

Mark Scheme (Results)

Summer 2014

GCE Biology (6BI04)
Paper 01

Unit 4: Natural Environment

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Summer 2014

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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.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:
 - i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
 - ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
 - iii) organise information clearly and coherently, using specialist vocabulary when appropriate

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:

- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.

() means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.

Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.

ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.

Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|---|---------------------|------|
| 1(a)(i) | 1. Molecule P - water / H ₂ O ; 2. Molecule Q - oxygen / O ₂ ; | | (1) |

| Question Number | Answer | Mark |
|-----------------|--------------------------|------|
| 1(a)(ii) | D ATP and reduced NADP ; | (1) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|---|--|------|
| 1(a)(iii) | 1. reference to RUBISCO as an {enzyme / catalyst} ; 2. in the Calvin cycle ; 3. involved in {carbon fixation / bonding of CO ₂ to RuBP / reaction between CO ₂ and RuBP / eq} ; 4. to form GP / eq ; 5. GP converted to GALP / eq ; 6. using ATP and {reduced NADP / NADPH} (CO ₂ to GALP / GP to GALP) ; | 1. ACCEPT catalyses 3. ACCEPT formation of 6C intermediate from RuBP 5. ACCEPT reduced to NB Award formation of GALP from reaction between CO ₂ and RuBP if mp 4 not awarded | (4) |

| Question Number | Answer | Mark | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------------|--|---------------------|-------------------------|--------------|--------------|-------------|----------|----|------|-------|---------|---------|------|--------|---------|-----------|-------------------------|-------|---------|----------|------------|------|----|------|-------|---------|------|------|--------|---------|-----------|-------|--|--|--|--|-----|----|------|-------|---------|----|------|--------|---------|-----------|-------|-------|---------|----------|------------|--|---------------|
| 1 (b) (i) | C stroma | (1) COMP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Question Number | Answer | Additional Guidance | Mark | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 (b) (ii) | <p>1. (image length) 76 / 76.5 / 77 (mm) ;</p> <p>2. (correct calculation = length /7500) / eq ;</p> <p>3. (correct units for given answer) μm / eq ;</p> <table border="1" data-bbox="376 655 1496 1054"> <thead> <tr> <th>length</th> <th>answer in μm</th> <th>answer in mm</th> <th>answer in cm</th> <th>answer in m</th> </tr> </thead> <tbody> <tr> <td>7.6 (cm)</td> <td>10</td> <td>0.01</td> <td>0.001</td> <td>0.00001</td> </tr> <tr> <td>76 (mm)</td> <td>10.1</td> <td>0.0101</td> <td>0.00101</td> <td>0.0000101</td> </tr> <tr> <td>76000 (μm)</td> <td>10.13</td> <td>0.01013</td> <td>0.001013</td> <td>0.00001013</td> </tr> <tr> <td>7.65</td> <td>10</td> <td>0.01</td> <td>0.001</td> <td>0.00001</td> </tr> <tr> <td>76.5</td> <td>10.2</td> <td>0.0102</td> <td>0.00102</td> <td>0.0000102</td> </tr> <tr> <td>76500</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>7.7</td> <td>10</td> <td>0.01</td> <td>0.001</td> <td>0.00001</td> </tr> <tr> <td>77</td> <td>10.3</td> <td>0.0103</td> <td>0.00103</td> <td>0.0000103</td> </tr> <tr> <td>77000</td> <td>10.27</td> <td>0.01027</td> <td>0.001027</td> <td>0.00001027</td> </tr> </tbody> </table> | length | answer in μm | answer in mm | answer in cm | answer in m | 7.6 (cm) | 10 | 0.01 | 0.001 | 0.00001 | 76 (mm) | 10.1 | 0.0101 | 0.00101 | 0.0000101 | 76000 (μm) | 10.13 | 0.01013 | 0.001013 | 0.00001013 | 7.65 | 10 | 0.01 | 0.001 | 0.00001 | 76.5 | 10.2 | 0.0102 | 0.00102 | 0.0000102 | 76500 | | | | | 7.7 | 10 | 0.01 | 0.001 | 0.00001 | 77 | 10.3 | 0.0103 | 0.00103 | 0.0000103 | 77000 | 10.27 | 0.01027 | 0.001027 | 0.00001027 | <p>Correct answer with units = 3 marks</p> <p>2. CE applies</p> <p>3. CE applies ACCEPT as standard form</p> | (3) EP |
| length | answer in μm | answer in mm | answer in cm | answer in m | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7.6 (cm) | 10 | 0.01 | 0.001 | 0.00001 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 76 (mm) | 10.1 | 0.0101 | 0.00101 | 0.0000101 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 76000 (μm) | 10.13 | 0.01013 | 0.001013 | 0.00001013 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7.65 | 10 | 0.01 | 0.001 | 0.00001 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 76.5 | 10.2 | 0.0102 | 0.00102 | 0.0000102 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 76500 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7.7 | 10 | 0.01 | 0.001 | 0.00001 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 77 | 10.3 | 0.0103 | 0.00103 | 0.0000103 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 77000 | 10.27 | 0.01027 | 0.001027 | 0.00001027 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|---|--|------------|
| 1(b)(iii) | <ol style="list-style-type: none"> 1. idea of compartmentalisation (from stroma) ; 2. site of light-dependent reaction ; 3. credit named molecules {within / on / eq} membrane ; 4. idea of {ATPase / eq } in (thylakoid) membranes ; 5. idea that (thylakoid) membranes provide a space for accumulation of H⁺ ; 6. reference to photophosphorylation ; | <ol style="list-style-type: none"> 1. ACCEPT description of separation 3. e.g. photosynthetic pigments / chlorophyll / carotenoids / photosystems / electron carrier proteins IGNORE electron acceptors 4. ACCEPT {ATP synthase / synthetase}, NADP reductase 6. ACCEPT chemiosmosis | (3) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|---|---|------------|
| 2(a) | <ol style="list-style-type: none"> 1. (structure G is {glycoprotein / gp120} ; 2. used for {attachment / eq} to CD4 (molecules / receptors /antigens) ; 3. on T helper {cells / lymphocytes} ; | <ol style="list-style-type: none"> 1. IGNORE gp 41 and gp 160 and other wrong numbers 3. ACCEPT macrophages / dendritic cells / CD4 cells | (3) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|--|--|------------|
| 2(b)(i) | <ol style="list-style-type: none"> 1. they are globular proteins ; 2. it has an active site ; 3. idea of {charged R groups on outside of molecules / composed of many small R groups} ; | <ol style="list-style-type: none"> 2. idea of active site R groups enable binding of substrate 3. idea of hydrophilic on the outside | (3) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|---|--|------------|
| *2(b)(ii) | <p>(QWC – spelling of technical terms must be correct and the answer must be organised in a logical sequence)</p> <ol style="list-style-type: none"> 1. idea that drugs would prevent viral replication ; 2. idea that T (helper) { cells / lymphocytes} will not be { killed / burst / destroyed} (by virus particles leaving cell) ; 3. idea of {inhibition / eq} of reverse transcriptase ; 4. idea that (viral) DNA could not be made; 5. from the (viral) RNA ; 6. idea of {inhibition / eq} of integrase ; 7. idea that (viral) DNA cannot integrate into (host) {DNA / genome} / eq ; | <p>QWC emphasis on clarity of expression</p> <ol style="list-style-type: none"> 1. ACCEPT description of virus formation 3. ACCEPT drugs prevent action of reverse transcriptase 4. reject idea that RNA is {turned into / converted into} DNA 6. ACCEPT drugs prevent action of integrase 7. ACCEPT idea that drugs would prevent {latency / formation of provirus / eq} ; | (5) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|--|---|------|
| *3(a)(i) | <p>(QWC – spelling of technical terms must be correct and the answer must be organised in a logical sequence)</p> <ol style="list-style-type: none"> 1. multiple copies of DNA made / eq ; 2. using {PCR / <i>polymerase chain reaction</i>} ; 3. credit any correct detail of PCR ; 4. reference to <i>restriction</i> {<i>enzymes</i> / <i>endonucleases</i>} to produce DNA {<i>fragments</i> / eq} ; 5. reference to (<i>gel</i>) <i>electrophoresis</i> ; 6. idea of {loading / eq} the DNA onto the {<i>gel</i> / named <i>gel</i>} ; 7. idea that an {<i>electric current</i> / charge} is applied ; 8. reference to use of {<i>dye</i> / <i>fluorescent tag</i> / <i>UV light</i> / <i>Southern blotting</i> / <i>gene probes</i> / <i>radioactive labelling</i> / eq} ; | <p>QWC emphasis on spelling</p> <ol style="list-style-type: none"> 1. IGNORE refs to amplification, large amounts 3. e.g. step 1: 90 to 95 °C, step 2: 50 to 65 °C, step 3: 70 to 80 °C, use of {<i>primers</i> / DNA <i>polymerase</i> / <i>nucleotides</i>}, many repetitions 6. e.g. <i>agarose</i>, <i>agar</i> 7. ACCEPT apply <i>potential difference</i> | (6) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|---|--|------------|
| 3(a)(ii) | <ol style="list-style-type: none"> 1. idea of comparing total number of {bands / eq} ; 2. idea of comparing position of {bands / eq} ; 3. idea of comparing {size / width} of {bands / eq} ; | ACCEPT idea of comparing bands for 1 mark if mps 1, 2 or 3 cannot be awarded ACCEPT bars / blocks | (3) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|---|--|------------|
| 3(b) | <ol style="list-style-type: none"> 1. {scientific / peer reviewed} {papers / journals / magazines / article} ; 2. (scientific) {conferences / lecture / forums} ; 3. media reports ; | <ol style="list-style-type: none"> 3. e.g. TV, radio, newspaper, internet | (2) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|--|--|------------|
| 4(a) | <ol style="list-style-type: none"> 1. idea that {bacteria / pathogen / virus / eq} have to be taken into macrophage / eq ; 2. idea of fusion of {phagosome / eq} with lysosome ; 3. idea that {bacteria/ pathogen / virus / eq} are {digested / broken down / eq} (by enzyme) ; 4. credit named enzyme other than lysozyme ; 5. idea that part of the {bacteria/ pathogen / virus / eq} has to be on {membrane / (outer) surface} (of the macrophage) ; | <ol style="list-style-type: none"> 1. IGNORE phagocytosis unqualified 2. ACCEPT phagocytic vesicle 3. IGNORE destroy / killed 4. e.g. protease. 5. ACCEPT antigen / protein | (4) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|--|---------------------|------------|
| 4(b) | <ol style="list-style-type: none"> 1. idea of macrophage {binding/ eq} to T (helper) {cell / lymphocyte} ; 2. reference to {MHC / major histocompatibility complex } (on macrophage) ; 3. reference to CD4 (receptor on T cell) ; | | (2) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|--|----------------------------------|------------|
| 4(c) | <ol style="list-style-type: none"> 1. idea that a mutation has occurred (in the DNA) ; 2. idea that there is a change in {antigen /outer surface / cell wall / slime layer} (of bacteria) ; 3. idea that memory (T) cells will not recognise the (new) antigen ; 4. idea that another (primary) immune response needed e.g. (new) antigen needs to be presented (to the T helper cell) ; 5. to activate (another) population of T (helper) cells / eq ; 6. idea that {phagocytes / macrophages} unable to {recognise / engulf / phagocytose / digest / destroy / eq} the {<i>Mycobacterium tuberculosis</i> / bacteria} ; 7. idea that antigen presentation is not possible ; | 1. NOT a mutation of the antigen | (3) |

| Question Number | Answer | Mark |
|-----------------|------------------------------|------|
| 5(a)(i) | A carbon dioxide and methane | (1) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|--|---|------|
| 5(a)(ii) | <ol style="list-style-type: none"> 1. idea that {using / burning} {fossil fuels / petrol / diesel} releases carbon dioxide ; 2. reference to {carbon dioxide / CO₂} as a greenhouse gas ; 3. idea that carbon dioxide is taken in for {photosynthesis / light-independent reaction / carbon fixation / eq} (during production of plants for biofuels) ; 4. idea of no net change of carbon dioxide in the atmosphere when biofuels are burnt / eq ; | <ol style="list-style-type: none"> 1. NOT methane Ignore burning biofuels releases carbon dioxide 4. ACCEPT biofuels are carbon neutral | (3) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|--|----------------------------------|------|
| 5(b)(i) | (plant) fibres / woody parts / xylem (vessels / tissue) / sclerenchyma (fibres / tissue) / lignified tissue / eq ; | ACCEPT vascular bundles / tissue | (1) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|---|---|------------|
| 5(b)(ii) | <ol style="list-style-type: none"> 1. idea that bacteria cannot breakdown cellulose fast enough ; 2. idea that {enzymes / cellulase} needed to break down cellulose into (β) glucose ; 3. by hydrolysing (1,4) glycosidic bonds / eq ; 4. idea of {respiration / fermentation} of {glucose / eq} (by bacteria) ; | <ol style="list-style-type: none"> 2. NOT hydrogen bonds 3. ACCEPT breaking | (2) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|---|--|------------|
| 6(a) | <ol style="list-style-type: none"> 1. idea that as the {distance from the front edge of the glacier / time} increases, the {complexity / biodiversity / size / eq } of the organisms increases ; 2. reference to (primary) succession ; 3. idea that {algae / lichens / pioneer species} are (the first) organisms to colonise bare rock / eq; 4. idea that {algae / lichen / pioneer species} improve conditions for plants ; 5. idea of competition (limiting species present) ; | <ol style="list-style-type: none"> 1. ACCEPT idea that climax community only reached at distance from glacier edge 2. NOT secondary succession 4. including e.g. change rock into soil / increase humus content of soil / increase water content 5. e.g. newer species outcompete previous species | (3) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|--|---|------------|
| 6(b)(i) | <ol style="list-style-type: none"> 1. the {role / interaction / eq} of an { <i>Epilobium latifolium</i> / organism / species} within its { ecosystem / habitat / environment } ; 2. (<i>Epilobium latifolium</i>) is a producer ; 3. idea that <i>Epilobium latifolium</i> provides {food / energy} for other organisms (herbivores / primary consumers / decomposers) ; 4. idea that <i>Epilobium latifolium</i> improves soil e.g. holds soil structure together, increases nutrients ; 5. idea that <i>Epilobium latifolium</i> provides {shelter / (micro) habitat} for organisms ; | <ol style="list-style-type: none"> 1. IGNORE community 3. NOT prey 4. IGNORE food in soil ACCEPT adds organic matter, humus 5. ACCEPT named organism e.g. insects | (3) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|--|---|------------|
| 6(b)(ii) | <ol style="list-style-type: none"> 1. idea of using a transect (from front edge of glacier); 2. credit method of sampling (along transect) ; 3. credit appropriate method of selecting sample sites (along transect) ; 4. description of estimate of abundance e.g. number of plants, percentage cover 5. idea of using more than one transect ; 6. credit appropriate method of recording quantitative data ; | <ol style="list-style-type: none"> 2. e.g. clumps touching transect, quadrat (on transect), number of plants along perpendicular 3. e.g. set distance, regular, systematic, flip-flop quadrats NOT random 5. IGNORE references to repeating investigation 6. e.g. tally chart, table, graph | (4) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|--|--|------------|
| 6(b)(iii) | <ol style="list-style-type: none"> 1. credit appropriate named abiotic factor; 2. credit appropriate method of measurement of factor ; 3. credit appropriate description of where reading should be taken ; 4. idea of taking several readings and getting an average / eq ; | <ol style="list-style-type: none"> 1. e.g. light, soil pH, water content, mineral content, temperature, salinity, wind IGNORE CO₂, O₂, rainfall, humidity 2. CE applied e.g. light {probe / sensor / meter / data logger}, {water gauge / drying out soil samples} 3. CE applied e.g. reading taken at height of plant, soil sample around roots, quadrat | (3) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|--|---|------------|
| 7(a)(i) | <ol style="list-style-type: none"> 1. levels of antibody rise sooner after infection / eq ; 2. levels of antibody rise faster after infection / eq ; 3. levels of antibody rise higher after infection / eq ; 4. credit comparative manipulation of data ; | <p>do not piece together ACCEPT converse for mps 1, 2 and 3 in context of vaccination</p> <p>4. e.g. increase after infection is {10 (au) more / 1.83 times more} peak after infection is 13 (au) higher rate of increase after infection is 1.27 au day⁻¹ faster</p> | (2) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|--|--|------------|
| 7(a)(ii) | <ol style="list-style-type: none"> 1. secondary (immune) response ; 2. reference to memory cells ; 3. idea that (on infection / second exposure) memory cells are {activated / cloned / stimulated / eq}; 4. idea that (in secondary response) antibodies are released from plasma cells ; | <ol style="list-style-type: none"> 1. ACCEPT secondary immunity 3. ACCEPT B memory cells differentiate into plasma cells | (3) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|--|---------------------|------------|
| 7(b)(i) | 1. idea that antibodies will only be present if antigen present ; 2. idea that antigen B is not present in vaccine ; 3. vaccination failed to stimulate immune response / eq ; | | (2) |

| Question Number | Answer | Mark |
|-----------------|-------------------------|------------|
| 7(b)(ii) | C natural active | (1) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|---|--|------------|
| 7(c) | 1. idea that {a comment cannot be made / caution in interpreting results should be taken / eq} ; 2. no indication of number of rats used / eq ; 3. no data points / eq ; 4. no error bars (on graph) / no indication of variability / eq ; 5. no statistical evidence / eq ; 6. idea that no indication of {experimental details / control variables / control group / eq} ; 7. idea that mean has been used therefore there must have been some repeats / eq ; | 1. IGNORE not reliable or is reliable 2. IGNORE no repeats / sample was small ACCEPT number of repeats not known / sample size not known | (3) |

| Question Number | Answer | Mark |
|-----------------|---------------------|------------|
| 8(a) | C hydrolysis | (1) |

| Question Number | Answer | Mark |
|-----------------|---|------------|
| 8(b)(i) | B to give a range of values for the independent variable | (1) |

| Question Number | Answer | Mark |
|-----------------|--------------|------------|
| 8(b)(ii) | B one | (1) |

| Question Number | Answer | Additional Guidance | Mark |
|-----------------|---|---|------------|
| 8(b)(iv) | <ol style="list-style-type: none"> 1. idea that an increase in temperature would increase the rate of decomposition (up to an optimum temperature) ; 2. reference to enzymes (in decomposition) ; 3. idea that increased {heat / kinetic} energy results increase in {number of collisions / energy of collisions (between enzymes and substrate) / enzyme-substrate complexes} ; 4. idea that increased temperature increases rate at which bacteria increase ; 5. idea that above a certain temperature rate of decomposition would {decrease / stop} ; 6. idea that at higher temperatures enzymes become denatured OR bacteria killed ; | <p>6. NOT enzymes start to denature NB need the term 'denaturing' or its derivative</p> | (4) |

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