ENVIRONMENTAL MANAGEMENT	**8291/11**
Paper 1 Principles of Environmental Management	**May/June 2024**
MARK SCHEME	
Maximum Mark: 80	

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.

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This document consists of **18** printed pages.

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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 descriptions 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	<u>'List rule' guidance</u> 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)	thermosphere = D; troposphere = A;	**2**
1(a)(ii)	*any one from (Layer A):* temperature decreases with altitude through layer **A**; *any one from (Layer B):* no temperature change up to 20 km in layer **B** / temperature stable or stays the same (at –55 °C) until 20 km; (above 20 km) temperature increases with altitude in layer **B**;	**2**
1(a)(iii)	*any three from:* (layer B) contains ozone (layer); (ozone) absorbs UV radiation / solar radiation / solar energy; (energy) warms / heats the atmosphere / layer B / stratosphere; lack of convection mixing;	**3**
1(b)(i)	*any four from:* UV / shortwave radiation; is absorbed by Earth's surface / the Earth / ground; IR / longwave radiation; (re-)emitted / 'given out' / released back (towards space); (IR) absorbed by atmospheric gases / greenhouse gases / named greenhouse gas e.g. carbon dioxide; (absorbed IR) warms the atmosphere;	**4**

Question	Answer	Marks
1(b)(ii)	*any four from:* cattle release methane / reduction of methane released; greenhouse gases trap heat / lead to the (enhanced) greenhouse effect; prevents deforestation (for land for cattle) / trees absorb carbon dioxide / allows planting of more fruit trees; prevents farmers having to grow crops for animal feed; lowers energy use because meat needs refrigeration / plant based foods require less energy to process; less emissions / greenhouse gases from meat processing factories; livestock farming (chicken / pigs) uses large amounts of energy for heating;	**4**
1(b)(iii)	*any two from:* planting rice fields / paddy fields; landfill sites; combustion / burning of fossil fuels or named fossil fuel; idea of wasting energy; use of concrete (releasing carbon dioxide) in building projects / cement manufacture; deforestation; incineration of trash / waste; CFCs from refrigeration or aerosols;	**2**

Question	Answer	Marks
2(a)(i)	*any one from:* bare rock / newly formed rock; only pioneer species / small plants shown; no soil / lack of soil; lack of vegetation / plants;	**1**
2(a)(ii)	*any six from:* pioneer species e.g. mosses or lichens colonise / grow on bare lava; mosses / lichens; soil begins to form / soil forms or develops; weathering of lava / rock; decomposition of pioneer species / release of nutrients into soil / increased soil fertility (as plants decompose); small plants / shrubs / bushes colonise; climax community / stable diverse community; trees / large plants / increase in size and complexity of plants; reference to colonisation by animal (species) / primary consumers, secondary consumers / more complex food webs develop; suitable time reference / hundreds of years / long time; biodiversity / biomass increases; functional processes change e.g. nutrient cycling / carbon storage / water retention;	**6**

Question	Answer	Marks
2(b)(i)	both axes labelled including unit on *y*-axis: *x*-axis, ecosystems **and** *y*-axis, net primary productivity (NPP) / g carbon m^{-2} year^{-1}; linear scale on *y*-axis with data occupying at least half of the grid; all 5 bars plotted to within ± half of a small square; bar chart with bars of equal width **and** not touching;	**4**
2(b)(ii)	16 – 32; *any two from:* greater productivity than sand dunes / less productivity than desert scrubland / (similar to desert scrubland as) small plants growing on lava field; low levels of photosynthesis; low nutrient content;	**3**
2(b)(iii)	*any four from (max three for GPP / max three for NPP):* GPP is the total productivity or rate at which energy is converted into biomass; GPP is not adjusted for energy losses / NPP is GPP minus energy lost or used; e.g. respiration / metabolism of producers; GPP will always be more than NPP; NPP is the amount of useful energy (for respiration / metabolism) in the ecosystem / NPP represents amount of productivity available to pass on to higher trophic levels;	**4**

Question	Answer	Marks
3(a)	*any five from:* removal of vegetation / deforestation; habitat loss; disruption of food chain / food web; migration of animals / animals scared away (due to noise); loss of biodiversity / extinction; soil erosion leads to reduction in organic matter / degradation of soil / soil less fertile; (leaching of chemicals in soil) reduce vegetation growth; change in water availability / deplete ground water; water pollution / contamination of water e.g. toxic chemical / acid mine water / salination of fresh water / impacts downstream; fragmentation;	5

Question	Answer	Marks
3(b)(i)	*any two from:* recycling is expensive or less profitable / recycling may require more energy than mining / mining is cheaper or more profitable; recycling is a difficult process / requires a higher level of technology / requires a lot more effort / time consuming / mining is a simple process; insufficient supply from recycling / mining can supply large amounts; reduction in quality of cobalt after recycling / recycled cobalt not as pure as mined / high quality cobalt needed for batteries; difficult to collect / sort old batteries from waste / limited recycling infrastructure; people need to be involved / know about recycling / cooperative; current methods of recycling cobalt produce dangerous waste products;	**2**

Question	Answer	Marks
3(b)(ii)	*any one from list:* landfill / disposal at sea / exporting / burial / composting; *any two from:* contamination of soil leading to leaching / contamination of (ground) water / production of toxic leachate; build-up and release of the greenhouse gas methane (CH_4) / methane leads to global warming or climate change; (with a) danger of explosions / landfill fires; visual / noise pollution / unpleasant odour; risk of spread of disease / vermin; landfill takes up space; (disposal at sea) release of toxic substances / chemicals / named toxin into ocean; bioaccumulation / biomagnification; plastics or microplastics in oceans / soil / water;	3

Question	Answer	Marks
3(b)(iii)	*any three from:* *(benefits of reducing use of rechargeable batteries - max 2)* less expense / less technology required; don't need to recharge batteries / less use of electricity (e.g. from leaving chargers in); doesn't deplete mineral supplies / less cobalt would need to be mined / less environmental impact due to mining; less complex recycling infrastructure required; potential safer disposal of alternatives to rechargeable batteries (as less harmful materials); less energy required for single-use battery production; *(limitations of reducing use of rechargeable batteries - max 2)* lots of devices dependent on rechargeable batteries / electric cars use rechargeable batteries; people will not buy into the strategy / people not complying; increased costs in long-term (constantly need to replace batteries); supply doesn't meet demand of alternatives to rechargeable batteries; (rechargeable batteries reduced) lead to greater use of single-use batteries and greater amount of waste produced / higher environmental impact;	3

Question	Answer	Marks
4(a)(i)	ability to meet the needs of the present; without compromising the ability of / with consideration of future generations to meet their own needs;	**2**
4(a)(ii)	*any three from:* reliable availability of energy; having diversity of supply / not dependent on one source (of energy); access to sufficient energy for all; at an affordable price; allows for economic development; with a consideration for the environment;	**3**

Question	Answer	Marks
4(a)(iii)	*any five from:* fossil fuel depletion / lack of fossil fuels / fossil fuels running out; unavailability of renewables / lack of investment in renewables; unavailable technology; inequality in global energy resources; named example e.g. availability of geothermal / tidal power; population growth; more demand than supply; differing energy needs of countries in different income groups / inequality of access due to poverty; climate change / global warming e.g. droughts; supply disruption / poor infrastructure; natural disasters e.g. earthquakes; piracy / terrorism / conflict; over-reliance on one energy source / reliance on importing of energy;	5

Question	Answer	Marks
4(b)	*any two from:* rationing; ensure all people have access / improve equal access to energy / make energy affordable to all; reduce environmental impacts e.g. laws or legislation against pollution; named example e.g. reduce (open cast) mining of fossil fuels; invest in or increase use of renewable resources /named renewable resource e.g. wind farms / carbon neutral fuels; increase energy efficiency e.g. A-rated appliances such as washing machines; increase energy production; reduce reliance on fossil fuels; develop energy technologies; investment in local energy projects;	2

Question	Answer	Marks
5	The question requirements are to: • show an understanding of the uses of water • describe the impacts of water insecurity • describe strategies for improving water security • evaluate the statement with particular emphasis on 'the most effective strategy'. Candidates may describe the uses of water, including domestic, industrial, agricultural. Candidates may describe local and global impacts of water insecurity including poverty, famine, malnourishment / dehydration and death, crop failure, lack of industrial development, migration / relocation etc. Candidates may describe agricultural techniques using reduced water including high-tech irrigation systems / aeroponics, drip irrigation methods, selective breeding / GM crops that are drought resistant, growing crops that require less water / not growing crops that require a lot of water, aquaponics / combining agricultural techniques, regenerative agriculture. Candidates may suggest that other strategies are more effective, such as reducing domestic use, improved extraction and supply, rain water harvesting, use of grey water / recycling water, desalination, education, legislation / rationing, reducing water wastage, and international agreements (climate change). Candidates are likely to be split about the effectiveness of the strategy but their reasoning should be balanced. Answers should be supported by case studies / relevant examples where this provides balanced evidence.	20

Question	Answer	Marks
6	The question requirements are to: • show an understanding of the trend in human population • describe successful and less successful policies • evaluate the success of policies Candidates should describe the trend in human population which may include a future prediction e.g. 11 billion in 2100 according to the UN. Candidates should describe local, national and global policies e.g. pronatalist and antinatalist polices, United Nations (UN) Agenda 21, The Club of Rome. Candidates may use specific examples of individual, local, national and international strategies. The examples should be balanced and show successful and less successful programmes/drawbacks of policies. These examples may highlight the difference in success of strategies in LICs and HICs and explain the reasons for the difference. Candidates are likely to conclude that strategies are ineffective but their reasoning should be balanced. Answers should be supported by case studies / relevant examples where this provides balanced evidence.	20

Generic levels of response

Level	AO2: Information handling and analysis	Marks
3	• Responses contain reasoned explanations with knowledge that indicates a strong conceptual understanding of the topic. • Incorporates frequent use of directly relevant examples.	7–8
2	• Responses contain explanations with some gaps or errors in the reasoning. • Explanations may lack detail or accurate knowledge. • Examples are included but some opportunities to include relevant examples are missed.	4–6
1	• Responses contain a few general points, which are mainly descriptive, comprising a few simple points. • Knowledge is basic and understanding may be poor and lack relevance to the question set. • Irrelevant or no examples are given.	1–3
0	• No creditable response.	0

Level	AO3: Investigation skills and making judgements	Marks
4	• Clearly presents and develops both sides of the argument. • Judgements are fully supported with relevant qualitative and/or quantitative information. • Clear, balanced conclusion which is consistent with the question and candidate response.	10–12
3	• One side of the argument is better developed than the other. • Judgements are partially supported with qualitative and/or quantitative information. • Conclusion is consistent with the question and candidate response.	7–9
2	• Describes only one side of the argument. • Judgements have minimal support; qualitative or quantitative information lacks relevance. • Conclusion may be inconsistent with the question and candidate response.	4–6
1	• Response is descriptive. • Minimal judgement is made, unsupported by qualitative or quantitative information. • Conclusion is inconsistent with the question and candidate response, or no conclusion made.	1–3
0	• No creditable response.	0