National
Qualifications
2018

2018 Environmental Science

Higher

Finalised Marking Instructions

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 <u>always</u> 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 CO_2, H_2O) 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.

Marking instructions for each question

Question			Expected response	Max mark	Additional guidance
1.	(a)	(i)	The researcher (kicks the riverbed and) dislodges organisms. **AND** The current carries the organisms into the net.	**2**	No mark awarded for naming the technique. No mark awarded for identification of organisms.
		(ii)	Increases the reliability/makes it more reliable**.** **OR** Provides a more representative sample.	**1**	Not just 'for reliability'. Not accuracy or validity.
		(iii)	• Same type of site in stream (pool, run, etc)/same range of sites. • Same mesh size/net size. • Same number of kicks per sample. • Same time of day/year. • Same water level/flow rate (accept same or similar). • Same length of time of sampling. • Same length of time spent kicking. • Same distance between the kicker and the net. • Or other valid response.	**2**	Any two. NOT same wellies/same weather/ same net.

Question			Expected response	Max mark	Additional guidance
1.	(b)		Biomass takes account of both size and number of organisms, allowing for a better comparison. **OR** Calculating the biomass is more valid than counting the individual organisms. **OR** Small organisms may be difficult to count (so it is easier to measure the mass). **OR** Each organism will have a different biomass so recording the biomass of the organisms allows the number of organisms to be compared. **OR** Any other valid response.	**1**	

Question			Expected response	Max mark	Additional guidance
1.	(c)	(i)	BOD is a measure of the oxygen required by microorganisms/bacteria <u>to decompose organic matter in water</u>.	**1**	BOD is most commonly expressed in milligrams of oxygen consumed per litre of water sample during 5 days of incubation at 20°C.
		(ii)	(Less pollution upstream so) lower bacterial count upstream SO lower BOD value than downstream.	**1**	Accept converse. Response should reflect the difference in bacterial/micro-organisms count above and below the suspected point of pollution. Not algae. Not: bacteria arrives in sewage.
		(iii)	A. As BOD increases, number of stonefly larvae decreases. **OR** Stonefly larvae cannot survive in (polluted) locations with a high BOD. B. As BOD increases, number of bloodworms increases. **OR** Bloodworms can survive in both high and low BOD conditions (but thrive where BOD is high).	**1** **1**	Accept converse.

Question			Expected response	Max mark	Additional guidance
2.	(a)		(Sustainable development is) development that "meets the needs of the present without compromising the ability of future generations to meet their own needs".	**1**	Response should refer to present and future.
	(b)	(i)	Water is a limited resource so requires management/sensible use of water resources. **OR** A lack of water can result in poor sanitation, which can increase spread of disease. **OR** To ensure there is a constant supply of water in countries which have a low precipitation rate. **OR** Water is vital for crop/food production as the world population increases. **OR** Water is important for industry in order to boost the economy/ employment. Or any other valid response.	**2**	1 mark for each valid point with suitable justification. Response should include reference to why water conservation would reduce/improve/sustain a current application in eg agriculture, health, energy supply, industry, domestic needs.
		(ii)	Low flush toilets/water-free urinals/ use of grey water/rainwater harvesting/efficient appliances. Any other valid response.	**1**	Any one.
		(iii)	(A circular economy is one that) practises re-use and recycling as much as possible to reduce waste.	**1**	

Question			Expected response	Max mark	Additional guidance
2.	(c)	(i)	ELDCs may be less able to cope with rising sea levels/unpredictable or severe weather/climate patterns/ less money to use for measures to mitigate against changes. **OR** Any other valid response.	**1**	
		(ii)	(The poor may have) fewer opportunities to relocate from areas affected by climate change events/ struggle to pay increased food prices/be unable to pay to alter their circumstances to accommodate changes in climate. **OR** Any other valid response.	**1**	
	(d)		IPCC assesses scientific and technical information about climate change. **OR** IPCC draws together scientific evidence to make (qualitative and quantitative) predictions of change. **OR** Any other valid response.	**2**	IPCC has an advisory role for policy-making. IPCC does not conduct own research but uses experts from around the world.

Question			Expected response	Max mark	Additional guidance
3.	(a)	(i)	4·3 (%)	**1**	(7·3 – 7·0) ÷ 7·0 x 100 Accept 4·29, 4·286, or 4
		(ii)	Surplus from previous harvest/ disease/changes in demand/weather changes/changes in farming practice. **OR** Any other valid response.	**2**	Any two reasons.
	(b)	(i)	1·50 (%)	**1**	(1·43+1·62+1·54+1·50+1·43) ÷ 5 Accept 1·504 or 1·5
		(ii)	0·31	**1**	1·72 – 1·41
		(iii)	Soil moisture content/pH/organic matter/other valid response.	**1**	Response must be soil-related and a controllable factor.
		(iv)	Spring barley has a higher nitrogen content/moisture.	**1**	
	(c)		(Seaweed) add nutrients which are used by plants for growth/provide food for soil fauna. **OR** Seaweed protects soil from erosion if used as a mulch. **OR** Alginates help bind soil which improves structure/moisture retention/aeration. **OR** Seaweed helps neutralise acidic soil making more soil nutrients accessible. **And** help increase yield/improve soil quality. Any other valid response.	**2**	Must be an expanded response to include cause and effect.

Question			Expected response	Max mark	Additional guidance
3.	(d)		(Brown earth) has a higher pH/ broader nutrient content/greater number of mixing organisms/better aeration (because of mixing organisms)/better at supporting root systems. **OR** Any other valid response.	**2**	Any two. Accept negatives for podzol eg more acidic/nutrients removed from top layer etc.
	(e)		Direct payments to farmers (Pillar 1) to support/stabilise their income. Promotion of rural development (Pillar 2). Greening of agriculture/requirement to follow specific environmental farming practices (crop diversification, maintenance of permanent grassland, establishment of Ecological Focus Areas). Young farmer/Active farmer/Small farmer schemes.	**2**	Any two. Responses may relate to the old or reformed CAP.

Question			Expected response	Max mark	Additional guidance
4.	(a)	(i)	3 000 : 7 000 : 1 England Scotland Wales	**1**	
		(ii)	Roe deer are a mobile species. **OR** May not be present in location where/when survey is taking place. **OR** Are difficult to spot (in a woodland setting). **OR** If estimate is based on cull data, may not all be reported. Or any other valid response.	**1**	Not just 'it's hard to count them all'.
	(b)	(i)	Carrying capacity.	**1**	
		(ii)	Density-dependent: competition for resources/disease/predation/culls. Density-independent: deer management scheme (eg fencing); introduction of predators; food limiting event (eg extreme weather; pollution; forest or moorland fire). Or any other valid response.	**2**	Do not accept duplication.
		(iii)	Income from stalking/venison sales/ tourism/other valid response.	**1**	

Question			Expected response	Max mark	Additional guidance
5.	(a)		Methane.	**1**	
	(b)	(i)	The rock is impermeable therefore the gas cannot diffuse out.	**1**	Response must include difficulty of gas escaping from the rock.
		(ii)	**Advantages:** Allows exposure to a larger surface area of shale rock/will come into contact with more shale rock than in vertical drilling/one horizontal well can replace several vertical wells (reducing footprint on landscape)/or any other valid response. **Disadvantages:** More water and chemicals required/higher capital cost/greater risk of collapse/only one well can be drilled in an area at any one time/ difficult to drain all gas using a single horizontal well/horizontal wells cannot be drilled as deep as vertical wells/or any other valid response.	**2**	1 mark for advantage. Not just 'to get the gas out'. 1 mark for disadvantage. Accept <u>more</u> seismic activity, not just 'causes earthquakes'.
		(iii)	Sand prevents fractures from closing/holds open pores. Chemicals dissolve minerals/kill microorganisms/reduce friction/ prevent corrosion of pipes or wells/assist with fracturing rock/ increase viscosity of fluid. Other valid response.	**2**	1 mark for correct description for the use of sand. 1 mark for the correct description of the use of chemicals.
		(iv)	Ground water/aquifer.	**1**	Not water table.
	(c)	(i)	Increase in global temperatures/ melting of ice/increased sea levels/ species redistribution or any other valid response.	**2**	Any two. Response should indicate an increase/decrease/stay the same AND justification.
		(ii)	140 (billion cubic metres).	**1**	
		(iii)	1 mark for correctly completing 2040 entry for US.	**1**	

Question			Expected response	Max mark	Additional guidance
6.	(a)		Outcompetes for space/light/ moisture/nutrients. **OR** Any other valid response.	**1**	Any one.
	(b)		Cutting **and** treating stumps with herbicide/stem injection with herbicide/spraying regrowth with herbicide/mechanical flailing to smash the stumps/dig it out. Any other valid response.	**1**	Any one.
	(c)		Grey squirrel – depletes red squirrel population by out-competing for resources/introducing disease/ squirrel pox. Sika deer – reduces genetic integrity of native red deer through interbreeding, producing hybrid deer. Any other valid response.	**2**	1 mark for named species. 1 mark for impact.
	(d)	(i)	To know which species are present/ to monitor changes in populations/to direct appropriate conservation measures/other valid response.	**1**	Any one. Response must relate to nature conservation.
		(ii)	2. Oblong-ovate leaf shape R.sikkimense Oval leaf shape R. fulgens 3. Go to 4 R. wallichii 4. Leaf margins inrolled R. aeruginosum Leaf margins not inrolled R.campanulatum	**3**	1 mark for each paired statement.

Question			Expected response	Max Mark	Additional guidance
7.	(a)		Burning of fossil fuels (or named fossil fuel).	**1**	Not factory/vehicle emissions as these are a consequence of fossil fuel combustion.
	(b)		(Westerly) winds carry emissions eastwards from Scotland towards Scandinavia. **AND** Wind current driven from high pressure to low pressure. **OR** The warm current can hold lots of moisture. **OR** The Coriolis effect deflects the current to the right. **OR** Any other valid response.	**3**	1 mark for movement of emissions eastwards from Scotland to Scandinavia through westerly winds. 1 mark each for two additional points relating to atmospheric circulation. Award mark(s) for relevant application of the tricellular model.
	(c)		Take a water sample and dip pH paper in. Compare the colour to the pH scale. **OR** Take a water sample and add a few drops of (universal) indicator. Compare the colour to the pH scale. **OR** Insert a pH probe into the water and read the pH value from the display.	**2**	
	(d)	(i)	Kills crops, reducing food availability/kills fish, reducing food supply/can remove mercury from soil which would run off into drinking supplies/kills forests affecting timber supplies. **OR** Any other valid response.	**1**	Any one.

Question			Expected response	Max Mark	Additional guidance
7.	(d)	(ii)	**Agriculture:** Use natural fertilisers/ alternatives to mechanisation/ precision farming/hydroponics. **Transport:** Use low sulfur fuel/ install catalytic convertors/walk/car pool/cycle/use public transport/ switch to electric or hybrid cars/ switch to biofuelled cars/congestion charges. **Manufacturing:** Install scrubbers/ switch from fossil fuels to renewables/switch to low sulfur fuel/remove sulfur from fossil fuels before combustion. **OR** Any other valid response.	**1** **1** **1**	1 mark for each industry.
		(iii)	Indicator species.	**1**	

Question			Expected response	Max mark	Additional guidance
8.	(a)	(i)	Increased population growth/more people to feed/increased wealth/ affordability. **OR** Any other valid response.	**2**	Any two.
		(ii)	Land-based strategy: could include mechanisation/use of fossil fuels in food production/ agrochemicals (fertilisers, pesticides)/irrigation/land management (crop rotation, drainage, hedgerow removal, cultivation of marginal land, conservation practices, diversification)/genetic engineering/ GM crops/high yield varieties/ selective breeding/hydroponics. For example: pesticide use **Social impact** Negative: health issues through bioaccumulation. Positive: increased food production/ food security. **Economic impact** Negative: have to buy fertiliser/ potential to be tied in to agrichemical company. Positive: profit from increased yield. **Environmental impact** Negative: impact on food chain/ biodiversity of killing (pest and/or non-target) species. Positive: reduced disease transfer from pest species. **OR** Any other valid response.	**1** **1** **1** **1**	1 mark for named strategy. 1 mark for each impact, which could be positive or negative. For full marks, all three impacts must be covered **AND** related to the named strategy.

Question			Expected response	Max mark	Additional guidance
8.	(b)	(i)	**The consumer:** Wider range of cheaper goods/ increased food security/negative impact – moral impact/food miles.	**1**	
		(ii)	**The producer:** Higher yields/reduced costs/ increase disease/vulnerability to natural disasters/pests/soil erosion.	**1**	
		(iii)	**Biodiversity** Loss of habitat to species/potential extinction of species/future medical supplies/soil erosion/leaching of nutrients.	**1**	
	(c)	(i)	**households**: buy what you need/eat what you buy/smart shopping/use leftovers/freeze leftovers/donate surplus food to community fridge.	**1**	1 mark for each category. Do not accept duplicated responses.
		(ii)	**schools & colleges**: educate students/forward planning for meal choices.	**1**	
		(iii)	**supermarkets**: remove best before dates/donate excess food to food banks/better planning with suppliers. **OR** Any other valid response.	**1**	

Question			Expected response	Max mark	Additional guidance
9.	**A**		The LCA should consider the following while discussing the making, using and disposing of a named product: • Materials • Energy • Transport Example: a glass drinks bottle. Materials (**1 mark for each, up to 4 marks**) • Silica/sand. • Soda ash/sodium carbonate. • Limestone/calcium carbonate. • Metallic salts (for colour). • Or recycled glass/cullet - glass can be recycled an unlimited number of times without deterioration in quality. (**1 additional mark**) Energy (**1 mark for each, up to 4 marks**) • Extraction/quarrying of raw materials. • Processing of raw materials/ cullet. • Production and combustion of fuels and energy for melting and forming glass. • Additional energy used in the facility eg lighting. • Washing/sterilisation of the finished product. • Bottling. • Fuel for transportation of raw materials/distribution of finished product. Transport (**1 mark for each, up to 4 marks**) • Movement of raw materials from source to glass processing facility. • Transportation of finished product to: o bottling plant o commercial outlet o user o landfill o recycling centre o glass processing centre (for re-use). Any other valid response.	**10**	0 marks for naming the product. Maximum of 4 marks for each stage. Composite items (eg TV, mobile phone) may result in complex responses, but the focus should still be on the materials, energy (inputs and/or outputs) and transport. Give credit where an appropriate and correct diagram has been included eg a flowchart, but this should have accompanying commentary. Energy: every stage of an LCA will have an energy input and output. Give additional credit where a candidate discusses energy input type (eg renewables vs non-renewables/oil/gas/coal), or outputs (eg heat/energy loss or re-use, greenhouse gas emissions), or minimisation of these. Give credit where reference is made to environmental impact, or to the circular vs linear economic model. Responses should be well-structured and marker judgement should be used where bullet points have been included. These are acceptable for listing items or points, but it is expected that the candidate will then discuss each item in more detail.

Question			Expected response	Max mark	Additional guidance
9.	**B**		**Methods to improve quality of water supply:** • Reason for implementing improvements (**1 mark)** • Naming and brief description of steps used to improve water quality. (**1 mark for each well-structured statement. Up to max of 6 marks)** Methods: • Aim is to remove contaminants that can harm human health (**1 mark)**, including waterborne organisms. (**1 mark)** • Three main methods: filtration, purification, disinfection. (**1 mark for each, up to max of 3 marks)** • Filtration removes suspended solids. (**1 mark)** • Filtration methods include use of sand filters (fast or slow), ceramic, membranes, or activated charcoal. (**1 mark for each, up to max of 2 marks)** • Purification removes chemicals, contaminants, gases. (**1 mark)** • Purification methods include screening, pH adjustment, coagulation and flocculation, clarification. (**1 mark for each, up to max of 2 marks)** • Disinfection kills micro-organisms. (**1 mark)** • Disinfection methods include boiling, chlorination, use of ozone, use of solar energy (solar disinfection, solar thermal, solar UV). **(1 mark for each, up to max of 2 marks)**	**10**	Focus of part (a) must be on improving the quality of water supply, not on supply of water. Maximum of 7 marks for methods used to improve quality of drinking water. Maximum of 6 marks for inputs of UN and NGOs. If a candidate is to achieve maximum marks they must explain why there is a need to improve the quality of drinking water; name and describe steps involved in water treatment; and describe the inputs of the UN and NGOs (including reference to named UN agencies and NGOs) in LEDCs. Responses should be well-structured and marker judgement should be used where bullet points have been included. These are acceptable for listing items or points, but it is expected that the candidate will then discuss each item in more detail.

Question			Expected response	Max mark	Additional guidance
9.	**B**		**Continued** **Advisory role of the UN and input of NGOs:** • Advisory role of UN. (**1 mark for each well-structured statement, up to max of 2 marks)** • Input of NGOs. (**1 mark for each well-structured statement, up to max of 2 marks)** • Named example of a UN agency **(1 mark)** and an NGO **(1 mark)** involved in a safe water supply project. **(Max of 2 marks)** Inputs: • UN works at a strategic level. **(1 mark)** • UN-Water (**1 mark)** is a UN group which supports and advises nations in their efforts to improve aspects of freshwater and sanitation. **(1 mark)**, including cooperation between cooperating bodies and development organisations. (**1 mark)** • NGOs work at a local level, focusing on community engagement. (**1 mark)** • Water Aid UK **(1 mark)** is an NGO which works with local partners to help communities (**1 mark)** access safe drinking water and sanitation. **(1 mark**). • NGOs are well placed to raise awareness/promote community education/implement practical solutions/introduce good practice in improving and maintaining safe drinking water supply. (**1 mark for each, up to max of 2 marks.** Any other valid response.		

Question			Expected response	Max mark	Additional guidance
10.	**A**		**Advantages** (**1 mark for each up to max of 6 marks**) • Are renewable/can be replenished constantly. • Can be inexpensive (include context). • Can be sourced or produced locally/improve energy security. • Can be used with current/ modified engine designs. • Can prolong the working life of engines (**1 mark**) so reduce repair and maintenance costs. (**1 mark**) OR can prevent knocking of engines. (**1 mark**) • Biofuel crops are carbon neutral/release the same CO_2 on burning as was absorbed by the source plant during growth, so no extra CO_2 released. • Can be processed from a wide range of organic materials. • Can reduce waste management problems/landfill gas emissions (from decomposition). • Glycerol/by-product of transesterification can be used in other industries. • Alcohol used in transesterification process can be recovered and re-used. • Biofuels from algae produce much higher yields than other feedstocks.	**10**	No credit for greener or cleaner emissions without reference to sulfur emissions. Max of 6 marks for advantages. Max of 6 marks for disadvantages. A candidate may be given credit for describing advantages/ disadvantages of specific biofuels eg biodiesel biodegrades rapidly; is non-toxic; has a higher flash point than fossil diesel so is safer in a crash; can divert large quantities of waste materials from landfill. Accept valid comments on socio-economic advantages/disadvantages. Responses should be well-structured and marker judgement should be used where bullet points have been included. These are acceptable for listing items or points, but it is expected that the candidate will then discuss each item in more detail.

Question			Expected response	Max mark	Additional guidance
10.	A		**Disadvantages** (**1 mark for each up to max of 6 marks**) • Land/water is being diverted from food production to grow biofuel crops/reduced food security. • Change in land use/loss of marginal land/woodland to grow biofuel crops. • Monoculture crops require fertiliser/pesticides to maximise yield. • Some countries lack suitable soil/climate for biofuel crop production (**1 mark**) so have reduced energy security. (**1 mark**) • Biofuels (are seen as carbon-neutral but still) release CO_2 when burned so do not reduce emissions. • Biofuel processing can release nitrous oxide (**1 mark**) contributing to the enhanced greenhouse effect/global warming/climate change/acid rain. (**1 mark**) • Limitations of use in some vehicles/some vehicles require engine modification (**1 mark**), so biofuels are used as additives rather than replacements. (**1 mark**) • Fertiliser production currently required for algae production produces more greenhouse gas emissions than would be saved. • Biomethanol is highly toxic. **OR** Any other valid response.		

Question			Expected response	Max mark	Additional guidance
10.	**B**		Climate is the average weather in an area over a long period of time. (**1 mark**) A biome is a large geographical area defined by its climate, flora and fauna. (**1 mark**) Major terrestrial biomes include: • tundra • temperate deciduous/ broadleaved forest • desert • rainforest. Typical climatic conditions associated with each biome type (**max of 2 marks for each biome general description, up to a max of 6 marks**). **Tundra** • Arctic - long, very cold winters; short, cool summers; low precipitation. • Alpine/montane – cold and dry throughout the year. **Temperate deciduous/ broadleaved forest** – cold, snowy winters; warm, moist summers; 4-season variation. **Desert** • Hot – very warm, dry winters; very warm, less dry summers. • Cold – cold, wetter/snowy winters; warmer, dry summers. **Equatorial Rainforest** • Warm and wet all year. The most important abiotic factors involved in biome classification are temperature (**1 mark**) and precipitation (**1 mark**).	**10**	Max of 3 marks for list of biomes without expanded discussion. Discussion should focus on the typical climatic conditions associated with a biome (rather than on species typically found in them) and could include appropriate discussion of the influence of atmospheric pressure. Candidates should be aware of biomes associated with low atmospheric pressure (equatorial and temperate rainforests) and high atmospheric pressure (hot deserts and tundra). Give credit where a candidate provides an in-depth commentary on a limited range of biomes, linking temperature, precipitation and/or atmospheric pressure. No mark awarded for a vice versa point unless it is expanded. Candidates may also refer to other major terrestrial biomes: <u>Boreal forest/taiga/coniferous forest</u> – long, very cold winters; short, relatively warm but wet summers. <u>Grasslands</u> • temperate (includes pampas, veldt, Great Plains, steppe) – cold, dry winters; warmer, wetter summers. Variation in timing and intensity of precipitation depending on location. • savannah – mild, very dry winters; mild, wet summers. <u>Chaparral</u> – cool, wet winters; warm, very dry summers. <u>Temperate forests</u> – cold, snowy winters; mild, wet summers.

Question			Expected response	Max mark	Additional guidance
10.	**B**		• Areas of low atmospheric pressure experience higher precipitation/the lower the atmospheric pressure, the more moisture the air will hold, and the more likely it is to fall as precipitation (**1 mark**), and vice versa for high pressure. • Relationship between atmospheric pressure and temperature will dictate whether atmospheric moisture evaporates or precipitates (**1 mark**) and falls as rain/snow/sleet/hail (**1 mark**). • Atmospheric pressure is inversely proportional to altitude/the higher the elevation the lower the air pressure, and vice versa (**1 mark**). Temperature ranges experienced in each biome are linked to distribution of solar energy across the Earth's surface (**1 mark**). Some biomes lie in areas of energy surplus/where the sun's rays hit the Earth's surface at a direct angle and is very intense (**1 mark**). Others lie in areas of energy deficit/where the sun's rays arrive at an angle and is less intense (**1 mark**). Changes in axial tilt result in seasonal variation (**1 mark**).		Responses should be well-structured and marker judgement should be used where bullet points have been included. These are acceptable for listing items or points, but it is expected that the candidate will then discuss each item in more detail.

[END OF MARKING INSTRUCTIONS]