



National
Qualifications
2017

2017 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, award the mark.
- (m) Unless otherwise required by the question, use of abbreviations (eg DNA, ATP) or chemical formulae (eg CO₂, H₂O) 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 award the mark;
 - and the term can easily be confused with another biological term then do not award the mark eg ureter and urethra;
 - and the term is a mixture of other biological terms then do not award 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;
 - **define**, they should give a statement of the definition;
 - **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.

Question			Expected answer(s)	Max mark	Additional guidance
1.	(a)		A group of organisms able to (inter)breed AND produce fertile offspring.	1	Both parts of the definition must be included for the mark to be awarded.
	(b)		Interspecific competition occurs/ <i>Balanus balanoides</i> outcompetes <i>Chthamalus stellatus</i> for space.	1	Response should include mention of competition between the two species. Do not accept just competition
	(c)	(i)	<p>Any description of a suitable quantitative method.</p> <p><i>Example:</i> Use of a quadrat (1 mark)</p> <p><i>Systematic sampling (max 2 marks):</i> measure a straight line/transect down the shore (high water to low water) (1 mark). Sample at regular intervals along the tape (1 mark). Repeat at set distances across the beach profile (1 mark).</p> <p><i>Random sampling description (max 1 mark)</i></p>	3	<p>1 mark for naming the equipment. 2 marks for describing the methodology.</p> <p>Max of 1 mark out of 2 for describing random sampling methodology, since the focus should be on assessing frequency & distribution along the shoreline and random sampling is not entirely appropriate (though candidates may have seen this used).</p> <p>Description of stratified random sampling methodology could gain 2 marks.</p>
		(ii)	Any qualitative method that allows for preparation of species/descriptive lists.	1	<p>Response must include reference to assessment of different species.</p> <p>Accept quadrat, which can be used for both qualitative and quantitative purposes.</p>

Question		Expected answer(s)	Max mark	Additional guidance
1.	(d)	<p>Both species will be wiped out because ocean acidification will affect the shells of both species.</p> <p>OR</p> <p><i>Chthalamus</i> will be wiped out but <i>Balanus</i> will be unaffected/less affected because <i>Chthalamus</i> will be more exposed to rainfall/runoff than <i>Balanus</i>.</p> <p>OR</p> <p><i>Balanus</i> will reduce (<i>Chthalamus</i> may increase) because it will be more exposed to increased ocean acidification.</p> <p>OR</p> <p>Other appropriate justification.</p>	2	<p>Either increased or decreased abundance, but not stay the same (since the calcium carbonate shell will be affected by pH change).</p> <p>1 mark for prediction.</p> <p>1 mark for appropriate justification.</p>
	(e)	The EU	1	Not SEPA.

Question			Expected answer(s)	Max mark	Additional guidance
2.	(a)	(i)	Constructive/divergent	1	
		(ii)	<p>Is a destructive/convergent/tensional boundary (1 mark)</p> <p>Nazca plate/oceanic crust moves/subducts below the South American plate/continental crust (1 mark)</p> <p>Increased pressure/friction can cause earthquakes (1 mark)</p> <p>Magma may rise to the surface through rock fractures and erupt as lava via volcanoes (1 mark) or offshore island arcs (1 mark)</p> <p>Can also form fold mountains in the crumple zone (1 mark)</p> <p>OR</p> <p>Other reasonable response.</p>	3	<p>An annotated diagram could be used as part of the answer.</p> <p>Response must include tectonic activity AND effect.</p>
		(iii)	<p>Pressure and friction at subduction zones generates heat (1 mark)</p> <p>Magma rises through the rock fractures, also carrying super-heated water and suspended/dissolved minerals (1 mark)</p> <p>The water evaporates and leaves behind gold deposits (as veins within the fractured rock) (1 mark)</p> <p>Weathering of gold-bearing rocks releases gold dust/flakes/nuggets, (which may be washed into watercourses and form alluvial deposits) (1 mark)</p>	2	Any two for 1 mark each.

Question			Expected answer(s)	Max mark	Additional guidance
2.	(a)	(iv)	<p>Land disturbance leading to Deforestation/habitat loss/soil erosion.</p> <p>Mining process will result in waste rock/noise from machinery/dust.</p> <p>Emissions from energy inputs contribute to climate change.</p> <p>Use of chemicals to extract gold (from crushed rock) eg cyanide/mercury could contaminate land or water/bioaccumulate.</p> <p>OR</p> <p>Other reasonable response.</p>	2	Any two developed points.
	(b)	(i)	Is best practice advice for field workers/aims to enhance public interest and awareness/educate the public on the importance of geological formations/prevent harmful development (under the Nature Conservation (Scotland) Act 2004)	1	Any one.
		(ii)	Geoparks advance the protection and use of geological heritage in a sustainable way	1	Promote a range of sustainable development/educational activities. NB geoparks are promotional only and have no legal or planning protection role.

Question		Expected answer(s)	Max mark	Additional guidance
3.	(a)	<p>Social: lorries operating/ congestion at bridges/ plant operating through night/ industrialisation of wild land</p> <p>Economic: creation of income stream/ possibility of taking waste outside the area</p> <p>OR</p> <p>Other reasonable response.</p>	2	<p>One from each category.</p> <p>Responses must be based on information provided in the passage or map.</p>
	(b)	<p>Impact on wetland/ wading birds/ possibility of runoff/ pollution from incineration/ carbon increase/ transport & construction costs/ noise pollution/ use of non-native species/ lack of any existing survey so no knowledge of species already present</p> <p>OR</p> <p>Other reasonable response.</p>	3	<p>1 mark for named implication.</p> <p>1 mark for each developed idea relating to the named implication.</p>
	(c)	<p>Location B is more remote so there would be less noticeable noise pollution compared with Location A (1 mark)</p> <p>Increased risk of runoff at Location B than Location A (1 mark).</p> <p>Location A is on land that is already disturbed and possibly contaminated (1 mark) so there would be less risk of additional soil contamination compared with Location B (1 mark)</p> <p>Prevailing wind would carry pollution/ odour across the city from A; at B it would be carried away from the city.</p> <p>OR</p> <p>Other reasonable response.</p>	3	<p>1 mark for each justification of why one location would be more suitable than the other.</p> <p>Candidates must evaluate why one site is better/worse than the other, and not just state an issue.</p> <p>Reasons given could be environmental, economic or social.</p>

Question		Expected answer(s)	Max mark	Additional guidance
3.	(d)	<p>Possibility of pollution/ contaminated ash would need special handling for disposal/ increased greenhouse gas or fossil- fuel derived CO₂ emissions/a tall chimney would be required that would have a visual impact</p> <p>OR</p> <p>Other reasonable response.</p>	1	

Question			Expected answer(s)	Max mark	Additional guidance
4.	(a)	(i)	<p>Clay is formed through the chemical breakdown of rocks/ feldspar/other clay minerals (1 mark)</p> <p>Residual clays are most commonly formed by surface weathering processes (1 mark) releasing clay particles such as:</p> <ul style="list-style-type: none"> • chemical decomposition of rocks containing aluminium or silica (1 mark) • clay left behind when surrounding rock dissolves (1 mark) • breakdown of shale (1 mark) <p>Transported clays have been removed from the place of origin by an agent of erosion/water/ice/wind (1 mark) (and deposited in a new position).</p> <p>OR</p> <p>Other reasonable response.</p>	2	Any two relevant points.
		(ii)	The clay can absorb moisture (and odour)	1	
		(iii)	Cleaning (woollen cloth, terracotta tiles)/oil well drilling/refining edible oils & fats/other reasonable response	1	
	(b)	(i) (A)	(Hot or polar) desert/tundra	1	
		(i) (B)	<p>(In the Ferrel cells/30-60°N and S) air cools and starts to descend, causing high pressure (1 mark). The air is dry because of the high temperature (1 mark), causing desert biomes to form.</p> <p>(In the Polar cells/60°N to N Pole) cold air sinks, causing high pressure (1 mark). The air is dry because of the low temperature (1 mark), causing tundra to form.</p>	2	<p>2 marks for an explanation relevant to the stated biome, which should ideally make some reference to the tri-cellular model or cells within it.</p> <p>Candidates may also make reference to anticyclones.</p> <p>An annotated diagram could be used as part of the answer.</p>

Question			Expected answer(s)	Max mark	Additional guidance
4.	(b)	(ii) (A)	Any appropriate named factor eg cosmic changes, Sunspot activity, Milankovitch cycles, volcanic activity, plate tectonics	1	
		(ii) (B)	<p>Cosmic changes:</p> <ul style="list-style-type: none"> relationship between solar activity + cosmic radiation (1 mark), resulting in annual changes in global temperature (1 mark) weak solar activity allows more cosmic rays to enter atmosphere (1 mark), resulting in more cloud cover/cooling global temperature (1 mark) strong solar activity allows fewer cosmic rays to enter atmosphere (1 mark), resulting in less cloud cover/increasing global temperature (1 mark) <p>OR</p> <p>Sun spot activity: increased sunspot activity may lead to a (slight) increase in solar energy entering the atmosphere (1 mark) and temporary global warming (1 mark)</p> <p>OR</p> <p>Milankovitch cycles: variations in the Earth's orbit (1 mark) bring about long term changes in climate (1 mark)</p> <p>OR</p> <p>Volcanic activity: ejection of ash/dust/gases into the atmosphere (1 mark) decreases the amount of solar energy able to reach the Earth's surface, causing (temporary) global cooling (1 mark)</p>	2	<p>Explanation must be for the named factor in (A), otherwise 0 marks should be awarded.</p> <p>Variations in Milankovitch might include 'stretch, wobble, and roll' or 'eccentricity, precession, and tilt', or similar.</p> <p>Volcanic gases might include carbon dioxide or sulfur dioxide.</p>

Question		Expected answer(s)	Max mark	Additional guidance
5.	(a)	<p>Increase in cod/herring/sand eel/mussel/oyster/sculpin as these are prey species of the halibut (1 mark)</p> <p>(Potential) decrease in seal numbers as they lose a food source (1 mark)</p> <p>No change to seal numbers as they would predate other food sources (1 mark)</p> <p>Increased interspecific competition between cod and sculpin resulting in overall decreases in numbers of either (1 mark)</p> <p>Increase in oyster/mussel would result in decrease in zooplankton/herring/seal (1 mark)</p> <p>OR</p> <p>Other reasonable response.</p>	3	Three well-defined impacts on the food web.

Question			Expected answer(s)	Max mark	Additional guidance
5.	(b)	(i)	<p>Fish (in nets) would attract predators</p> <p>OR</p> <p>Increased number of predators would impact on local prey species</p> <p>OR</p> <p>Accumulation of fish waste around nets could cause eutrophication</p> <p>OR</p> <p>Medication/hormones/steroids for farmed fish could be taken in by wild populations</p> <p>OR</p> <p>Parasites from farmed fish can infect wild fish populations, causing a crash in population</p> <p>OR</p> <p>Other reasonable response.</p>	2	<p>Any two but must be a cause & effect.</p> <p>Max of 1 mark if either one is missed.</p>

Question			Expected answer(s)	Max mark	Additional guidance
5.	(b)	(ii)	<p>Effluents/waste/excess food can be controlled</p> <p>OR</p> <p>Medical treatments can be contained within a smaller area</p> <p>OR</p> <p>Reduced conflict over use of waterways for recreation</p> <p>OR</p> <p>Reduced impact on wild fish population</p> <p>OR</p> <p>Reduced transport costs, reduced CO₂</p> <p>OR</p> <p>Reduced visual impact (as could be sited anywhere)</p> <p>OR</p> <p>Other reasonable response.</p>	1	

Question		Expected answer(s)	Max mark	Additional guidance
6.	(a)	Genetic engineering/modification/ selective breeding OR Other reasonable response.	1	Do not accept high yield varieties/HYV.
	(b)	(i) Waterlogging of soil/artificial increase in salts (from irrigation water)/salinization of soil/leaching of nutrients/change in soil gas concentration/loss of biota/soil erosion OR Other reasonable response.	2	Any two.
		(ii) New (freshwater) ecosystem created / increased biodiversity/hydroelectric potential/increased drinking water security/potential to breed fish/controlling flooding downstream/increased demand for fresh water resources OR Other reasonable response	1	Any one.
	(c)	Land reform led to farm consolidation/larger farms, which leads to unemployment OR Changes in technology/mechanisation required fewer workers, so people left the land OR Urbanisation, as people moved off land (voluntary or forced) into urban areas OR Class conflict, between rich and poor farmers OR Other reasonable response.	2	1 mark for cause. 1 mark for corresponding effect.

Question			Expected answer(s)	Max mark	Additional guidance
6.	(d)	(i)	1: 44	1	$176 / 4 = 44$
		(ii)	y-axis scale and label. Accurate plotting.	2	1 mark for appropriate scale and label on y-axis. 1 mark for accurate plotting ie within $\frac{1}{2}$ box tolerance.
		(iii)	After an initial rise, the area under cultivation remains fairly static/has not changed (1 mark) However/but, after an initial slow start, fertiliser use has continued to increase (1 mark) OR Between 1950 and 1970 both the fertiliser use and the area under cultivation show an increase (1 mark) Between 1970 and 2010 fertiliser use continues to increase but the area under cultivation stays the same (1 mark)	2	

Question			Expected answer(s)	Max mark	Additional guidance
7.	(a)	(i)	The maximum population size of a species that a given environment can sustain.	1	In population biology, carrying capacity is defined as the environment's maximal sustainable load.
		(ii)	Resource availability (excluding food and water supplies)/space/predation/disease/the environment's capacity to safely absorb and detoxify waste OR Other reasonable response.	2	Any two.
	(b)	(i)	Any reasonable response eg importing water to a desert community/desalination to obtain drinking or irrigation water/increased use of fertilisers/land reclamation/improve land management/improve energy efficiency.	1	
		(ii)	Any reasonable response that is linked to previous response eg increased water availability (via desalination) will increase food supply, but could lead to a decrease in water availability (through irrigation)/increase fertiliser production would mean more fossil fuels required which are finite.	1	

Question			Expected answer(s)	Max mark	Additional guidance
7.	(c)	(i)	<p>Greater human population means greater use of resources, including energy and fossil fuels (1 mark) producing more carbon emissions (1 mark)</p> <p>Greater availability of/ accessibility to energy means more human population can be supported (1 mark) producing more carbon emissions (1 mark)</p> <p>Greater availability of/ accessibility to energy has enabled advances in medical knowledge and sanitation so there is a lower death rate and increased population (1 mark) producing more carbon emissions (1 mark)</p> <p>Greater human population means increased demand for agricultural produce (1 mark) producing more carbon emissions (1 mark)</p> <p>OR</p> <p>Other reasonable response.</p>	2	Response must link population increase, energy increase and carbon emissions increase.
		(ii)	<p>Increased investment in renewable energy/green technology to reduce fossil fuel use/legislation</p> <p>OR</p> <p>Other reasonable response.</p>	1	

Question		Expected answer(s)	Max mark	Additional guidance
7.	(d)	<p>Human increase in population altering ecosystems, so other species lose their niches or can't evolve fast enough to keep up with change.</p> <p>OR</p> <p>Human population taking more resources, so less for other species.</p> <p>OR</p> <p>Habitat destruction</p> <p>OR</p> <p>Hunting/poaching</p> <p>OR</p> <p>Pollution</p> <p>OR</p> <p>Other reasonable response.</p>	2	1 mark for each reasonable response.

Question			Expected answer(s)	Max mark	Additional guidance
8.	(a)	(i)	A large system of circulating ocean currents.	1	
		(ii)	The Coriolis effect is the deflection of major surface currents due to the Earth's rotation (1 mark) This causes ocean gyres in the northern hemisphere to rotate clockwise, and anti-clockwise in the southern hemisphere (1 mark)	2	
	(b)	(i)	6 001 793	1	1337 × 4489
		(ii)	0.011 g	1	$\frac{6.6}{595}$ Unit required otherwise 0 marks. Accept: 0.01, 0.0111, 0.01109
		(iii)	(A) Procedure was not repeated.	1	
			(B) 48 sampling sites along a 4489 km-long transect would not provide a representative sample OR The counted data have been converted from sampling along a measurement of length to one of area, which could introduce error OR Plastics present will depend on wave and weather conditions OR Other reasonable response.	1	

Question			Expected answer(s)	Max mark	Additional guidance
8.	(c)	(i)	<p>Best site: B</p> <p>Justification: A - has high wave power potential but may be too high/too remote/too expensive to transfer the electricity.</p> <p>B - close to populous countries, with high energy demand.</p> <p>C - potential power is too low / political instability.</p> <p>OR</p> <p>Other reasonable response.</p>	2	<p>No mark is available for the identification of the site.</p> <p>Reasons could be positive for a chosen location or negative for other locations, and for one location or multiple.</p> <p>Do not accept a vice versa response.</p>
		(ii)	<p>Inexpensive to operate compared to a conventional/nuclear power station</p> <p>OR</p> <p>Is a renewable, flow resource so is sustainable unlike fossil fuels</p> <p>OR</p> <p>Reliable, as waves are not usually interrupted and almost always in motion / more reliable than named type of energy, with justification (eg solar can be interrupted by clouds)</p> <p>OR</p> <p>Lower/no greenhouse gas emissions, so less environmental impact than fossil fuels.</p> <p>OR</p> <p>Offshore wave power plant has little aesthetic impact in comparison with wind turbines/large power stations</p> <p>OR</p> <p>Other reasonable response.</p>	2	Any two.

Question		Expected answer(s)	Max mark	Additional guidance
9.	(A)	<p>(a) Water movement processes, could include:</p> <ul style="list-style-type: none"> • Evaporation • Condensation • Precipitation • Infiltration • Percolation • Transpiration • Sublimation • Runoff <p>Evaporation:</p> <ul style="list-style-type: none"> • The physical state of water changes from liquid to gaseous/vapour (1 mark) as surface water is warmed by the sun's heat (1 mark) <p>Condensation:</p> <ul style="list-style-type: none"> • The cooling of water vapour until it becomes a liquid (1 mark) • Water vapour condenses onto small airborne particles to form dew, fog or clouds (1 mark) <p>Precipitation:</p> <ul style="list-style-type: none"> • The moisture that falls from the atmosphere as rain, snow, sleet or hail (1 mark) • The volume/intensity/form/geographic location (1 mark for each) will influence whether the water will flow into streams/runoff or infiltrate into the ground (1 mark) <p>Infiltration:</p> <ul style="list-style-type: none"> • Is the process by which water on the ground surface enters the soil (1 mark) • Is influenced by ground cover/existing moisture content of the soil/soil temperature/rainfall intensity (1 mark for each developed point up to max of 3 marks) <p>Percolation:</p> <ul style="list-style-type: none"> • Is the downward movement of water through soil pores (and rock) (1 mark) 	10	<p>Give credit for an annotated diagram, but it should be accompanied by detailed comments.</p> <p>Maximum of 5 marks if only an annotated diagram or list of processes (movement and storage) has been provided but no discussion.</p> <p>Maximum of 7 marks for description of water movement processes.</p> <p>Maximum of 5 marks for description of water storage.</p> <p>Accept additional water movement process such as throughflow, groundwater flow, stemflow, evapotranspiration.</p>

Question		Expected answer(s)	Max mark	Additional guidance
9.	(A)	<p>Continued.</p> <p>Transpiration:</p> <ul style="list-style-type: none"> • Is the process by which plants return moisture to the air • (1 mark) • Plants take up water through their roots and then lose some through leaf pores when air passes over (1 mark) <p>Sublimation:</p> <ul style="list-style-type: none"> • Is the process whereby snow/ice changes into water vapour without first melting into water (1 mark) • Occurs more at high altitude (1 mark) when there is low humidity/dry winds/low air pressure (1 mark) <p>Runoff:</p> <ul style="list-style-type: none"> • The movement of water across the ground surface (1 mark) • Is influenced by rainfall intensity/duration/ground slope/soil type/ground cover/permeability of rock (1 mark for each developed point up to max of 3 marks) <p>(b) Storage</p> <ul style="list-style-type: none"> • Can be both surface or subterranean (1 mark) • Includes atmospheric moisture (1 mark) • Stored on the surface as soil moisture (in upper layer)/snow & ice/glaciers/watercourses (rivers, streams etc)/lakes/oceans (1 mark) • Interception occurs when trees/vegetation or other barriers (natural or man-made) prevent precipitation reaching the ground surface (1 mark) • Subterranean/groundwater storage includes soil moisture (in lower layers)/aquifers/rock fractures/crevices (1 mark) 		

Question		Expected answer(s)	Max mark	Additional guidance
9.	(B)	<p>(a) Brown earth</p> <ul style="list-style-type: none"> • Typically found under deciduous/broadleaved woodland or grassland (1 mark) • Rich humus layer/leaf litter decomposes quickly (1 mark), because of intense biological activity (1 mark), especially by earthworms (1 mark) • Evidence of earthworm channels/animal burrows (1 mark) • Indistinct O-A horizon (or organic layer-topsoil) boundary (1 mark), because of mixing action of soil biota (1 mark) • A-horizon/topsoil is often red-brown (1 mark), because of iron oxidation (1 mark) • Depth of A-horizon/topsoil can be considerable (1 mark), because of significant organic input (1 mark) • Plant root system can be extensive (1 mark), because soil type supports rich vegetation (1 mark) • B-horizon/subsoil is a distinctive brown colour (1 mark), lightening with depth as humus and iron content decreases (1 mark) 	10	<p>The candidate must comment on features that distinguish between the profiles. These could be:</p> <ul style="list-style-type: none"> • Typical ecosystem for each • Level of decomposition, and types of decomposer organisms • Characteristic horizons: deep A-horizon and/or indistinct O-A horizon boundary in brown earths; presence of an ashy layer and/or iron pan in podzols <p>Give credit for annotated diagrams, but these should be accompanied by detailed comments.</p> <p>Maximum of 5 marks if only (annotated) diagrams have been provided but no discussion.</p> <p>Maximum of 7 marks for each soil type.</p>

Question		Expected answer(s)	Max mark	Additional guidance
9.	(B)	<p>Continued.</p> <p>(b) Podzol</p> <ul style="list-style-type: none"> • Typically found under moorland/heathland/coarse grassland/coniferous woodland (1 mark) • Deep organic/O-horizon (1 mark), because poor soil biodiversity limits decomposition (1 mark) • Few/no earthworms (1 mark) • No mixing agents so distinct horizons (1 mark) • Decomposers likely to be fungi (1 mark) • A-horizon likely to be ashy-grey/silica-rich, (1 mark) because iron/aluminium has leached downwards/eluviated (1 mark) <ul style="list-style-type: none"> • B-horizon may be rusty-red colour and very hard (1 mark) because of formation of an iron pan (1 mark), from accumulation/illuviation of iron from A-horizon (1 mark). Or could be very dark, because of washing down of humus (1 mark), forming a humic pan (1 mark) 		

Question		Expected answer(s)	Max mark	Additional guidance
10.	A	<p>Candidates could consider the following:</p> <ul style="list-style-type: none"> • Source • Mode of entry into the environment • Bioaccumulation • Biomagnification • Impact on biodiversity <p><i>Example: pesticides</i></p> <p><i>Source:</i></p> <p>POPs include pesticides, industrial chemicals and unintentional by-products of industrial processes (1 mark)</p> <p><i>Mode of entry into environment:</i></p> <p>(Agricultural) pesticides are applied as sprays/granules/seed coatings (1 mark). Excess pesticide can be carried by wind away from the point of application (1 mark), or dissolve in groundwater (1 mark), or enter watercourses via surface runoff (1 mark)</p> <p><i>Bioaccumulation:</i></p> <p>The POP can enter an organism via breathing, swallowing or absorption through the skin. (1 mark)</p> <p>POPs are insoluble in water (1 mark) and are stored in the body in fatty tissue (1 mark). They are not metabolised or excreted, or only very slowly (1 mark). Over time the level of POP stored in the body may equal that of the surrounding environment (1 mark) but generally will be too low to cause the organism harm (1 mark)</p>	10	<p>The question stem mentions pesticides so this is likely to be the focus of discussion, but credit should be given where other POPs are discussed.</p> <p>Commentary on the impact on biodiversity must be included. Maximum of 6 marks if this is omitted.</p> <p>To achieve maximum marks, the candidate should give a good account of the reason for using the POP, how it is applied, how it enters the food chain, accumulation within the individual, movement of the POP between trophic levels, and the impact on biodiversity.</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
10.	A	<p>Continued.</p> <p><i>Biomagnification:</i></p> <p>POPs in contaminated prey are transferred to other organisms via predation (1 mark) and the POP concentration in the fatty tissues of the predator will start to increase (1 mark). The level of POP will increase at each trophic level (1 mark) until it is eventually high enough to cause death or have an adverse effect (on behaviour, reproduction or disease resistance) (1 mark)</p> <p><i>Impact on biodiversity:</i></p> <p>Pesticides are used to control pest species and thereby reduce damage or increase (agricultural) yield (1 mark). Removal of a food species from a food chain will have a negative impact on biodiversity (1 mark), either local (through point pollution) or more widespread (through diffuse pollution) (1 mark).</p> <p>Pesticides are generally designed to control target species (herbicides, insecticides, fungicides etc) (1 mark) but may prove toxic to non-target species and pose a longer term threat to local biodiversity (1 mark).</p> <p>Genetic resistance to a pesticide in a given species does not prevent bioaccumulation or biomagnification, and could still prove harmful to other species further up the food chain. (1 mark)</p>		

Question		Expected answer(s)	Max mark	Additional guidance
10	B	<p>Definition of abiotic: a non-living condition that influences or affects an ecosystem and the organisms within in, or similar (1 mark)</p> <p>Definition of biodiversity: the range of plant & animal species within a given ecosystem at any given time, or similar (1 mark). Can include species diversity, genetic diversity, or ecosystem diversity (1 mark)</p> <p><i>Abiotic factors affecting aquatic ecosystems:</i></p> <ul style="list-style-type: none"> • Water flow rate • Oxygen concentration • Water pH • Salinity • Tidal effects • Could also discuss: <ul style="list-style-type: none"> ○ Water temperature, and link to oxygen concentration ○ Light intensity/penetration ○ Carbon dioxide concentration, linked with acidification of oceans, loss of coral reefs ○ Nutrient content, including influence of currents and ocean conveyor system/upwelling ○ Depth of water, linked with temperature, light penetration, photosynthesis ○ Wave height and intensity ○ Pressure, decreasing with depth ○ Stratification due to changes in density, halocline, thermocline. 	10	<p>The ecosystem(s) may be freshwater or marine or both</p> <p>Candidates should know about factors that influence biodiversity in an aquatic ecosystem (of international importance), and also about how abiotic factors affect frequency and distribution of organisms in an aquatic ecosystem.</p> <p>To achieve maximum marks, a candidate should discuss a range of abiotic factors and their local impact on species frequency and distribution, but should expand this to discussion of the wider effect on biodiversity. They should ideally also include definitions. eg oxygen concentration (1 mark) decreasing would result in an increase in sludgeworms/ bloodworms (1 mark) and a decrease in mayfly/stonefly larvae (1 mark)</p> <p>No credit should be awarded for biotic factors on their own.</p> <p>Responses should be well-structured, and marker judgement should be used where bullet points have been included without wider discussion of the point.</p> <p>Maximum of 5 marks if only a list of abiotic factors has been provided but no discussion.</p>

[END OF MARKING INSTRUCTIONS]