

# Mark Scheme (Results)

## October 2022

Pearson Edexcel International Advanced Level
In Biology (WBI14) Paper 01
Energy, Environment, Microbiology
and Immunity

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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

| | Answer | Mark |
|---|---|---|
| **1(a)** | The only correct answer is **A** $\log_{10}$ number of living bacterial cells<br><br>**B** *is incorrect because the total cell number plotted would not sow the death phase*<br>***C*** *is incorrect because the exponential phase would not be a straight line*<br>***D*** *is incorrect because the exponential phase would not be a straight line* | **(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **1(b)(i)** | An explanation that includes the following points:<br><br>• because we do not want {other bacteria in the culture / contamination} (1)<br><br>• as they could {compete for nutrients / produce toxins (to the bacteria being cultured)}<br><br>**OR**<br><br>• because we do not want to transfer the bacteria onto {ourselves / surroundings}<br><br>• as they may be {pathogenic / harmful} (1) | **ACCEPT** microorganisms / pathogens<br><br>**ACCEPT** microorganisms<br>competition for space<br><br>**ACCEPT** prevent infection | **(2)** |

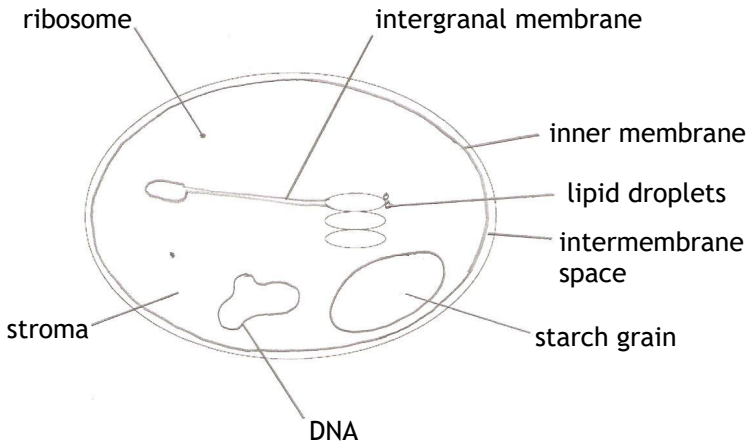
| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **1(b)(ii)** | An explanation that includes the following points:<br><br>• one named technique explained (1)<br><br>• a second named technique explained (1) | e.g.<br>working by a Bunsen burner<br>+<br>to create an updraft / to move the microorganisms in the air away / to prevent {bacteria / microorganisms / spores} falling into culture<br>**IGNORE** kill bacteria in the air<br><br>autoclaving {agar / culture fluid / equipment}<br>using sterile equipment<br>disinfecting work area<br>washing hands<br>+<br>to kill any {bacteria / microorganisms / spores} present<br><br>washing hands<br>flaming necks od bottles<br>+<br>to prevent transferring {bacteria / microorganisms / spores} into cultures<br><br>reducing exposure of cultures to air<br>+<br>to reduce chance of contamination<br><br>close {doors / windows}<br>+<br>to avoid draughts | **(2)** |

| Question number | Answer | Mark |
|---|---|---|
| 2(a) | <table><tr><th rowspan="2">Structure</th><th colspan="4">Virus</th></tr><tr><th>Ebola only</th><th>HIV only</th><th>both Ebola and HIV</th><th>neither Ebola nor HIV</th></tr><tr><td>DNA</td><td>[x]</td><td>[x]</td><td>[x]</td><td>[x]</td></tr><tr><td>helical capsid</td><td>[x]</td><td>[x]</td><td>[x]</td><td>[x]</td></tr><tr><td>envelope</td><td>[x]</td><td>[x]</td><td>[x]</td><td>[x]</td></tr></table> | (3) |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 2(b)(i) | • (RNA) reverse transcriptase | **ACCEPT** RNA-dependent DNA polymerase<br>DNA nucleotidyltransferase (RNA-directed) revertase<br><br>**DO NOT ACCEPT** other named enzymes / molecules | (1) |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **2(b)(ii)** | • (this DNA polymerase found in cancer cells) so healthy cells will not be affected by the drug | **ACCEPT** so that DNA synthesis will not occur and the cancer cells cannot divide | **(1)** |

| Question number | Answer | Mark |
|---|---|---|
| **3(a)** | The only correct answer is **B**<br><br>ADP is phosphorylated, requiring energy \| ATP is hydrolysed, releasing energy<br><br>**A** *is incorrect because energy is not released when ADP is phosphorylated*<br>***C*** *is incorrect because ADP is not hydrolysed in the light-dependent reactions*<br>***D*** *is incorrect because ADP is not hydrolysed in the light-dependent reactions* | **(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **3(b)(i)** | An answer that includes three of the following points:<br><br>• DNA (loop) (1)<br>• stroma<br>• starch {grain / granule} (1)<br>• inner membrane (1)<br>• inter membrane space<br>• intergranal membrane / (stromal) lamellae / intergranal thylakoid (1)<br>• (small / 70S) ribosome (1)<br>• lipid droplets | **DO NOT ACCEPT** if drawn as linear DNA<br><br>**DO NOT ACCEPT** stoma<br><br><br> | **(3)**<br>**EXP** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **3(b)(ii)** | An answer that includes four of the following points:<br><br>**Similarities:**<br><br>• both {consist of phospholipid bilayer / contain phospholipids} (1)<br><br>• both have proteins (1)<br><br>**Differences:**<br><br>• thylakoid membrane has ATP synthase but outer membrane does not (1)<br><br>• thylakoid membrane has {chlorophyll / carotenoids / light-absorbing pigments / PS I / PS II} but outer membrane does not (1)<br><br>• thylakoid membrane has electron carriers but outer membrane does not (1) | **DO NOT PIECE TOGETHER**<br><br>**ACCEPT** ATPase | **(4)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **4(a)** | The only correct answer is **A** 4524 $cm^3$<br><br>**A** *is incorrect because the answer has been incorrectly rounded*<br>***C*** *is incorrect because the diameter has been used and the answer incorrectly rounded*<br>***D*** *is incorrect because the diameter has been used* | | **(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **4(b)(i)** | • scale worked out as 300 (1)<br><br>• 750 / 780 (years) (1) | | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **4(b)(ii)** | An explanation that includes four of the following points:<br><br>• type of plant present when conditions are favourable (1)<br><br>• type F found for greater number of years because { lives in a range of conditions / conditions did not change (much) / no competition from other (plant) species} (1)<br><br>• conditions changed allowing type {D / E} to grow (1)<br><br>• credit reason for a type of plant to disappear (1)<br><br>• credit example of what plants are competing for (1) | **NB** Accept pollen grains for plants<br><br>**ACCEPT** named condition<br>different plants grew at different times because conditions were different<br>in context of the plant types<br><br>**ACCEPT** named condition that did not change<br><br>**ACCEPT** named condition<br><br>e.g F disappeared because conditions changed<br>E disappeared because of competition from another species<br><br>e.g. space, light, water, nutrients | **(4)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **5(a)(i)** | • 113 | | **(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **5(a)(ii)** | An explanation that includes the following points:<br>• (albumin / R groups) {negatively charged / polar / hydrophilic} (1)<br>• and will therefore dissolve in the {water / blood <u>plasma</u>} (1)<br>• forms hydrogen bonds with water (1) | **ACCEPT** water / plasma is a polar solvent<br>**ACCEPT** description of H bonds / weak bonds / Van der Waals forces<br>**DO NOT ACCEPT** ionic bonds | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **5(b)(i)** | • 1.175 ($g\ dm^{-3}$) | **ACCEPT** 3 / 3.2 / 3.24 (times higher) | **(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **5(b)(ii)** | An explanation that includes the following points:<br>• (thickest band) albumin is the most concentrated (in this sample) (1)<br>• (moved the furthest) albumin could be the most soluble (1)<br>• in the solvent used (1)<br>• (moved the furthest) albumin could be the {lowest mass / lightest} (1) | **ACCEPT** more albumin present<br>**ACCEPT** most (negatively) charged | **(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **5(c)** | An explanation that includes the following points:<br><br>• 15 μmol $dm^{-3}$. is too low to activate the channel / 500 μmol $dm^{-3}$ will activate the channel (1)<br><br>• therefore sperm will not be activated in the {seminal fluid / male} / therefore sperm activated in the {uterus / female} (1)<br><br>• this will avoid waste of {resources / named resource} (1)<br><br>• so more {viable / healthy} sperm (1)<br><br>• so more likely fertilisation will take place (1) | **ACCEPT** refs to high or low concentrations<br><br>**ACCEPT** fewer sperm activated / more sperm activated<br>prevent early activation<br>sperm can swim faster / acrosome enzymes will be released / sperm ready to digest the egg cell membrane<br><br>e.g. energy / ATP / acrosome<br><br>**ACCEPT** successful | **(4)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **6(a)** | A description that includes three of the following points:<br>• whether it caused side effects (in humans) (1)<br>• whether or not it reduced the size of the plaques (1)<br>• {(an effective) concentration / the half life} of the drug (1)<br>• the (best) method to administer the drug (1)<br>• how long to administer drug (for amyloid to be destroyed) (1) | **ACCEPT** named side effect e.g. allergic reaction<br>**ACCEPT** {plaque / amyloid} disappeared better than existing drugs effective<br>**ACCEPT** dose | **(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **6(b)(i)** | An explanation that includes the following points:<br>• antibodies can <u>only</u> bind to their antigen / this antibody can <u>only</u> bind to ß amyloid (1)<br>• because of the (complementary) shape of {antigen / antibody} (1) | **ACCEPT** FAB region / FAB receptor / receptor | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **6(b)(ii)** | An answer that includes the following points:<br><br>• {ATD / antibodies} will bind to the amyloid (1)<br><br>• macrophages engulf the amyloid (1)<br><br>• macrophages {destroy / digest} the amyloid with {enzymes / lysozymes} (1) | **ACCEPT** opsonisation<br><br>**ACCEPT** phagocytes / neutrophils<br><br>**ACCEPT** phagocytes / neutrophils protease<br>**DO NOT ACCEPT** lysosome | **(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **6(c)(i)** | An answer that includes the following points:<br><br>• because their immune system had already been activated (against amyloid) (1)<br><br>• and therefore {the amyloid was broken down / plaques could not form} (by phagocytes) (1) | **ACCEPT** a description e.g. a primary immune response had already taken place, the person had memory cells (to amyloid)<br>antibodies present<br><br>**DO NOT ACCEPT** by antibodies / B cells | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **6(c)(ii)** | An explanation that includes the following points:<br><br>• because people with Alzheimer's disease will not have these memory cells (1)<br><br>• and therefore there will not be any memory cells that can differentiate into the plasma cells that produce the antibody (1) | **ACCEPT** B memory cells not effective<br><br>**ACCEPT** no memory cells that will result in the production of antibody<br>**DO NOT ACCEPT** no memory cells to produce the antibody | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **7(a)** | An explanation that includes the following points:<br><br>• because MRSA has developed {antibiotic / methicillin} resistance (1)<br><br>• so we have had to find new drugs that this bacteria is not resistant to (1) | **NB ACCEPT** pathogens / bacteria throughout<br>**DO NOT ACCEPT** immune for resistance throughout<br><br>**ACCEPT** spreading / increasing<br><br>**ACCEPT** that will destroy it | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **7(b)** | An explanation that includes the following points:<br><br>• because skin flora {prevent the growth of / destroy / kill} {other bacteria / pathogens} (1)<br><br>• by competing for {space / nutrients} / producing toxins (1) | **ACCEPT** provide a barrier in protecting the body from infection<br><br>**ACCEPT** produce lactic acid<br>**DO NOT ACCEPT** sebum | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **7(c)** | An answer that includes two of the following points:<br><br>• (if the bacteria are weaker) they will {not reproduce as fast / infect fewer cells} (1)<br><br>• therefore there will be fewer toxins produced (1)<br><br>• therefore an immune response will be more effective (1) | **ACCEPT** descriptions e.g. macrophages will be able to engulf more, more antibodies produced, more T killer cells activated | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **7(d)(i)** | An explanation that includes the following points:<br><br>• so that the size of the infection with the solvent could be measured (1)<br><br>• so that the effect of the drug itself can be determined (1) | **ACCEPT** to show {the effect of Castaneroxy / that Castaneroxy is effective} | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **7(d)(ii)** | An answer that includes any **two** of the following points:<br><br>• comment about effect of Castaneroxy on size during time period 0 and 6 days (1)<br><br>• comment made about Castaneroxy (compared to solvent) on size during time period {0 / 6} and 14 days (1)<br><br>• comment comparing the two concentrations of Castaneroxy (1)<br><br>**AND**<br><br>• credit calculation to quantify reduction in size (1) | e.g. Castaneroxy does not prevent increase in size, the size does not increase as much as the solvent<br><br>e.g. Castaneroxy reduces mean size<br><br>e.g. Castaneroxy at high concentration decreases the size more than at lower concentrations, high concentrations clear up the infection completely but low concentrations do not | **(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 7(d)(iii) | • mass of Castaneroxy A needed in 1 $dm^3$ calculated (1)<br>• mass of leaves needed for 50 000 µg (1)<br>• converted into kg and rounded up to 3 (kg) (1)<br>**OR**<br>• 50 µg converted into kg (1)<br>• mass needed in 1 litre (1)<br>• converted into kg and rounded up to 3 (kg) | 50 000<br>2 631 578 947<br>0.00000005<br>0.00005 | **(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 8(a)(i) | • anthropogenic (climate change / activity / events) | | **(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **8(a)(ii)** | An explanation that includes the following points:<br><br>• because {there is no evidence that climate change has actually caused the forest fires / it is only a correlation} (1)<br><br>• because certain {parties / politicians / business people} {have different opinions / want to continue their activities} (1)<br><br>• forest fires are caused for other reasons / other (non-human) factors cause climate change (1)<br><br>• lack of education (1) | **ACCEPT** lack of trust in scientists<br><br>**ACCEPT** named factor e.g. volcanic eruptions, solar flares | **(2)** |

| Question number | Answer | Mark |
|---|---|---|
| *8(b) | **Local atmosphere:**<br><br>• increase in $CO_2$ levels in the atmosphere<br>• increase global warming<br>• increase in soot / smoke<br>• when the organic matter is burnt<br>• soot prevents so much light penetrating<br>• details of global warming<br>• extent depends on {size / frequency} of fires<br>• less $CO_2$ being removed from the atmosphere<br>• as there are fewer trees to photosynthesise<br>• $CO_2$ levels in atmosphere will begin to drop<br>• as $CO_2$ diffuses away from the area<br>• new plants will begin to grow<br>• growing plants will be photosynthesising faster (than established plants)<br>• therefore will be absorbing $CO_2$ from the atmosphere<br>**Local biodiversity:**<br><br>• biodiversity will decrease<br>• because plants and animals are killed<br>• because plant and animal homes will be destroyed<br>• animals depend on plants<br>• effect on food chains<br>• fragmentation of habitat<br>• fewer organisms of a species could affect gene pool<br>• increase in inbreeding further decreasing biodiversity<br>• plants will begin to sprout<br>• seeds will germinate<br>• (secondary) succession begins<br>• increasing biodiversity<br>• as biodiversity of plants increases so does the biodiversity of animals<br>• eventually climax community re-established | **(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. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context. | Simple links made between the forest fires and the effects on biodiversity and atmosphere<br>1 mark = effect of forest fires on either biodiversity or atmosphere<br>2 marks = effect of forest fires on both biodiversity and atmosphere |
| Level 2 | 3-4 | Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts / concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure. | Extended links made the forest fires and the effects on biodiversity and atmosphere<br>3 marks = comments on both biodiversity and atmosphere with extended comment on one<br>4 marks = extended comments made on both biodiversity and atmosphere |
| Level 3 | 5-6 | Demonstrates comprehensive knowledge and understanding by selecting and applying relevant biological facts / concepts. Consequences are discussed which supported throughout by sustained linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured. | Clear discussions on the short-term and long-term effects of the forest fires on biodiversity and atmosphere<br>5 marks = plus clear discussion on the short-term and long-term effects of the forest fires on either biodiversity or atmosphere<br>6 marks = plus clear discussions on the short-term and long-term effects of the forest fires on both biodiversity and atmosphere |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **8(c)** | An explanation that includes four of the following points:<br><br>• choose different trees if original trees not suited to the new conditions (1)<br><br>• credit one change to consider (1)<br><br>• credit second change to consider (1)<br><br>• credit an explanation for one of the choices made (1)<br><br>• consideration of {needs of / needs for} animals (1) | **ACCEPT** keep same trees if they are suited to new conditions<br>Choose trees that are adapted to the new conditions<br>**ACCEPT** increased light intensity if linked to lack of tree cover<br>decreases mineral ions if linked to leaching<br><br>e.gs.<br>fire resistant so less likely to be destroyed again<br>higher productivity {so habitat replaced faster / <u>more</u> carbon dioxide removed from the atmosphere}<br>(drought) so that they will not dehydrate<br>(flooding) so that {ground will not be water-logged / trees do not get washed away<br>(temperature) so that their enzymes will function | **(4)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **9(a)** | • mass of carbon in gt calculated in one year (1)<br>• $1.13 \times 10^{13}$ (kg) (1)<br><br>**OR**<br><br>• mass in gt converted into mass in kg (1)<br><br>• $1.13 \times 10^{13}$ (kg) (1) | 11.3 (gt per year)<br><br>$113 \times 10^{12}$/ $1.13 \times 10^{14}$ / $11.3 \times 10^{13}$ | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 9(b) | A description that includes four of the following points:<br>• GALP converted into glucose (1)<br>• glucose and fructose used to produce sucrose (in the leaves) (1)<br>• {sucrose / amino acids} moved (to the roots) in the phloem (1)<br>• {glucose / sucrose / amino acids} used to make {organic molecules / named organic molecule / named cell component} (in the roots) (1)<br>• credit details of how a named polymer is synthesised (1) | **DO NOT ACCEPT** glucose / protein<br>**DO NOT ACCEPT** chlorophyll<br>e.g. calcium ions used to make (calcium pectate / cell walls), condensation reaction to form starch | **(4)** |

| Question number | | Mark |
|---|---|---|
| 9(c) | | **(3)** |

| Molecule | Inorganic ion | | | |
|---|---|---|---|---|
| | nitrate only | phosphate only | both nitrate and phosphate | neither nitrate nor phosphate |
| cellulose | [x] | [x] | [x] | [x] |
| nucleic acid | [x] | [x] | [x] | [x] |
| triglyceride | [x] | [x] | [x] | [x] |

| Question | Answer | Mark |
|---|---|---|
| *9(d) | **Yearly mean temperature:**<br>• (overall) has the greatest influence /has the greatest influence in forests and shrublands<br>• because temperature affects enzyme activity<br>• details of effects<br>• in plants of all three ecosystems<br>• therefore faster photosynthesis and production of glucose<br>• RUBISCO works faster increasing light-independent reactions<br>• and production of GALP<br>**Soil moisture content:**<br>• has the greatest influence in grasslands / second greatest influence (overall)<br>• because water needed for photolysis / light-dependent reactions<br>• without which photosynthesis will not occur and GALP will not be made<br>• water needed for transpiration and transport of mineral ions<br>• water needed to transport sucrose / amino acids to roots<br>• water maybe more important to trees / grass as they have extensive root systems<br>**Density of trees:**<br>• influential in all ecosystems<br>• high density of trees will cause {competition for light / shading}<br>• so rate of light-dependent reactions will be slower<br>• so less ATP for light-independent reactions<br>• so less biomass available in the roots<br>**Carbon : nitrogen ratio:**<br>• affects all three types of plant to some extent but low importance<br>• plants need soil nitrates for amino acid production<br>• less nitrogen less protein available<br>• protein examples e.g. enzymes, RUBISCO<br>• for active transport of mineral ions<br>**Depth of soil:**<br>• affects trees the most but least importance<br>• soil needed for anchorage / water / mineral ions<br>• because they need deeper soil and more extensive root system<br>• therefore more biomass needed in their roots<br>• shrubs / grass can grow in shallow soil as root system less extensive | **(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. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context. | Simple links made between factors and the ecosystems<br><br>1 mark = simple comment about {one factor / one ecosystem}<br>2 marks = simple comments about {three factors / three ecosystems} |
| Level 2 | 3-4 | Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts / concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure. | Extended links made between factors and ecosystems<br><br>3 marks = extended comments on one factor<br>4 marks = extended comments on two factors |
| Level 3 | 5-6 | Demonstrates comprehensive knowledge and understanding by selecting and applying relevant biological facts / concepts. Consequences are discussed which supported throughout by sustained linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured. | Extended links made between factors and ecosystems that includes discussion about the relative importance of factors in root biomass in the different ecosystems<br><br>5 marks = extended comments on three factors<br>6 marks = extended comments on four factors |

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