Question Number	Answer	Mark
1(a)(i)	**The only correct answer is B - lipid and protein** ***A*** *is incorrect because water does not contain carbon* ***C*** *is incorrect because water does not contain carbon* ***D*** *is incorrect because water does not contain carbon*	**(1)**

Question Number	Answer	Mark
1(a)(ii)	**The only correct answer is A - bacteria and fungi** ***B*** *is incorrect because viruses are not decomposers* ***C*** *is incorrect because maggots are not microorganisms* ***D*** *is incorrect because viruses are not decomposers*	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	1. (high temperatures) { kill microorganisms / denature enzymes / changes shape of active site / eq } ; 2. therefore enzymes { will not be released / will be inactive / eq} ; 3. therefore bonds between {organic molecules / eq} will not be broken down / eq ;	**1 DO NOT ACCEPT** {enzymes start to / microorganisms} denature **2 ACCEPT** substrate can no longer bind to active site **3 ACCEPT** named bonds and named organic molecules	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	1. no oxygen (available for microorganisms) ; 2. therefore no aerobic respiration ; 3. therefore no energy for { chemical reactions / growth of microorganisms } / eq ;	**1 IGNORE** less oxygen **2 ACCEPT** (only) anaerobic respiration **3 ACCEPT** less energy . . .	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(b)(iii)	1. (vinegar) { is an acid / is acidic / has a low pH } ; 2. enzymes are denatured / active site has changed shape / eq ; 3. due to {ionisation of the R groups / changes in bonding within active site / eq} ;	**2. DO NOT ACCEPT** {enzymes start to / microorganisms} denature	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(b)(iv)	1. idea that presence of salt draws water out of the microorganisms ; 2. by osmosis (out of food or microorganism); 3. dehydrating the microorganisms / no solvent for enzymes / eq ;	**1. IGNORE** out of food **2. IGNORE** references to water concentration **DO NOT ACCEPT** incorrect references to water potential etc	**(2)**

Question Number	Answer	Mark
2(a)(i)	**The only correct answer is C – oxygen** ***A*** *is incorrect because GALP is produced in the light-independent reaction* ***B*** *is incorrect because hydrogen ions form reduced NADP* ***D*** *is incorrect because water is used not produced*	**(1)**

Question Number	Answer	Mark
2(a)(ii)	**The only correct answer is - D** Reduced NADP | ATP ***A*** *is incorrect because carbon dioxide does not come from the light-dependent reaction* ***B*** *is incorrect because the NADP is reduced* ***C*** *is incorrect because carbon dioxide does not come from the light-dependent reaction*	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	1. (µmol) {concentration / moles} of named { substrate / product } ; 2. (m^{-2}) area of leaf / eq ; 3. (s^{-1}) (extent of reaction) in one second / per unit time / eq ;	**1. IGNORE** amount e.g. glucose, oxygen, GALP, GP, CO_2 **3. ACCEPT** explanation of calculating extent of reaction in one second	**(3)**

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	1. as nitrates (from soil) ; 2. taken up (by roots from soil) by active transport ; 3. {transported / eq} in the {xylem / transpiration stream} ;	**Penalise {wrong form of nitrogen / formula} once** **1. ACCEPT** ammonium (ions) **2. IGNORE** diffusion	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(b)(iii)	1. (nitrogen / nitrates) used to make {chlorophyll / amino acids} ; 2. more chlorophyll results in more light absorption / eq ; 3. amino acids used to make RUBISCO ; 4. RUBISCO **catalyses** {carbon fixation / eq} ; 5. (the more nitrogen) the more RUBISCO, the faster the rate of photosynthesis / eq ;	**ACCEPT** ribulose bisphosphate carboxylase throughout **4**. **ACCEPT** description of carbon fixation e.g.binding of carbon dioxide to RuBP **5. PIECE TOGETHER** **ACCEPT** a description on increased rate of photosynthesis	**(3)**

Question Number	Answer	Additional Guidance	Mark
3(a)(i)	mutation in bacteria (present in sharks) / (resistant) bacteria taken up (from the water) / eating contaminated food / eq ;		**(1)**

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	1. idea that (resistant) bacteria can be consumed (in shark meat) ; 2. increasing the number of resistant bacteria in human population / eq ; 3. idea that { genes for resistance can be spread to other bacteria / resistant bacteria will outcompete non-resistant bacteria } ; 4. idea that these bacteria cause disease because they cannot be treated (with antibiotics) ;		**(2)**

Question Number	Answer	Additional Guidance	Mark
3(b)	{ sulfamethoxazole / bacteriostatic antibiotics } prevent the growth of bacteria and { gentamicin / bactericidal antibiotics } kill bacteria / eq ;	**ACCEPT** multiplying / reproducing - equiv to growth destroy - equiv to kill **IGNORE** modes of action given	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(c)(i)	1. mRNA will not {bind / eq} to ribosomes ; 2. {tRNA will not be able to bind / wrong tRNA will bind / eq} to **codons** (on mRNA) ; 3. { wrong / no / eq } amino acids will line up ;	**3. ACCEPT** translation will not take place / error in translation / incorrect translation / eq	**(2)**

Question Number	Answer	Mark
3(c)(ii)	**The only correct answer is C – peptide** ***A*** *is incorrect because ester bonds form during lipid synthesis* ***B*** *is incorrect because glycosidic bonds form during carbohydrate synthesis* ***D*** *is incorrect because phosphodiester bonds do not form during translation*	**(1)**

Question Number	Answer	Additional Guidance	Mark
3(c)(iii)	1. idea that {human ribosomes are different from bacterial ribosomes / antibiotics cannot bind to human ribosomes} ; 2. idea that enzymes in human cells are different from those in bacteria ; 3. idea that these antibiotics cannot enter human cells ; 4. idea that human cells have enzymes that can break down these antibiotics ;	e.g. human cells have 80S and bacteria have 70S ribosomes, antibiotics bind to only 70S ribosomes	**(2)**

Question Number	Answer	Additional Guidance	Mark
3(d)	1. sulfamethoxazole has a similar structure to PABA / eq ; 2. therefore binds to dihydropteroate synthetase / reacts with dihydropteroate diphosphate ; 5. therefore no dihydropteroic acid made ; 6. idea that there is no {substrate / dihydropteroic acid} to synthesise folic acid ;	**ACCEPT** description of similarity e.g. both have an H_2N group attached to a ring structure **2 ACCEPT** PABA cannot bind **DO NOT ACCEPT** dihydropteroic acid 3. PABA and sulfamethoxazole join together (by condensation reaction / by a peptide bond); 4. and this structure cannot {bind to dihydropteroate synthetase / react with dihydropteroate diphosphate} ; **6. ACCEPT** idea that a different molecule will be mad that cannot be converted to folic acid	**(3)**

Question Number	Answer	Mark
3(e)	**The only correct answer is D – peptidoglycan** ***A*** *is incorrect because amylopectin is in starch* ***B*** *is incorrect because cellulose is present in plant cell walls* ***C*** *is incorrect because glycogen is a storage molecule*	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(a)	1. (total number of squirrels) = 2 500 000 + 140 000 / 2 640 000 ; 2. (percentage) = 5 / 5.3 / 5.303 (%) ;	**2 ACCEPT** ecf for (140 000 × 100) ÷ 2 500 000 = 56 (%) **NB** If no working is shown: 5 / 5.3 / 5.303 (%) scores 2 marks 56 (%) scores 1 mark	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(b)	1. idea that areas occupied by red squirrels (in 1945) are occupied by grey squirrels (in 2010) ; 2. idea that areas occupied by red squirrels (in 1945) are occupied by both squirrels (in 2010) ; 3. idea that areas occupied by both squirrels (in 1945) are occupied by grey squirrels (in 2010) ;	**IGNORE** refs to numbers of squirrels throughout **ACCEPT** (overall) an increase in distribution of grey squirrels if no other mark points awarded	**(3)**

Question Number	Answer	Additional Guidance	Mark
4(c)(i)	1. competition for food ; 2. competition for { space / habitat / shelter / territory / eq } ; 3. niches {overlap / eq} ; 4. grey squirrels attack red squirrels / eq ;	**1. ACCEPT** description **IGNORE** nutrients **2. ACCEPT** description **IGNORE** niche, mates **3. DO NOT ACCEPT** same niche **4. ACCEPT** grey squirrels are predators	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(c)(ii)	In the grey squirrels: 1. antibodies {bind/eq} to virus ; 2. (antibodies binding to virus) will result in phagocytosis ; 3. macrophages destroy virus with enzymes / eq ; 4. (antibodies binding to virus) will {inactivate virus / prevent the binding of virus to host cells / eq} ; In the red squirrels: 5. idea immune system is weaker ; 6. no plasma cells to produce antibodies ; 7. idea that the virus will be able to {infect / destroy / eq} host cells ; 8. no killer cells to destroy infected cells / eq ;	**2. ACCEPT** opsonisation, agglutination, **4. DO NOT ACCEPT** antibodies {kill / destroy} virus **6. DO NOT ACCEPT** B cells	**(4)**

Question Number	Answer	Additional Guidance	Mark
***5(a)**	1. DNA sample taken from parents using {blood / hair / skin / faeces / claw / eq} ; 2. amplification of the DNA from all three tigers using { PCR / polymerase chain reaction } / eq ; 3. credit details of PCR ; 4. DNA cut into fragments using restriction enzymes / eq ; 5. reference to (gel) **electrophoresis** ; 6. credit details of (gel) electrophoresis ; 7. comparison of the DNA **bands** from the three tigers ;	**QWC emphasis on logical sequence** **1. IGNORE** method of taking DNA from dead tiger **3.** e.g. primers added, different temperatures used for different stages **6.** e.g. electric current applied, use of agarose gel	**(6)**

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	1. body temperature measured on discovery / eq ; 2. body temperature decreases (with time after death) ; 3. (body temperature of dead animal) depends on {ambient temperature / position of body / wounds / eq} ; 4. idea of {working backwards to estimate time of death / using a cooling curve for appropriate ambient temperature} ;	**2. ACCEPT** body loses heat	**(3)**

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	1. (state of) rigor ; 2. idea of looking at the degree of rigor ; 3. idea that (ambient / body) temperature has to be taken into account ; 4. idea that this method has time limitations ; OR 5. (stage of) decomposition ; 6. idea that decomposition occurs in a specific sequence ; 7. idea that ambient temperature has to be taken into account ; 8. credit details or what would be looked for ; OR 9. (forensic) entomology / the study of insects ; 10. idea that insects colonise the body in a specific sequence ; 11. stage in life cycle depends on ambient temperature ; 12. credit details of what would be looked for;	**NB each set of mps can be credited anywhere in the answer** **1. ACCEPT** rigor mortis / muscle contraction Degree of rigor mortis = 2 marks **4.** e.g. changes in rigor occur in first few hours **8.** e.g. {decomposers / insects} arrive in specific sequence, body becomes bloated **12.** e.g description of life cycle, eggs collected and hatched for identification	**(3)**

Question Number	Answer	Additional Guidance	Mark
6(a)	1. (atherosclerosis results in) coronary artery being blocked / reduced blood flow in the coronary artery / eq ; 2. heart {cells / tissue / muscle} die as a result of a lack of oxygen / eq ; 3. resulting in lack of oxygen to the brain / eq ;	**2. ACCEPT** conditions become anaerobic results in heart attack / infarction	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(b)	1. idea that less air can enter {lungs / alveoli / air sacs} ; 2. therefore the oxygen concentration gradient (between lungs and blood) is lower / eq ; 3. therefore diffusion of oxygen into the blood is reduced / eq ;	**1. ACCEPT** less oxygen	**(2)**

Question Number	Answer	Additional Guidance	Mark
***6(c)**	1. HIV reduces the activity of the immune system ; 2. because the virus destroys {T helper / CD4 } cells ; 3. idea that TB is resistant to destruction by macrophages ; 4. idea that antigen presentation to T helper cells is impaired (further) ; 5. therefore { B / T killer } cells cannot be activated / eq ; 6. no antibodies (from plasma cells) for {opsonisation / agglutination / eq} ; 7. no {perforins / enzymes / eq} (from T killer cells) to destroy virus-infected cells ; 8. idea that TB is an opportunistic infection ; 9. credit description of how TB results in death ;	**QWC emphasis on clarity of expression** **1. ACCEPT** weakened immune system / reduced T cell count **2. ACCEPT** T killer cells destroy infected T helper cells **3. ACCEPT** macrophages destroyed **4. ACCEPT** T helper cells are not activated **6. DO NOT ACCEPT** kills TB **9.** e.g. high fever, lung damage, organ failure	**(6)**

Question Number	Answer	Mark
7(a)(i)	The only correct answer is **B –** 3 ***A*** *is incorrect because statements 1, 2 and 4 relate to topography* ***C*** *is incorrect because statements 1, 2 and 4 relate to topography* ***D*** *is incorrect because statements 1, 2 and 4 relate to topography*	**(1)**

Question Number	Answer	Additional Guidance	Mark
7(a)(ii)	endemic (species) ;	**ACCEPT** endemism	**(1)**

Question Number	Answer	Additional Guidance	Mark
7(b)(i)	1. 3 210 x 27 ÷ 100 ; 2. 0.6 / 0.58 / 0.577 ;	**1. ACCEPT** 866.7 / 867 **IGNORE** 866 **NB** If no working has been shown, 0.6 / 0.58 / 0.577 = 2 marks 866.7 / 867 = 1 mark	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(b)(ii)		**Descriptions of sowing seeds or planting small plants can score these mps**	
	1. use of a transect / measuring at (minimum 5) different altitudes ;	**1. ACCEPT** long rope	
	2. from {sea level / 0m} to <u>above</u> 2000 m ;		
	3. systematic sampling (at points along transect) / eq;	'sample at 0, 500, 1000, 1500, 2000 and 2500m' = mark points 1, 2 and 3	
	4. measuring the height (of the Binara) ;	**4. ACCEPT** record height / count number that are 1m high length for height	
	5. of as many (Binara) plants as possible ;		
	6. idea that other areas would be looked at if no plants at 1 m in height are found ;		**(5)**

Question Number	Answer	Additional Guidance	Mark
7(b)(iii)	1. (soil) pH ; 2. (soil) sample removed ; 3. credit use of { indicator solution / pH probe / pH meter} ; OR 4. (soil) mineral ion content ; 5. (soil) sample removed ; 6. credit use of chemical testing kits ; OR 7. (soil) water / moisture ; 8. (soil) sample removed ; 9. description of determining water content ; OR 10. air spaces (in soil) ; 11. (soil) sample removed ; 12. description of measuring { drainage rate / volume with and without air } ;	**ACCEPT** inserting probe into soil for 2 marks **4. ACCEPT** salinity **9.** e.g. moisture {probe / meter}, weighing soil then drying and reweighing **ACCEPT** inserting probe into soil for 2 marks	

	OR 13. (soil) {structure / type} ; 14. (soil) sample removed ; 15. description of measuring {size of soil particles / extent of sand and clay / humus content / eq} ; OR 16. (soil) temperature ; 17. soil *in situ* measured / eq ; 18. description of measuring temperature ;	**18. ACCEPT** inserting {temperature probe / thermometer} into soil = 2 marks	**(3)**

Question Number	Answer	Additional Guidance	Mark
8(a)	1. GPP increases and then starts to {level off / increase more slowly / eq} / eq ; 2. R increases (throughout) / eq ; 3. NPP increases and then decreases / eq ;	**1. ACCEPT** GPP increases (throughout) but at different rates **2. DO NOT ACCEPT** linearly / steadily	**(3)**

Question Number	Answer	Additional Guidance	Mark
8(b)(i)	1. idea that tree is increasing in size so more { ATP / energy } is needed ; 2. credit example of what energy is needed for ;	**2.** e.g. active transport / chemical reactions / mineral ion uptake / new cells / cell division / metabolism **IGNORE** growth	**(2)**

Question Number	Answer	Additional Guidance	Mark
8(b)(ii)	1. idea that the number of leaves is increasing ; 2. therefore greater surface area to **absorb** more light ; 3. more {ATP / reduced NADP} generated in the light-dependent reaction / eq ; 4. more GALP made in the light-independent reaction / eq ; 5. so more {organic matter / protein / biomass / cellulose} synthesised from {GALP / sugar / glucose} / eq ;	**1. ACCEPT** more / larger leaves **2. ACCEPT** more chlorophyll / chloroplasts to absorb light **3. ACCEPT** (non-cyclic) photophosphorylation **4. ACCEPT** Calvin cycle **5. ACCEPT** more energy converted into {biomass / organic matter}	**(3)**

Question Number	Answer	Additional Guidance	Mark
8(b)(iii)	1. NPP = GPP - R / eq ; 2. GPP increase is {steady / slow / eq} but R is increasing faster ; 3. idea that R (continues to) increases as the tree is larger ; 4. idea that a larger tree requires more { ATP / energy } ; 5. idea that although there are more leaves GPP is not increasing (very much) ; 6. because the top leaves are shading the lower leaves ;	**2. ACCEPT** (with time) increase in R is greater than increase in GPP	**(4)**