| 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**<br><br>**ACCEPT** phonetic spelling<br>**IGNORE** polymer<br>**IGNORE** oligosaccharide |
| | | (ii) | *similarity*<br>chain / unbranched / glycosidic bonds / (contain) hexose / hex ring / O in each ring / CHO **;**<br><br>*difference*<br>*agarose has:*<br><br>two types of (glycosidic) bond<br><br>**or**<br><br>two different, sugars / sugar residues / monosaccharides<br><br>**or**<br><br>disaccharide, monomer / subunit / AW<br><br>**or**<br><br>(residues) are alternately rotated / AW<br><br>**or**<br><br>straight chain **;** | **2** | **IGNORE** polysaccharides<br>**IGNORE** 6-carbon ring **ACCEPT** 5-carbon ring<br><br>Assume answer refers to agarose unless otherwise stated<br>**ACCEPT** ora for any point<br><br>**DO NOT CREDIT** references to any incorrect bond<br>**ACCEPT** any suggestion of bonding to different numbered carbon atoms (as numbers are not given in diagram)<br>**ACCEPT** 'alternating bonds'<br><br>**IGNORE** refs to glucose<br><br>**ACCEPT** 'flipped' / 'reflected'<br><br>**ACCEPT** 'amylose is coiled' |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| | (b) | | (bacteria) do not, make / have, correct <u>enzyme</u> (to digest agarose) **;**<br><br>agarose, does not fit / not complementary to, <u>active site</u> (of bacterial enzymes) **;**<br><br>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> **;**<br><br>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'<br>**IGNORE** 'compare the tubes' |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| | (c) | (i | *idea that*<br><br>some, starch / other polysaccharide / (reducing) sugar present in , nutrient solution / culture solution / bacteria (at start) **;**<br><br>presence of some mutated , *E. coli* / bacteria , (that can break it down) **;**<br><br>presence of (other) microorganism that can break it down **;** | **1 max** | **IGNORE** experimental error unqualified<br>**IGNORE** any reference to temperature<br><br>**IGNORE** other carbohydrate |
| | | (iii) | replicate(s) / repeat(s) **;**<br><br>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**<br><br>**IGNORE** 'do more tests'<br><br>**IGNORE** 'disregard anomalous results'<br>**IGNORE** 'compare with other results'<br>**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'<br>**1 DO NOT CREDIT** if adding acid / hydrolysing |
| | | | **2** | heat **;** | | **2 ALLOW** boil<br>**2 IGNORE** warm<br>**2 ACCEPT** any temperature between 80°C and 100°C<br>**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'<br>**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<br>**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<br>**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<br>**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.**<br>**ACCEPT** ora throughout |
| | | | **1** | nucleus / nuclei **;** | | **1 ACCEPT** 'DNA not free' |
| | | | **2** | other named organelle / membrane bound organelles **;** | | **2** e.g. mitochondria / Golgi / etc<br>**2 ACCEPT** compartmentalized organelles<br>**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) | | | | 1 max | **Mark the first answer**<br>**ACCEPT** ora for what student should have typed |
| | | | capital letter on, specific name / Vivax **;** | | | |
| | | | not italicised / not underlined **;** | | | **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<br>**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'<br>**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<br>**4 IGNORE** ref to parasite in blood after liver |

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| | (c) | (ii) | destruction of a species is, morally / ethically, wrong **;**<br>might cause unintended health problems in humans **;**<br>might harm, other / unintended, species **;**<br>*idea of* bioaccumulation / biomagnification **;** | 1 max | **Mark the first suggestion**<br><br>**IGNORE** 'might enter human food' unqualified<br>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.**<br>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.<br>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<br>**F3 ACCEPT** insect net<br>**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<br>**ACCEPT** count the number of dead ones |
| | | | **L3** | controlling one named key variable **;** | | **L3 and L4** *award up to 2 marks for*<br>exposure time<br>species of mosquito<br>stage of mosquito life cycle<br>sex of mosquito<br>number of mosquitos<br>insecticide type<br>insecticide concentration<br>volume of insecticide<br>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 **;**<br>**2** beating / beat trees and bushes **;**<br>**3** pooter / pooting / described **;** | **1 max** | **2** **ACCEPT** fogging<br>**3** **ACCEPT** pitfall traps / described |
| | | | | | |
| | (a) | (ii) | *idea of* ladybirds not evenly distributed /<br>some parts of hill different /<br>more representative **;**<br><br>lets <u>reliability</u> be assessed / anomalies identified **;** | **1 max** | **ACCEPT** description<br>e.g. could be more ladybirds one side than another<br><br>**ACCEPT** increases reliability<br>**IGNORE** accuracy / precision / removes anomalies |
| | | | | | |
| | (b) | (i) | **M1** (calculate) % / proportion / ratio **;**<br>**E1** as different total numbers at each site **;**<br><br>**or**<br><br>**M2** (draw) bar chart / kite diagram **;**<br>**E2** pictorial data easier to understand **;** | **2 max** | **M1** **IGNORE** $\chi^2$<br><br>**M2** **IGNORE** histogram / line graph |
| | | | | | |

| Question | | | Expected Answers | Marks | Additional Guidance |
|---|---|---|---|---|---|
| | (b) | (ii) | *yes (for first statement)*<br>**1** first statement true / correlation exists **;**<br>**2** number of black ladybirds increase **,**<br>from 100m to 300m / until 300m **;**<br>**3** 400m number decrease **but** % black increases **;**<br><br>*no (for second statement)*<br>**4** correlation not proof of causation /<br>no proof of causal link /<br>second statement not (necessarily) true **;**<br>**5** another (named) factor could be involved **;** | **3 max** | **If candidates argues 'yes' exclusively, can only be awarded mps 1-3**<br>**If candidate answers 'no' exclusively, can only be awarded mps 4 & 5**<br><br>***Note*** *percentage of black ladybirds increases as you go up the hill* = 2 marks (mps 2 & 3)<br><br>**5** **CREDIT** could be due to distance from town /<br>more **or** less predation high up /<br>camouflage / warning colours |
| | (c) | (i) | only expressed , when homozygous /<br>in absence of dominant (allele) **;**<br>not expressed when heterozygous /<br>expression masked by dominant (allele) **;** | **1 max** | **DO NOT CREDIT gene**<br>**IGNORE letters / genotypes**<br><br>**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 **;**<br><br>**2** q = √previous answer or 0.92 / 0.93 **;**<br>**3** p = 1 – previous answer or 0.08 / 0.07 **;** | **3** | **1** **DO NOT CREDIT** calculation or figure unless it has been indicated as $q^2$<br>**2** **ACCEPT ecf**<br>**3** **ACCEPT ecf**<br><br>***Note***<br>**If both p and q are correct = 3 marks**<br>*If p and q not given to 2 decimal places* then penalise 1 mark and then apply ecf<br><br>• If the 2 final answers add up to 1 give mp 3, then look for evidence of mps 1 or 2 in the working<br>• If the 2 final answers do not add up to 1, look for evidence of mps 1, 2 & 3 in the working<br><br>• 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)<br><br>*e.g. if black allele wrongly assumed to be recessive*<br>$q = 0.38$ or $q = \sqrt{0.1445}$ give mp 2 as ecf<br>$p = 0.62$ or $p = 1 - 0.38$ give mp 3 as ecf<br><br>*e.g. if answer given as*<br>$q = 0.85$ *and* $p = 0.15$ give mp 3<br>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**.<br>**DO NOT CREDIT** diffusion |
| | | | | | |
| | | (ii) | fit between (phospho)lipids / through (phospho)lipid (bi)layer **;**<br><br>via, protein <u>channels</u> / protein <u>pores</u> / aquaporins **;** | 2 | **DO NOT CREDIT** fit through phospholipids (molecules)<br><br>**DO NOT CREDIT** carrier proteins – if this is used do not award mp 2<br>**IGNORE** transport proteins |
| | | | | | |
| | (b) | | cell wall **;**<br><br>provides strength / withstands (internal) pressure / prevents cell membrane over expanding / exerts pressure potential **;**<br><br>limits uptake of water **;** | 2 max | **'has a strong cell wall' = 2 marks**<br><br>**IGNORE** rigidity (of wall), cytoplasm pushes against cell wall<br><br>**ACCEPT** stops uptake of water (when turgid) |
| | | | | | |
| | (c) | (i) | between –1451 and –1799 **;** | 1 | **Ensure figure is a negative number**<br>**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**.<br>**DO NOT CREDIT** diffusion |
| | | | | | |
| | | **(ii)** | fit between (phospho)lipids / through (phospho)lipid (bi)layer **;**<br><br>via, protein <u>channels</u> / protein <u>pores</u> / aquaporins **;** | **2** | **DO NOT CREDIT** fit through phospholipids (molecules)<br><br>**DO NOT CREDIT** carrier proteins – if this is used do not award mp 2<br>**IGNORE** transport proteins |
| | | | | | |
| | **(b)** | | cell wall **;**<br><br>provides strength / withstands (internal) pressure /<br>prevents cell membrane over expanding /<br>exerts pressure potential **;**<br><br>limits uptake of water **;** | **2 max** | **'has a strong cell wall' = 2 marks**<br><br>**IGNORE** rigidity (of wall), cytoplasm pushes against cell wall<br><br>**ACCEPT** stops uptake of water (when turgid) |
| | | | | | |
| | **(c)** | **(i)** | between –1451 and –1799 **;** | **1** | **Ensure figure is a negative number**<br>**CREDIT** a range or single value within this range |
| | | | | | |

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