PEARSON EDEXCEL IAL BIOLOGY · YBI11

# BIOLOGY



## MARK SCHEME

UNIT 2: PLANT STRUCTURE AND FUNCTION, BIODIVERSITY AND CONSERVATION

| SCORE | PERCENTAGE |
| --- | --- |
| /310 | % |

STEMUP

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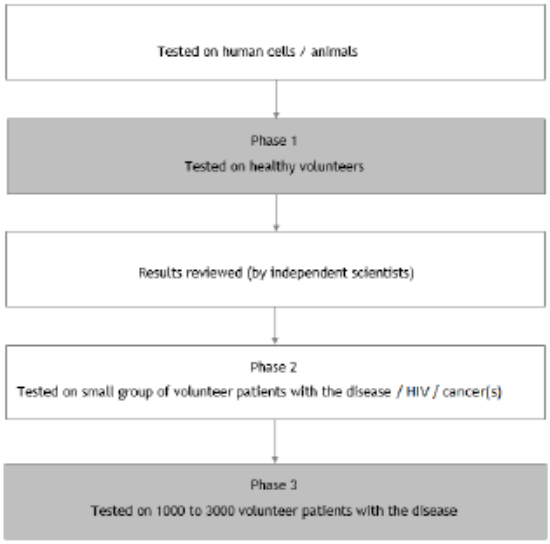
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# Mark Scheme

Q1.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (a) | An answer that makes reference to the following:<br><br>• named nitrogen containing compound synthesised (1)<br><br>• credit role of this compound in the plant (1) | <br><br>e.g. amino acids / proteins / nucleic acids / ATP / NADP<br><br>e.g. {Proteins/ (peptide) hormones} are needed for {growth / repair} / DNA is needed for protein synthesis<br>Ignore amino acids needed to form proteins<br>Ignore nucleotides needed to form DNA/RNA | (2) |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)** | A description that makes reference to two of the following:<br>• modification of protein (into enzyme) (1)<br>• **enzyme**(s) packaged into (secretory) vesicles (1)<br>• **enzyme**(s) leave cell by exocytosis (1) | Accept vesicles fuse with cell (surface) membrane and release enzyme(s) outside cell | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)** |  | Accept identification of side effects<br>Ignore identification of appropriate dosage<br><br>Accept tested on 100-500 volunteer patients with {disease / HIV/ cancer}<br>Ignore patients unqualified | **(3)** |

Q2.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)** | An explanation that makes reference to the following:<br>• introduction of new (beaver) species increased the {species richness / biodiversity} (1)<br>• reduction in (plant) biodiversity due to trees being cut down / reduction in (animal) biodiversity as {habitat / food} reduced (by the trees being cut down) (1)<br>• (increase in biodiversity) due to {pond being created / new habitat / increased space (due to trees being cut down)} (1)<br>• (increase in biodiversity) due to new food source (1) | Accept number of {species/ organisms} for biodiversity<br><br>Ignore genetic diversity<br><br>Accept reduction in animal biodiversity due to {competition with / predation from} beavers<br><br>Accept plant or beaver as food source | **(4)** |

| Question Number | Answer |
|---|---|
| (b) | Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.<br><br>The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant.<br><br>• genetic diversity identified as the variety of alleles in the population<br>• only small numbers of introduced beavers could reduce the genetic diversity<br>• loss of alleles from population<br>• increased homozygosity<br><br>• introducing more Norwegian beavers could increase genetic diversity<br>• but could have same alleles so no effect on genetic diversity<br><br>• introducing beavers from different European locations could increase genetic diversity<br>• could be many different alleles in wider populations of European beavers<br>• however the map shows many geographically isolated populations<br>• these small populations could also have low genetic diversity<br>• reproductive isolation could have occurred<br>• preventing introduced beavers mating with Scottish beavers<br><br>**(6)** |

| | | | Additional guidance |
|---|---|---|---|
| Level 0 | 0 | No awardable content | |
| Level 1 | 1-2 | Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made.<br><br>Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures.<br><br>The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context. | Discussion of at least one solution and the impact on genetic diversity<br><br>1 solution = 1 mark<br><br>2 solutions = 2 marks |
| Level 2 | 3-4 | Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts.<br><br>Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures.<br><br>The discussion shows some linkages and lines of scientific reasoning with some structure. | Discussion of both solutions and their impact on genetic diversity<br><br>plus<br>consideration of effect of geographically isolated populations on genetic diversity 1 mark (accept description e.g. scattered populations)<br><br>plus alleles 1 mark |

| | | | |
|---|---|---|---|
| Level 3 | 5-6 | Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts.<br><br>Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures.<br><br>The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured. | all level 2 content<br><br>plus<br>reproductive isolation one mark<br><br>plus<br>inbreeding / heterozygosity index one mark |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)** | A calculation showing the following steps:<br><br>• value for q (1)<br><br>• value for p (1)<br><br>• calculation of correct percentage for $p^2$ (1) | Example of calculation<br><br>Accept values for either p or q:<br><br>√0.09 / 0.3<br><br>(1 – 0.3) / 0.7<br><br>$p^2 = 49\%$<br><br>Correct answer with no working scores full marks | **(3)** |

Q3.

| Question number | Answer | Mark |
|---|---|---|
| **(a)** | B anatomical, physiological, behavioural | **(1)** |

| Question number | Answer | Mark |
|---|---|---|
| **(b)** | An explanation that includes the following points:<br><br>• mimics the *Canthigaster valenti* by having similar markings (1)<br><br>• mimics the *Canthigaster valenti* by having similar {size / shape} (1)<br><br>• therefore it still deters predators even though it does not produce poison (1) | **(3)** |

| Question number | Answer | Mark |
|---|---|---|
| (c) | An explanation that includes the following points:<br>• because they are different species (1)<br>• therefore cannot produce fertile offspring (1) | (2) |

Q4.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (a) | A calculation in which:<br>• total population of Santa Cruz in 2020 calculated (1)<br>• total population of Santa Cruz in 2025 calculated (1)<br>• population given to whole number (1) | Example of calculation<br>(17000÷85) × 100 = 20 000<br>20 000× $1.064^5$ =27 273.3 / 27 273.328 / 27 273.33<br>{27 273 / 27 000}<br>Correct answer with no working scores full marks ecf applies<br>{26400 / 26000} = 2 marks | (3) |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (b) | • positive correlation between the number of recorded nonendemic species and the number of tourists increased | ACCEPT number of recorded non endemic species increased as the number of tourists increased | (1) |

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional guidance</th><th>Mark</th></tr>
<tr><td>(c)(i)</td><td>A calculation in which:<br><br>• N(N-1) correctly calculated (1)<br><br>• Σn(n-1) correctly calculated (1)<br><br>• correct substitution to obtain D to 1 d.p. (1)</td><td><u>Example of calculation</u><br><br>(147 x 146) = 21462<br><br>4684<br><br>4.6<br>(4.58 = 2 marks)<br><br>
<table>
<tr><th>Species</th><th>Number of individuals (n)</th><th>(n-1)</th><th>n(n-1)</th></tr>
<tr><td>A</td><td>21</td><td>20</td><td>420</td></tr>
<tr><td>B</td><td>2</td><td>1</td><td>2</td></tr>
<tr><td>C</td><td>4</td><td>3</td><td>12</td></tr>
<tr><td>D</td><td>13</td><td>12</td><td>156</td></tr>
<tr><td>E</td><td>54</td><td>53</td><td>2862</td></tr>
<tr><td>F</td><td>15</td><td>14</td><td>210</td></tr>
<tr><td>G</td><td>6</td><td>5</td><td>30</td></tr>
<tr><td>H</td><td>32</td><td>31</td><td>992</td></tr>
<tr><td></td><td>Total (N)=147</td><td></td><td>Σn(n-1)=4684</td></tr>
</table>
<br>Correct answer with no working scores full marks<br>ECF applied</td><td>(3)</td></tr>
</table>

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional guidance</th><th>Mark</th></tr>
<tr><td>(c)(ii)</td><td>An answer that includes five of the following points:<br><br>• reduction in biodiversity (1)<br><br>• as forest is habitat for many species of plants (1)<br><br>• (because) populations will decrease because loss of forest will result in {reduced habitat for animals / reduced food} / increasedcompetition between (animal) species} (1)<br><br>• causing reduction in species richness (1)<br><br>• (because) loss of forest will result in reduction of genetic diversity(1)<br><br>• (due to) reproduction in {smaller / isolated} populations (1)</td><td><br><br>Accept possible increase in species thathave blackberry as part of food chain<br><br>Accept reduction in forest habitat (for many species unqualified) / blackberry {outcompetes (the forest) plants /introduces disease}<br><br>Accept animals not adapted to feed on blackberry / blackberry is poisonous tothe animals<br>Accept descriptions of what animalswould compete for e.g. nesting sites<br><br>Accept reduction in gene pool</td><td>(5)</td></tr>
</table>

Q5.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)** | An explanation that includes four of the following points:<br>• cortical granules are released (from the egg cell) (1)<br>• cortical granules fuse with the {zona pellucida / egg cell membrane} (1)<br>• cortical granules release {chemicals / enzymes / proteins} tocause the hardening of zona pellucida (1)<br>• prevents more than one sperm (cell) entering the egg cell (1)<br>• egg cell and sperm nuclei are haploid and they fuse (during fertilisation) (1) | ACCEPT prevents polyspermy | **(4)** |

| Question Number | Answer |
|---|---|
| * **(b)** | Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.<br>The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant.<br><br><u>length of middle region</u><br>• increased length of mid region size increases swimming speed (I)<br>• due to more mitochondria supplying more {energy/ ATP} to move the flagella (I)<br>• increased chance of that male's sperm {reaching the egg cell(s) first / fertilising the egg cell(s)} / reproductive successfor that male} (R)<br>• selection pressure / males with alleles for longer mid sections will have an advantage over other males (R)<br>• more offspring will {have the same father/ inherit same alleles} (G)<br>• leading to possible reduction in genetic diversity (G)<br>• many males and many egg cells could lead to an increased genetic diversity of offspring (G)<br><br><u>spermatophore</u><br>• spermatophore contains sperm cells for fertilisation of egg (I)<br>• nutrients will be used by female to produce {egg cells with more nutrients / more egg cells} (R)<br>• {chemicals / pheromones} reduce chances of other males mating with the female (R)<br>• increased chance of that male's sperm {reaching the egg cells(s) first / fertilising the egg cell(s)} / reproductivesuccess for that male} (R)<br>• more offspring will {have the same father/ inherit same alleles} (G)<br>• leading to possible reduction in genetic diversity (G)<br><br><u>storage of sperm</u><br>• {fertilised eggs / offspring} can be produced in absence of a mate (I)<br>• increased reproductive success for {that female / males that mated} (R)<br>• increased chance that offspring will {have different father/ inherit different alleles} (G)<br>• leading to possible increase in genetic diversity (G)<br>• not mating with (new) males every year could reduce genetic diversity (G)<br>**(6)** |

| | | | Additional guidance |
|---|---|---|---|
| Level 0 | 0 | No awardable content | |
| Level 1 | 1-2 | Limited number of the most important or relevant scientific factors from the data/information provided are synthesised.<br><br>No judgement is made. | 1 mark – either R or G for one mating strategy<br>2 marks – either R+G for one mating strategy<br>OR<br>either R or G for two mating strategies<br><br>OR<br><br>1 mark - basic information (I) given<br>2 marks - basic information (I) given + 1 or<br>2 x {R orG} |
| Level 2 | 3-4 | Some of the most important or relevant scientific factorsfrom the data/information provided are synthesised.<br><br>A limited accurate judgement is made. | 3 marks – 3 x (R or G) considered<br>4 marks = 4 x (R or G) considered |
| Level 3 | 5-6 | Most of the important or relevant scientific factors from the data/information provided are synthesised.<br><br>A detailed and accurate judgement is made. | 5 marks = either reproductive success for all strategies considered plus genetic diversity of two strategies considered OR genetic diversity for all strategies considered plus reproductive success of two strategies considered<br><br>6 marks genetic diversity and reproductive successconsidered for all strategies |

Q6.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)** | An answer that includes at least one similarity and one difference:<br><br>similarities:<br><br>• both contain membrane bound organelles (1)<br><br>• both contain a {cell membrane / cell wall} (1)<br><br>max 2 differences:<br><br>• plant cell wall is composed of cellulose whereas a fungal cellwall is composed of chitin (1)<br><br>• fungal cells contain glycogen granules whereas plant cells contain {starch grains / amyloplasts} (1)<br><br>• plant cells contain {chloroplasts / plasmodesmata /tonoplast} whereas fungal cells do not (1) | ACCEPT named organelle(s) e.g. nucleus,mitochondria, 80S ribosomes etc<br>ACCEPT both contain DNA associated with histones (1)<br><br>ACCEPT fungal cells contain lysosomes whereas plant cells do not / plant vacuole may be larger than fungal vacuole | **(3)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(i)** | An explanation that makes reference to four of the following points:<br><br>• reduction in growth (1)<br><br>and any three from:<br><br>• due to reduced {cell division / mitosis} (1)<br><br>• reduced gene expression will cause reduction in {enzyme/ protein} production (1)<br><br>• reduced phospholipids which are needed for (growth of) {cell /organelle} membranes (in daughter cells) (1)<br><br>• reduced transport of sucrose (around the plant) in the phloem /reduced sucrose available for other plant cells (1) | ACCEPT reduced DNA synthesis resultsin fewer cells in S phase / not enough DNA produced for mitosis to occur<br><br>ACCEPT named enzyme e.g. DNA polymerase<br><br>ACCEPT correct examples of sucrose useby plant e.g. reduced {respiration / ATP production} | **(4)** |

| Question Number | Answer |
|---|---|
| * **(b)(ii)** | Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.<br>The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant.<br><br><u>Description of data</u><br>• infection with fungus results in increased {tannin/ flavonoid} production<br>• increasing the concentration of tannin reduces the leaf damage from herbivores<br>• negative correlation / linear decrease<br>• increasing the concentration of flavonoids increases the diameter of inhibition zone<br>• doubling the concentration of flavonoids increases the diameter of inhibition zone by 28.6%<br><br><u>Plant</u><br>• explanation of how tannins reduce leaf damage e.g. herbivores don't like the taste / toxic / poisonous therefore less likely to eat the plant (A)<br>• more leaves for photosynthesis and therefore increased growth (A)<br>• explanation of what the diameter of inhibition zone shows = link to bactericidal/ bacteriostatic effect of flavonoids (A)<br>• reduced plant infections (A)<br>• link to why reduced herbivory and reduced plant infection benefits the infected plant e.g. fewer resources goes into growing new leaves and more can go into sexual reproduction (A)<br>• disadvantage for plant – increased fungal growth (D)<br>• more resources required {to produce tannins / for gene expression} instead of being used for {growth / sexualreproduction} (D)<br><u>Fungus</u><br>• link to why reduced herbivory benefits the fungus e.g. reduced competition for plant resources from herbivores, more plant resources available to fungus (A)<br>• link to why reduced plant infection benefits the fungus e.g. reduced competition for plant resources from {bacteria / other fungi} (A)<br>• reduced resources for fungus from plant as more used to synthesise tannins / flavonoids (D) |

| | | | |
|---|---|---|---|
| | • the fungus might only be able to {influence / live in / complete life cycle in} darnel plants (D) **(6)** | | |
| | | | Additional guidance |
| Level 0 | 0 | No awardable content | |
| Level 1 | 1-2 | Demonstrates isolated elements of biological knowledgeand understanding to the given context with generalised comments made.<br>Vague statements related to consequences are made withlimited linkage to a range of scientific ideas, processes, techniques and procedures.<br>The discussion will contain basic information with some attempt made to link knowledge and understanding to thegiven context. | Information from one section |
| Level 2 | 3-4 | Demonstrates adequate knowledge and understanding byselecting and applying some relevant biological facts/concepts.<br>Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures.<br>The discussion shows some linkages and lines of scientificreasoning with some structure. | level one content plus consideration of advantage(s)and / or disadvantage(s)<br>5 marks = L1+ one from {FA / FD / PA / PD}<br>6 marks = L1+ two from {FA / FD / PA / PD}<br><br>FA = fungal advantage<br>FD = fungal disadvantage<br>PA = plant advantage<br>PD = plant disadvantage |
| Level 3 | 5-6 | Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledgeof biological facts/concepts.<br>Consequences are discussed which are supported throughout by sustained linkage to a range of scientificideas, processes, techniques and procedures.<br>The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured. | Information from three sections applied to the givencontext showing a good understanding of the advantages and disadvantages to the infected plant and to the fungus<br><br>7 marks = L2 + three from {FA / FD / PA / PD}<br>6 marks – all four of {FA / FD / PA / PD} discussed |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(iii)** | A description that includes reference to the following points:<br><br>• (flavonoid drug) tested on small numbers of patients with {*P. aeruginosa* / lung infection} (1)<br><br>• use of double-blind trial (1) | ACCEPT tested on {100 to 500} of patientswith {*P. aeruginosa* / lung infection}<br><br>ACCEPT placebo / established drugtreatment | **(2)** |

Q7.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(i)** | A calculation in which:<br>• conversion of actual length of scale into nm (1)<br>• actual length divided by the given length (answer given to 2significant figures and in standard form) (1) | <u>Example of calculation:</u><br>30mm = 30 000 000 nm<br>30 000 000 ÷1200 = ×2.5 x $10^4$<br>accept +/- 1mm for length of bar | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(ii)** | An explanation that makes reference to two of the following points:<br>• electron microscope (1)<br>• due to high magnification (1) | ecf from 2(a)(i) applies<br>Accept high resolution<br>Accept converse for light microscope<br>Accept 3D image if qualified as scanningelectron microscope | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(i)** | An answer that makes reference to the following points:<br>• presence of {(peptidoglycan) cell wall / circular chromosome(s) /DNA associated with histones / 70S ribosomes / RNA polymerase} (1)<br>• absence of {nucleus / membrane bound organelles} (1) | Accept ether bonds | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(ii)** | An explanation that makes reference to three of the following points:<br>• (analysis of) molecular evidence (1)<br>• to identify similarities and differences in biological molecules /comparison of biological molecules (1)<br>• (analysis of) phenotype (1)<br>• to identify similarities and differences between the two microorganisms (phenotype) (1) | e.g. DNA, mRNA, proteins, enzymes<br>e.g. cell structure / anatomical features,grow in different {habitats/ conditions}<br>e.g. named similarities and differences incell structure | **(3)** |

Q8.

| Question Number | Answer | Mark |
|---|---|---|
| **(a)(i)** | The only correct answer is B ß-glucose<br><br>*A is not correct because the molecule is* ß-glucose<br><br>*C is not correct because the molecule is* ß-glucose<br><br>*D is not correct because the molecule is* ß-glucose | **(1)** |

| Question Number | Answer | Mark |
|---|---|---|
| **(a)(ii)** | The only correct answer is C form microfibrils<br><br>*A is not correct because cellulose forms microfibrils*<br><br>*B is not correct because cellulose forms microfibrils*<br><br>*D is not correct because cellulose forms microfibrils* | **(1)** |

| Question Number | Answer | Mark |
|---|---|---|
| **(a)(iii)** | The only correct answer is B chlorophyll<br><br>*A is not correct because magnesium is not a component of calcium pectate*<br><br>*C is not correct because magnesium is not a component of DNA*<br><br>*D is not correct because magnesium is not a component of starch* | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(i)** | • xylem | | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(ii)** | • sclerenchyma | Accept tracheids | **(1)** |

Q9.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(i)** | A description that makes reference to the following points:<br>• the germination of the seeds remains {high/ constant} for aninitial period of time (1)<br>• (after this) the germination of the seeds (rapidly) {decreases / reduces} with increased time in storage (1) | | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(ii)** | An explanation that makes reference to four of the following points:<br>• (many different plants result in) increased genetic diversityof the seeds stored (1)<br>• because more (seeds from different) {individuals/ plants} increases the probability of having {more alleles / differentgenotypes / heterozygotes} (1)<br>• adult plants allow {pollination / sexual reproduction} tooccur (1)<br>• to produce new seeds (for storage) (1)<br>• to replace those seeds stored for a long time (1) | Accept reduces chance of seeds from(mainly) {homozygous recessive / diseased} plants<br>Accept to produce seeds which are genetically different (from parent plants)<br>Accept to increase the {viability of storedseeds / percentage of seeds that will germinate} | **(4)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(i)** | A calculation in which:<br>• mass of cutlery per month calculated (1)<br>• mass of cutlery per year calculated to two significant figures withunit (1) | <u>Example of calculation</u><br>(130000 ÷ 100) × 60 = 78000 (kg)<br>(78 000 × 12) = 940 000 kg / 9.4 x $10^5$ kg<br>Correct answer with no working scoresfull marks | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(ii)** | An answer that includes the following points:<br>• more (cutlery) can (constantly) be made from avocado seeds(1)<br>• as avocados are {continually being grown / can be grown byfuture generations} (1) | Accept carbon neutral / lower carbon emissions (than oil-based plastic production) / biodegradable Accept as avocado seeds are waste products | **(2)** |

Q10.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(i)** | An explanation that includes three of the following points:<br>• oxygen for (aerobic) respiration (1)<br>• glucose for {respiration / ATP production} / amino acids for protein synthesis (1)<br>• optimum temperature for {enzyme / metabolic} reaction (1)<br>• water for {hydrolysis reactions / solvent} (1)<br>• optimum pH for {enzyme / metabolic} reaction (1) | accept lack of oxygen for survival of obligate anaerobes<br>accept lipids for synthesis of cell membranes<br>accept suitable stated temperature for {faster/optimum} enzyme activity<br>accept to prevent dehydration<br>accept suitable stated pH for {faster/optimum} enzyme rate of reaction | **(3)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(ii)** | An explanation that makes reference to two of the following points:<br>• oil-based plastic is non-renewable (1)<br>• oil-based plastic {takes a long time to decompose / isn't biodegradable} (1)<br>• contributes to increased carbon dioxide (in atmosphere) / not carbon neutral (1) | accept (oil is a) finite resource / may run out / may not always be available for future generations<br>accept contributes to {global warming/ greenhouse effect} | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(i)** | An answer that makes reference to three of the following:<br><br>• bacterial survival decreases over time (on all three boards) (1)<br><br>• bacterial survival is lowest on pine chopping board (1)<br><br>• no change in number of bacteria surviving on plastic during first 4 hours (1)<br><br>• relevant comment about validity of data (1) | accept converse for plastic<br><br>accept only significant difference between spruce and plastic is at 4 hours / only slight difference between spruce and plastic at 24 hours<br>accept same survival for {spruce/plastic} after 1 hour<br><br>e.g. no reference to repeats, no error bars | **(3)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(ii)** | An answer that includes one of the following points:<br><br>• pine boards have antimicrobial properties (1)<br><br>• pine chopping boards have a pH outside of bacterial optimum pH (1) | accept pine boards contain chemicals which kill bacteria<br><br>accept converse for plastic ignore temperature and water | **(1)** |

Q11.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(i)** | The only correct answer is D the number of species<br><br>*A is not correct because it refers to more than just animals*<br><br>*B is not correct because it refers to more than just plants*<br><br>*C is not correct because that is species evenness* | | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(ii)** | A description that includes two of the following points:<br>• determining the genetic {diversity / variation} (of a species) (1)<br>• by the number of different alleles present (1)<br>• by calculating the heterozygosity index (1) | Mark their first method<br>ignore allele frequency<br>ignore genes<br>Accept correct equation | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)** | An explanation that includes three of the following points:<br>• deforestation (of mangroves) causing habitat loss (1)<br>• reduction in food due to {deforestation (of mangroves) / competition with other species / overfishing} (1)<br>• {pollution / change in salinity} of river making it unsuitable habitat (for the crocodile) (1)<br>• {disease / hunting} (causing death of crocodiles) (1) | ignore water levels<br>Accept reduction in food due to pollution of river<br>Accept pollution killed {crocodiles / caused migration of crocodile}<br>Accept fewer mates due to lower population / {gender imbalance / fewer eggs hatching} due to global warming | **(3)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)(i)** | A calculation that shows the following steps:<br>• calculation of percentage of females (1)<br>• calculation of number that would develop (1) | Example of calculation:<br>100-23 = 77<br>(350 ÷ 100) x 77 = 269 / 270<br>Do not accept a decimal answer<br>Correct answer with no working shown scores full marks | **(2)** |

| Question Number | Answer | |
|---|---|---|
| * (c)(ii) | Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.<br><br>The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant.<br><br>• numbers will increase faster if there are more females hatching<br>• as more females to lay eggs<br>• more eggs increases likelihood of more offspring hatching<br><br>• 31°C not selected as there are significantly more males hatching than females / 82:18<br>• more females develop at 29/30/32/33°C<br><br>• too few males develop at 29°C<br>• future offspring would only inherit these alleles<br>• reduction in genetic diversity of a population could occur when there are small numbers of one of the sexes<br>• as offspring would only inherit these few alleles<br>• increased number of homozygotes for these few alleles / reduction in heterozygosity index of population over time<br>• reference to competition for mates<br>• more males develop at 30/32/33°C than 29°C<br>• too few males hatching could reduce genetic diversity of offspring<br>• therefore reduced probability of reduction in genetic diversity of future population<br><br>• eggs taken from nests throughout National Park are likely to contain different alleles<br>• analyse genetic makeup of individuals<br>• use this analysis to choose individuals for breeding programme / prevent inbreeding<br>• use of stud books<br><br>**(6)**<br>**Expert** | |

| | | | Additional guidance |
|---|---|---|---|
| Level 0 | 0 | No awardable content | |
| Level 1 | 1-2 | An explanation may be attempted but with limited interpretation or analysis of the scientific information and with a focus on mainly just one piece of scientific information.<br><br>The explanation will contain basic information, with some attempt made to link knowledge and understanding to the given context. | A temperature selected with an attempt to explain why<br><br>OR<br>basic recognition of male:female ratio = 1 mark<br>attempt at explanation of need for acceptable male:female ratio (e.g. more females than males would increase population faster) = 2 marks<br><br>basic comments linked to genetic diversity (not linked to graph) |
| Level 2 | 3-4 | An explanation will be given, with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information.<br><br>The explanation shows some linkages and lines of scientific reasoning, with some structure. | Level 1 content plus supported reasoning of selection of {30/32/33} °C to address idea of increase population quickly e.g. consideration of appropriate male:female ratio (depth of answer determines mark)<br><br>OR<br>explanation linked to way(s) in which genetic diversity could be maintained (depth of answer determines mark) |
| Level 3 | 5-6 | An explanation is made that is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information.<br><br>The explanation shows a well-developed and sustained line of scientific reasoning, which is clear and logically structured. | All level 2 content plus<br>Supported reasoning of selection of {30/32/33}°C<br>plus<br>linked to maintaining genetic diversity<br><br>(depth of answer determines mark) |

Q12.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(i)** | A calculation in which:<br><br>• calculation of volume of sphere (1)<br><br>• calculation of volume of hemisphere to nearest whole number (1) | <u>Example of calculation:</u><br><br>answer between 65416.67 to 65476.19<br>whole number answer between 32708 to 32738<br><br>Correct answer scores full marks | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(ii)** | An explanation that makes reference to two of the following:<br><br>• (because) calabash fruits are renewable / more can be grown / will not run out / available to future generations (1)<br><br>• biodegradable / can be broken down by decomposers (1)<br><br>• carbon neutral (1) | ignore produces less greenhouse gases | **(2)** |

| Question Number | Answer | Mark |
|---|---|---|
| **(b)(i)** | The only correct answer is B one<br><br>*A is not correct because they provide support to the plant*<br><br>*B is not correct because they are not involved in transporting substances*<br><br>*C is not correct because they are not involved in transporting substances* | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(ii)** | An answer that makes reference to four of the following:<br><br>Similarities:<br><br>• both (fibres) contain cellulose (in the cell wall) (1)<br><br>• both have tubular structures (1)<br><br>• both do not contain a nucleus (1)<br><br>Differences (max 3):<br><br>• phloem (sieve tubes) have {sieve plates / (perforated) end walls} whereas xylem (vessels) have no {end walls / sieve plates} (1)<br><br>• phloem (sieve tubes) {contain cytoplasm / are not hollow} whereas xylem (vessels) {do not contain cytoplasm / are hollow} (1)<br><br>• phloem (sieve tubes) contain no {lignin / secondary thickening} whereas xylem contain {lignin / secondary thickening} (1) | ACCEPT piecing together from adjacent sentences<br><br>ACCEPT both have a cell wall<br><br>ignore organelles<br><br>ACCEPT phloem (sieve tubes) contain living cells whereas xylem (vessels) contain dead cells<br><br>ACCEPT phloem cell walls are thinner than xylem cell walls / converse | **(4)** |

| | | | |
|---|---|---|---|
| | • phloem have plasmodesmata whereas xylem have pits (1) | ACCEPT xylem have pits whereas phloem do not / phloem have plasmodesmata whereas xylem do not | |

Q13.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(i)** | The only correct answer is C Eukarya<br><br>*A is incorrect because plants are found in the domain Eukarya*<br><br>*B is incorrect because plants are found in the domain Eukarya*<br><br>*D is incorrect because plants are found in the domain Eukarya* | | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(ii)** | A description that makes reference to the following:<br><br>• (evidence from) molecular phylogeny (1)<br><br>• identification of {similarities / differences} in {DNA / RNA / proteins / enzymes / ribosomes / membrane components / cell wall components} (1) | Accept comparing {DNA / RNA / proteins / enzymes / ribosomes / membrane components / cell wall components}<br><br>Ignore {looking at / analysing} the {DNA / RNA / proteins / enzymes / ribosomes / membrane components / cell wall components / genetic makeup} | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)** | An explanation that includes three of the following points:<br><br>• (tube) grows (through style) to {ovary / ovule / egg cell} / transports the {male nuclei / generative nucleus / male gametes} to {ovary / ovule / egg cell} (1)<br><br>• (and secretes) digestive enzymes used to aid growth of tube (to ovule) (1)<br><br>• (therefore) male nuclei can fuse with {egg cell (nucleus) / polar nuclei} (1) | Ignore micropyle<br>Accept forms pathway to reach {ovary / ovule / egg cell}<br><br>Accept enzymes digest through the style<br><br>Accept fertilisation occurs to form {zygote / endosperm}<br>Accept double fertilisation occurs / zygote and endosperm formed | **(3)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)(i)** | An answer that makes reference to the following:<br><br>• as the Verapamil concentration increases the length of the pollen tube decreases (1)<br><br>• credit a correct manipulated mathematical statement (1) | Accept negative correlation | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (c)(ii) | An answer that makes reference to the following:<br>• lower concentration of calcium ions (in the cells) (1)<br>• fewer {pectin / calcium pectate} molecules formed (1)<br>• therefore increased flexibility of {microfibrils / cellulose} (due to fewer {pectin / calcium pectate} molecules) (1) | Accept no calcium ions present (in the cells)<br>Accept calcium (ions) needed to produce {pectin / calcium pectate}<br>Accept {calcium pectate / pectin} (are needed to) hold {microfibrils / cellulose} together (in a matrix)<br>Accept {microfibrils / cellulose} are not held together by {calcium pectate / pectin}<br>Accept calcium pectate helps middle lamella to hold adjacent cell walls together | (3) |

Q14.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (a) | • anatomical<br>• behavioural | | (2) |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (b)(i) | electron (microscope) | | (1) |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (b)(ii) | A description that includes the following points:<br>• aerobic respiration (1)<br>• produce ATP (1)<br>• for cell metabolism / named cell process (1) | Accept {Krebs / citric acid} cycle / oxidative phosphorylation<br>accept cell {reactions / processes} / named process e.g. mitosis, protein synthesis, muscle contraction, active transport etc<br>accept contains ribosomes for protein synthesis | (3) |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (c) | An answer showing:<br>• at least two tubules with ribosomes on surface (1)<br>• {cisternae / membrane} labelled (1)<br>• ribosomes labelled (1) | Accept tubules<br>ignore cell membrane | (3) |

Q15.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (a)(i) | The only correct answer is D animal, plant and prokaryotic cells<br>*A is not correct because all three cell types contain a cell membrane*<br>*B is not correct because all three cell types contain a cell membrane*<br>*C is not correct because all three cell types contain a cell membrane* | | (1) |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (a)(ii) | The only correct answer is C plant and prokaryotic cells only<br>*A is not correct because prokaryotic cells contain a cell wall*<br>*B is not correct because animal cells do not contain a cell wall*<br>*D is not correct because animal cells do not contain a cell wall* | | (1) |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(i)** | A calculation in which:<br>• cell diameter measured and converted into micrometres (1)<br>• diameter divided by 25 with no units (1)<br>OR<br>• 25 converted to mm<br>• diameter divided by 0.025 with no units | <u>Example of calculation:</u><br>42mm=42000 µm<br>42000 ÷ 25 = x1680<br>ecf for ±1mm and incorrect conversions<br>Correct answer with no units and with no working scores full marks | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(ii)** | An answer that includes one of the following points:<br>• (site of) photosynthesis / converts light energy to {chemical energy / ATP} (1) | ACCEPT formation of correct named product of photosynthesis e.g. glucose<br>ignore makes food | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(iii)** | An answer that includes the following point:<br>• this organism has a nucleus / prokaryotic cells do not contain a nucleus (1) | DO NOT ACCEPT cell membrane / cytoplasm<br>ignore contains membrane bound organelles | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)(i)** | • plasmodesma / plasmodesmata (1) | | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)(ii)** | An explanation that includes the following points:<br>• communication between / connects (connected) cells (1)<br>• therefore signalling substances pass through {symplast / cytoplasm} / cytoplasmic streaming / transport of suitable named molecules e.g. minerals, water, glucose, amino acids, proteins, RNA (1) | allow ECF for pits, cell wall and middle lamella only<br>pits<br>• communication between / connects (connected) cells<br>• therefore transport of suitable named molecules<br>cell wall<br>• (sieve like network made of) cellulose fibres support the cell<br>• therefore helps retain rigid structure / prevent cell lysis<br>middle lamella<br>• joins (adjacent) cell (walls) together<br>• therefore increases {strength / stability} of {plant / cell (wall)} | **(2)** |

Q16.

| Question number | Answer | Mark |
|---|---|---|
| (a) | B species richness of all the species within a habitat | (1) |

| Question number | Answer | Mark |
|---|---|---|
| (b) | Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.<br><br>The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant.<br><br>**Indicative content**<br><br>• good diversity for birds in all sections except Section 4, which decreases to moderate<br><br>• good diversity for birds is very similar in Sections 1, 2 and 3<br><br>• moderate diversity for fish in Section 1, which increases in Section 2 but then decreases again in Sections 3 and 4<br><br>• moderate diversity is very similar in the three sections<br><br>• good diversity for aquatic plants in Sections 1 and 2, which has decreased by Section 4<br><br>• good biodiversity for mussels in stretch 1, decreasing to moderate biodiversity in stretch 2 and poor diversity in stretch 4<br><br>• no overall trends as you move down the river | (6) |

| Level | Marks | Descriptor |
|---|---|---|
| | 0 | No awardable content. |
| 1 | 1-2 | Demonstrates isolated elements of biological knowledge related to the given context with generalised comments made.<br><br>The description will contain basic information with some attempt made to link knowledge and understanding to the given context. |
| 2 | 3-4 | Demonstrates adequate knowledge by selecting and applying some relevant biological facts/concepts to provide the description being presented.<br><br>The description shows some linkages and lines of reasoning with some structure. |
| 3 | 5-6 | Demonstrates comprehensive knowledge by selecting and applying relevant knowledge of biological facts/concepts to provide the description being presented.<br><br>The description is clear, coherent and logically structured. |

| Question number | Answer | Mark |
|---|---|---|
| (c) | An answer that includes the following points:<br>• there are more species of fish than birds (1)<br>• therefore a value of 2.5 has a relatively lower biodiversity than a value of 1.6 (1) | (2) |

| Question number | Answer | Mark |
|---|---|---|
| (d)(i) | | (1) |

| Species of aquatic plant | Number of aquatic plants counted | (n-1) | n(n-1) |
|---|---|---|---|
| Coontail | 8 | 7 | 56 |
| Tape grass | 6 | 5 | 30 |
| Common waterweed | 3 | 2 | 6 |
| Northern water milfoil | 2 | 1 | 2 |
| Star duckweed | 9 | 8 | 72 |
| White water lily | 2 | 1 | 2 |
| Water star-grass | 2 | 1 | 2 |
| Eurasian water milfoil | 6 | 5 | 30 |
| Curly pondweed | 5 | 4 | 20 |
| European frogbit | 2 | 1 | 2 |
| Flowering rush | 3 | 2 | 6 |

| Question number | Answer | Mark |
|---|---|---|
| (d)(ii) | • $\Sigma n(n-1)$ is 228 (1)<br>• value for N(N-1) is (11 × 10) = 110 (1)<br>• diversity index is 0.48 (1) | (3) |

Q17.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)** | An explanation that includes four of the following points:<br><br>• water for {hydrolysis reactions / form cytoplasm / solvent / hydration} (1)<br><br>• (some bacteria require) oxygen for (aerobic) respiration (1)<br><br>• (suitable/optimum) temperature for {enzyme-controlled / metabolic} reactions to occur (at suitable rate) (1)<br><br>• (suitable/optimum) pH for {enzyme-controlled / metabolic} reactions to occur (at suitable rate) (1)<br><br>• named organic molecule and an explanation of why that organic molecule is needed (1) | ACCEPT (some anaerobic bacteria require) no oxygen for anaerobic respiration<br><br>ACCEPT (suitable) temperature so enzymes do not denature<br><br>ACCEPT (suitable) pH so enzymes do not denature<br><br>e.g. glucose for respiration / lipids to provide fatty acid chains for new cell membrane / proteins to provide amino acids for {protein synthesis / growth} | **(4)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(i)** | A calculation showing the following steps:<br><br>• calculation of difference in mean area of ulcer (1)<br><br>• calculation of percentage decrease (1) | <u>Example of calculation</u><br><br>(802.71-95.71) =707<br><br>$\frac{(802.71-95.71)}{802.71} \times 100 = 88$ / 88.077 / 88.08 / 88.1 (%)<br><br>Correct answer with no working shown scores full marks | **(2)** |

| Question Number | Answer | |
|---|---|---|
| (b)(ii) | Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.<br><br>The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant.<br><br><u>Description of data in table</u><br>• mass of mucus<br>• ulcer area<br><br><u>Conclusions and Explanations</u><br>• omeprazole was most effective treatment /none of the extracts were as effective as omeprazole at reducing ulcer area / all treatments resulted in {reduction of ulcer area / increased mass of mucus}<br>• correlation between mucus mass and ulcer area (apart from omeprazole)<br>• bacteria damage stomach lining causing ulcers<br>• suggestion that {omeprazole / extract} increases mucus production<br>• high mucus content prevents bacteria {reaching / damaging} stomach lining<br>• explanation of how mucus production links to ulcer area<br>• high mucus content prevents acid contents damaging stomach lining<br><br><u>Sustained</u><br>• link to biological process resulting in increased mucus production<br>• {omeprazole / extract} causes the {stomach lining / goblet cells} increases mucus production<br>• suggestion that {omeprazole / extract} reduces acidity of stomach making it less suitable for *H. pylori*<br>• antimicrobial properties of {omeprazole / extract} reducing {number / reproduction} of bacteria<br>• therefore {slow population growth / reduced population of bacteria} results in {reduced damage to stomach lining / smaller ulcer area}<br><br>**(6)** | |

| | | | Additional guidance |
|---|---|---|---|
| Level 0 | 0 | No awardable content | |
| Level 1 | 1-2 | An explanation may be attempted but with limited interpretation or analysis of the scientific information and with a focus on mainly just one piece of scientific information.<br><br>The explanation will contain basic information, with some attempt made to link knowledge and understanding to the given context. | Either<br>Description of:<br>mass of mucus data<br>and/or<br>ulcer area data<br><br>OR<br>description of one<br>and/or<br>conclusion / explanation of one data set |
| Level 2 | 3-4 | An explanation will be given, with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information.<br><br>The explanation shows some linkages and lines of scientific reasoning, with some structure. | description of both data plus:<br>explanation of mass of mucus / ulcer area<br>and/or<br>simple conclusion of most effective treatment |
| Level 3 | 5-6 | An explanation is made that is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information.<br><br>The explanation shows a well-developed and sustained line of scientific reasoning, which is clear and logically structured. | all level 2 plus:<br>a detailed explanation using sustained application. The detail of sustained application determines the mark in this level. |

Q18.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)** | An answer that includes two of the following points:<br><br>• minerals (1)<br><br>• (suitable) pH (1)<br><br>• (suitable) light (intensity) (1) | ACCEPT named mineral e.g. phosphate, nitrates<br>ACCEPT oxygen, nitrogen, carbon dioxide, water<br>ignore nutrients / moisture / predation / glucose / temperature<br><br>ACCEPT suitable wavelength of light /sunlight | **(2)** |

| Question Number | Answer | Mark |
|---|---|---|
| **(b)(i)** | The only correct answer is D William Withering<br><br>*A is not correct because Withering tested his digitalis soup*<br><br>*B is not correct because Withering tested his digitalis soup*<br><br>*C is not correct because Withering tested his digitalis soup* | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(ii)** | An explanation that includes the following points:<br><br>• patients given a range of {doses / concentrations} / doses increase in concentration (throughout the investigation) (1)<br><br>• (to allow selection of) lowest effective concentration / highest dose that can be tolerated without serious side effects (1) | ACCEPT (selection of) dose that iseffective with minimal side effects | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(iii)** | A description that includes the following points:<br><br>• (selection of) patients with (colon / kidney) **cancer** (1)<br><br>• {half / one group} given {curacin A / (this) cancer drug}and {half / one group} given current (best) drug (1)<br><br>• neither doctor nor patient knows which treatment has beengiven (1)<br><br>• analysis of data to see if curacin A is more effective than the {current best drug / placebo} (1) | ignore ref to stage of trial<br><br>ACCEPT placebo / sugar pill<br><br>ACCEPT analysis to see if there is a {significant difference/improvement} between those who took the drug compared to the placebo | **(4)** |

Q19.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(i)** | An answer that includes the following point:<br><br>• group of (similar) cells (working together to) perform a (specific) function (1) | ACCEPT cells with similar {structure / function / origin} | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(ii)** | An answer that includes the following points:<br><br>• patient P has a mitotic index of 20 (1)<br><br>• patient R has a mitotic index of 45 (1)<br><br>• correct order of cancer stage identified (1) | e.g. P has an earlier stage of cancer (than R), R has a more advanced stage of cancer<br>ACCEPT ecf from calculated MI for P and R | **(3)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)** | An answer that includes at least one similarity and one difference:<br><br>similarity:<br><br>• the survival probability decreases over time (for all three stages) (1)<br><br>differences:<br><br>• stage I has the highest survival probability for all years whereas stage IV has the lowest probability for all years (1)<br><br>• stage IV has the {fastest/steeper} decrease (in survival probability) / stage I has the slowest decrease (in survival probability) (1) | ACCEPT correct order of survival probability for a point on the graph | **(3)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)** | A description that includes the following points:<br><br>• correct description of a placebo being given to one group (and the other group receiving (anticancer) drug) (1)<br><br>• neither the patient nor the doctor knows whether the patient is receiving (the drug or) the placebo (1) | ACCEPT description of a placebo e.g. has no active ingredient / already known drug / sugar pill / dummy drug<br><br>ACCEPT scientist / researcher for doctor | **(2)** |

Q20.

| Question number | Answer | Mark |
|---|---|---|
| (a) | • {restricted / native} to a particular area | (1) |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (b)(i) | • subtraction (1)<br>• percentage (1)<br>Example of calculation:<br>5 500 – 3 000 / 2 500<br>(2 500 ÷ 5 500) × 100 = 45.45 | Accept 45.5 and 45 | (2) |

| Question number | Answer | Mark |
|---|---|---|
| (b)(ii) | An explanation that includes three of the following points:<br>• because of habitat destruction there is no food (1)<br>• because of habitat destruction there is no shelter (1)<br>• fragmentation of habitat makes it harder to find a mate (1)<br>• therefore, there is a decrease in genetic diversity (1) | (3) |

| Question number | Answer | Mark |
|---|---|---|
| (c)(i) | A description that includes the following points:<br>• sperm observed under a microscope to assess {motility / ability to swim in a straight line} (1)<br>• use of {stains / microscope} to observe the integrity of the acrosome (1)<br>• comparisons need to be made to freshly collected sperm so that effects can be calculated (1) | (3) |

| Question number | Answer | Mark |
|---|---|---|
| (c)(ii) | An explanation that includes any four of the following points:<br>• because sperm can be frozen from different males to increase genetic diversity (1)<br>• because frozen sperm will always be available if numbers of Baird's tapir decrease too far (1)<br>• can freeze sperm so that they are available when females come in to season (1)<br>• freezing could reduce the number of successful fertilisations because of poor viability (1)<br>• more sperm would need to be used as viability is low, reducing stocks (1) | (4) |

Q21.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)** | An answer that includes three of the following points:<br>• deforestation / loss of habitat (1)<br>• increased grazing (of forest) (1)<br>• reduced number of new trees (1)<br>• disease (that has killed the trees) (1)<br>• reduced genetic diversity (1) | ACCEPT loss of trees due to natural events e.g. landslides / tsunamis / fire / poor soil quality<br>ACCEPT new grazing species<br>e.g. reduced {pollination / reproduction / pollinators} / tree doesn't flower often / reduced enzymeactivity due to {changing temperatures / drought} / few trees producing seeds / {air pollution / global warming / climate change}<br>e.g. fungal disease<br>ACCEPT reproduce asexually so no variation | **(3)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(i)** | • correct line measurement and conversion (1)<br>• correct calculation (1)<br>• correct answer in standard form (1) | ACCEPT ±1mm<br><u>Example of calculation:</u><br>38 000μm<br>(38 000 ÷ 200) =190 (μm)<br>$1.9 \times 10^2$ (μm)<br>ecf applies<br>Correct answer with no workingshown scores full marks | **(3)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(ii)** | An answer that includes the following points:<br>• {transport/ translocation} of {sucrose / amino acids} (1)<br>• from {source /site of production / leaves} to {sink / siteof use / site of storage} (1) | ACCEPT products of photosynthesis /lipids / hormones / mRNA / sugars<br>ignore glucose | **(2)** |

| Question Number | Answer | Mark |
|---|---|---|
| **(b)(iii)** | The only correct answer is C two<br><br>*A is not correct because all the statements are correct apart from, they do not contain cytoplasm*<br><br>*B is not correct because all the statements are correct apart from, they do not contain cytoplasm*<br><br>*D is not correct because they do not contain cytoplasm* | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)** | An answer that includes three of the following points:<br><br>• the edge of the xylem is closer to the {outside ofthe structure / epidermis} (than the phloem) in the root / the phloem is closer to the {outside ofthe structure / epidermis} than the xylem in the stem (1)<br><br>• xylem and phloem are contained in (separatevascular) bundles in the stem (1)<br><br>• more equal phloem:xylem in stem (whereas 4:1in root)<br><br>• (xylem and phloem / (vascular) bundles) are arranged in {outer part of / a circular pattern in}stem (1) | ACCEPT xylem and phloem are separated by cambium in stem ignore sclerenchyma/parenchyma<br>ACCEPT xylem and phloem togethermake an oval shape<br><br>ignore {sizes/number unqualified} of {xylem/phloem}<br><br>ACCEPT both xylem and phloem arecloser to epidermis in stem<br>ACCEPT (xylem and phloem/ (vascular) bundles) are arranged in allareas of stem (in monocots)<br>ACCEPT vascular tissue in one area inthe root whereas in several areas in the stem<br>ACCEPT labelled diagram showing thedistribution in the stem | **(3)** |

Q22.

| Question Number | Answer | Mark |
|---|---|---|
| **(a)** | The only correct answer is B endemic<br><br>*A is not correct because the answer is endemic*<br><br>*C is not correct because the answer is endemic*<br><br>*D is not correct because the answer is endemic* | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(i)** | An answer that makes reference to the following:<br><br>• anatomical (1)<br><br>• anatomical (1)<br><br>• behavioural (1) | | **(3)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(ii)** | An answer that makes reference to one of the following points:<br>• competition for a {mate / territory} (1)<br><br>• competition for food / height of food (1) | ignore mutation<br>ACCEPT predators<br><br>e.g. more food sources above height of shell | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)(i)** | A calculation in which:<br><br>• calculation of percentage using correct data (1) | <u>Example of calculation:</u><br><br>(18÷27) × 100 = 66.67% / 66.7% / 67% | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)(ii)** | A calculation in which:<br><br>• calculation of increase in population (1)<br>• calculation of percentage increase using correct data (1) | <u>Example of calculation:</u><br><br>1800-15 = 1785<br>(1785÷1800) × 100 =99.2% | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)(iii)** | An explanation that makes reference to three of the following points:<br>• analysis of molecular evidence (of the zoo tortoise) (1)<br>• comparison (of molecular evidence) to a *C. hoodensis* tortoise (to see how similar the sequences are) (1)<br>• comparison of {phenotype / anatomy/physiology} to a *C. hoodensis* tortoise (1)<br>• breeding the tortoise with a *C. hoodensis* tortoise to see if **fertile** offspring are produced (1) | e.g. DNA / RNA / proteins<br>ACCEPT molecular phylogeny<br>ACCEPT comparison of bands (from gel electrophoresis) with *C. hoodensis* tortoise<br>ACCEPT identification of features {exclusive/similar} to *C. hoodensis* | **(3)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(d)** | An explanation that makes reference to two of the following points:<br>• DNA analysis to identify different alleles (1)<br>• use of Hardy-Weinberg equation / $p^2+2pq+q^2$ (1)<br>• (in order to) compare (recessive) allele frequency in previous generation(s) with current generation (1) | | **(2)** |

Q23.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(i)** | • the (Madagascan pygmy) kingfisher is found only in (forests in) Madagascar (1) | | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(ii)** | • Eukarya / Eukaryote (1) | | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(i)** | An answer that includes the following points:<br><br>• *Alcedo leucogaster* and *Alcedo cristata* (1)<br><br>• because they share (the most) recent common ancestor (1) | Accept they share most similarities in their {DNA / named biological molecule}<br>Accept converse for *Ceyx lecontei* and *Ceyx picta* | **(2)** |

| Question Number | Answer | |
|---|---|---|
| **(b)(ii)** | Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.<br><br>The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant.<br><br>• classification definitions historically based on similarities and differences in phenotype<br><br>• some examples of phenotypes used for previous classification, e.g. beak shape, bird size, diet, habitat<br>• previous classification had *Ceyx madagascariensis* as more closely related to other *Ceyx* kingfishers<br><br>• more recent classification based on molecular evidence / molecular phylogeny<br>• similarities and differences in mRNA / DNA / amino acid sequences identified<br>• explanation of how they are compared<br><br>• fewer differences means they are more closely related / have more recent common ancestor<br>• reference to closer together on evolutionary tree<br>• proposed classification had *Ceyx madagascariensis* as more closely related to *Alcedo* (*leucogaster* and / or *cristata*)<br><br>• scientist proposing a reclassification<br>• published in scientific journal<br>• reference to peer review (of molecular evidence)<br><br>• repetition of experiments by other scientists (to see if same data are collected)<br>• extend the analysis e.g. look for similarities / differences in more genes<br>• analysis of data to see if same conclusions can be reached / more research<br>• statistical analysis<br><br>**(6)**<br>**Expert** | |

| | | | Additional guidance |
|---|---|---|---|
| Level 0 | 0 | No awardable content | |
| Level 1 | 1-2 | An explanation may be attempted but with limited interpretation or analysis of the scientific information and with a focus on mainly just one piece of scientific information.<br><br>The explanation will contain basic information, with some attempt made to link knowledge and understanding to the given context. | 1 mark – information from one section 2 marks - information from two sections |
| Level 2 | 3-4 | An explanation will be given, with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information.<br><br>The explanation shows some linkages and lines of scientific reasoning, with some structure. | 3 marks - information from three sections 4 marks - information from four sections |
| Level 3 | 5-6 | An explanation is made that is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information.<br><br>The explanation shows a well-developed and sustained line of scientific reasoning, which is clear and logically structured. | 5 marks - information from five sections<br>6 marks - Information from all six sections applied to the given context showing a good understanding of the review process leading to an accepted reclassification by the scientific community |

Q24.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (a) | The correct answer is B endemic<br><br>*A is incorrect because the correct term is endemic*<br><br>*C is incorrect because the correct term is endemic*<br><br>*D is incorrect because the correct term is endemic* | | (1) |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (b) | An answer that makes reference to the following:<br><br>• anatomical (adaptation) (1)<br><br>• physiological (adaptation) (1)<br><br>• anatomical (adaptation) (1) | | (3) |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (c) | An answer that makes reference to the following:<br><br>• {poison / skin colour/ spots} deters predators / reduce risk of predation (1)<br><br>• adhesive discs allow the frog to {climb / cling to} surfaces (to find food) (1) | <br><br>Accept reduce risk of being eaten / protects frog from predators<br>Ignore camouflage<br><br>e.g. trees / leaves | (2) |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (d) | An answer that makes reference to four of the following:<br><br>• (genetic) mutation(s) occurred (1)<br><br>• (new) **allele** coding for poison production (1)<br><br>• (which then) conferred a selective advantage / (those with poison) more likely to {survive and reproduce / pass alleles to offspring} (1)<br><br>• (therefore) increasing **allele** frequency (1)<br><br>• (resulting in) new species of frog with the ability to produce poison evolved (1) | Ignore genes<br><br><br><br>Accept those without the {mutation / poison / advantageous allele} were less likely to survive and reproduce | (4) |

Q25.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (a)(i) | The only correct answer is C plant cells and prokaryotic cells<br><br>*A is incorrect because prokaryotic cells also have a cell wall*<br><br>*B is incorrect because animal cells do not have a cell wall*<br><br>*D is incorrect because animal cells do not have a cell wall* | | (1) |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| (a)(ii) | **Drawing** (2):<br>• {double (nuclear) membrane / nuclear envelope} obvious<br>• nuclear pores shown and (1 or more) nucleoli present<br><br>**Labels** (max 2):<br>• (nuclear) envelope / <u>double</u> membrane / {<u>inner</u> / <u>outer</u>} (nuclear) membrane<br>• (nuclear) pore<br>• nucleolus<br>• correct reference to chromatin / nucleoplasm | if one incorrect label, max of 1 label mark<br>if two incorrect labels then no label marks can be awarded<br><br><br><br><br>Ignore DNA | (4) |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(i)** | An explanation that includes the following points:<br>• the two {layers (of the membrane) /membranes} are very close together / there is a very small distance between the {two layers / membranes} (1)<br>• therefore, the **resolution** of a light microscope is not high enough (1) | Accept the bilayer structure is very close together<br>Ignore the bilayer is too {small / thin} | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(ii)** | A calculation showing the following steps:<br>• length of XY measured correctly +/- 1mm (1)<br>• calculation of actual size (1)<br>• correct answer given in µm (1) | Mark the answer on answer line first<br>Example of calculation<br>26 mm / 2.6 cm<br>26 ÷ 200= 0.13 (mm)<br>= 130 (µm)<br>Correct answer scores full marks | **(3)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(iii)** | A description that makes reference to the following:<br>• form spindle {fibres / poles} in {prophase / mitosis / meiosis / cell division} (1)<br>• to separate {chromosomes/ chromatids} (1) | Ignore DNA / genetic material | **(2)** |

Q26.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(i)** | The correct answer is C two<br>*A is incorrect because lignin gives waterproofing properties and can form spiral shapes*<br>*B is incorrect because lignin gives waterproofing properties and can form spiral shapes*<br>*D is incorrect because lignin does not add strength to the cell membranes* | | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(ii)** | Similarity (1)<br>• both contain {cellulose / pits / dead cells / secondary walls}<br>• both {are hollow / do not contain cytoplasm}<br>Difference (1)<br>• sclerenchyma contain end walls whereas xylem do not | Ignore cell walls unqualified<br>Ignore no nucleus<br>Accept sclerenchyma are {pointed/closed} at each end whereas xylem are {not / open at each end}<br>Accept xylem contain tracheids whereas sclerenchyma do not | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)** | An explanation that makes reference to the following:<br>• hemp is renewable / more can be grown / will not run out (1)<br>• available to future generations (1) | | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)(I)** | • calculation of mean yearly increase (1)<br>• calculation of total volume in 2020 (1)<br>• correct answer for total volume in 2020 with units (1) | Example of calculation<br>(84,600,000,000 - 17,000,000,000) ÷11 = 6145454545.45<br>(6145454545.45 x 20) =1229090909 + 17,000,000,000 = $1.39 \times 10^{11}$ / $1.4 \times 10^{11}$ / $139909 \times 10^{6}$<br>= $1.39 \times 10^{11}$ $dm^3$ / $1.4 \times 10^{11}$ $dm^3$ / $139909 \times 10^{6}$ $dm^3$<br>Correct answer with no working gains full marks | **(3)** |

| Question Number | Answer |
|---|---|
| ✳ **(c)(II)** | Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.<br><br>The indicative content below is not prescriptive, and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant.<br><br>Advantages<br>• indication of sustainability in the context of biofuel production e.g. more plants can be grown, renewable<br>• available for future generations<br>• consideration of carbon neutral or removal of carbon dioxide from atmosphere (by photosynthesis) as plant is growing<br>• consideration of lower carbon emissions than fossil fuels<br>• linkage to greenhouse effect / global warming<br>• some biofuels require limited resources<br>• hemp produces the least carbon dioxide emissions of all fuels<br>• hemp and sugar beet require the least water<br>• hemp and soybean require fewer fertilisers<br>• hemp requires fewer fertilisers<br>• hemp requires fewest resources<br>• consideration of reduced water requirements for producing biofuels than food production<br>• hemp requires fewest resources so lowest production costs<br>• bioethanols require fewer resources so lower production costs<br><br>Disadvantages<br>• rapeseed and soybean production require high levels of water<br>• rapeseed and sugar beet production require high levels of fertilisers<br>• rapeseed, soybean and sugar beet production require high levels of pesticides<br>• rapeseed requires highest level of resources<br>• consideration of effect of fertilisers on ecosystem<br>• consideration of effect of pesticides on ecosystem<br>• disadvantage of reduced land available for food production<br>• disadvantage of reduced water available for food production<br>• disadvantage of reduced water available for population<br>• cost of providing resources<br>• biodiesels require more resources so higher production costs<br><br>• supported conclusion of which bioethanol fuel would be most sustainable **(6)** |

| | | | Additional guidance |
|---|---|---|---|
| Level 0 | 0 | No awardable content | |
| Level 1 | 1-2 | Limited scientific judgement made with a few strengths / weaknesses identified.<br><br>A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgment being made. | simple description of trends shown in the graph / table linked to basic advantages or disadvantages = lower mark<br><br>simple description of trends shown in the graph / table linked to basic advantages AND disadvantages = higher mark |
| Level 2 | 3-4 | A scientific judgement is made through the application of relevant evidence, with strengths and weaknesses identified.<br><br>A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made. | All level 1 plus<br>**sustainability** should be considered to access level 2<br><br>conclusion of which biofuel would be best attempted linked to the information given for lower mark<br><br>linked to the farmer OR population OR ecosystem for higher mark |
| Level 3 | 5-6 | A scientific judgement is made which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information.<br><br>A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made. | all level 2 plus<br>consideration to effect on **two** from farmer OR population OR ecosystem lower mark<br><br>consideration to effect on **three** from farmer OR population OR ecosystem higher mark |

Q27.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)** | • (a group of) organisms that are capable of {(inter)breeding / mating / reproducing} and producing fertile offspring (1) | Do not accept inbreeding<br>Accept 'offspring capable of producing offspring' as equivalent to fertile | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)** | An explanation that includes four of the following points:<br><br>• as the concentration of herbicide increases the (mean) number of (insect) species decreases (1)<br><br>• increase of 100 mg $dm^{-3}$ results in a decrease of {6.2 species /68.9%} (1)<br><br>• use of herbicides results in {fewer plant species / reduced plant diversity / reduced food supply (for insects)} (1)<br><br>• (therefore) some insects (species) {leave habitat / die (from lack of food)} (1)<br><br>• (fewer plant species results in) fewer habitats for insects (1) | Ignore converse statement<br>Accept negative correlation<br><br>Accept other correct reductions<br><br>Ignore herbicides kill insects<br><br>Accept reduced shelter for insects | **(4)** |

Q28.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)** | An explanation that makes reference to three of the following points:<br>• fewer young tree shoots eaten (after wolves were reintroduced) (1)<br>• (because) elk would not graze undisturbed when wolves were around (1)<br>• more (young tree shoots) were eaten in forest habitat (than riverside habitat) / fewer (young tree shoots) were eaten in riverside habitat (than forest habitat) (1)<br>• (because) the mature trees provided some {camouflage / protection} (from the wolves) (1) | ACCEPT the percentage (of young tree shoots eaten) decreased<br>ACCEPT converse<br>ACCEPT because some elk have been eaten by wolves / fewer elk because wolves are predators (of elk)<br>ACCEPT {larger/more rapid} decrease (in number of shoots eaten) in riverside habitat<br>ACCEPT (because) elk can hide (from the wolves) in the forest / elk have no {hiding places / protection} from being seen (by the wolves) by the river<br>ACCEPT predation of elk is higher in riverside (habitat) | **(3)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)** | A description that makes reference to the following points:<br>• as the number of elk (per $km^2$) increases the average beaver lifespan decreases (1)<br>• {larger/rapid} decrease {initially / as population increases from 30 elk (per $km^2$)} (1)<br>• very little change in average lifespan of beavers when the number of elk increase above {70/80/90} elk per $km^2$ (1) | ACCEPT negative correlation<br>ACCEPT {exponential / non-linear} decrease<br>ACCEPT the beaver lifespan plateaus when the number of elk increase above {70/80/90} elk per $km^2$ | **(3)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)(i)** | An answer which includes the following points:<br>• (count) number of species (1)<br>• {area / size} of habitat (1) | ACCEPT per unit area | **(2)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)(ii)** | • (D =) $\frac{N(N-1)}{\sum n(n-1)}$ | ACCEPT other correct equations<br><br>e.g. simple biodiversity index = species richness ÷ species evenness | **(1)** |

| Question Number | Answer |
|---|---|
| ***(d)** | Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.<br><br>The indicative content below is not prescriptive and candidates are not required to include all the material indicated as relevant. Additional content included in the response must be scientific and relevant.<br><br><u>Basic</u><br>• increasing numbers of wolves (until 2003) / decrease in number of wolves (from 2007 to 2010)<br>• overall increase in wolves / 20 more wolves in 2010 (than in 1995)<br><br>• the numbers of elk decreased as they were hunted by the wolves<br>• overall decrease in numbers of elk (from 1995 to 2010)<br><br>• the number of cottonwood shoots rapidly increased (after 2003)<br>• the number of beaver colonies increased from 1 (in 1999) to 12 (in 2009) |

| | | |
|---|---|---|
| | <u>Linkage</u><br>• the numbers of cottonwood shoots increased {when the numbers of elk decreased / as they weren't being eaten}<br><br>• beavers and elk have similar niches / beavers were outcompeted for young tree shoots by elk<br>• beaver {numbers/colonies} started to increase when {elk population size decreased / more shoots were available}<br><br>• discussion of causes of decrease in wolf population e.g. decrease in elk food source • introduction of wolves increases biodiversity<br><br><u>Sustained</u><br>• {more ponds / new habitat} increase {number of species / species richness / biodiversity}<br>• more trees (woodland and riverside habitats) increase {number of species / species richness / biodiversity}<br><br>• biodiversity increases due to additional species in Yellowstone National Park e.g. wolf<br>**(6)**<br>**Expert** | |

| | | | Additional guidance |
|---|---|---|---|
| Level 0 | 0 | No awardable content | |
| Level 1 | 1-2 | Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made.<br>Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures.<br>The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context. | Information from one section |
| Level 2 | 3-4 | Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts / concepts.<br>Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures.<br>The discussion shows some linkages and lines of scientific reasoning with some structure. | Information from two sections<br>linkage of 2 concepts |
| Level 3 | 5-6 | Demonstrates comprehensive knowledge and understanding by selecting and applying relevant biological facts / concepts.<br>Consequences are discussed which supported throughout by sustained linkage to a range of scientific ideas, processes, techniques and procedures.<br>The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured. | Level 2 plus<br>Discussion of how biodiversity would be increased |

Q29.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(i)** | • correct magnification calculated | ACCEPT range between x 14 000 - x 18 000<br>ACCEPT correct magnification in standard form | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(ii)** | An answer that makes reference to the following point:<br>• too small (0.5 µm) to be viewed (under a light microscope) / magnification (of x 14 000-16 000) can't be achieved by a light microscope / resolution would be too low} (1) | ecf applies<br>ignore references to 3D image | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)** | An explanation that makes reference to two of the following points:<br><br>• plant based packaging is (more) sustainable / biodegradable / carbon neutral (than traditional oil-based packaging) (1)<br><br>• (the antimicrobial property of the oregano oil) will {reduce the numbers of (*L. monocytogenes*) bacteria / prevent bacterial growth (on the food) / prevent microbial growth} (1)<br><br>• (resulting in) fewer people getting {listeriosis / (microbial) disease} (1) | ACCEPT plant-based packaging is {renewable / available for future generations}<br><br>ACCEPT kill bacteria<br>ignore reduce microbes entering packaging<br><br>ACCEPT so food will not go off as quick / extends shelf life | **(2)** |

| Question Number | Answer | Mark |
|---|---|---|
| **(c)(i)** | The only correct answer is C<br><br>*A is not correct because L. monocytogenes is least affected by the chemicals*<br><br>*B is not correct because L. monocytogenes is least affected by the chemicals*<br><br>*D is not correct because L. monocytogenes is least affected by the chemicals* | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(c)(ii)** | • 6.14 / 6.1 / 6 | <u>Example of calculation:</u><br><br>11.1+0.63=11.73<br>6.0-0.41=5.59<br>11.73-5.59=6.14 | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(d)** | A description that makes reference to the following points:<br>• to test for side-effects (1)<br>• to determine {safe / minimum / effective/ suitable} {dosage / concentration} (1)<br>• to determine if it is more effective than {existing treatments / placebo} (1) | ignore to check for safety<br>do not accept testing for side effects in context of {in-vitro/animal}<br>ACCEPT to {determine optimum dosage / adjust dose}<br>ACCEPT compare effectiveness with {existing treatments / placebo}<br>ignore to see if it's effective | **(3)** |

Q30.

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(i)** | The only correct answer is B one<br>A is not correct because starch only contains α-glucose and is stored in amyloplast<br>C is not correct because starch only contains α-glucose and is stored in amyloplast<br>D is not correct because starch only contains α-glucose and is stored in amyloplast | | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(a)(ii)** | The only correct answer is C two<br>*A is not correct because they are all correct apart from contains α-glucose and β-glucose*<br>*B is not correct because they are all correct apart from contains α-glucose and β-glucose*<br>*D is not correct because they are all correct apart from contains α-glucose and β-glucose* | | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(i)** | • (bacterial) chromosome<br><br>and<br><br>• (70S) ribosomes | Both structures required for the mark<br><br>Accept nucleoid / (circular) DNA / plasmid / (m)RNA<br><br>ignore size of ribosome | **(1)** |

| Question Number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **(b)(ii)** | An explanation that includes three of the following points:<br><br>• oxygen for (aerobic) respiration (1)<br><br>• glucose for respiration / amino acids for protein synthesis (1)<br><br>• optimum temperature for (faster) {enzyme / metabolic} reaction (1)<br><br>• optimum pH for (faster) {enzyme / metabolic} reaction (1) | accept lack of oxygen for survival ofobligate anaerobes<br><br>accept water for {hydrolysis reactions /solvent}<br><br>accept suitable stated temperature for {faster/optimum} enzyme rate of reaction<br><br>accept suitable stated pH for {faster/optimum} enzyme rate of reaction | **(3)** |