



Mark Scheme (Results)

October 2017

Pearson Edexcel International Advanced
Level Biology (WBI04) Paper 01
The Natural Environment and Species
Survival

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October 2017

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

| Question Number | Answer | Mark |
|-----------------|--|------------|
| 1(a)(i) | <p>D - thylakoid membrane</p> <p>The only correct answer is D</p> <p>A is not correct because the matrix is in the mitochondria</p> <p>B is not correct because electron transport occurs in the thylakoid membrane</p> <p>C is not correct because electron transport occurs in the thylakoid membrane</p> | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---|------------|
| 1(a)(ii) | <ol style="list-style-type: none"> 1. idea of moving protons (through the thylakoid membrane) into thylakoid space ; 2. idea of protons moving through ATP synthase channel (back into stroma) {releases energy to make ATP / produces reduced NADP / eq} ; 3. (ATP / reduced NADP used) for conversion of GP into GALP / eq ; | 1 ACCEPT results in accumulation of protons in thylakoid space | (2) |

| Question Number | Answer | Mark |
|------------------|--|------------|
| 1(a)(iii) | <p>C - 30 °C to 40 °C</p> <p>The only correct answer is C</p> <p>A is not correct because the optimum temperature lies between 30 °C to 40 °C</p> <p>B is not correct because the optimum temperature lies between 30 °C to 40 °C</p> <p>D is not correct because the optimum temperature lies between 30 °C to 40 °C</p> | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---|------------|
| 1(b)(i) | <ol style="list-style-type: none"> 1. to act as a catalyst ; 2. carbon fixation / eq ; 3. (so that) {GP / 6C intermediate} is formed ; | <p>1 ACCEPT lowers activation energy</p> <p>2 ACCEPT CO₂ binding to RuBP / CO₂ reacting with RuBP</p> | (3) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---|------------|
| 1(b)(ii) | <ol style="list-style-type: none"> 1. (μmol) {concentration / mass} of {product made / named product made} ; 2. (m^{-2}) leaf area ; 3. (s^{-1}) idea of time being measured ; 4. (mean) adding together the data and dividing by the number of results / eq ; 5. idea of measuring initial rate (of reaction) ; | <p>1 e.g. 6C intermediate, GP, GALP, glucose, oxygen ACCEPT {substrate used / named substrate used} e.g RuBP, CO_2 ALLOW volume of CO_2 / oxygen IGNORE amount 2 ACCEPT description of how this could be done e.g. draw round leaf and count squares and convert into m^2 IGNORE chloroplast</p> <p>3 ACCEPT stated period of time of at least 10 seconds</p> | (3) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---|------------|
| 1(c) | <ol style="list-style-type: none"> 1. RUBISCO data are reliable as a mean has been calculated / eq; 2. (RUBISCO data are) reliable as {error bars / eq} / eq ; 3. idea that (RUBISCO data are) not reliable as overlapping error bars ; 4. electron transport data may not be reliable as a mean has not been calculated / eq ; 5. (electron transport data) may not be reliable as there are no {error bars / eq} / eq; | <p>1 ACCEPT investigation has been repeated at each temperature</p> <p>2 ACCEPT reliable at {10°C / 40°C / 50°C} as {no overlap / small error bars}</p> <p>3 ACCEPT not reliable as long error bar at 30°C</p> | (3) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---|------------|
| *2(a) | <p>QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence</p> <p>Inflammation:</p> <ol style="list-style-type: none"> 1. {increased blood flow / eq} to the (infected) area ; 2. carrying {phagocytes / white blood cells / named white blood cell} ; <p>Interferon:</p> <ol style="list-style-type: none"> 3. binds to (uninfected host) cells / eq ; 4. prevents {infection by / attachment of / replication of / assembly of / multiplication of / eq} virus ; <p>Phagocytosis:</p> <ol style="list-style-type: none"> 5. to engulf {bacteria / virus / pathogen} / eq ; 6. so that {bacteria / virus / pathogen / antigen} can be {destroyed / digested / eq} ; 7. by enzymes / eq ; 8. idea that after phagocytosis the macrophage can present antigen ; | <p>QWC emphasis on clarity of expression</p> <p>1 ACCEPT vasodilation (of arteries) / eq 2 IGNORE macrophage</p> <p>4 DO NOT ACCEPT growth, bacteria IGNORE pathogen</p> <p>5 ACCEPT antigen</p> <p>6 ACCEPT kills but DO NOT ACCEPT kills {viruses /antigen}</p> | (6) |

| Question Number | Answer | Mark |
|-----------------|---|------------|
| 2(b)(i) | <p>B - glycosidic</p> <p>The only correct answer is B</p> <p>A is not correct because it is not a bond between a fatty acid and a glycerol</p> <p>C is not correct because it is not a bond between two amino acids</p> <p>D is not correct because it is not a bond between a phosphate group and a pentose sugar</p> | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--------------------------|---------------------|------------|
| 2(b)(ii) | water / H ₂ O | | (1) |

| Question Number | Answer | Additional guidance | Mark |
|------------------|---|--|------------|
| 2(b)(iii) | <ol style="list-style-type: none"> viruses surrounded by {envelope / protein coat / capsid / eq} ; so these bonds are not present ; | <p>1 ACCEPT viruses do not have {a cell wall / these molecules}</p> <p>2 ACCEPT outside of virus does not fit active site of the enzyme</p> <p>IGNORE named bonds</p> | (2) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|---|------------|
| 3(a)(i) | 1. $GPP = 1680$ and $R = 960$; 2. $NPP = 1680 - 960 = 720$; | NB Units not required 2 CE applies if calculation has used both values for GPP and R and includes either 1680 or 960 given | (2) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|--|------------|
| 3(a)(ii) | 1. 65% of 720 ($720 \times 65 / 100$) = 468 ; 2. $720 + 468 = 1188$; | 1 CE applies from (a)(i) 2 CE applies | (2) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---|------------|
| 3(b) | <ol style="list-style-type: none"> 1. (overall) GPP is decreasing (with age) / eq ; 2. at a faster rate than R / eq ; 3. more growth occurs in young trees / less growth in older trees / eq ; 4. idea that rate of photosynthesis decreases with age ; 5. credit reason for photosynthesis decreasing ; 6. idea that the mineral ions in the soil will be depleted ; 7. R decreases because some of the trees are {not respiring / dead / eq} ; | <p>2 ACCEPT converse</p> <p>4 ACCEPT description of photosynthesis</p> <p>5 e.g. lower ratio of leaves : rest of tree in older trees, 'trunk is thickening but no more leaves', trees shade each other</p> <p>7 DO NOT ACCEPT idea that trees are being removed from the area</p> | (4) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---|------------|
| 3 (c) | <ol style="list-style-type: none"> 1. reforestation {increases / eq} photosynthesis ; 2. more {trees / photosynthesis} removes carbon dioxide from the atmosphere ; 3. idea that cars put more {carbon dioxide / carbon} into the atmosphere than trees can remove ; 4. idea that large {areas of forest / numbers of trees} would be needed to compensate for all the carbon dioxide being put into the atmosphere ; 5. idea that there are more than just cars putting carbon dioxide into the atmosphere ; 6. idea that land being used to grow trees may be needed for {housing / farming / eq} ; | <p>1 ACCEPT more plants to photosynthesise</p> <p>NB `more trees to photosynthesise so more carbon dioxide taken up' = mp 1+2 `more plants to photosynthesise and take up carbon dioxide' = mp 1+2</p> <p>5 ACCEPT an example e.g. respiration by animals</p> | (4) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|--|------------|
| *4 | <p>(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence)</p> <ol style="list-style-type: none"> 1. idea that some would die (straightaway) ; 2. because of {exhaustion / dehydration / lack of food on island / predation / disease / eq } ; 3. idea that (original) iguanas would breed together (population increased) ; 4. idea of mutations in {DNA / genes} occurring ; 5. idea that conditions {on / within} Anguilla were different ; 6. idea of different selection pressures ; 7. idea that most adapted iguanas {survived / reproduced / eq} passing alleles onto offspring ; 8. idea of reproductive isolation occurring (after time on Anguilla) ; 9. therefore new species of iguana could evolve ; 10.by natural selection ; | <p>QWC emphasis logical account</p> <p>5 ACCEPT an appropriate example</p> <p>7 DO NOT ACCEPT genes / features / characteristics</p> <p>8 ACCEPT a description e.g. different breeding seasons</p> <p>9 ALLOW subspecies / speciation</p> | (6) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|--|------------|
| 5(a)(i) | <p>1. to provide protection to the newborn baby against {infection / pathogen / named pathogen / toxin } ;</p> <p>2. until (newborn baby's) own immune system develops / eq ;</p> | <p>1 ACCEPT disease provides (natural) passive immunity</p> <p>2 ACCEPT idea that a newborn baby's immune system is {not developed / weak}</p> | (2) |

| Question Number | Answer | Mark |
|-----------------|---|------------|
| 5(a)(ii) | <p>D - natural passive</p> <p>The only correct answer is D</p> <p>A is not correct because antibodies passed on from the mother is natural</p> <p>B is not correct because antibodies passed on from the mother is natural and passive</p> <p>C is not correct because antibodies passed on from the mother is passive</p> | (1) |

| Question Number | Answer | Additional guidance | Mark |
|------------------|---|---|------------|
| 5(a)(iii) | <ol style="list-style-type: none"> 1. to {bind / present (to themselves)} antigen ; 2. B cells become plasma cells ; 3. (so that) antibody can be {produced / released / eq} (from plasma cells) ; 4. for {opsonisation / agglutination / antitoxin / eq } ; 5. B cells generate (B) memory cells ; 6. for long term immunity / rapid response on reinfection / eq; | <p>1 ACCEPT act as antigen-presenting cells (to themselves) NB Accept mp 2 and 3 in context of primary or secondary immune response 3 ACCEPT idea that B cells are involved in the humoral (immune) response</p> | (4) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|---|------------|
| 5(b)(i) | <ol style="list-style-type: none"> 1. substance / eq ; 2. that stimulates {immune response / antibody production (by plasma cells) / eq} ; | <p>1 ACCEPT protein / chemical / molecule / appropriate named molecule / particle 2 ACCEPT {recognition / identification / eq} of {non-self / pathogen / eq}</p> | (2) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|--|------------|
| 5(b)(ii) | <ol style="list-style-type: none"> 1. maternal antibodies will {bind to/ attach to / stick to / agglutinate / opsonise /eq} the {antigen / eq} (in the vaccine) ; 2. phagocytes will {engulf / destroy / eq} the {antigen / eq} ; 3. (the child's) immune system is not activated / eq; 4. credit details of what would not happen ; | <p>2 ACCEPT antibodies will neutralise the toxin DO NOT ACCEPT antibodies destroy antigen</p> <p>3 ACCEPT no {(artificial) active immunity / humoral response} 4 e.g. macrophages cannot present the antigen, B cells cannot bind to antigen, no plasma cells, no memory cells</p> | (3) |

| Question Number | Answer | Mark | | | | |
|-----------------|---|---------------|--------------------|-------------|------------------|------------|
| 6(a)(i) | <p>A <table border="1" data-bbox="439 331 1413 408"> <tr> <td>transcription</td> <td>post-transcription</td> <td>translation</td> <td>post-translation</td> </tr> </table> ;</p> <p>The only correct answer is A</p> <p>B is not correct because post-transcription comes after transcription</p> <p>C is not correct because post-transcription comes after transcription</p> <p>D is not correct because translation comes after post-transcription</p> | transcription | post-transcription | translation | post-translation | (1) |
| transcription | post-transcription | translation | post-translation | | | |

| Question Number | Answer | | | | | |
|-----------------|--|-----------|-----------------|-----------|-----------------|--|
| 6(a)(ii) | <p>C <table border="1" data-bbox="454 876 1384 952"> <tr> <td>nucleus</td> <td>nucleus</td> <td>ribosomes</td> <td>Golgi apparatus</td> </tr> </table> ;</p> <p>The only correct answer is C</p> <p>A is not correct because translation occurs on the ribosomes</p> <p>B is not correct because transcription occurs in the nucleus</p> <p>D is not correct because translation occurs on the ribosomes</p> | nucleus | nucleus | ribosomes | Golgi apparatus | |
| nucleus | nucleus | ribosomes | Golgi apparatus | | | |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---|------------|
| 6(b)(i) | <ol style="list-style-type: none"> idea that a correlation is when a change in one {variable / factor} is reflected by a change in another {variable / factor} ; idea that there is no {proof / evidence} that a change in one variable {causes / results in / eq} a change in the other variable ; | <p>1 ACCEPT reference to change once DO NOT ACCEPT {causes / affects / responsible for / eq}</p> <p>2 ACCEPT no evidence for a causal relationship</p> <p>NB for 2 marks to be awarded there must be some context i.e {time / severity of disease / eq} and calcitonin levels,</p> | (2) |

| Question Number | Answer | Additional guidance | Mark | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------|--|--|-------------|------------------------|--------------------------|---|----|----|---|------|---------|---|-----------|---------|---|------|----|---|------|----|----|------|----|----|---|-------|------------|
| 6(b)(ii) | <ol style="list-style-type: none"> idea that the doubling time is more than 24 months (at any one time) ; treatment is effective /eq ; credit an appropriate calculation to justify either mp 1 or mp 2 ; | <p>1 ACCEPT has not doubled in 24 months</p> <p>3 e.g.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Time period</th> <th>Doubling time / months</th> <th>% increase in calcitonin</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>36</td> <td>50</td> </tr> <tr> <td>2</td> <td>31.2</td> <td>67 / 68</td> </tr> <tr> <td>4</td> <td>31.2/33.6</td> <td>79 / 80</td> </tr> <tr> <td>6</td> <td>38.4</td> <td>55</td> </tr> <tr> <td>8</td> <td>38.4</td> <td>57</td> </tr> <tr> <td>10</td> <td>43.2</td> <td>50</td> </tr> <tr> <td>12</td> <td>-</td> <td>51/52</td> </tr> </tbody> </table> | Time period | Doubling time / months | % increase in calcitonin | 0 | 36 | 50 | 2 | 31.2 | 67 / 68 | 4 | 31.2/33.6 | 79 / 80 | 6 | 38.4 | 55 | 8 | 38.4 | 57 | 10 | 43.2 | 50 | 12 | - | 51/52 | (3) |
| Time period | Doubling time / months | % increase in calcitonin | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 36 | 50 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 31.2 | 67 / 68 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 31.2/33.6 | 79 / 80 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | 38.4 | 55 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | 38.4 | 57 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | 43.2 | 50 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | - | 51/52 | | | | | | | | | | | | | | | | | | | | | | | | | |

| Question Number | Answer | Additional guidance | Mark |
|------------------|---|---|------------|
| 6(b)(iii) | <ol style="list-style-type: none"> 1. calcitonin is an antigen ; 2. idea that antibodies bind to {calcitonin /specific molecule / eq} ; 3. idea that antibodies can be labelled to be visualised ; | <p>1 ACCEPT has antigens</p> <p>3 e.g. fluorescence, radiolabelled, dye, enzyme ACCEPT idea of change in levels of {calcitonin / antibody} when mixed together / idea if antibody to calcitonin is present calcitonin must be too</p> | (3) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|--|------------|
| 6(c) | <ol style="list-style-type: none"> 1. post-transcriptional {modification / eq} (of RNA) ; 2. reference to spliceosomes ; 3. idea that (mRNA) introns (and exons) can be removed ; 4. idea that {exons are recombined / (different) RNA} (coding) for either CGRP or calcitonin ; | <p>1 ACCEPT RNA splicing</p> <p>4 ACCEPT (coding for) {either / each} (CGRP and calcitonin) proteins</p> | (3) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|--|------------|
| 7(a) | <ol style="list-style-type: none"> idea that locusts food store (fat) has a high energy content ; idea that their metabolic rate is lower so that energy is not used as quickly ; idea that they do not use as much of their {food / energy} store because hourly consumption is low ; | <p>2 ACCEPT idea of {do not require so much energy / can use stored energy for a longer time}</p> | (3) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|---|---|------------|
| 7(b)(i) | <ol style="list-style-type: none"> idea of using eggs to obtain the locusts ; idea of timing each stage of development ; growth measured by {length / (fresh) mass / eq} (of locust) ; idea of dividing growth measurement by time (to calculate rate) ; idea of using several {locusts / eggs} to calculate a mean ; credit a named relevant control variable being kept constant (if more than one {locust / egg} used) ; | <p>1 ACCEPT idea of starting with eggs and locusts at each stage</p> <p>3 ACCEPT description of how it is measured</p> <p>4 ACCEPT plot a graph of growth measurement against time and work out the gradient</p> <p>6 e.g. species, gender, type of food, humidity IGNORE light, water, food, temperature</p> | (4) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|--|------------|
| 7(b)(ii) | <ol style="list-style-type: none"> idea that {growth / life cycle / development} is controlled by enzymes ; credit explanation of effect of temperature on enzyme action ; | <p>1 IGNORE metabolism, respiration</p> <p>2 e.g. increase in temperature increases number of enzyme-substrate complexes, increase in temperature may denature enzymes</p> | (2) |

| Question Number | Answer | Mark |
|-----------------|---|------------|
| 7(c)(i) | <p>A carbon dioxide, methane and water vapour</p> <p>The only correct answer is A</p> <p>B is not correct because oxygen is not a greenhouse gas</p> <p>C is not correct because oxygen is not a greenhouse gas</p> <p>D is not correct because oxygen is not a greenhouse gas</p> | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|--|------------|
| 7(c)(ii) | <ol style="list-style-type: none"> 1. locusts will reduce global warming / eq ; 2. idea that if less {greenhouse gases / carbon dioxide} produced there will be less accumulation (of gases in the atmosphere) ; 3. idea that {greenhouse gases / carbon dioxide} trap {infra-red radiation / eq} (in the atmosphere) ; 4. therefore the temperature of the earth's {atmosphere / surface} will not increase (as much) ; | <p>2 IGNORE other named greenhouse gases</p> <p>3 ACCEPT absorb, heat energy, long wavelength IGNORE other named greenhouse gases</p> | (3) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|---|------------|
| 8(a) | (mitochondrial) membrane proteins / matrix enzymes / enzymes involved in (aerobic) respiration / ribosome proteins / named protein found in mitochondria e.g. ATP synthase ; | electron transport proteins / enzymes involved in (mitochondrial) {DNA / RNA / protein} synthesis | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|---|------------|
| 8(b)(i) | <p>Similarities:</p> <ol style="list-style-type: none"> 1. idea that both strands in each DNA molecule are acting as templates ; 2. idea that each new DNA molecule consists of one old strand and one newly-synthesised molecule ; 3. {(DNA mono)nucleotides / primers / DNA polymerase} used ; <p>Differences:</p> <ol style="list-style-type: none"> 4. heat is used in PCR to separate strands whereas the cell uses {enzymes / helicase} / eq ; 5. PCR temperatures are higher than cell temperatures ; 6. PCR is quicker ; | <p>DO NOT PIECE TOGETHER</p> <p>2 ACCEPT producing identical molecules / both involved complementary base pairing 3 IGNORE PCR uses primers semi-conservative replication does not</p> <p>4 ACCEPT PCR uses Taq polymerase but cells do not / cells use ligase but PCR does not ;</p> <p>5 ACCEPT PCR temperatures vary but cell temperatures do not 6 ACCEPT converse for S-CR</p> | (4) |

| Question Number | Answer Additional guidance | Mark |
|-----------------|---|------------|
| 8(b)(ii) | <p>C smaller DNA fragments move further because they travel faster than the larger fragments</p> <p>The only correct answer is C</p> <p>A is not correct because larger DNA fragments do not push the smaller fragments</p> <p>B is not correct because larger fragments do not have more negative charges</p> <p>D is not correct because smaller fragments do not have more negative charges</p> | (1) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|---|------------|
| 8(c) | <ol style="list-style-type: none"> 1. idea that mt DNA is unique to the individual ; 2. idea that mitochondria {persist longer than nuclei / are still present but nuclei are not in the skeleton }; 3. idea that there are many mitochondria present ; 4. so there would be multiple copies of the DNA ; | <p>NB Accept mitochondria or mtDNA throughout where appropriate</p> <p>4 ACCEPT any indication that there is more mtDNA</p> | (2) |

| Question Number | Answer | Additional guidance | Mark |
|-----------------|--|--|------------|
| 8(d) | <ol style="list-style-type: none"> 1. mitochondria only inherited from the mother / eq ; 2. mitochondria are present in the {secondary oocyte / ovum } ; 3. mitochondria are present in the {mid-piece / neck / eq} (of the sperm) / eq ; 4. which does not enter the {secondary oocyte / ovum} (on fertilisation) ; 5. idea that an individual's mitochondria are derived from the zygote ; | <p>NB Accept mitochondria or mtDNA throughout where appropriate</p> <p>2 ACCEPT egg cell / female gamete IGNORE egg</p> <p>4 ACCEPT sperm mitochondria do not enter secondary oocyte</p> <p>5 ACCEPT idea that the child's mtDNA will be copied from the mother's mtDNA</p> | (3) |

