



# Cambridge International AS Level

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ENVIRONMENTAL MANAGEMENT

8291/13

Paper 1

October/November 2021

MARK SCHEME

Maximum Mark: 80

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2021 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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This document consists of **16** printed pages.

**PUBLISHED****Generic Marking Principles**

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

**GENERIC MARKING PRINCIPLE 1:**

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

**GENERIC MARKING PRINCIPLE 2:**

Marks awarded are always **whole marks** (not half marks, or other fractions).

**GENERIC MARKING PRINCIPLE 3:**

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

**GENERIC MARKING PRINCIPLE 4:**

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

**GENERIC MARKING PRINCIPLE 5:**

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

**GENERIC MARKING PRINCIPLE 6:**

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

**Science-Specific Marking Principles**

1 Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.

2 The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.

3 Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).

4 The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.

5 'List rule' guidance

For questions that require *n* responses (e.g. State **two** reasons ...):

- The response should be read as continuous prose, even when numbered answer spaces are provided.
- Any response marked *ignore* in the mark scheme should not count towards *n*.
- Incorrect responses should not be awarded credit but will still count towards *n*.
- Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response.
- Non-contradictory responses after the first *n* responses may be ignored even if they include incorrect science.

**6** Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g.  $a \times 10^n$ ) in which the convention of restricting the value of the coefficient ( $a$ ) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

**7** Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

| Question  | Answer  | Marks    |
|-----------|---|----------|
| 1(a)(i)   | Tokyo has higher rainfall than Sydney in August;<br>Tokyo has higher temperatures than Sydney in August;<br>credit data;  | <b>3</b> |
| 1(a)(ii)  | highest temperatures for Tokyo occur in July / August;<br>indicating summer months;<br>during July / August the Northern Hemisphere is tilted towards the sun;<br>during July / August the sun is higher in the sky;<br>rays are concentrated in a smaller area causing higher temperatures;  | <b>2</b> |
| 1(a)(iii) | mountains have more rainfall;<br>because air is forced over high ground and cools;<br>causes damp air to condense (and fall as rain);<br>higher the mountain is above sea level, the colder the temperatures;<br>at high altitude air is thinner;<br>high altitude more exposed to high wind speeds;<br>fewer trees at altitude to shelter from wind;<br>high altitude more exposed to relief rainfall; | <b>4</b> |
| 1(a)(iv)  | currents from poles bring colder conditions;<br>currents from equator bring warmer conditions;  | <b>1</b> |
| 1(b)(i)   | medium high rainfall on west coast (when wet monsoon winds meet coast);<br>slightly lower rainfall 10–20 or 20–40 for middle part of India;<br>high rainfall (when winds travel to Bangladesh / Bhutan / Nepal / Himalayas);<br>lower rainfall in north-west area of India / Pakistan;  | <b>2</b> |
| 1(b)(ii)  | (seasonal) difference in temperature between land and ocean;<br>land heats up more quickly than ocean;<br>causes pressure change ;<br>air, above ocean has higher pressure / above land has lower pressure;<br>leads to wind direction change;<br>as wind flows from low to high pressure;<br>brings moist air from ocean;<br>which condenses as rain;  | <b>3</b> |

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| Question | Answer   | Marks    |
|----------|--|----------|
| 1(c)     | impact on agricultural production;<br>leads to reduced GDP;<br>damage to rice harvest effects food security;<br>rainfall at higher than expected intensity leads to flooding;<br>flooding can cause loss of life and damage to property;<br>unexpected high levels of rainfall lead to landslides;<br>lower intensity or a break in rainfall may lead to water shortage;<br>contamination of water supply;<br>leads to water related diseases e.g. cholera etc.;<br>livestock down / starve;<br>leads to famine;<br>soil erosion;<br>leads to desertification; | <b>5</b> |

| Question | Answer  | Marks    |
|----------|---|----------|
| 2(a)(i)  | the rocks do not change in composition;<br>water gets into cracks, freezes and expands, then thaws;<br>rocks break down into smaller pieces;<br>no chemical change is involved;   | <b>2</b> |
| 2(a)(ii) | structure / texture of rock;<br>if rock contains many cracks for water to get in it will break apart more easily;<br><br>temperature;<br>if temperature fluctuates above and below zero degrees then freeze and thaw happen regularly to break rock down;<br><br>available water; | <b>4</b> |
| 2(b)(i)  | sandy clay loam;  | <b>1</b> |
| 2(b)(ii) | organic matter;<br>oxygen / air;<br>water;<br>micro-organisms;  | <b>2</b> |

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| <b>Question</b> | <b>Answer</b>   | <b>Marks</b> |
|-----------------|---|--------------|
| 2(c)(i)         | overall northern hemisphere gain;<br>overall southern hemisphere loss;<br>describe areas with no change;  | <b>3</b>     |
| 2(c)(ii)        | when trees are removed roots, which bind the soil are also removed;<br>soil is then exposed to rainfall and surface runoff;<br>water / wind remove soil and transport down slope;<br>soil has lower organic matter resulting in a weaker structure;   | <b>2</b>     |
| 2(c)(iii)       | agricultural machinery may damage structure of soil;<br>grazing may cause compaction by livestock;<br>salinisation caused by higher levels of evaporation;<br>compaction increased exposure to vehicles, humans causing airspace to be removed;<br>flooding;<br>intensive agriculture;<br>trampling of soil;<br>land pollution or named e.g. fertiliser / DDT / sewage;<br>landslide;   | <b>2</b>     |
| 2(d)            | terraces stabilised with grasses;<br>provide level areas for planting to prevent soil being washed away;<br>mulch;<br>protects soil from raindrop splashing;<br>plants added to add roots and stability to terraces;<br>cover crops to help soil absorb water;<br>bunds / raised edges - prevent water runoff / wind or water erosion;<br>terraces<br>prevent soil being washed away / water erosion;<br>stops crops / trees being washed away;<br>drainage<br>prevents water logging;<br>stops roots of crops rotting; | <b>4</b>     |

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| <b>Question</b> | <b>Answer</b>  | <b>Marks</b> |
|-----------------|--|--------------|
| 3(a)            | <p>Immediately after eruption pyroclastic flows occur, devastating to area very close to volcano, may not occur in all directions from volcano, area affected is small but high risk to life and property as virtually no warning.</p> <p>Tsunami triggered by volcano may reach area 100 km from site, cause severe effects to low lying coastal areas but higher ground is safer, some warning is given as tsunami early warning systems are used, may be caused by later tremors associated with volcano.</p> <p>Ashfall covers a wider area up to 100 km, may take longer to settle, may cause some respiratory problems or damage to habitats, damage to buildings, much less severe than pyroclastic flow.</p> <p>Ash may cause no flying area which may extend 100 km from eruption site, if ignored may cause danger to those flying, flight ban may affect transport arrangements, supply chains and cause large insurance payouts but if followed is less likely to cause risk to life and property.</p> <p>Long-term effects of gaseous emissions include sulfur dioxide being erupted into the atmosphere along with ash. These reflect incoming solar radiation which may cause global cooling for 3–4 years, this may cause reduction of food supply or famine which effects large numbers of people over long periods of time.</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-top: 10px;"> <p><b>please use level descriptors 1</b></p> </div> | <b>10</b>    |

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| Question | Answer  | Marks     |
|----------|---|-----------|
| 3(b)     | <p><i>The question requirements are:</i></p> <ul style="list-style-type: none"> <li>• damage caused by explosive volcanoes</li> <li>• damage caused by effusive volcanoes</li> <li>• factors which determine damage and loss of life other than eruption style.</li> </ul> <p><i>Indicative content:</i></p> <p>Candidates are likely to describe the hazards associated with explosive eruptions and the damage they may cause. Explosive eruptions cause pyroclastic flows / nuee ardentes / hot ash clouds to form, this is a fluidised mixture of hot rock fragments, hot gases and trapped gas which moves at high speed as a thick, turbulent cloud. These are extremely dangerous cause burning of buildings in their path and widespread death by asphyxiation. Gases released by explosive volcanoes can cause acid rain in the short term and global cooling long term due to sulfur dioxide aerosols reflecting sunlight. Gases released may be poisonous, for example hydrogen sulfide. Explosive volcanic activity may trigger landslides and volcanic mudflows with very little warning which may cause damage to buildings and loss of life. Supported by example, Mt St Helens, Pinatubo, Montserrat.</p> <p>Effusive, basaltic eruptions, effusive eruptions occur when gas concentrations are lower, these lava flow in a more fluid manner, they may cause less risk to life as people can move away from them as they flow. They are very hot so may burn property and vegetation. Gases may still be produced for example fluorine gas causes harm to animals. It is absorbed into plants and then when animals eat the plants it makes animals bones to break down which may lead to famine if eruption occurs over long-time scale. Carbon dioxide released by eruptions may collect in low lying areas displace oxygen and cause animals and plants to suffocate.</p> <p>Other factors which impact on severity of a volcanic eruption are population density, a sparsely populated area has lower chance of volcanic hazard causing damage to property and loss of life compared to area of high population density, Topography, low lying natural basins most likely to accumulate deadly gases compared to slopes. Natural river channels more likely to be exploited by volcanic mudflows and may therefore direct to settlements on near river. Coastal areas most at risk from tsunamis. Mountainous regions at higher risk from landslides linked to ground movement from rising magma. Monitoring factors such as ground movement, gas concentrations may have allowed some warning.</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-top: 10px;"> <p><b>please use level descriptors 2</b></p> </div> | <b>30</b> |

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| <b>Question</b> | <b>Answer</b>   | <b>Marks</b> |
|-----------------|---|--------------|
| 4(a)            | <p>Ice melting.<br/>Reduction in albedo, less reflection of incoming solar radiation therefore temperatures increase, increased flooding of low-lying areas, melting of permafrost releases gas hydrates which increase greenhouse gases, damage foundations of buildings, reduce biodiversity due to habitat loss in this environment.<br/>Circulation change.<br/>Impact on seasonal weather patterns, impacts on planting and harvesting seasons, fishing, tourism, increased storm intensity and frequency, risk of property damage and loss of life. Effect on fish populations due to change in upwelling of nutrients. Arrival of monsoons change affecting planting / harvesting.<br/>Biome loss.<br/>Habitat loss for species, reduction in biodiversity, increased soil erosion, extinction of species, loss of potential medicines, carbon store in plants and trees released.</p> <div data-bbox="338 632 801 687" style="border: 1px solid black; padding: 2px; width: fit-content;"><b>please use level descriptors 1</b></div> | <b>10</b>    |

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| Question | Answer   | Marks     |
|----------|--|-----------|
| 4(b)     | <p><i>The question requirements are:</i></p> <ul style="list-style-type: none"> <li>• to talk about MEDCs use of renewable and why they can do this</li> <li>• why LEDCs can't</li> <li>• reasons why alternative technologies needed</li> <li>• reasons why MEDC's should take responsibilities for alternative technologies</li> <li>• reasons why LEDC's should develop own alternative technologies.</li> </ul> <p><i>Indicative content:</i><br/> MEDCs can because ...<br/> LEDCs can't easily change because ...<br/> Candidates may discuss how using alternative technologies is necessary for reducing atmospheric pollution and may discuss how particular emissions are causing certain effects, sulfur dioxide leading to acid rain. The sustainable use of fossil fuels and other resources from the lithosphere may be discussed and the idea that humans must be more efficient or look to alternatives in terms of use of resources.</p> <p>MEDC have higher GDP and therefore more money available to invest in alternative technologies, carry out research and development to find most appropriate ways to harness energy. MEDC may have more existing research facilities that can be used to develop further. Existing interconnecting grid for electricity may allow alternative technologies to be accessed over wide area. MEDC's may be responsible for the atmospheric pollution over its industrial history, has benefitted economically for the development and therefore should take responsibility for the pollution. MEDC's can lead by example to other countries by using alternative technologies.</p> <p>LEDC's should develop their own alternative technologies, as they have greater knowledge of their countries natural environment and therefore can design bespoke technology to suit. Could benefit economically from design by exporting idea. LEDC's would be independent of any dept caused by taking on technology from other countries. Pollution is being caused by all countries by vehicles, manufacturing, domestic use, agriculture and therefore all countries need to improve efficiency and increase use of alternative technologies.</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-top: 10px;"> <p><b>please use level descriptors 2</b></p> </div> | <b>30</b> |

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| <b>Question</b> | <b>Answer</b>  | <b>Marks</b> |
|-----------------|--|--------------|
| 5(a)            | <p>International cooperation.<br/>Nearly all nations worked together putting differences aside, rapid action meant it was kept a priority. Banning by this many countries caused reduction in CFC's. CFC containing products were not available to import / export. Multilateral funding available for companies to adapt to alternatives.<br/>Satellite data.<br/>Clear differences, evidence based, significant differences seen on short time scales.<br/>Replacement.<br/>Alternatives provided so products can still be used.<br/>Gradual ban.<br/>Allowed some countries to gradually replace when ready.<br/>Scientific research.<br/>All publishing supported with evidence.</p> <div data-bbox="338 667 801 727" style="border: 1px solid black; padding: 2px; width: fit-content;"><b>please use level descriptors 1</b></div> | <b>10</b>    |

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| Question | Answer   | Marks     |
|----------|--|-----------|
| 5(b)     | <p><i>The question requirements are:</i></p> <ul style="list-style-type: none"> <li>• why air pollution is a problem in cities and urban areas</li> <li>• strategies for managing air pollution</li> <li>• difficulties managing air pollution.</li> </ul> <p><i>Indicative content:</i></p> <p>Cities and urban areas have high population density and many people means high demand for services and transport use. Often manufacturing is concentrated in urban areas for ease of workforce and transport links. Air pollution associated with transport and energy demand includes high levels of carbon dioxide produced by fuel combustion, sulfur dioxide and nitrogen oxides formed during combustion of fuels, ground level ozone from vehicle emissions together with sunlight.</p> <p>Strategies for managing air pollution in a city are numerous. Candidates may discuss the use of alternative fuels such as solar panels on building roofs to reduce demand on fossil fuel power stations, increased passive homes to reduce fuel demands, improvements to public transport systems to reduce vehicle use in city centres, introducing low emission zones, congestion charges, car share programs. Improved facilities for walking, cycling in the city.</p> <p>Improved planning for new industry locations considering prevailing winds, use of renewables, public transport to move products and materials. Addition of scrubbers to emission chimneys, use of filters for all emissions.</p> <p>Challenges associated with this include cost of building and running large scale improved public transport systems, require large investment to build, during the time it takes to build atmospheric pollution increases. Challenges persuading members of the public to use public transport rather than cars. Systems required to monitor and regulate low emission zones, congestion charge and car share. Public information on improving efficiency, challenge to make people change their lifestyle and make cutbacks. Maintaining the countries' economy when the cutbacks are made. Industrial filters must be monitored and changed regularly. Alternative technology may not always be available and therefore backup systems may be needed.</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-top: 10px;"> <p><b>please use level descriptors 2</b></p> </div> | <b>30</b> |

**Section B descriptor levels:**

| <b>Descriptor</b>                                      | <b>Award Mark</b>                                 |
|--|---|
| Consistently meets the level criteria                  | Mark at top of level                              |
| Meets the criteria, but with some inconsistency        | Middle, mark to just below top mark               |
| Meets most of level criteria, but not all convincingly | Just below middle, mark to just above bottom mark |
| On the borderline of this level and the one below      | Mark at bottom of level                           |

**Section B (part a),****Level descriptors 1****8–10 marks**

The response:

- contains few errors
- shows a very good understanding of the question
- shows a good use of data or the information provided, where appropriate
- provides a balanced answer

**5–7 marks**

The response:

- may contain some errors
- shows an adequate understanding of the question
- shows some use of data or the information provided, where appropriate
- may lack balance

**1–4 marks**

The response:

- may contain errors
- shows limited understanding of the question
- shows little or no use of data or the information, where appropriate
- lacks balance

**Section B (part b),****Level descriptors 2**

Responses:

**Level one, 25–30 marks**

- fulfil all the requirements of the question
- contain a very good understanding of the content required
- contain a very good balance of content
- contain substantial critical and supportive evaluations
- make accurate use of relevant vocabulary

**Level two, 19–24 marks**

- fulfil most of the requirements of the question
- contain a good understanding of the content required
- contain a good balance of content
- contain some critical and supportive evaluations
- make good use of relevant vocabulary

**Level three, 13–18 marks**

- fulfil some requirements of the question
- contain some understanding of the content required
- may contain some limited balance of content
- may contain brief evaluations
- make some use of relevant vocabulary

**Level four, 6–12 marks**

- fulfil limited requirements of the question
- contain limited understanding of the content required
- may contain poorly balanced of content
- may not contain evaluations
- make limited use of relevant vocabulary

|  |   |  |
|--|---|--|
|  | <p><b>Level five, 1–5 marks</b></p> <ul style="list-style-type: none"><li>• fulfil a few of the requirements of the question</li><li>• contain a very limited understanding of the content required</li><li>• are likely to be unbalanced and undeveloped</li><li>• evaluative statements are likely to be missing</li><li>• make no use of relevant vocabulary</li></ul> |  |
|--|---|--|