase **,** from 100m to 300m / until 300m **;** **3** 400m number decrease **but** % black increases **;** *no (for second statement)* **4** correlation not proof of causation / no proof of causal link / second statement not (necessarily) true **;** **5** another (named) factor could be involved **;**	**3 max**	**If candidates argues 'yes' exclusively, can only be awarded mps 1-3** **If candidate answers 'no' exclusively, can only be awarded mps 4 & 5** ***Note*** *percentage of black ladybirds increases as you go up the hill* = 2 marks (mps 2 & 3) **5** **CREDIT** could be due to distance from town / more **or** less predation high up / camouflage / warning colours
	(c)	(i)	only expressed , when homozygous / in absence of dominant (allele) **;** not expressed when heterozygous / expression masked by dominant (allele) **;**	**1 max**	**DO NOT CREDIT gene** **IGNORE letters / genotypes** **ACCEPT only seen in phenotype when it is present in 'double dose'**

Question			Expected Answers	Marks	Additional Guidance
	(c)	(ii)	**1** $\underline{q^2}$ = 296 / 346 or 0.85 / 0.855 / 0.86 ; **2** q = √previous answer or 0.92 / 0.93 ; **3** p = 1 – previous answer or 0.08 / 0.07 ;	**3**	**1** **DO NOT CREDIT** calculation or figure unless it has been indicated as q^2 **2** **ACCEPT ecf** **3** **ACCEPT ecf** ***Note*** **If both p and q are correct = 3 marks** *If p and q not given to 2 decimal places* then penalise 1 mark and then apply ecf • If the 2 final answers add up to 1 give mp 3, then look for evidence of mps 1 or 2 in the working • If the 2 final answers do not add up to 1, look for evidence of mps 1, 2 & 3 in the working • Award the working mark(s) if method correct, even if subsequent calculation incorrect (e.g. $1 - 0.54 = 0.56$ could get mp 3 for '1 – previous answer' even though 0.56 is the incorrect answer for the calculation) *e.g. if black allele wrongly assumed to be recessive* $q = 0.38$ or $q = \sqrt{0.1445}$ give mp 2 as ecf $p = 0.62$ or $p = 1 - 0.38$ give mp 3 as ecf *e.g. if answer given as* $q = 0.85$ *and* $p = 0.15$ give mp 3 They will not get mp 1 as they think that 296/346 = q (rather than q^2) and so will not square root it so they won't get mp 2
				11	

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	osmosis ;	1	**Mark the first answer.** If the first answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**. **DO NOT CREDIT** diffusion
		(ii)	fit between (phospho)lipids / through (phospho)lipid (bi)layer ; via, protein channels / protein pores / aquaporins ;	2	**DO NOT CREDIT** fit through phospholipids (molecules) **DO NOT CREDIT** carrier proteins – if this is used do not award mp 2 **IGNORE** transport proteins
	(b)		cell wall ; provides strength / withstands (internal) pressure / prevents cell membrane over expanding / exerts pressure potential ; limits uptake of water ;	2 max	**'has a strong cell wall' = 2 marks** **IGNORE** rigidity (of wall), cytoplasm pushes against cell wall **ACCEPT** stops uptake of water (when turgid)
	(c)	(i)	between –1451 and –1799 ;	1	**Ensure figure is a negative number** **CREDIT** a range or single value within this range

Question			Expected Answers	Marks	Additional Guidance
	(a)	**(i)**	osmosis **;**	**1**	**Mark the first answer.** If the first answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**. **DO NOT CREDIT** diffusion
		(ii)	fit between (phospho)lipids / through (phospho)lipid (bi)layer **;** via, protein <u>channels</u> / protein <u>pores</u> / aquaporins **;**	**2**	**DO NOT CREDIT** fit through phospholipids (molecules) **DO NOT CREDIT** carrier proteins – if this is used do not award mp 2 **IGNORE** transport proteins
	(b)		cell wall **;** provides strength / withstands (internal) pressure / prevents cell membrane over expanding / exerts pressure potential **;** limits uptake of water **;**	**2 max**	**'has a strong cell wall' = 2 marks** **IGNORE** rigidity (of wall), cytoplasm pushes against cell wall **ACCEPT** stops uptake of water (when turgid)
	(c)	**(i)**	between –1451 and –1799 **;**	**1**	**Ensure figure is a negative number** **CREDIT** a range or single value within this range

Question	Expected Answers	Marks	Additional Guidance
(d)	*reliable* **R1** observe more pieces of onion (epidermis from each solution) ; **R2** count more cells (in each piece of epidermis) ; **R3** calculate a mean ; **R4** identify / ignore anomalous results ; **max 3** *accurate* *idea of:* **A1** use, more / intermediate, concentrations within existing range / smaller gap between concentrations / closer (concentration) values ; **A2** narrower range around 50% plasmolysis / 0.4 - 0.7 mol dm^{-3} / -1120 to -2180 kPa ; **A3** take photographs and mark cells as counting ;	**4 max**	**DO NOT CREDIT** 'repeats' unless qualified **ALLOW** 'repeat the results / experiment' to indicate more pieces of epidermis **IGNORE** average **ACCEPT** outliers for anomalies **IGNORE** removes / avoids, anomalies **IGNORE** lack of units **ACCEPT** examples of values quoted in between original values e.g. 0.25, 0.35, etc. **ACCEPT** 0.2 **and** 0.9 **ACCEPT** examples of values if clearly showing application of correct narrower range e.g. 0.45, 0.55 , 0.65 For A2 **DO NOT CREDIT** quoted values extend beyond correct narrower range e.g. 0.35, 0.55, 0.75
	Total	**12**	