GradeMax



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# Mark Scheme (Results)

## January 2020

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.

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 1(a) | Box **A** gross primary productivity (1)<br><br>Box **B** (plant) respiration (1) | **NB** Both correct for one mark<br><br>**ACCEPT** GPP<br><br>**ACCEPT** R<br>energy lost by respiration<br>**DO NOT ACCEPT** energy lost for respiration | **(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 1(b)(i) | organisms interacting with each other<br><br>**AND**<br><br>with (physical / chemical) environment | **ACCEPT** species / plants **and** animals / biotic factors<br>**IGNORE** habitat<br><br>**ACCEPT** abiotic factors / non-living environment<br><br>**e.g.** all organisms interacting with each other and the abiotic factors | **(1)** |

| Question number | Answer | Mark |
|---|---|---|
| 1(b)(ii) | **D** kJ $m^{-2}$ $yr^{-1}$<br><br>The only correct answer is **D**<br><br>***A*** *is incorrect because it is kJ not kg and should be* $m^{-2}$<br>***B*** *is incorrect because it is kJ not kg and should be* $yr^{-1}$<br>***C*** *is incorrect because it should be* $m^{-2}$ | **(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 1(b)(iii) | A calculation that shows the following steps:<br><br>• percentage of NPP contained in the roots (1)<br><br>• units of NPP calculated (1)<br><br>**OR**<br><br>• units of NPP in leaves and wood calculated (1)<br><br>• units of NPP in leaves and wood subtracted from 11 700 (1) | Example of calculation<br><br>27<br><br>3159<br><br><br><br>3978 and 4563 / 8541<br><br>3159<br><br>Correct answer with no working gains 2 marks<br>**IGNORE** any units given | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **2(a)(i)** | An explanation that includes two of the following points:<br><br>• microorganisms are (already) involved in the {carbon cycle / decomposition} (1)<br><br>• because they {produce enzymes (for decomposition) / will be able to produce enzymes for break down of plastics} (1)<br><br>• mutation occurs (that results in the breakdown plastics) (1) | **ACCEPT** microorganisms can (already) break down {polymers / organic molecules}<br>**DO NOT ACCEPT** break down plastics | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **2(a)(ii)** | An explanation that includes the following points:<br><br>• mutation occurs resulting in an enzyme that breaks down plastics (1)<br><br>• (presence of) {plastics / lack of food} acts as a selection pressure (1)<br><br>• these {genes / alleles } are passed onto next generation (by asexual reproduction / conjugation / plasmids) (1) | **NB** this mp can only be awarded if the allele / gene has been linked to breaking down plastics<br>**IGNORE** mitosis | **(3)** |

| Question number | Answer | Mark |
|---|---|---|
| 2(b) | **D**<br><br>hydrolysis \| hydrolysis<br><br>The only correct answer is **D**<br><br>***A*** *is incorrect because molecules break down by hydrolysis and both reactions are breaking molecules down*<br>***B*** *is incorrect because molecules break down by hydrolysis and both reactions are breaking molecules down*<br>***C*** *is incorrect because molecules break down by hydrolysis and both reactions are breaking molecules down* | **(1)** |

| Question number | Answer | Mark |
|---|---|---|
| 3(a) | **A** carbon dioxide and methane<br><br>The only correct answer is **A**<br><br>***B*** *is incorrect because oxygen is not a greenhouse gas*<br>***C*** *is incorrect because oxygen is not a greenhouse gas*<br>***D*** *is incorrect because oxygen is not a greenhouse gas* | **(1)** |

| Question number | Answer | Mark |
|---|---|---|
| 3(b) | **B** 1.1<br><br>The only correct answer is **B**<br><br>***A*** *is incorrect because the data should not be extrapolated from the peaks*<br>***C*** *is incorrect because the data should not be extrapolated from the troughs*<br>***D*** *is incorrect because the general trend is increasing not decreasing* | **(1)** |

| Question number | Answer | Mark |
|---|---|---|
| 3(c) | **B**<br><br>passes through / does not pass through<br><br>The only correct answer is **B**<br><br>***A*** *is incorrect because infra-red is absorbed by greenhouse gases*<br>***C*** *is incorrect because ultraviolet light passes through and infra-red is absorbed by greenhouse gases*<br>***D*** *is incorrect because ultraviolet passes through greenhouse gases* | **(1)** |

| Question number | Answer | Mark |
|---|---|---|
| 3(d)(i) | **A** dendrochronology<br><br>The only correct answer is **A**<br><br>***B*** *is incorrect because entomology is the study of insects*<br>***C*** *is incorrect because epigenetics is the modification of DNA*<br>***D*** *is incorrect because proteomics is the study of proteins* | **(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 3(d)(ii) | An explanation that includes three of the following points:<br><br>• the tree rings (in1970) would be narrower because (mean) temperatures were cooler (1)<br><br>• {enzymes / RUBISCO} would be working more slowly (1)<br><br>• photosynthesis would be slower / less GALP produced (1)<br><br>• therefore less {biomass / organic matter / xylem } would be produced (1) | **Accept the converse for 2010**<br><br>**ACCEPT** smaller rings<br>less carbon dioxide<br>more water wider rings<br><br>**ACCEPT** more xylem if more water stated in 1970<br>**IGNORE** growth | **(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **4(a)(i)** | A calculation showing the following steps:<br><br>• 1% of 47 278 calculated (1)<br><br>• 85.6% calculated and added to 47 278 (1)<br><br>• answer expressed in standard form with between 2 and 5 sig figs (1) | Example of calculation<br><br>1% = 47 278 ÷ 14.4 = 3283.194<br><br>3283.194 × 85.6 + 47 278 = 328319.4<br><br>$3.28 \times 10^5$<br><br>**NB** wrong value correctly expressed in standard form = 1 mark | **(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **4(a)(ii)** | An explanation that includes the following points:<br><br>• biodiversity could decrease as species {become extinct / number decrease} due to {loss of habitat / decrease in food}<br><br>**OR**<br><br>biodiversity could decrease due to as decrease in genetic diversity within a species due to {loss of habitat / decrease in food} (1)<br><br>• population could decrease as organisms (of one species) die because there is not enough {food / habitat / camouflage} (1) | **ACCEPT** territory<br>decrease in species richness<br>**IGNORE** migration<br><br>**ACCEPT** territory<br>starve if not enough food<br>**IGNORE** migration<br><br>Award 1 mark if biodiversity and population given the wrong way round or rolled in together | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **4(b)(i)** | An explanation that includes the following points:<br><br>• behavioural because the moths are drinking where the bees drink (1)<br><br>• {anatomical / physical / structural / morphological} because the moths have the {transparent wings / fur} like the bees (1) | **ACCEPT** blue bands to blend in with the water<br><br>**NB** two explained adaptations given but not linked to type = 1 mark<br>one example given for each stated type of adaptation but no link to bees = 1 mark | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **4(b)(ii)** | An answer that includes two of the following points:<br><br>• deter predators (as they resemble bees / bees sting) (1)<br><br>• the bees may not attack the moths (1)<br><br>• moths are hidden in amongst the bees whilst drinking (1) | **ACCEPT** less likely to be eaten as more (insects) present | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **4(b)(iii)** | An answer that includes three of the following points:<br><br>• amplify the DNA of both species using PCR (1)<br><br>• use of (gel) electrophoresis (1)<br><br>• credit details of gel electrophoresis (1)<br><br>• compare the DNA **bands** of the two moths (1) | <br><br><br><br><br><br>e.g. agarose gel, apply a current, use of dye, use of restriction enzymes | **(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **5(a)(i)** | An answer that includes the following points:<br><br>• {(genetic) code / genetic material / genetic information / genes} for {(viral) proteins / amino acid sequence} (1)<br><br>• credit a named example from the diagram (1) | <br><br>**IGNORE** references to transcription, DNA and RNA synthesis<br><br>e.g. RNA polymerase, VP 40<br>**ACCEPT** glycoproteins / protein coat / capsid<br><br>'carry the genetic code for the proteins shown in the diagram' = 2 marks | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **5(a)(ii)** | An answer that includes two of the following points:<br>• attach to the host cell (1)<br>• by binding to (specific) receptors (1)<br>• avoid host's immune sytem (1) | **ACCEPT** {liver / endothelial / immune} cells<br>**ACCEPT** molecules / antigens / glycoproteins / TIM-1<br>' bind to receptors on host cell' = 2 marks | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **5(b)** | An explanation that includes the following points:<br>• to make (viral) RNA / transcription (of viral RNA) (1)<br>• because the host cell does not have this enzyme (1) | **ACCEPT** mRNA<br>**DO NOT ACCEPT** to make DNA / protein | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **5(c)** | An answer that includes the following points:<br>• (assembling) {**RNA** / (viral) **genome**} and **proteins** (1)<br>• to make a (new) virus particle (1)<br>• credit example given from diagram (1) | **IGNORE** envelope<br>e.g. VP 40 incorporated into the capsid, RNA enclosed in the capsid | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **5(d)** | An explanation that includes the following points:<br><br>• interferon is involved in the non-specific response (against viruses) (1)<br><br>• therefore (if no interferons are produced) the host cells will not be protected from infection with Ebola (1) | **NB ACCEPT** converse where appropriate<br><br>**ACCEPT** inhibits viral replication<br>named examples e.g. stimulates production of protein kinase, reduced protein synthesis, stimulates destruction of RNA, stimulates host cell (self) destruction, increases MHC I antigens on host cells, increases recognition of host cells by T killer cells<br>**DO NOT ACCEPT** {specific / immune response}<br><br>**ACCEPT** virus can {spread / infect other cells}<br><br>**DO NOT ACCEPT** virus being killed or dying throughout<br>**IGNORE** interferons prevent binding of virus to host cells throughout | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **6(a)** | An explanation that includes three of the following points:<br><br>• niche is the role that an organism plays (in its habitat) (1)<br><br>• the two types of barnacles are found on different parts of the rock<br><br>• credit a stated reason (1)<br><br>• which reduces competition (between the two species) (1) | **ACCEPT** a description pieced together<br><br>e.g. food sources / temperature tolerances / dessication rates / rock types | **(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **6(b)(i)** | An answer that includes four of the following points:<br><br>• reliable because the mean is calculated (1)<br><br>• more larvae settled on rock with barnacles, then bare rock, then stones (1)<br><br>• error bars (between rock with barnacles and either of the other two surfaces) do not overlap so this is reliable (1)<br><br>• data for bare rock and stones is less reliable as the error bars are touching (1)<br><br>• the most reliable data is for rock with barnacle as the error bars are relatively smaller than the other sets of data (1) | **ACCEPT** standard deviation / range bars for error bars throughout<br>significant / reproducible and repeatable for reliable throughout<br><br>**ACCEPT** most larvae on the rock with barnacles **and** the least on the stones **PIECE TOGETHER**<br><br>**ACCEPT** error bars (just) overlap | **(4)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **6(b)(ii)** | An answer that includes four of the following points:<br><br>• all three surfaces set up in (same) {container / water} (1)<br><br>• all surfaces should have the same (surface) area (1)<br><br>• stated number (min 100) of larvae added to the tank (1)<br><br>• leave for a period of time (for larvae to settle) (1)<br><br>• calculate number of larvae per unit area / experiment repeated (minimum 3 times) and the mean and standard deviation calculated (1) | **ACCEPT** min 50 larvae added to each tank if first mp not awarded<br>**ACCEPT** when all larvae have settled<br><br>in vivo expts described could be awarded mp 2 and 5 | **(4)** |

| Question number | Answer | Mark |
|---|---|---|
| 7(a)(i) | <table><tr><td>green</td><td>brown</td><td>red</td></tr></table><br>The only correct answer is **A**<br><br>***B*** *is incorrect because C. officinalis has a lot of carotenoids*<br>***C*** *is incorrect because U.fasciata has a lot of chlorophylls a and b*<br>***D*** *is incorrect because U.fasciata has a lot of chlorophylls a and b and C. officinalis has a lot of carotenoids* | **(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 7(a)(ii) | An explanation that includes the following points:<br><br>• to **absorb** light so that the electrons will be {excited / released from photosystems} (1)<br><br>• so that reduced NADP and ATP can be synthesised (1) | **ACCEPT** NADPH / photophosphorylation | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **7(b)(i)** | An answer that includes three of the following points:<br><br>• GALP converted into {hexose / glucose / sugar} (1)<br><br>• amino acids made from {hexose / glucose / sugar} and nitrates (1)<br><br>• amino acids joined by {peptide bonds / condensation reactions} (1)<br><br>• glucose respired to produce ATP for protein synthesis (1) | **IGNORE** other nitrogenous compounds | **(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| *7(b)(ii) | Indicative content:<br><br>**Healthy**<br><br>• source of protein – for growth and repair<br>• source of carbohydrate – source of energy<br>• low lipid - reducing risk of heart disease<br>• antioxidants present - reducing risk of heart disease<br>• presence of lipid - risk factor for heart disease<br><br>**Environmentally-friendly**<br><br>• sustainable<br>• grows naturally - no need to destroy other habitats / seashore habitats destroyed<br>• photosynthesise - remove carbon dioxide from the atmosphere<br>• do not produce methane like cattle do – less greenhouse gas<br>• vehicles needed to harvest seaweed - produce carbon dioxide<br><br>**Economic**<br><br>• seaweed can be grown in situ – no costs planting<br>• do not need fertilisers – no costs buying fertilisers<br>• no buildings needed<br>• no heat needed<br><br>Level 1 : 1 or 2 relevant points made from at least one aspect<br><br>Level 2 : 3 or 4 relevant points made from at least two aspects<br><br>Level 3 : 5 or 6 relevant points from all three aspects which include 1 or 2 justifications | | **(6)** |

| Question number | Answer | Mark |
|---|---|---|
| 8(a) | **C**<br><br>The only correct answer is **C**<br><br>***A*** *is incorrect because macrophages present antigen to T helper cells*<br>***B*** *is incorrect because macrophages present antigen to T helper cells and host-infected cells present antigen to T killer cells*<br>***D*** *is incorrect because host-infected cells present antigen to T killer cells* | **(1)** |

| Question number | Answer | Mark |
|---|---|---|
| 8(b)(i) | The only correct answer is **B** Human immunodeficiency virus<br><br>***A*** *is incorrect because Ebola infects endothelial cells and liver cells*<br>***C*** *is incorrect because λ phage infects bacteria*<br>***D*** *is incorrect because TMV infects plants* | **(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 8(b)(ii) | An explanation that includes the following points:<br><br>• T cells need to {express CAR gene / produce CAR receptor} (1)<br><br>• in order to bind to the {tumour (cells) / tumour antigen / specific (tumour) antigen} (1) | **ACCEPT** cancer | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **8(b)(iii)** | An explanation that includes the following points:<br><br>• to produce genetically-identical cells (1)<br><br>• that will all have the {the CAR gene / CAR receptor} (1)<br><br>• to increase the number of cells so that there are enough {for the treatment / to destroy the cancer cells} (1) | **ACCEPT** clones<br><br>**ACCEPT** fast treatment | **(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **8(b)(iv)** | An explanation that includes the following points:<br><br>• so that the patient will not have an immune response against the T cells (1)<br><br>• because there will not be any foreign **antigens** on the T cells (1)<br><br>• therefore the T cells will not be destroyed (1)<br><br>• to reduce the risk of transmitting pathogens / no need to take immunosuppressants / no need to find a donor (1) | **ACCEPT** lower chance of rejection<br><br>**ACCEPT** will have same / self **antigens**<br><br>**ACCEPT** description e.g engulfed, digested | **(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **8(b)(v)** | An answer that includes two of the following points:<br><br>• {CAR-T cell / CAR receptor} does not bind to {solid / other types of} tumour (1)<br><br>• {solid / other types of} tumours {do not have the specific **antigen** / have different **antigens**} (1)<br><br>• T cells are not able to reach the cancer cells / too many cancerous cells for the treatment to work (1) | **ACCEPT** {CAR-T cell / CAR receptor} **only** bind to blood cell cancers<br><br>**ACCEPT only** blood cell tumours have the specific **antigen**<br><br>**ACCEPT** reason why T cells cannot reach the cancer cells e.g T cells cannot leave the blood stream, solid tumours produce T cell inhibitors, no chemicals released to attract the T cells to the solid tumour | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **9(a)** | • the larger the {microorganisms / cells} the greater the optical density (1) | **ACCEPT** converse<br>**ACCEPT** positive correlation | **(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **9(b)** | A calculation that shows the following steps:<br><br>values read from the graph (1)<br><br>bacteria number divided by yeast number (1) | <br><br>$0.5\times10^6$ and $12.5\times10^6$<br><br>25 | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 9(c)(i) | • as the concentration (of bacteria) increases, the optical density increases and then levels off (between 15 and 16 $\times 10^6$ cells per $cm^3$) (1) | | **(1)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 9(c)(ii) | An answer that includes two of the following points:<br><br>• with more cells present there is **more** reflection of light from the cells (1)<br><br>• some light being reflected away from the detector (1)<br><br>• some light being reflected towards the detector (1) | **ACCEPT** scattered / hitting converse<br><br>**ACCEPT** bacteria block the light so that it does not reach the detector<br><br>**'** at higher concentration the optical density levels off ' = 1 mark if no other marks awarded | **(2)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| **9(d)** | A calculation that shows the following steps:<br><br>• numbers substituted into equation (1)<br><br>• equation rearranged (1)<br><br>• time given in hours (to a maximum of 3 decimal places) (1) | Example of calculation<br><br>$0.963 = (7.079 - 3.778) \div 0.301t$<br><br>$0.963 \times 0.301\ t = 3.301$<br>$0.289863\ t = 3.301$<br>CE if log of logs taken<br>$0.963 \times 0.301t = 11994000$<br><br>11 / 11.4 / 11.39 / 11.388 (hours)<br>CE if log of logs taken<br>41378168 hours<br>**ACCEPT**<br>11 hours = 660 minutes<br>11.4 hours = 684 minutes<br>11.39 hours = 683.4 minutes<br>11.388 hours = 683.28 minutes | **(3)** |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| *9(e) | Indicative content:<br><br>• some organisms are larger than others<br>• light more likely to hit a larger organism and be reflected<br>• therefore optical density will be higher<br><br>• photometers are designed differently<br>• light may have further to travel through the organisms<br>• so is more likely to be reflected back<br>• decreasing optical density<br><br>• concentration of organisms affects the optical density<br>• so different calibration curves may be necessary for higher concentrations<br><br>• the light absorbance is specific to the organism<br>• and therefore will affect the absorbance value<br><br>Level 1 :<br>1 mark = 1 comment<br>2 marks = 2 comments<br>Level 2 :<br>3 marks = 3 comments that includes 1 description / explanation<br>4 marks = 4 comments that includes 1 description / explanation<br>Level 3 :<br>5 marks = 5 comments that includes 2 description / explanation<br>6 marks = 6 comments that includes 2 description / explanation | | **(6)** |

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