



# Mark Scheme (Results)

January 2019

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

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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 |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------|
| <b>1(a)(i)</b>  | 1. has (two single stranded molecules of) RNA ;<br>2. protein coat / capsid ;<br>3. has an envelope ;<br>4. has {reverse transcriptase / integrase} ;<br>5. has {glycoproteins / gp 120 / gp 41} ; | <b>1 DO NOT ACCEPT</b> DNA<br><br><b>3 ACCEPT</b> lipid layer<br><br><b>5 ACCEPT</b> any other appropriately named molecule | (2)  |

| Question Number | Answer                       | Additional Guidance                               | Mark |
|-----------------|------------------------------|---------------------------------------------------|------|
| <b>1(a)(ii)</b> | T helper (lymphocyte / cell) | <b>ACCEPT</b> CD4 (positive) {cell / lymphocyte}; | (1)  |

| Question Number | Answer                                                                                                                                                                                                           | Additional Guidance                                                          | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|------|
| <b>1(b)(i)</b>  | 1. idea that viruses {attach to / target / eq} (specific) cells ;<br>2. {nucleic acid / DNA / RNA / genes / genetic material} enters the cell / eq ;<br>3. idea that viruses are hollow so can carry the genes ; | <b>1 ACCEPT</b> tissues<br><br><b>2 ACCEPT</b> virus {enters / infects} cell | (2)  |

| Question Number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                              | Additional Guidance                                                                                                                                                                                                                                              | Mark |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>1(b)(ii)</b> | <ol style="list-style-type: none"> <li>1. idea that viruses have {receptors / eq} for {molecules / eq} on their target cells ;</li> <li>2. and therefore cannot {attach to / target / enter} all cell types ;</li> <li>3. idea that some viruses are too small to carry all the genetic material inside them ;</li> <li>4. idea that some viruses may cause disease ;</li> <li>5. idea that people may be immune to a particular virus ;</li> </ol> | <p><b>1 ACCEPT</b> glycoproteins / antigens / attachment proteins / binding sites</p> <p><b>2 ACCEPT</b> only target one type of cell / only target specific cells / attach to their host cells / different types of viruses bind to different types of cell</p> | (2)  |

| Question Number | Answer                                                                                                                                                                                                                                                                                     | Additional Guidance | Mark |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------|
| <b>2(a)(i)</b>  | <ol style="list-style-type: none"> <li>1. phospholipid bilayer / eq ;</li> <li>2. proteins present (in the bilayer) / eq ;</li> <li>3. cholesterol embedded amongst the fatty acid tails / eq ;</li> <li>4. {glycoproteins / receptors / glycolipids} attached on the surface ;</li> </ol> |                     | (2)  |

| Question Number  | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Additional Guidance                                                                                                                                                                                                                                                                 | Mark |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>*2(a)(ii)</b> | <ol style="list-style-type: none"> <li>1. phagocytosis / {microorganism / eq} is {engulfed by / eq} (the macrophage) ;</li> <li>2. idea that the {microorganism / eq} is within a {vacuole / vesicle} ;</li> <li>3. (then) {microorganism / eq} destroyed by the macrophage enzymes / eq ;</li> <li>4. idea of antigens (of destroyed microorganism) attach to (MHC) molecules on the surface of the macrophage ;</li> <li>5. for presentation of antigen to T helper cells ;</li> <li>6. T helper cells become activated / {immune / eq} response initiated / eq ;</li> <li>7. antibody-binding sites on the surface of the macrophage ;</li> <li>8. for opsonisation / eq ;</li> </ol> | <p>QWC focusing on logical sequence</p> <p><b>2 ACCEPT</b> reference to phagosome</p> <p><b>3 DO NOT ACCEPT</b> virus is killed</p> <p><b>5 ACCEPT</b> macrophages are APC to T helper cells</p> <p><b>7 ACCEPT</b> description e.g. macrophage membrane can attach to antibody</p> | (6)  |

| Question Number | Answer                                                                                                                                                                                                                                                                                                                                                      | Additional Guidance                                                                                                                                                                                                                              | Mark |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>2(b)(i)</b>  | <ol style="list-style-type: none"> <li>1. {modification / processed / eq} of protein ;</li> <li>2. idea of packaging protein into {vesicles / lysosomes / eq} ;</li> <li>3. credit named example of enzymes ;</li> <li>4. credit named molecule expressed on cell surface membrane ;</li> <li>5. credit named molecule released by macrophages ;</li> </ol> | <p><b>1 ACCEPT</b> suitable named protein e.g. enzyme, receptor, cytokine, interleukin</p> <p><b>3</b> e.g. lysozyme, hydrolases, lipases, ATP synthetase</p> <p>4. e.g. MHC, antibody receptor</p> <p><b>5</b> e.g. interleukins, cytokines</p> | (3)  |

| Question Number | Answer                                                                                                                                                                                                                | Additional Guidance                                   | Mark |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|------|
| <b>2(b)(ii)</b> | <ol style="list-style-type: none"> <li>1. contain {digestive enzymes / hydrolytic enzymes / lysozyme / named enzyme} ;</li> <li>2. idea of destruction of microorganisms (inside macrophage) / apoptosis ;</li> </ol> | <p><b>NB</b> enzymes to digest bacteria = 2 marks</p> | (2)  |

| Question Number | Answer    | Additional Guidance                       | Mark |
|-----------------|-----------|-------------------------------------------|------|
| <b>3(a)</b>     | Eukarya ; | Accept Eukaryota / Eukaryote / Eukaryotic | (1)  |

| Question Number | Answer    | Additional Guidance     | Mark                                |                               |     |  |                            |                                     |
|-----------------|-----------|-------------------------|-------------------------------------|-------------------------------|-----|--|----------------------------|-------------------------------------|
| 3(b)            |           |                         |                                     |                               |     |  |                            |                                     |
|                 | Structure | Structure found in      |                                     |                               |     |  |                            |                                     |
|                 |           | Both bacteria and fungi | Bacteria but <b>not</b> fungi       | Fungi but <b>not</b> bacteria |     |  | Neither bacteria nor fungi |                                     |
|                 |           | Cell membrane           | <input checked="" type="checkbox"/> | <input type="checkbox"/>      |     |  | <input type="checkbox"/>   | <input type="checkbox"/>            |
|                 |           | Chloroplast             | <input type="checkbox"/>            | <input type="checkbox"/>      |     |  | <input type="checkbox"/>   | <input checked="" type="checkbox"/> |
|                 |           | Ribosomes               | <input checked="" type="checkbox"/> | <input type="checkbox"/>      |     |  | <input type="checkbox"/>   | <input type="checkbox"/>            |
|                 |           |                         |                                     |                               | (3) |  |                            |                                     |

| Question Number | Answer                  | Additional Guidance                                                                                                                                                                                                                                                       | Mark |
|-----------------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>3(c)</b>     | <b>C</b> polysaccharide | <p><b>A</b> is incorrect because there is the wrong ratio of C, H, O and there are no ester bonds</p> <p><b>B</b> is incorrect because there are no nitrogenous bases or phosphate groups</p> <p><b>D</b> is incorrect because there are no R groups or peptide bonds</p> | (1)  |

| Question Number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Additional Guidance                                                                                                                                                                                                                                                                                                                                      | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>3(d)(i)</b>  | <ol style="list-style-type: none"> <li>1. antibiotics are effective against bacteria / antibiotics are used to treat bacterial infections / antibiotic target sites are specific to prokaryotic cells / eq ;</li> <li>2. antibiotics do not affect viruses because they {are not living / do not have the target sites / eq ;</li> <li>3. antibiotics do not affect fungi because they {are eukaryotic cells / are not prokaryotic cells} ;</li> <li>4. idea that some bacteria are resistant to specific antibiotics ;</li> </ol> | <p><b>1 IGNORE</b> fungi</p> <p><b>2 DO NOT ACCEPT</b> does not kill viruses</p> <p><b>3 ACCEPT</b> named difference<br/> e.g. cell wall of fungi are made of {chitin / glucan / not peptidoglycan / not murein}<br/>           membranes of fungi are made of ergosterol<br/>           fungi have {80s ribosomes / do not have 70s ribosomes / eq}</p> | (3)  |

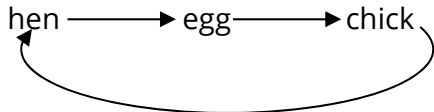
| Question Number | Answer                                                                                                                                                                                                                                                                                                                                                                                                    | Additional Guidance                                                                                                                                                                                                                                                                                                                                         | Mark |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>3(d)(ii)</b> | <ol style="list-style-type: none"> <li>idea of taking a swab from the ear ;</li> <li>credit method of culturing the bacteria in the swab ;</li> <li>credit appropriate method of adding a range of antibiotics ;</li> <li>idea of culturing the bacteria with the antibiotics for a period of time at an appropriate temperature ;</li> <li>credit an indication of what is being looked for ;</li> </ol> | <p><b>ACCEPT</b> fungi for bacteria throughout</p> <p><b>2</b> e.g. on agar, in an agar plate<br/> <b>IGNORE</b> in a petri dish<br/> <b>IGNORE</b> virus</p> <p><b>3</b> e.g. soaked onto a disc / added to the agar</p> <p><b>4</b> temp. range 25°C - 45°C<br/> incubation time 24 hours - 2 weeks</p> <p><b>5</b> e.g. inhibition zone / clear zone</p> | (3)  |

| Question Number | Answer                              | Additional Guidance                                                                                                                                                                                                 | Mark |
|-----------------|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>4(a)</b>     | <b>B</b> methane and carbon dioxide | <i><b>A</b> is incorrect because nitrogen is not a greenhouse gas</i><br><i><b>C</b> is incorrect because oxygen is not a greenhouse gas</i><br><i><b>D</b> is incorrect because oxygen is not a greenhouse gas</i> | (1)  |

| Question Number | Answer                                                     | Additional Guidance                                                                                                                                                                                          | Mark |
|-----------------|------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>4(b)</b>     | <b>B</b> lower the activation energy and increase the rate | <i><b>A</b> is incorrect because enzymes increase the rate</i><br><i><b>C</b> is incorrect because enzymes increase the rate</i><br><i><b>D</b> is incorrect because enzymes lower the activation energy</i> | (1)  |

| Question Number | Answer                                                                                                                 | Additional Guidance                                                                                                                                                                                                                                                                      | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>4(c)(i)</b>  | 1. growth is the increase in {size / height / mass / eq} ;<br><br>2. credit appropriate example shown in the diagram ; | <b>1 ACCEPT</b> larger / bigger / increase in number cells<br><b>DO NOT ACCEPT</b> older<br><br><b>2</b> e.g. chick increases in size, chick's legs get longer<br><b>IGNORE</b> chick grows into a chicken<br><br><b>NB</b> e.g. growth is the increase in height of the chick = 2 marks | (2)  |

| Question Number | Answer                                                                                                                                                                           | Additional Guidance                                                                                                                                                                                                                                                        | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>4(c)(ii)</b> | <p>1. development is the change in {features / structures / phenotype / complexity} (as an organism ages) / eq ;</p> <p>2. credit appropriate example shown in the diagram ;</p> | <p><b>1 ACCEPT</b> differentiation of cells / move from one stage in lifecycle to the next<br/><b>IGNORE</b> growth</p> <p><b>2</b> e.g. hen has a comb but the chick does not,<br/>hen has a tail but the chick does not,<br/>chick developing from embryo inside egg</p> | (2)  |

| Question Number  | Answer                                                                                                                                                             | Additional Guidance                                                                                                                                                                                                      | Mark |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>4(c)(iii)</b> | <p>1. {stages / changes / forms / eq} in the life of an organism / eq ;</p> <p>2. idea that eggs hatch into chicks and chicks become chickens which lay eggs ;</p> | <p><b>2 ACCEPT</b> from a flow diagram e.g.</p>  <pre> graph LR     hen --&gt; egg     egg --&gt; chick     chick --&gt; hen </pre> | (2)  |

| Question Number | Answer                                                                                                                                                                                                                                                                                                                           | Additional Guidance      | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------|
| <b>4(d)(i)</b>  | 1. dendrochronology is the study of tree rings ;<br>2. idea that the size of the rings depends on the size of the xylem vessels ;<br>3. idea that size of rings depends on availability of water ;<br>4. idea that size of ring depends on temperature ;<br>5. idea that size of rings depends on (the rate of) photosynthesis ; | <b>3 ACCEPT</b> rainfall | (3)  |

| Question Number | Answer                                                                                                                                                                                            | Additional Guidance | Mark |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------|
| <b>4(d)(ii)</b> | 1. pollen is preserved (in peat bogs) / eq ;<br>2. idea that plants can be identified from pollen ;<br>3. idea that the plants that can grow depends on {rainfall / temperature / climate / eq} ; |                     | (2)  |



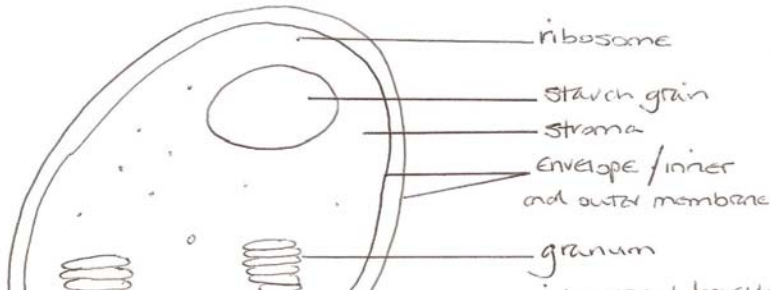
| Question Number | Answer                                                                                                    | Additional Guidance | Mark |
|-----------------|-----------------------------------------------------------------------------------------------------------|---------------------|------|
| <b>5(a)(i)</b>  | 1. contains the (genetic) {information / code} for a polypeptide / codes for the synthesis of mRNA / eq ; |                     | (1)  |

| Question Number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Additional Guidance                                                                                                                                                                                                                                                                                                                                                       | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>5(a)(ii)</b> | 1. mutation will result in different bases (on the DNA / mRNA) ;<br><br>2. this may result in spliceosome not {binding to / splicing / eq} the mRNA ;<br><br>3. so introns and exons may not be separated from each other ;<br><br>4. mRNA would {be too long / have too many bases / eq} ;<br><br>5. resulting in a longer <u>β subunit</u> / more amino acids in <u>β subunit</u> / eq ;<br><br>6. {folding / bonding / structure / shape} of {β subunit / haemoglobin} may be different ; | <b>2 ACCEPT</b> spliceosome does not recognise the splice site<br><br><b>3 ACCEPT</b> introns (and some exons) may not be removed<br><b>4 ACCEPT</b> different sequence of bases if introns not removed<br><b>5 ACCEPT</b> different sequence of amino acids in the <u>β subunit</u> if introns not removed<br><b>6 ACCEPT</b> haemoglobin may not be able to bind oxygen | (4)  |

| Question Number  | Answer                                                                                                                                                                                                                                                                                                                                        | Additional Guidance                                                           | Mark |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------|
| <b>5(a)(iii)</b> | <ol style="list-style-type: none"> <li>1. idea that the stop codon is transcribed (from the DNA into the mRNA) ;</li> <li>2. no tRNA has an anticodon for the (mRNA) stop codon ;</li> <li>3. so no amino acid can be {attached / brought to the ribosome} by tRNA ;</li> <li>4. {mRNA / ribosome} and polypeptide separate / eq ;</li> </ol> | <p><b>4 ACCEPT</b> {signals the end of / used to stop} <u>translation</u></p> | (2)  |

| Question Number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Additional Guidance                                                                                                                                                                                                                             | Mark |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>*5(b)</b>    | <ol style="list-style-type: none"> <li>1. idea of (extracting) haemoglobin from {blood / a patient} ;</li> <li>2. {<math>\beta</math> subunit / haemoglobin / protein} cut into {fragments / peptides} ;</li> <li>3. by {(protease) enzymes / proteases} ;</li> <li>4. reference to {hydrolysis / eq} of peptide bonds ;</li> <li>5. idea of loading onto gel ;</li> <li>6. electrical field applied to gel / eq ;</li> <li>7. idea that the peptides are {stained / made visible} ;</li> <li>8. idea of comparing the (peptide) bands with bands from a {normal</li> </ol> | <p>QWC focusing on clarity</p> <p><b>5 NB</b> this mark point can be applied even if DNA is used in the answer</p> <p><b>6 NB</b> this mark point can be applied even if DNA is used in the answer</p> <p><b>7 IGNORE</b> southern blotting</p> |      |

|  |                                                                                                            |                                                                                                                                                  |     |
|--|------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----|
|  | / known $\beta$ thalassaemia} { $\beta$ subunit / haemoglobin} ;<br><br>9. credit what is being compared ; | <b>9 ACCEPT</b> {position / number / width / size} of <u>bands</u><br><b>NB</b> this mark point can be applied even if DNA is used in the answer | (6) |
|--|------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----|

| Question Number | Answer                                                                            | Additional Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Mark |
|-----------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>6(a)</b>     | 1. envelope and grana drawn ;<br><br>2. & 3. two structures correctly labelled ;; | <p><b>1</b> envelope should be drawn as two lines<br/>         grana should be drawn as a minimum of two sacs on top of one another<br/> <b>IGNORE</b> labels</p> <p><b>2 ACCEPT</b> plasmids<br/> <b>IGNORE</b> any named size given to ribosomes<br/>         If one incorrect label, max of 1 label mark<br/>         If two incorrect labels then no label marks can be awarded</p> <p>e.g.</p>  |      |

|  |  |  |     |
|--|--|--|-----|
|  |  |  | (3) |
|--|--|--|-----|

| Question Number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Additional Guidance                                                                                                                                    | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>6(b)</b>     | <ol style="list-style-type: none"> <li>1. compartmentalisation (from cytoplasm) / idea of keeping photosynthesis separate from other (metabolic) reactions in the cell ;</li> <li>2. {increase / large} surface area (of membrane) so that {more / more} {photosynthetic pigments / photosystems / light absorbed};</li> <li>3. contain {photosynthetic pigments / named pigment / photosystems};</li> <li>4. so that light can be <u>absorbed</u>;</li> </ol> | <p><b>1 ACCEPT</b> idea that reactants are kept close together</p> <p><b>2 NB</b> this may get mp 3 as well</p> <p><b>4</b> must be linked to mp 3</p> |      |

|  |                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                      |     |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
|  | <p>5. contain the electron carrier (proteins) ;</p> <p>6. so that {protons / eq} can be pumped into thylakoid space ;</p> <p>7. provide a thylakoid space / eq ;</p> <p>8. so that {protons / eq} can accumulate ;</p> <p>9. contains ATP synthase (channels) ;</p> <p>10. so that energy released will result in photophosphorylation / eq ;</p> | <p><b>5 ALLOW</b> electron transport chain</p> <p><b>6</b> must be linked to mp 5</p> <p><b>8</b> must be linked to mp 7</p> <p><b>10</b> must be linked to mp 9</p> | (4) |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|

| Question Number | Answer                                                                                                                            | Additional Guidance                                                                                                      | Mark |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|------|
| <b>6(c)(i)</b>  | 1. {volume / concentration} of {carbon dioxide used / oxygen evolved / eq} ;<br><br>2. over a period of time / in a stated time ; | <b>1 ACCEPT</b> (increase) pH / number of (oxygen) bubbles<br><b>IGNORE</b> amount<br><br><b>2</b> minimum of 10 seconds | (2)  |

| Question Number | Answer                                                                                                                                                                                                                                                                                                          | Additional Guidance                                                                                                                                                                                                                                                                                                      | Mark |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>6(c)(ii)</b> | 1. increase in $\text{NaHCO}_3$ concentration increases rate of photosynthesis above {35 /36} (a.u.) light intensity ;<br><br>2. increase in light intensity increases rate of photosynthesis but then it levels off ;<br><br>3. idea that the levelling off depends on the concentration of $\text{NaHCO}_3$ ; | <b>1 ACCEPT</b> idea that this is an overall trend but not true at lower light intensities<br><br><b>2 ACCEPT</b> idea of increase and then (small) fluctuations<br><br><b>NB</b> increase in light intensity and $\text{NaHCO}_3$ increases rate of photosynthesis gains 1 mark if no other mark awarded piece together | (3)  |

| Question Number  | Answer                                                                                                  | Additional Guidance | Mark |
|------------------|---------------------------------------------------------------------------------------------------------|---------------------|------|
| <b>6(c)(iii)</b> | carbon dioxide from the air has dissolved in the water / respiration has produced carbon dioxide / eq ; |                     | (1)  |

| Question Number | Answer     | Additional Guidance | Mark |
|-----------------|------------|---------------------|------|
| <b>7(a)</b>     | 28.5 (%) ; |                     | (1)  |

| Question Number | Answer                                                                   | Additional Guidance                                | Mark |
|-----------------|--------------------------------------------------------------------------|----------------------------------------------------|------|
| <b>7(b)(i)</b>  | 1. 1 500 - 125 / 1375;<br>2. $(1\,375 \times 100 \div 125 =) 1100$ (%) ; | Correct answer with no working shown gains 2 marks | (2)  |

| Question Number | Answer                                                                                                                                                                         | Additional Guidance                                                                                                                                   | Mark |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>7(b)(ii)</b> | 1. open ocean has a greater percentage (of the Earth's) NPP and the NPP is lower / eq ;<br>2. because the open ocean covers a far greater area (of the Earth's surface) / eq ; | <b>ACCEPT</b> converse for the estuary applies throughout<br><br><b>2 ACCEPT</b> ocean represents 65% of Earth's surface and estuary <u>only</u> 0.3% | (2)  |

| Question Number  | Answer                                                                                                                                                                                                                                                                                                                                                                                                                 | Additional Guidance                                                                                                                                                                                                                           | Mark |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>7(b)(iii)</b> | <ol style="list-style-type: none"> <li>1. idea that there are {fewer / not many} plants growing ;</li> <li>2. due to the lack of water ;</li> <li>3. credit correct link between lack of water and (lack of) plants ;</li> <li>4. due to {extreme / very high / very cold} temperatures ;</li> <li>5. credit correct link between extreme temperature and the effect on enzyme activity in photosynthesis ;</li> </ol> | <p><b>1 ACCEPT</b> few species of plant</p> <p><b>3</b> e.g. less photolysis, dehydration</p> <p><b>4 ACCEPT</b> so or too {high / low}</p> <p><b>5</b> e.g. low temperatures result in slow activity, high temperatures denature enzymes</p> | (3)  |

| Question Number | Answer                                                                                                                                             | Additional Guidance                               | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|------|
| <b>7(b)(iv)</b> | <ol style="list-style-type: none"> <li>1. GPP would be higher (than 2000 / NPP) ;</li> <li>2. because <math>NPP = GPP - R</math> / eq ;</li> </ol> | <p><b>2 ACCEPT</b> <math>GPP = NPP + R</math></p> | (2)  |

| Question Number | Answer                                                                                                                                                                                                                                                                                | Additional Guidance | Mark |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------|
| <b>8(a)</b>     | 1. idea that the viral DNA will be replicated (only) when the cell is {replicating its own DNA / in S phase / eq} ;<br><br>2. therefore new viruses will be formed (only) in dividing cells / eq ;<br><br>3. idea that tissue damage is caused by the viruses leaving the host cell ; |                     | (2)  |

| Question Number | Answer                   | Additional Guidance                                                                                                                                                                                                                                                                                                                      | Mark |
|-----------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| <b>8(b)(i)</b>  | <b>D</b> natural passive | <i><b>A</b> is incorrect because antibodies from the mother is a natural occurrence and they do not stimulate the immune response</i><br><i><b>B</b> is incorrect because antibodies from the mother is a natural occurrence</i><br><i><b>C</b> is incorrect because antibodies from the mother do not stimulate the immune response</i> | (1)  |

| Question Number | Answer                         | Additional Guidance                                       | Mark |
|-----------------|--------------------------------|-----------------------------------------------------------|------|
| <b>8(b)(ii)</b> | 5.2 to 6.5 weeks after birth ; | <b>ACCEPT</b> any pair of values in the range 5 - 7 weeks | (1)  |

| Question Number  | Answer                                                                                                                                                                                                                                                                                                                                                                                                                           | Additional Guidance                                                          | Mark |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|------|
| <b>8(b)(iii)</b> | <ol style="list-style-type: none"> <li>1. idea that kittens injected with {(FPV) antigens / attenuated FPV / eq} ;</li> <li>2. which stimulate the (primary) immune response ;</li> <li>3. resulting in the formation of (T / B) memory cells ;</li> <li>4. idea that these memory cells are activated on infection with FPV ;</li> <li>5. resulting in {higher / faster} production of antibodies (by plasma cells);</li> </ol> | <p><b>1 IGNORE</b> dead virus</p> <p><b>2 ACCEPT</b> correct description</p> | (4)  |

| Question Number | Answer                                                                                                                                                                                                                                                                                                              | Additional Guidance                                                                                              | Mark |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|------|
| <b>8(b)(iv)</b> | <ol style="list-style-type: none"> <li>1. idea that the (maternal) antibodies will bind to the {antigens / virus} (in the vaccine) ;</li> <li>2. therefore macrophages will engulf the antigens / eq ;</li> <li>3. idea that the antigens {cannot bind / will not be available to bind} to the B cells ;</li> </ol> | <p><b>1 ACCEPT</b> agglutinate / opsonise</p> <p><b>DO NOT ACCEPT</b> {destroy / kill} the {antigen / virus}</p> | (2)  |

