



National  
Qualifications  
2016

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**Environmental Science**

**Higher**

**Finalised Marking Instructions**

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## General Marking Principles for Environmental Science Higher

*This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this Paper. These principles must be read in conjunction with the detailed marking instructions, which identify the key features required in candidate responses.*

- (a) Marks for each candidate response must always be assigned in line with these General Marking Principles and the Detailed Marking Instructions for this assessment.
- (b) Marking should always be positive ie, marks should be awarded for what is correct and not deducted for errors or omissions.
- (c) If a specific candidate response does not seem to be covered by either the principles or detailed Marking Instructions, and you are uncertain how to assess it, you must seek guidance from your Team Leader.
- (d) Half marks may not be awarded.
- (e) Where a candidate makes an error at an early stage in a multi-stage calculation, credit should normally be given for correct follow-on working in subsequent stages, unless the error significantly reduces the complexity of the remaining stages. The same principle should be applied in questions which require several stages of non-mathematical reasoning.
- (f) Unless a numerical question specifically requires evidence of working to be shown, full marks should be awarded for a correct final answer (including units if required) on its own.
- (g) Larger mark allocations may be fully accessed whether responses are provided in continuous prose, linked statements or a series of discrete developed points.
- (h) In the detailed Marking Instructions, if a word is **underlined** then it is essential; if a word is **(bracketed)** then it is not essential.
- (i) In the detailed Marking Instructions, words separated by/are alternatives.
- (j) If two answers are given where one is correct and the other is incorrect, no marks are awarded.
- (k) Where the candidate is instructed to choose one question to answer but instead answers both questions, both responses should be marked and the better mark awarded.
- (l) The assessment is of skills, knowledge and understanding in Environmental Science, so marks should be awarded for a valid response, even if the response is not presented in the format expected. For example, if the response is correct but is not presented in the table as requested, or if it is circled rather than underlined as requested, give the mark.
- (m) Unless otherwise required by the question, use of abbreviations (eg DNA, ATP) or chemical formulae (eg CO<sub>2</sub>, H<sub>2</sub>O) are acceptable alternatives to naming.
- (n) Content that is outwith the course assessment specification should be given credit if used appropriately eg metaphase of meiosis.
- (o) If a numerical answer is required and units are not given in the stem of the question or in the answer space, candidates must supply the units to gain the mark. If units are required on more than one occasion, candidates should not be penalised repeatedly.

- (p) If incorrect **spelling** is used:
- and the term is recognisable then give the mark;
  - and the term can easily be confused with another biological term then do not give the mark eg ureter and urethra;
  - and the term is a mixture of other biological terms then do not give the mark, eg mellum, melebrum, amniosynthesis.
- (q) When presenting data:
- if a candidate provides two graphs or charts in response to one question (eg one in the question and another at the end of the booklet), mark both and give the higher mark
  - for marking purposes no distinction is made between bar charts (used to show discontinuous features, have descriptions on the x-axis and have separate columns) and histograms (used to show continuous features, have ranges of numbers on the x-axis and have contiguous columns)
  - other than in the case of bar charts/histograms, if the question asks for a particular type of graph or chart and the wrong type is given, then do not give the mark(s) for this. Where provided, marks may still be awarded for correctly labelling the axes, plotting the points, joining the points either with straight lines or curves (best fit rarely used), etc.
  - the relevant mark should not be awarded if the graph uses less than 50% of the axes; if the x and y data are transposed; if 0 is plotted when no data for this is given (ie candidates should only plot the data given)
- (r) Marks are awarded only for a valid response to the question asked. For example, in response to questions that ask candidates to:
- **identify, name, give, or state**, they need only name or present in brief form;
  - **calculate**, they must determine a number from given facts, figures or information;
  - **compare**, they must demonstrate knowledge and understanding of the similarities and/or differences between things;
  - **describe**, they must provide a statement or structure of characteristics and/or features;
  - **evaluate**, they must make a judgement based on criteria;
  - **explain**, they must relate cause and effect and/or make relationships between things clear;
  - **outline**, they must provide a brief sketch of content - more than naming but not a detailed description;
  - **predict**, they must suggest what may happen based on available information;
  - **suggest**, they must apply their knowledge and understanding of Environmental Science to a new situation. A number of responses are acceptable: marks will be awarded for any suggestions that are supported by knowledge and understanding of Environmental Science.

Marking Instructions for each question

Question			Expected Answer(s)	Max Mark	Additional Guidance
1.	(a)	(i)	A biofuel is a hydrocarbon/organic/resource that is made by or from a living organism and that humans can use for fuel.	1	Must include mention of processing.
		(ii)	The % used for human consumption has fallen by 12%.  The % used for animal feed has fallen by 20%.  Other uses has fallen by 8%.  Use as a biofuel has been introduced since 2000 and accounts for 40%.	2	1 mark for identifying all of the reductions (human consumption, animal feed, other).  1 mark for identifying the increase (biofuel) and its %.  Responses should include the % change. Max of 1 mark if not included.
		(iii)	(Growing corn for biofuel) offers a new market/increased range of markets  <b>OR</b>  Could bring in more income for farmers.  Other reasonable response.	1	
		(iv)	Corn diverted for biofuel means less is available for human consumption/animal feed or higher animal feed costs will increase food prices for the consumer.  Other reasonable response.	1	
	(b)		39 286 (truckloads).	1	Answer must be rounded up to the nearest whole truckload.  $110 \text{ million}/2800 = 39 \text{ 285.7.}$

Question		Expected Answer(s)	Max Mark	Additional Guidance
	(c)	<p><b>For:</b> the carbon produced from burning the biofuels will be offset by the carbon the plants absorbed during photosynthesis/growth.</p> <p><b>Against:</b> energy must be used in producing the crops eg synthesising and applying fertilisers/fuel used in harvesting/processing/transportation.</p> <p>Other reasonable response.</p>	2	<p>1 mark for pro carbon-neutral.</p> <p>1 mark for against.</p>
	(d)	<p>EU - legislative role in farming and fishing (CAP and CFP).</p> <p>UK/Scottish policies and legislation eg National Food and Drink Policy for Scotland.</p>	2	<p>Candidates may name a role of a specific Government (EU, UK, or Scotland).</p> <p>Fishing - responses may also relate to freshwater fishing eg seasonal.</p> <p>1 mark for named example.</p> <p>1 mark for description.</p>

Question			Expected Answer(s)	Max Mark	Additional Guidance
2.	(a)	(i)	<p>(More precipitation will fall as rain instead of snow so) snow will melt earlier/permanent snowpack will reduce/less freshwater stored as snow or ice, causing seasonal shortages when demand is highest.</p> <p>Or other reasonable response.</p>	1	Emphasis should be on lack of water storage/rapid runoff in the mountains and consequences of this.
		(ii)	<p>Rising sea levels could cause seawater to degrade the coastal aquifers</p> <p><b>OR</b></p> <p>Overreliance on coastal aquifers could reduce these</p> <p><b>OR</b></p> <p>Aquifers not refilling due to lack of snow/rain.</p> <p>Or other reasonable response.</p>	1	

Question		Expected Answer(s)	Max Mark	Additional Guidance
	(b)	<p><b>Urban</b> - Increased demand for drinking water/showers/swimming pools/domestic use, in drought year (1 mark).</p> <p><b>Agriculture</b> - increased irrigation/more water required for livestock in drought year (1 mark).</p> <p><b>Environmental</b> - pressure shifts to human needs in a drought year (1 mark).</p> <p>Difficult to reduce actual usage for urban and agricultural in a drought year (1 mark).</p> <p>Actual usage in a drought year could remain the same but it is a higher proportion of a smaller total (1 mark).</p> <p>Other reasonable response.</p>	3	<p>Any 3 appropriate responses, (but must comment on each sector).</p> <p>Each response should include comment on increase/decrease in normal/drought year.</p>
	(c) (i)	<p>Greater investment in trees as they take longer to grow than annual crops but provide high returns.</p> <p>Trees are more resilient in drought periods (due to their deeper roots) so makes sense to focus on vegetables.</p> <p>Trees, as roots bind soil and help prevent soil erosion.</p> <p>Vegetables need regular irrigation but provide an immediate financial return.</p> <p>Other reasonable response.</p>	1	
	(ii)	<p>If the rate of removal is greater than the rate of recharge then the water resource is diminished (1 mark).</p> <p>In times of drought the groundwater is not replenished in the short term so will not be a potential source of water in the future (1 mark).</p> <p>Other reasonable response.</p>	2	<p>1 mark for comparison of removal &amp; recharge (quantity).</p> <p>1 mark for longer term/future effects (time).</p>
	(iii)	<p>Cultivation of GM crops/selective breeding/genetic engineering for drought tolerance/drip or targeted irrigation/water transfer scheme/grey water/‘magic stones’</p> <p>Other reasonable response.</p>	1	<p>Accept local or global focus.</p> <p>Response could relate to changing the nature of the crop or changing the farming practice.</p>

Question		Expected Answer(s)	Max Mark	Additional Guidance
3.	(a)	<p>Changes in the hare population are mirrored in the lynx population</p> <p><b>OR</b></p> <p>As the hare population increases, so does the lynx population AND as the hare population falls, so does the lynx population.</p>	1	This type of response must cover both increase and decrease.
	(b)	<p>In some years the lynx population is greater than the hare population.</p> <p>Specify 1916 and/or 1925-30.</p>	2	<p>1 mark for the general trend.</p> <p>1 mark for specifying year(s).</p>
	(c)	<p>(Increased hunting of lynx by humans would result in) reduced predation by lynx would lead to more rapid build-up of hare numbers (1 mark) and lead to a shorter period between population peaks (1 mark)</p> <p><b>OR</b></p> <p>Reduced predation by lynx would have no effect on hare numbers (1 mark) as they are dictated by the recovery of vegetation (1 mark)/ alternative predator fills the niche (1 mark).</p> <p>Or other reasonable response.</p>	2	<p>1 mark for the prediction.</p> <p>1 mark for the effect.</p>

Question		Expected Answer(s)	Max Mark	Additional Guidance
	(d)	<p>Reduced hare population allows the vegetation to recover and the cycle repeats.</p> <p>Decrease because competitive grasses would not be kept in check and would out-compete other plant species.</p> <p>Increase because there would be more plant variety/potentially be more insect pollinators/other species moving in.</p> <p>Stays the same because other grazers move in.</p> <p>Or other reasonable response.</p>	2	<p>1 mark for how biodiversity would change.</p> <p>1 mark for justification.</p> <p>Candidates may use terms such as overshoot, carrying capacity, population oscillations, and should be given credit where they are used appropriately.</p>
	(e)	Sea eagle/red kite/capercaillie/beaver/reindeer.	1	Any one.

Question			Expected Answer(s)	Max Mark	Additional Guidance
4.	(a)	(i)	<p><b>Psychological:</b> consumers are persuaded by advertising/peer pressure that an updated model is better in terms of design/technology/must-have value.</p> <p><b>Technological:</b> innovative advances/technical support no longer available.</p> <p>Other reasonable response.</p>	1	Justification must match the category chosen.
		(ii)	<p><b>Planned:</b> cartridge contains a set amount of ink so must be refilled/replaced.</p> <p>Or other reasonable response.</p>	1	Justification must match the category chosen.

Question		Expected Answer(s)	Max Mark	Additional Guidance
	(b)	(i)	3	1 mark for each.  Must comment on all three categories.
		(ii)	1	Any one.
	(c)	(i)	1	Any one.

Question			Expected Answer(s)	Max Mark	Additional Guidance
5.	(a)	(i)	14 (%)	1	1381/9865 x 100.
		(ii)	Multi stage life cycle Difficult to identify/track/monitor (because of large number of species/ small size of organism/number of identification experts). Accessibility of habitat eg due to weather, terrain, war, politics.  Other reasonable response.	1	
	(b)		Deforestation (directly eliminating tree species/removing habitat of forest species.)  Increased use herbicides, (removing weed species.)  Removal of hedgerows, (reducing habitat.)  Drainage of wetlands, (reducing habitat.)  Use of artificial fertilisers, (altering nutrients in the soil.)  Cultivating monocultures (using up nutrients.)  Or other reasonable response.	2	Any two.
	(c)	(i)	(Over-use of fertilisers) stimulates algal growth (1 mark).  AND  At night oxygen levels decrease due to increased respiration and this could negatively impact on the amphibians (1 mark)  OR  Decomposition of algae and other aquatic vegetation causes bacterial decomposition (1 mark) which results in anaerobic conditions/lack of oxygen/release toxic gases (1 mark).  Other reasonable response.	2	Response must relate back to the amphibians.

Question			Expected Answer(s)	Max Mark	Additional Guidance
		(ii) (A)	<b>SEPA:</b> responsibility for monitoring/preserving/improving water quality/enforcing legislation/advising landowners/education.	1	
		(ii) (B)	<b>SSSIs:</b> designated areas of specific biological or geological interest/give protection against development/habitat destruction.	1	Focus should be on habitat protection, not specifically amphibians.

Question			Expected Answer(s)	Max Mark	Additional Guidance
6.	(a)	(i)	Troposphere.	1	
		(ii)	<p>Able to take advantage of fast moving wind, so reduces fuel use and less GHG released.</p> <p>Fewer bird strikes, so less physical impact on species.</p> <p>Lower noise pollution, so less disturbance of species.</p> <p>Other reasonable response.</p>	2	Any one but must be related to the environment.
		(iii)	Stratosphere.	1	
	(b)	(i)	Carbon dioxide/methane/water vapour/halons/nitrogen oxides/ carbon monoxide/sulfur dioxide.	1	<p>Carbon monoxide is a very weak direct GHG but has important indirect effects on global warming. Sources: burning biomass and fossil fuels.</p> <p>Sulfur dioxide is an indirect GHG. Sources: combustion of fossil fuels.</p>
		(ii)	<p>Enhanced greenhouse effect is the result of human activities. (1 mark)</p> <p>Source(s) of the named anthropogenic greenhouse gas. (1 mark)</p> <p>Impact: greenhouse gas absorbs outgoing radiated energy/ heat/ longwave/IR radiation (1 mark), reducing the loss of heat back into space (1 mark), keeping the atmosphere warmer than it would otherwise be. (1 mark)</p> <p>Other reasonable response.</p>	3	The greenhouse effect is a natural phenomenon, but human activities release more emissions and exacerbate the natural greenhouse effect. Response should make this clear.

Question		Expected Answer(s)	Max Mark	Additional Guidance
7.	(a)	Industrial revolution/new jobs and opportunities in urban areas/agricultural revolution/reduction in jobs in farming communities/changing land ownership practices eg enclosures, clearances, change in claims of ownership of natural resources (game, fish, forest etc)/wars/ other reasonable response.	2	Any two.
	(b)	Desire to live in the countryside/cheaper house prices/quality of life/rural birth rate is higher than urban birth rate/faster transport links/ other reasonable response.	2	Any two.
	(c)	(i) Urban living provides greater opportunities for large scale recycling/ less inputs needed per person to create solutions eg brown waste collection.  Or other reasonable response.	1	
		(ii) Urban living can be less energy intensive than rural living/shared living, co-housing and tenement housing solutions can give rise to district heating solutions as opposed to single household heating.  Or other reasonable response.	1	

Question		Expected Answer(s)	Max Mark	Additional Guidance	
	(d)	<p><b>(Negative impacts:)</b> Construction destroys habitats/reduces/impacts on sensitive species.</p> <p>High speed travel, collision impacts on mammals and other species.</p> <p>Winter gritting/salting runoff, impacts on species in verges.</p> <p>Roads can split up populations.</p> <p>More vehicles, increased pollution.</p> <p>Introduction of alien species via construction vehicles/verge construction (through importation of topsoil).</p> <p>More tarmac, sealing in of soil/increased runoff.</p> <p><b>(Positive impacts:)</b> Wildlife and animal corridors can be constructed.</p> <p>Sensitive planning can help protect or enhance pockets of biodiversity.</p> <p>Verges often untouched, resulting in higher biodiversity.</p> <p>Or other reasonable response.</p>	3	Any three.	
	(e)	(i)	Is a procedure that ensures that the environmental implications of development are considered <u>before</u> a development decision is made.	1	
		(ii)	EIA is an environmental assessment for an individual project.  SEA is an environmental assessment for public/Gov-led plans or programmes.	1	Response should include both for the mark.

Question		Expected Answer(s)	Max Mark	Additional Guidance
8.	(a)	<p>Land:</p> <ul style="list-style-type: none"> <li>• Mechanisation</li> <li>• Agrochemicals</li> <li>• Hormone treatment/antibiotics</li> <li>• Irrigation</li> <li>• Land management</li> <li>• Genetic engineering</li> <li>• GM crops</li> <li>• High yield varieties</li> <li>• Selective breeding</li> <li>• Hydroponics.</li> </ul> <p>Aquatic:</p> <ul style="list-style-type: none"> <li>• Aquaculture (eg fish farms/seaweed farms)/high density cages/hormone treatment/GM fish/pesticides/medication/‘cleaner’ fish (eg wrasse)/selective breeding</li> <li>• Management of marine fishing.</li> </ul> <p>Other reasonable response.</p>	2	<p>1 mark for land example. 1 mark for aquatic example.</p>
	(b)	<p>Scales and labels must be appropriate.</p> <p>Points should be accurately plotted and joined with a straight edge.</p> <p>Key should be included.</p>	3	<p>1 mark for appropriate scales.</p> <p>1 mark for appropriate labels and provision of key.</p> <p>1 mark for accurate plotting of points and joining with straight lines.</p> <p>NB graph should take up at least half of the grid.</p>
	(c)	<p>Gross (primary) productivity is the amount of organic matter produced/synthesised by the producer per unit area in a unit time.</p>	2	<p>1 mark for mentioning organic matter (or similar terminology).</p> <p>1 mark for including unit area and unit time.</p>

Question		Expected Answer(s)	Max Mark	Additional Guidance
	(d)	<p>Meat production requires more resources/land/water than vegetable production. (1 mark)</p> <p>Increasing population/demand for meat will place greater pressure on existing resources and could create shortages/increase prices. (1 mark)</p> <p>Increased animal production will result in slurry disposal issues. (1 mark)</p> <p>Other reasonable response.</p>	2	Cause and effect should be provided for both marks.

Question			Expected Answer(s)	Max Mark	Additional Guidance
9.	(a)	(i)	Both high and low tides occur on a cyclical/regular basis.  The highest high tides correspond to the lowest low tides (or similar).	2	1 mark for cyclical nature of the tidal heights.  1 mark for commenting on relationship between tide heights.
		(ii)	1.8 m	1	$3.4 - 1.6 = 1.8$ m  Neap tide = the point where there is least change between high and low tides.
		(iii)	15 <sup>th</sup> and 16 <sup>th</sup> (June 2014).	1	Both dates should be provided for one mark.
	(b)		A spring tide occurs when there is a full and a new moon.  A neap tide occurs when there is a half moon.	2	1 mark for each.  Must mention both full and new moon for the spring tide mark.
	(c)		The Coriolis effect is caused by the Earth's rotation (around its axis) (1 mark).  The Earth's rotation causes a deflection of air (1 mark).  The Coriolis effect is zero at the equator (1 mark).  Deflection is to the right in the northern hemisphere and to the left in the southern hemisphere (1 mark).  Air movement/wind blowing closer to the poles will be deflected more than wind blowing at the same speed closer to the equator (1 mark).  Other reasonable response.	4	Response should include cause of the Coriolis effect. Maximum of three marks if not included.  Credit should be given for a correct diagram.

Question			Expected Answer(s)	Max Mark	Additional Guidance
10.	A	(a)	<p><b>Brewing</b></p> <p>Water footprinting for brewing should consider:</p> <ul style="list-style-type: none"> <li>• Crop cultivation</li> <li>• Crop processing</li> <li>• Brewing process</li> <li>• Bottling</li> <li>• Waste disposal/grey water/effluent</li> </ul> <p><i>Crop cultivation:</i> eg barley or hops requires water (1 mark).</p> <p>Crop cultivation: eg is either rain-fed or irrigated (1 mark).</p> <p>Water is used in the production of pesticides and fertilisers (1 mark)</p> <p><i>Crop processing:</i> eg the grain is malted by soaking in water (and then being allowed to germinate, before drying, roasting, milling into grist) (1 mark).</p> <p>The water may be drawn from the local drinking water supply or a private supply (and may be treated to adjust pH, water hardness and mineral content) (1 mark).</p> <p><i>Brewing process:</i> eg addition of hot water to the grist activates enzymes (which convert starch into fermentable sugars) (1 mark).</p> <p>The resulting mash is sprayed with hot water (to extract sugars, colours and flavour) to form the wort (which is further processed into beer with addition of hops and yeast) (1 mark).</p> <p><i>Bottling:</i> eg sterilising of bottles and equipment at bottling plant/recycling plant, resulting in grey water (1 mark).</p>	10	<p>Candidates may not be familiar with the term ‘water footprint’ but should be able to discuss water use in both brewing and paper making. Credit should be given where the process is described appropriately but the stage name differs or is absent.</p> <p>The focus should be on discussion of intensive water use in each of the stages of brewing/paper making rather than on just naming the stages.</p> <p>Maximum of 2 marks in <b>each section</b> for naming the stages (or approximation of) without any discussion.</p> <p>Maximum of 7 marks for water-intensive stages in brewing.</p> <p>Maximum of 7 marks for water-intensive stages in paper-making.</p> <p>Responses should be well-structured and marker judgement should be used where bullet points have been included.</p>

Question	Expected Answer(s)	Max Mark	Additional Guidance
	<p><i>Effluent disposal/grey water:</i> eg waste water from the brewing process can be re-used (eg for watering gardens) or sent to waste water treatment works (1 mark).</p> <p>(b) <b>Paper making</b></p> <p>Water footprinting for paper making should consider:</p> <ul style="list-style-type: none"> <li>• Timber cultivation</li> <li>• Pulp production</li> <li>• Pulp processing</li> <li>• Effluent disposal/grey water.</li> </ul> <p><i>Timber cultivation:</i> part of the natural water cycle (1 mark).</p> <p>Timber cultivation: is mostly rain-fed but irrigation is used in some countries (1 mark).</p> <p><i>Pulp production:</i></p> <ul style="list-style-type: none"> <li>• The timber/recycled paper is turned into a pulp (mechanically or chemically) (1 mark)</li> <li>• Steam treatment can be used in mechanical pulping (1 mark)</li> <li>• Chemical pulping uses water to rinse out water-soluble impurities (1 mark).</li> </ul> <p><i>Pulp processing:</i></p> <ul style="list-style-type: none"> <li>• The pulp is mixed into a slurry with water (1 mark)</li> <li>• Pulp can be chemically bleached to produce white paper, which requires water for rinsing (1 mark).</li> </ul> <p><i>Effluent disposal/grey water:</i></p> <ul style="list-style-type: none"> <li>• Water is re-used within the paper making process where possible (1 mark)</li> <li>• Process effluents are treated in wastewater treatment plants (1 mark).</li> </ul>		

Question		Expected Answer(s)	Max Mark	Additional Guidance
10.	B	<p>Hydrogen as a fuel could be considered from the following angles:</p> <ul style="list-style-type: none"> <li>• Relevant source (1 mark)</li> <li>• Production (1 mark)</li> <li>• Storage</li> </ul> <p><b>Benefits:</b></p> <p>(a)</p> <ul style="list-style-type: none"> <li>• Is abundant and readily available (1 mark)</li> <li>• Is a continuous/renewable source of energy and able to be produced on demand (1 mark)</li> <li>• Does not produce greenhouse gas emissions if produced from electrolysis of water (1 mark)</li> <li>• Is powerful and efficient (producing more energy per unit of fuel than traditional sources of energy) (1 mark)</li> <li>• Most fuel cells run silently (1 mark) and have no moving parts so are easy to maintain (1 mark)</li> <li>• Does not require a centralised power grid or power station as small/local fuel cells can be set up (1 mark)</li> <li>• Compressed hydrogen gas is easy to use and can be stored indefinitely (1 mark)</li> <li>• Metal hydrides are efficient sources of hydrogen and easy to store (1 mark).</li> </ul>	10	<p>The focus should be on discussion of the benefits and challenges of using hydrogen as a fuel, rather than on a series of statements.</p> <p>Responses to a) and b) could be linked to provide opposing opinions.</p> <p>Maximum of 7 marks for benefits.</p> <p>Maximum of 7 marks for challenges.</p> <p>Responses should be well-structured and marker judgement should be used where bullet points have been included.</p>

Question	Expected Answer(s)	Max Mark	Additional Guidance	
	(b)	<p><b>Challenges:</b></p> <ul style="list-style-type: none"> <li>• More energy is required to isolate hydrogen (from natural compounds eg water, natural gas, biomass) than can be recovered (1 mark)</li> <li>• Requires input of energy (mostly from fossil fuels) and water, both under pressure from increasing demand/ population/distribution issues (1 mark)</li> <li>• Production of hydrogen gas is expensive and time-consuming (1 mark)</li> <li>• Is low density so requires large storage areas (1 mark)</li> <li>• Large-scale production/transportation/distribution/storage is difficult (1 mark)</li> <li>• Fuel cells are expensive to produce (1 mark)</li> <li>• Refuelling and starting time of H-powered vehicles takes longer than traditional fuels (1 mark)</li> <li>• Driving range of H-powered vehicles is shorter than with traditional fuels (1 mark)</li> <li>• New, expensive infrastructure would have to be installed, and be widespread, to encourage consumers to transfer from traditional fuels (1 mark)</li> <li>• Would have to overcome consumer apathy - fossil fuels are easily available and still relatively cheap (1 mark).</li> </ul>		

Question		Expected Answer(s)	Max Mark	Additional Guidance
11.	(a)	<p>Qualitative techniques assess the presence/absence of species/provide species lists (1 mark).</p> <p>Quantitative techniques provide information/data about numbers and densities (1 mark).</p> <p>Sampling techniques could include the following:</p> <ul style="list-style-type: none"> <li>• Quadrats</li> <li>• Transects (line, belt, point)</li> <li>• Nets (sweep, mist, NOT dip)</li> <li>• Traps (mammal, Longworth, pitfall, moth, camera, hair)</li> <li>• Bat detector</li> <li>• Tullgren funnel</li> <li>• Baermann funnel</li> <li>• Faecal pellets/scats.</li> </ul> <p><i>For example:</i>  Plant species observed while walking through an area can provide qualitative information (1 mark) but use of a quadrat would provide both qualitative and quantitative data (1 mark).  Description of use (1 mark).</p> <p>Bird species, identification through bird song or egg fragments (qualitative) (1 mark) or observation of feeding activity at bird table or nests (quantitative) (1 mark).</p> <p>Bats, identifying calls through use of a bat detector (qualitative) (1 mark) or flying/feeding activity along a transect (quantitative) (1 mark).</p> <p>Moths, use of a moth trap can provide both qualitative and quantitative data (1 mark). Description of how a moth trap works eg moths attracted to the light, fall into a chamber (1 mark), identified later through use of keys (qualitative)(1 mark).</p>	10	<p>Focus is on sampling of named species or groups. Candidates should use techniques relevant to the named species/group and not simply provide a list of qualitative vs quantitative techniques.</p> <p>Some sampling techniques can be used for both qualitative and quantitative purposes and candidates could comment on this, where appropriate.</p> <p>Techniques discussed must be appropriate for terrestrial ecosystems. Do not accept techniques used for aquatic ecosystems eg dip nets, electrofishing.</p> <p>Candidates should include both qualitative and quantitative sampling techniques:  Maximum of 6 marks for each.</p> <p>Credit of 1 mark should be given for each description of use of a named sampling technique.</p> <p>To achieve maximum marks, the candidate must have used named groups/ species, discussed the techniques appropriate for sampling them, and stated whether these are qualitative or quantitative techniques (or both).</p> <p>Statements should be well structured and marker judgement should be used where bullet points have been included.</p>

Question	Expected Answer(s)	Max Mark	Additional Guidance
	<p>Small mammals, use of live traps eg Longworth, camera trap, hair trap will provide qualitative data, while tagging can provide quantitative data (1 mark). Issues associated with live trapping eg shrews (1 mark).</p> <p>Accurate identification of species through use of keys (qualitative) (1 mark) can then be used for quantitative purposes (1 mark).</p> <p>Or other reasonable response.</p>		

Question		Expected Answer(s)	Max Mark	Additional Guidance
11.	B	<p>Climate change includes global warming and other changes brought about by increasing levels of greenhouse gases in the atmosphere (1 mark).</p> <p>Biodiversity definition (1 mark).</p> <p><i>Biodiversity:</i> There are only three possible outcomes for biodiversity: increase in biodiversity, decrease in biodiversity, or no change (1 mark).</p> <p>At any one point, it is forecast that:</p> <ul style="list-style-type: none"> <li>• Climatic conditions are likely to become warmer ie average temperatures will increase in both summer and winter. (1 mark). Increased temperature may lead to increased biodiversity generally as a result of increased energy flow in ecosystems (1 mark).</li> <li>• Climatic conditions are likely to become more extreme ie more events further from the average, hotter/ colder, stormier, windier, drier/wetter (1 mark for each, maximum of 3 marks).</li> <li>• Annual precipitation may alter eg increased/decreased rainfall, increased/reduced snow fall (1 mark for each, maximum of 2 marks).</li> <li>• <i>Species distribution:</i></li> <li>• Changing climatic conditions will alter the ability of a species to survive at any given point (1 mark).</li> <li>• Each species has its own environmental tolerance limits (1 mark), within which some individuals will be able to withstand extreme conditions and this may lead to mutations/new species better able to tolerate the new climatic conditions (1 mark).</li> </ul>	10	<p>Candidates should link the climatic change with one of the three possible outcomes for biodiversity, with appropriate explanation.</p> <p>Maximum of 6 marks for discussion of impact on terrestrial biodiversity.</p> <p>Maximum of 6 marks for discussion of impact on species distribution.</p> <p>To achieve maximum marks, the candidate should discuss forecasted climate changes, how these will impact on biomes/ ecosystems, and the ability of species to survive in current locations ie impact on biodiversity.</p> <p>No credit should be given for impacts on aquatic biodiversity/ species distribution.</p> <p>Statements should be well structured and marker judgement should be used where bullet points have been included.</p>

Question	Expected Answer(s)	Max Mark	Additional Guidance
	<ul style="list-style-type: none"> <li>• Biomes/ecosystems will generally move north/south (1 mark) eg the Mediterranean zone will extend northwards as the climate warms (1 mark).</li> <li>• Biomes/ecosystems will generally move uphill as the climate warms (1 mark). For example, as conditions change, the treeline in Scotland will exist at a higher altitude and more woodland will be able to survive higher on Scottish hills/mountains (1 mark).</li> <li>• Some species will become locally extinct as conditions cease to suit them in a particular location (1 mark) eg the ptarmigan, a sub-Arctic species.</li> <li>• Some species will become globally extinct as conditions cannot support them anywhere (1 mark) eg the polar bear.</li> <li>• New species will appear in areas where not previously found (1 mark) eg the little egret.</li> <li>• Migration patterns will change (1 mark).</li> </ul>		

**[END OF MARKING INSTRUCTIONS]**