A-level
ENVIRONMENTAL SCIENCE
7447/2

Paper 2

Mark scheme

June 2020

Version: 1.0 Final Mark Scheme

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

Qu	Part	Marking guidance	Comments	Total marks	AO
01				5	**AO1**

Ecological activity	Equipment
Sample freshwater invertebrates	
	Light trap
Sample insects in ground vegetation	
	Beating tray
Separate soil animals from soil/ leaf litter	

Qu	Part	Marking guidance	Comments	Total marks	AO
02	1	• **16770** • **10106** ecf • **1.66** Award **three** marks if correct answer but no working shown		Max 3	AO2= 2 AO3= 1
02	2	Any **two** from • same time of the year for before and after eradication • same random/systematic sampling in both • large sample size in both • same number of samples in each • same trap position in both		2	AO2
02	3	Any **two** from: • disease introduction • habitat change • competition for food • competition for breeding site		2	AO2
02	4	**Two** marks for changes caused by reduced light levels **One** mark for effect on invertebrate community eg fewer ground plants reduced food/egg laying sites/DOM food reduction in population/diversity reduced temperature beyond range of tolerance reduction in population/diversity		3	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
03	1	Maximum population that can be supported sustainably		1	AO1
03	2	**Two marks for named habitat provision** **Two marks for linked explanation of population increase** **e.g.** • larger total habitat • more breeding sites/ more food resources • biological corridors/ no road allows successful migration • greater access more breeding sites/ more breeding partners/ more food resources • woodland provides protection from agrochemical pollution • fewer killed by pesticides/ eutrophication/ named farm pollutant • ponds closer together allowing more successful migration • to more breeding sites/ more breeding partners/ more food resources • more terrestrial hibernation sites • successful winter survival • trees create shade/ humidity/ modifies temperature • within range of tolerance **Accept converse for Site B**		4	AO3
03	3	Any **two** advantages of eDNA instead of traditional method • DNA more accurate identification (of species than sight or sound) • can give information on individuals/population genetics • less time consuming at site (no need to sit and wait for sighting/hearing) • less disturbance (because less time at site) Any **two** disadvantages of eDNA instead of traditional method • takes longer to obtain results (from laboratory) • may not sample enough water to collect eDNA • DNA degrade quickly (in warm conditions) • frogs may have just arrived at the pond		2 2	AO2

03	4	**Any three** from **Standardisation between methods** • observation and water sample taken at the same time [R season] • same sample sizes of both methods (water taken and time to observe frogs) **Standardisation between ponds of same method** • same time-period of observation at each pond/ time of day/ time of lifecycle (when frogs breeding/ active) • same weather conditions of observation at each pond • water sample taken from the same position in each pond • same size water sample at each pond	3	AO2

03	5	B Spearman's rank	1	AO2

03	6	Any **two** from • test value is less than the critical value • there is >5% / 0.05 probability the correlation is due to chance • no significant correlation/ accept null hypothesis	2	AO3

<table>
<tr><th>Qu</th><th>Part</th><th>Marking guidance</th><th>Comments</th><th>Total marks</th><th>AO</th></tr>
<tr><td>04</td><td>1</td><td>2%</td><td>100/5000 x 100</td><td>1</td><td>AO3</td></tr>
<tr><td>04</td><td>2</td><td>Students should make links between the following:

• monitoring technology
• data provided
• how data helps conservation

Level 3 responses will include a range of different technologies

Indicative content
<table>
<tr><th>Technology</th><th>Data provided</th><th>Conservation value</th></tr>
<tr><td>Satellite tracking/ imaging/ GPS tracking</td><td>Habitat range/ area. Migration pathways and stop over destinations
Migration dates
Mortality locations</td><td>Inform the size/ location of designations
Identification of threats, to inform /enforce legislation/ designations
Habitat management
Control human activities during breeding periods</td></tr>
<tr><td>Camera trapping/ Photography/ drones</td><td>Species present, Range
Dates & times
Health
Unique markings for Lincoln index</td><td>Designations,
Habitat are required
Restrictions of human activities
Medical/ resource intervention
Population trends – IUCN categorisation
Documentaries for awareness</td></tr>
<tr><td>Sonograms</td><td>Presence of species
Date and timings.
Identification of new individuals</td><td>Habitat management
Control human activities during Breeding periods
Control of invasive species</td></tr>
<tr><td>eDNA/ blood/tissue samples/ DNA</td><td>Species present
Individuals present
Genetic diversity</td><td>Protection of habitat
Carry out habitat management
Gene pool – potential breeding pairs for CBR
Dispersion – biological corridors</td></tr>
<tr><td>Environmental monitoring satellites/ Argo floats / Turbidity/light meter</td><td>Atmospheric/ ocean temperatures
Ice extent
Salinity
turbidity</td><td>Monitor environmental changes that may affect wildlife to inform policy makers on GCC

Inform impacts on coral reefs and need to action management</td></tr>
</table>
</td><td>9</td><td>AO1:4
AO2:3
AO3:2</td></tr>
</table>

Examiners are reminded that AO1, AO2 and AO3 are regarded as interdependent. When deciding on a mark all should be considered together using the best fit approach. In doing so, examiners should bear

in mind the relative weightings of the assessment objectives. More weight should therefore be given to AO1 than AO2 and AO3.

Level	Marks	Descriptor
3	7–9	A comprehensive response to the question, with the focus sustained. A conclusion is presented in a logical and coherent way, fully supported by relevant judgements. A wide range of knowledge and understanding of natural processes/systems is applied. The answer clearly identifies relationships between environmental issues. Relevant environmental terminology is used consistently and accurately throughout, with no more than minor omissions and errors.
2	4–6	A response to the question which is focussed in parts but lacking appropriate depth. A conclusion may be present, supported by some judgements, but it is likely not all will be relevant. A range of knowledge and understanding of natural processes/systems is shown. There is an attempt to apply this to the question, but there may be a few inconsistencies, errors and/or omissions. The answer attempts to identify relationships between environmental issues, with some success. Environmental terminology is used, but not always consistently.
1	1–3	A response to the question which is unbalanced and lacking focus. It is likely to consist of fragmented points that are unrelated. A conclusion may be stated, but it is not supported by any judgments and is likely to be irrelevant. A limited range of knowledge and understanding of natural processes/systems is shown. There is an attempt to apply this to the question, but there are fundamental errors and/or omissions. The answer may attempt to identify relationship between environmental issues, but is rarely successful. Limited environmental terminology is used, and a lack of understanding is evident.
	0	Nothing written worthy of credit.

Qu	Part	Marking guidance	Comments	Total marks	AO
05				5	AO1

Feature of Earth	How the feature makes Earth suitable for life
High mass/gravity	
	Reduced daily temperature range [A regulates suitable temperatures]
	Deflection of solar winds/ radiation [R UV]
Inclined axis of rotation/tilt	
	Presence of liquid water

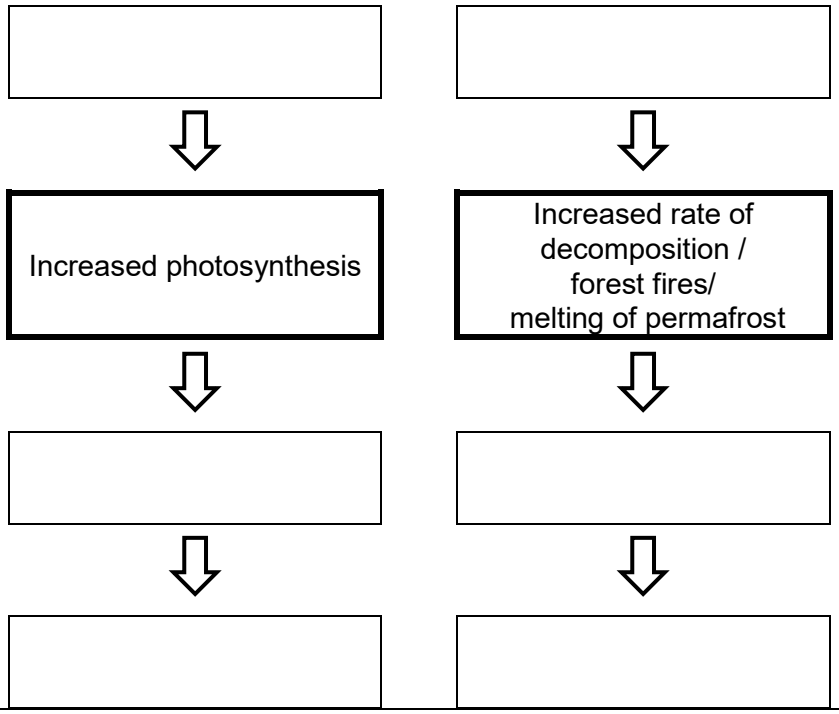
Qu	Part	Marking guidance	Comments	Total marks	AO
06	1	Any **three** from Energy used in: • fertiliser manufacture /named agrochemical manufacturer • fuel used ploughing/spraying agrochemicals • pumped irrigation • artificial control of temperatures • artificial lighting • fossil fuel burned for CO_2 (in glasshouses) • manufacture of machinery/ equipment • transportation of named resources		3	AO2
06	2	• $\frac{0.85 \times 41000 \times 3}{46600}$ ecf • **2.2** Accept correct answer for **two** marks	Output: 85% of edible weight Multiplied by energy per kg Output/input 104 550 / 46 600 2.24 to 2 significant figures = 2.2	2	AO2
06	3	**One mark for equipment/ technique** • use of beating tray/suction sampler/ observation/pheromone traps **Two marks from features of method** • baseline study before pest methods used • systematic/ random sampling • large number of samples in both areas (minimum of 10) for reliable mean/ total • conduct study at time of maximum aphid population **Two marks for standardisation** • number of beats/ time using suction sampler/number traps set/ time observing • both areas at the same time/ weather conditions • same number of samples on each site • test area 1 and 2 in the same location/ named regional variable /same tree density/ species of tree **One mark for suitable statistical test** • Mann Whitney U (if mean data per tree recorded) • Chi-squared (if total aphid data used)		5	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
07	1	• 4.22 & 0.89 **ecf** • 3.33 [1 mark for 3.34 rounding error]	Productivity = yield/ area Oil palm: 69.50/16.46 = 4.22 Rapeseed: 29.27/ 32.90 = 0.89 Difference: 4.22 – 0.89 = 3.33 1 mark	2	AO3
07	2	• All other crops less productive • more land required/ greater area of habitat destruction		2	AO3
07	3	**Up to four management methods (4 marks)** **Up to four ways methods increase sustainability (4 marks)** (max 2 management methods for one limiting factor) e.g. <u>Pest control</u> **Up to two management pest control methods** • IPM • biological control • maintenance of predator habitats • mulching • pest resistant varieties • barrier crops • multi cropping • crop rotation **Up to two ways method increases sustainability:** • reduces use of pesticides • death of non-target species <u>Water</u> **Up to two water management methods** • drip irrigation • drought tolerant varieties • mulch • addition of OM **Up to two ways method increases sustainability** • reduced over-abstraction (from water sources) • reduced named impact of over-abstraction		6	AO1

		Soil nutrients **Up to two nutrient management methods** • crop rotation • green manures • legumes • aeration of the soil aerobic decomposition • addition of organic manures **Up to two ways method increases sustainability** • reduced eutrophication • reduced greenhouse gas emissions via Haber process Any other suitable examples		

Qu	Part	Marking guidance	Comments	Total marks	AO
08	1	• nutrients needed in photic zone/ nutrients are a limiting factor • nutrients at surface on continental shelf due to disturbance of seabed/ runoff from land • less nutrients near surface in open oceans because DOM sinks		3	AO1
08	2	• move up to surface in the day to access light for photosynthesis • move down to access nutrients (when less impact on photosynthesis/ at night) • correctly linked data <20m (light) and >70m (nutrients)		3	AO3
08	3	**Up to four explanations:** • no land area required preventing habitat destruction/ loss of biodiversity/ enabling afforestation/ re-wilding • no irrigation required reduces over-abstraction/ impacts on natural aquatic communities/ reduces freshwater resource demand • no ploughing reduces soil erosion/ sedimentation • no ploughing reduces CO_2 released from soil • no artificial fertilisers used reduces eutrophication risks • no artificial fertilisers used GHG emissions from manufacture • any other relevant examples		4	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
09	1	**One change caused by fewer trees** **One linked subsequent change to hydrology** eg • reduced interception • greater river volume/ run off/ soil moisture • reduced evapotranspiration • reduced humidity/ rainfall		2	AO3
09	2	• faster growing • less pest damage		Max 1	AO1
09	3	**Two** from: • standard deviations do not overlap • means are (likely to be) significantly different • deciduous woodland data more spread around the mean than conifer woodland		2	AO3
09	4	**One mark for equipment/ technique** • pitfall traps/ leaf litter samples sorted in trays/ Tullgren funnel **Three marks for features of method** • systematic sampling • number of different species counted • large number of traps set (min 10) • multiple woodland habitat sites sampled for each for reliable mean **Two marks for standardisation** • same size traps/same size litter sample • same number of traps in each area • same number different habitat sites sampled for each woodland • all set at same time/season/weather conditions/left for the same time		4	AO2
09	5	**One from** • non-indigenous trees therefore fewer food sources/fewer breeding sites • more acidic soil therefore reduces diversity of food sources/outside range tolerance of some species [A less diversity in conifer (assumption of monoculture) reduced food]		1	AO2

Qu	Part	Marking guidance	Comments	Total marks	AO
10	1			2	AO1
10	2	• reduction in ice cover • reduced albedo • less incoming radiation reflected/more incoming radiation absorbed by surface • increased rate of temperature change		4	AO2
10	3	• 0.2 and 0.8 • 0.6	**One** mark for Change in CO_2 1900 to 1950: 310-300 = 10 Annual change / 50 years: 10/50 = 0.2 Change in CO_2 1960 to 2010: 380-340 = 40 Annual change / 50 years: 40/50 = 0.8 **One** mark for difference: 0.8 - 0.2 = 0.6	2	AO3
10	4	Oxygen isotope data/ CO_2		1	AO1
10	5	Indirect data that could be affected by other factors		1	AO1

Level	Marks	Descriptor
5	21–25	A comprehensive response with a clear and sustained focus. Content is accurate and detailed. Relationships are identified, reflecting the holistic nature of environmental science and the answer as a whole is coherent. A wide range of relevant natural processes/systems and environmental issues are described and articulated clearly. These are applied systematically to the question, with clear relevance to the context. Where conclusions are made, these are fully supported by judgements and presented in a logical and coherent way. Relevant environmental terminology is used consistently and accurately throughout. If there are errors, these are very minor indeed and not sufficient to detract from the answer.
4	16–20	A response in which the focus is largely sustained, with content that is mainly accurate and detailed. Relationships are identified and the answer is largely coherent. A range of natural processes/systems and environmental issues are described and articulated clearly. In most cases, these are applied appropriately to the question but, in some, it is less clear why they are relevant. Where conclusions are made, these are supported by judgements which are mostly coherent and relevant. Relevant environmental terminology is used consistently and throughout, with no more than minor errors.
3	11–15	A partial response which is focused in parts. The content is mostly accurate but not always detailed. There is an attempt at identifying relationships, but the answer as a whole is not fully coherent. A range of natural processes/systems and environmental issues are described, most are articulated clearly. In some cases, these are applied appropriately to the context but, in most, it is less clear why they are relevant. Where conclusions are made, it is not always clear how they relate to the judgments given and are likely to contain errors. Relevant environmental terminology is used, but not consistently and there may be errors.
2	6–10	An unbalanced response, lacking in focus. The content may be inaccurate and lacking detail. There is some attempt at identifying relationships, but the answer is not coherent. A limited range of natural processes/systems and environmental issues are described but not articulated clearly and likely to contain errors and/or omissions. There is a limited attempt to apply them to the context. Any conclusions are likely to be asserted, with no supporting judgements and fundamental errors. Environmental terminology is used, but not always appropriately and sometimes
1	1–5	Fragmented points, whose relevance to the question and relationships to each other are unclear. A few natural processes/systems and environmental issues are listed, but unlikely to be described and many may be irrelevant. There is no clear attempt to apply them to the context. It is unlikely that a conclusion will be present. There is an attempt to use environmental terminology, but seldom appropriately.
	0	Nothing written worthy of credit.

Qu	Part	Marking guidance	Comments	Total marks	AO
11	1	**Indicative content:** overfishing/fish impacts of feed production methods to reduce overfishing/fish impacts of feed production e.g. farming herbivorous fish plant based protein feed pellets control feed waste by CCTV/ laser shut off impacts of predator control/culling methods to reduce predator control/culling e.g. better cage design sterile fish avoid non-indigenous species with potential to be invasive impacts from fish escapees methods to reduce impacts from fish escapees e.g. better cage design sterile fish avoid non-indigenous species with potential to be invasive impacts from high faecal/food waste/ DOM/ turbidity methods to reduce impacts from high faecal/food waste/ DOM/ turbidity e.g. rotation of sites locations of cages in currents IMTA water treatment controlling feeding quantities to reduce waste reed beds impacts of using pesticides to kill lice/ antibiotics methods to reduce the use of pesticides to kill lice/ antibiotics e.g. using cleaner fish e.g. wrasse/ lumpsuckers removing excessive growth of weed and crustaceans by mechanical cleaning of cages reduce stocking density vaccinations/ breed in disease resistance tanks with single age group habitat destruction methods to reduce habitat destruction e.g. careful site selection designation of protected areas		**25**	AO1:10 AO2:10 AO3: 5

11	2	**Indicative content:** impacts caused by land clearance methods used to reduce impacts from land clearance e.g. offset loss of carbon sink by afforestation extensive grazing on rough grassland impacts caused by livestock feed production methods to reduce Impacts caused by livestock feed production e.g. cultural/ biological pest control to reduce pesticide impacts organic fertilisers/ green manures/ crop rotation to reduce artificial fertiliser impacts polyculture to increase biodiversity buffer strips to reduce eutrophication/ soil erosion drip irrigation to reduce over-abstraction impact impacts of livestock on soil methods to reduce impacts of livestock on soil e.g. reduce stocking density to reduce overgrazing and erosion rotate feeding stations to avoid compaction do not let out into field on very wet days to avoid compaction impacts of greenhouse gas emissions from livestock production methods to reduce greenhouse gas emissions from livestock e.g. change livestock diet to reduce CH_4 production reduce nitrate fertilisers for feed to reduce N_2O from denitrification reduce long distance exportation travel to reduce CO_2 impacts of livestock on water resources methods to reduce impacts of livestock on water resources e.g. buffer strips to reduce manure run off/ deoxygenation/ eutrophication slurry pits reduce antibiotics by vaccinations/stocking density	**25**	AO1:10 AO2:10 AO3:5