## Unit 4: The Natural Environment & Species Survival

| Question Number | Question |
|---|---|
| 1.(a) | The table below gives one function of each of the three structures labelled **A**, **B** and **C** on the electron microscope image. Complete the table below by writing in the appropriate letter and the name of each structure. |
| | Answer |

| Function | Label letter | Name of structure |
|---|---|---|
| Photophosphorylation | **A** | granum |
| Stores non-carbohydrate organic material | **C** | oil droplet |
| Carbon fixation | **B** | stroma |

| Correct Answer | Acceptable Answers | Reject | Mark |
|---|---|---|---|
| Award 1 mark per correct row as in the table above.<br><br>**A**<br><br>granum<br><br>**C**<br><br>oil droplet<br><br>**B**<br><br>stroma | <br><br><br><br>grana (stack) / thylakoids / thylakoid membrane<br><br>lipid {droplet / drop} | <br><br><br><br>grain<br><br><br><br>fat<br><br><br><br>stoma | 3 |

| Question Number | Question | |
|---|---|---|
| 1.(b)(i) | Explain what happens to the electrons released by photolysis. | |
| | Answer | Mark |
| | Award one mark for each of the following points in context to a maximum of **two** marks.<br><br>1. {enter / used in} {Photosystem II / PSII};<br><br>2. replace electrons lost by chlorophyll;<br><br>3. after {excitation by light / absorption of light};<br><br>4. which were used in production of reduced NADP; | 2 |

| Question Number | Question | |
|---|---|---|
| 1.(b)(ii) | The electrons are later involved in the reduction of NADP. Explain the importance of reduced NADP in the light-independent reactions of photosynthesis. | |
| | Answer | Mark |
| | Award one mark for each of the following points in context to a maximum of **three** marks.<br><br>1. ref to reduction of $CO_2$;<br><br>2. (reduced NADP / eq) used to reduce {GP / G3P/eq};<br><br>3. in Calvin cycle;<br><br>4. after fixation of $CO_2$ by RuBP (to produce GP / G3P/eq);<br><br>5. leads to formation of carbohydrate;<br><br>6. {GALP / TP/eq} is the carbohydrate; | 3 |

| Question Number | Question | |
|---|---|---|
| 1.(c) | Put a cross in the box next to the equation that shows the relationship between gross primary productivity (GPP), net primary productivity (NPP) and respiration (R). | |
| | Correct Answer | Mark |
| | ☒ GPP = NPP + R | 1 |

| Question Number | Question | |
|---|---|---|
| 1.(d)(i) | It is estimated that 85% of the energy available to primary consumers will not be available to secondary consumers. Calculate the energy that will be available to the secondary consumers in the **tropical rainforest**. Show your working. | |
| | Answer | Mark |
| | Correct answer (with or without working) = 2 marks<br><br>Answer: 5 670;;<br><br>Correct working with incorrect answer = 1 mark<br><br>Accept any working that would give correct answer<br><br>eg (37 800 / 100) x 85 = 32 130<br><br>37 800 – 32 130 =<br><br>or<br><br>(37 800 / 100) x 15 = | 2 |

| Question Number | Question | |
|---|---|---|
| 1.(d)(ii) | Suggest **two** reasons for the differences in the net primary productivity as the distance from the equator increases. | |
| | Answer | Mark |
| | Award one mark for each of the following points in context to a maximum of **two** marks.<br><br>1. less light available farther from equator;<br><br>2. lower temperatures farther from equator;<br><br>3. {less water available / lower rainfall} farther from equator;<br><br>4. less minerals available farther from equator;<br><br>Statements must use comparative terms.<br>Accept converse statements. | 2 |

| Question Number | Question | |
|---|---|---|
| 2.(a)(i) | Put a cross in the box next to the statement that could form part of a valid conclusion from the data shown in the graph. | |
| | Correct Answer | Mark |
| | ☒ **C** | 1 |

| Question Number | Question | |
|---|---|---|
| 2.(a)(ii) | With reference to the graph, discuss the validity of statements **A**, **B** and **C**. | |
| | Answer | |
| | Award one mark for each of the following points in context of whether or not statement was chosen to a maximum of **three** marks.<br><br>1. as *Ascophyllum* decreases, *Chondrus* increases / *Chondrus* has low percentage where *Ascophyllum* has high percentage/eq;<br><br>2. no data to say how *Fucus* grows when not covered by water;<br><br>3. *Ascophyllum* still present in low tidal regions; | |

| Question Number | Question | |
|---|---|---|
| 2.(b) | Suggest **two** abiotic factors, other than the length of time the seaweeds are out of water, that could affect the distribution of the seaweeds on this shore. | |
| | Answer | Mark |
| | Award one mark for each of the following points in context to a maximum of **two** marks.<br><br>1. temperature;<br><br>2. light intensity;<br><br>3. nature of rock / substratum/eq;<br><br>4. slope/eq;<br><br>5. aspect/eq;<br><br>6. salinity/eq;<br><br>7. ref to pollution; | 2 |

| Question Number | Question | |
|---|---|---|
| 2.(c) | Describe a technique that you have used to study the distribution of a named organism within its habitat. | |
| | Answer | Mark |
| | Award one mark for each of the following points in context to a maximum of **four** marks.<br><br>1. suitable named organism linked with habitat;<br><br>2. reference to suitable technique for the organism;<br><br>3. eg use of quadrat, transect;<br><br>4. reference to systematic sampling;<br><br>5. detail of method;<br><br>6. stated measurement;<br><br>7. reference to two abiotic measurements;<br><br>8. reference to a safety procedure; | 4 |

| Question Number | Question | |
|---|---|---|
| 3.(a) | Suggest how pollen grains can provide evidence about which types of tree were growing successfully in Finland as the peat bog was forming. | |
| | Answer | Mark |
| | Award one mark for each of the following points in context to a maximum of **two** marks.<br><br>1. tree types can be identified from their pollen;<br><br>2. pollen only produced by {fully-grown / mature/eq} trees;<br><br>3. trees need to {grow/eq} for a long time before maturity/eq; | 2 |

| Question Number | Question | |
|---|---|---|
| 3.(b)(i) | Put a cross in the box next to the type of tree that does not provide evidence about the changes in climate in Finland during the last 10 000 years. | |
| | Correct Answer | Mark |
| | ☒ **D** | 1 |

| Question Number | Question | |
|---|---|---|
| 3.(b)(ii) | Explain your answer to (b)(i). | |
| | Answer | Mark |
| | Award one mark for each of the following points in context.<br><br>1. reference to distributed across several climatic zones;<br><br>2. reference to little fluctuation in the pollen data from different ages; | 2 |

| Question Number | Question | |
|---|---|---|
| 3.(c) | With reference to the present-day distribution of the four tree types and the results of the pollen grain study, suggest in what way the climate in Finland has changed during the last 10 000 years. Give reasons for your answer. | |
| | Answer | Mark |
| | Award one mark for each of the following points in context to a maximum of **five** marks.<br><br>1. climate has become warmer/eq;<br><br>2. reference to a change between 8 700 and 6 390 years ago;<br><br>3. {larch / spruce} were growing but died out/eq;<br><br>4. (larch / spruce) are only found in boreal and northern temperature regions (in present day);<br><br>5. (boreal and temperate regions) are cold climates;<br><br>6. pine was not growing but has become established more recently;<br><br>7. pine is only found in southern boreal and temperate regions (in present day);<br><br>8. (southern boreal and temperate regions) are warmer climates; | 5 |

| Question Number | Question | |
|---|---|---|
| 3.(d) | Describe how dendrochronology can be used to provide evidence for climate change. | |
| | Answer | Mark |
| | Award one mark for each of the following points.<br><br>1. idea that dendrochronology uses evidence from {tree / annual} rings;<br><br>2. {density / thickness/eq} of rings changes with climatic conditions / thicker ring indicates warmer year; | 2 |

| Question Number | Question | | | |
|---|---|---|---|---|
| 4.(a)(i) | State the term used to describe the separation into two populations that do not interbreed. | | | |
| | Correct Answer | Acceptable Answers | Reject | Mark |
| | reproductive isolation | reproductively isolated | | 1 |

| Question Number | Question | | | |
|---|---|---|---|---|
| 4.(a)(ii) | State the term used to describe the formation of two new species from one species. | | | |
| | Correct Answer | Acceptable Answers | Reject | Mark |
| | speciation | | | 1 |

| Question Number | Question | | | |
|---|---|---|---|---|
| 4.(a)(iii) | State the term used to describe the relative proportion of different forms of a particular gene within a gene pool. | | | |
| | Correct Answer | Acceptable Answers | Reject | Mark |
| | allele frequency | % allele frequency | gene frequency<br>% gene frequency | 1 |

| Question Number | Question | |
|---|---|---|
| 4.(b) | Suggest how the two populations of salmon developed differences in their gene pools. | |
| | Answer | Mark |
| | Award one mark for each of the following points in context to a maximum of **five** marks.<br><br>1. different (environmental) conditions in the different areas;<br><br>2. different selective pressures;<br><br>3. some fish better adapted than others (in each population);<br><br>4. use of example of an adaptation from information;<br><br>5. these more likely to survive to breed;<br><br>6. and pass on their {alleles / genes} (to next generation);<br><br>7. process of selection continues {in each generation / over many generations};<br><br>8. allele frequencies of {favourable/eq} increases;<br><br>9. correct use of term natural selection; | 5 |

| Question Number | Question | |
|---|---|---|
| 4.(c) | Explain how new alleles might appear in the gene pool of a species. | |
| | Answer | Mark |
| | Award one mark for each of the following points in context to a maximum of **two** marks.<br><br>1. reference to mutation;<br><br>2. change in {base / eq} sequences in DNA;<br><br>3. can occur during {DNA replication / cell division};<br><br>4. can be caused by named example of a mutagen; | 2 |

| Question Number | Question | |
|---|---|---|
| 5.(a) | Describe and explain the changes that occur in the concentration of antibodies in the blood plasma following vaccination. | |
| | Answer | Mark |
| | Award one mark for each of the following points in context to a maximum of **six** marks.<br><br>1. No antibody in blood plasma in first 5 days;<br><br>2. Because lymphocytes need to come in contact with antigens;<br><br>3. Time needed for {lymphocyte activation/ lymphocyte cloning/ B cell differentiation};<br><br>4. Rise in antibody concentration between 5 and 15 days;<br><br>5. As plasma cells release antibody;<br><br>6. Decrease in antibody concentration after 15 days;<br><br>7. Infection has been cleared up;<br><br>8. Antibodies removed from blood stream by kidneys;<br><br>9. Residual level of antibodies in blood (at 30 days) | 6 |

| Question Number | Question | |
|---|---|---|
| 5.(b)(i) | Explain the meaning of the term **mutation**. | |
| | Answer | Mark |
| | 1. Change in sequence of DNA;<br><br>2. Change in {mass of DNA / number of chromosomes}; | 2 |

| Question Number | Question | |
|---|---|---|
| 5.(b)(ii) | Suggest why the vaccine contains a cocktail of antigens. | |
| | Answer | Mark |
| | Award one mark for each of the following points in context to a maximum of **two** marks.<br><br>1. mutation causes change in gene product/eq;<br><br>2. idea that structure of antigen may change (as result of mutation);<br><br>3. idea that individual will not be protected if flu virus does not have same antigens present in vaccine;<br><br>4. idea that a cocktail of antigens will increase the chance of matching antigens; | 2 |

| Question Number | Question | |
|---|---|---|
| 6.(a)(i) | Using information in the diagram, calculate the total percentage of the life cycle that a blowfly spends as a larva when the surrounding temperature is 21 °C. | |
| | Correct Answer | Mark |
| | Correct answer (with or without working) = 2 marks<br><br>Answer: 51.9% (accept 52% or 51.88%)<br><br>Correct working with incorrect answer = 1 mark<br><br>Accept any working that would give correct answer<br><br>eg 179 / 345 x 100 = 52% | 2 |

| Question Number | Question | |
|---|---|---|
| 6.(a)(ii) | Temperature has an effect on the length of the blowfly lifecycle. Suggest an explanation for the effect of temperature on the length of the blowfly lifecycle. | |
| | Correct Answer | Mark |
| | Award one mark for each of the following points in context to a maximum of **two** marks.<br><br>1. idea that length of life cycle is dependant on metabolic rate of blow fly;<br><br>2. metabolic rate is determined by enzyme activity/eq;<br><br>3. as temperature increases (up to an optimum) enzyme activity increases;<br><br>4. idea that as a result of temperature increase (to a max) length of lifecycle decreases; | 2 |

| Question Number | Question | |
|---|---|---|
| 6.(a)(iii) | Suggest **two** factors, other than temperature, that may affect the timing of the blowfly life cycle and lead to an incorrect estimate of the time of death. | |
| | Answer | Mark |
| | Award one mark for each of the following points in context to a maximum of **two** marks.<br><br>1. humidity;<br><br>2. drugs;<br><br>3. oxygen;<br><br>4. ref. to genetic differences; | 2 |

| Question Number | Question | |
|---|---|---|
| Q6(b) | Describe how rigor mortis in muscles occurs. | |
| | Answer | Mark |
| | Award **three** marks for the following in context.<br><br>1. Muscle cells deprived of oxygen<br><br>2. Respiration becomes anaerobic/reference to lactic acid<br><br>3. Fall in pH<br><br>4. Inhibits enzymes<br><br>5. ATP no longer produced<br><br>6. Bonds between muscle proteins become fixed | 3 |

| Question Number | Question | |
|---|---|---|
| 6.(c) | The process of succession occurs in plant communities as well as in a dead body. Compare these two forms of succession. | |
| | Answer | Mark |
| | Award one mark for each of the following points in context to a maximum of **three** marks.<br><br>1. as each organism feeds it changes the body / environment<br><br>2. this allows conditions suitable for colonisation/growth of other species<br><br>3. ref to other organisms eg microbes<br><br>4. in plant succession many early species are replaced over time<br><br>5. in this case most of the early insects remain as others colonise<br><br>6. suitable reference to climax community in plants<br><br>7. {longer timescale / larger area} in plants | 3 |

| Question Number | Question | |
|---|---|---|
| 7.(a) | The table below lists **five** structural features that may be found in bacteria and viruses. Put a cross in the box if the structural feature is present. | |
| | Answer | Mark |
| | Award 1 mark for each correct row in the following table. | 5 |

| Structural feature | Bacteria | Viruses |
|---|---|---|
| Mesosomes | ☒ | |
| Capsid | | ☒ |
| Nucleic acid | ☒ | ☒ |
| Cytoplasm | ☒ | |
| Ribosomes | ☒ | |

| Question Number | Question | |
|---|---|---|
| 7.(b)(i) | Describe the trends shown by the data. | |
| | Answer | Mark |
| | Award one mark for each of the following points in context to a maximum of **two** marks.<br><br>1. Increase in number of new cases in Africa and Europe<br><br>2. Decrease in number of new cases in Asia and South America<br><br>3. Any relevant manipulation of data | 2 |

| Question Number | Question | |
|---|---|---|
| 7.(b)(ii) | HIV positive people were excluded from the data. If they had been included suggest how the data would differ. Give an explanation for your answer. | |
| | Answer | Mark |
| | Explanation:<br>• More incidence of TB in the population/eq<br><br>Award one mark for each of the following points in context to a maximum of **two** marks.<br><br>1. Ref to opportunistic infection<br><br>2. HIV positive people have weakened immune system<br><br>3. A higher proportion of HIV positive people are infected by TB | 3 |

| Question Number | Question | |
|---|---|---|
| 7.(c) | TB is increasing in some countries which have well-funded health services. Suggest **two** reasons for this. | |
| | Answer | Mark |
| | Award one mark for each of the following points in context to a maximum of **two** marks.<br><br>1. TB bacteria {mutate / become resistant to antibiotics}<br><br>2. immigration from countries with high incidence of TB<br><br>3. increased travel<br><br>4. increase in HIV infection<br><br>5. lower rates of immunisation against TB | 2 |

| Question Number | Question | |
|---|---|---|
| 8.(a)(i) | Distinguish between bacteriostatic and bacteriocidal antibiotics. | |
| | Correct Answer | Mark |
| | Bacteriostatic prevent bacteria multiplying and bacteriocidal kill bacteria | 1 |

| Question Number | Question | |
|---|---|---|
| 8.(a)(ii) | Suggest why mammalian cells are unharmed by antibiotics. | |
| | Correct Answer | Mark |
| | Award one mark for each of the following points up to a maximum of **two** marks.<br><br>Mammalian cells:<br>1. are eukaryotic<br><br>2. have different enzymes<br><br>3. do not have cell walls<br><br>4. have {80s / larger/eq} ribosomes / different protein synthesis | 2 |

| Question Number | Question | |
|---|---|---|
| 8.(b) | Suggest ways by which doctors and patients can help to prevent the further spread of antibiotic resistance in bacteria. | |
| | Answer | Mark |
| | Award one mark for each of the following points up to a maximum of **three** marks.<br><br>1. do not prescribe antibiotics for minor infections /viral infections<br><br>2. do not prescribe antibiotics to prevent infections<br><br>3. reference to narrow spectrum antibiotics<br><br>4. ref to rotation in the use of different antibiotics<br><br>5. {advise / take} the full course of antibiotics<br><br>6. ref to hand-washing (between patients / by visitors of hospitals)<br><br>7. use of isolation wards | 3 |

| Question Number | Question | |
|---|---|---|
| 8.(c) | Describe a procedure that you have used to investigate the effect of different antibiotics on bacterial growth. | |
| | Answer | Mark |
| | Award one mark for each of the following points up to a maximum of **four** marks.<br><br>1. Ref. to a specific aseptic technique<br><br>2. Bacterial lawn/pour plate<br><br>3. Use of antibiotic discs / antibiotics incorporated into agar /eq<br><br>4. Incubate for 24-36 hours<br><br>5. At 25-30 °C<br><br>6. Record bacterial growth/eq | 4 |