AQA

AS
Environmental Science

7446 – Paper 1

Mark scheme

7446
June 2018

Version/Stage: 1.0 Final

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 Assessment Writer.

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	1	A = nitrification/oxidation B = decomposition/decay/ ammonification	[**R** bacteria unless linked to specific process]	1	**AO1**
01	2	**0.85×10^6** OR **850 000** Allow other standard form expressions	**Input to soil**: Fertiliser application x Nitrogen fixation = 0.5×10^6 Addition of crop residue = 0.06×10^6 Total input = x + 0.56 **Output from soil**: Absorption= 0.69×10^6 Leaching = 0.47×10^6 Denitrification = 0.25×10^6 Total output = 1.41×10^6 **For dynamic equilibrium:** **Input = output** X = 1.41 – 0.56 ($\times 10^6$) = 0.85×10^6	1	**AO3**
01	3	Correct method linked to correct process Any **three** from the following: • planting legumes/named legume • N_2 fixing bacteria in root (nodules)/Rhizobium • planting green manure/ catch crop/cover crop/ named examples eg clover, alfalfa, radish, cowpea, buckwheat • (ploughed in to) add nitrogen to soil by decomposition/ ammonification [**R** decomposition if not linked to choice of crop] • planting long-term crops eg fruit, permanent pasture • reduced soil disturbance/ slows infiltration/ slows leaching • crops with low nitrogen requirement		3	**AO2 = 3**

<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>02</td><td>1</td><td><table><tr><th></th><th>2015</th></tr><tr><td>Per capita water consumption / m^3 yr^{-1}</td><td>1500/
1600</td></tr><tr><td>Per capita GDP / US $</td><td>31000/
32000</td></tr></table>Award one mark if two correct answers, but reported to wrong significant figures</td><td>Answers to 2 significant figures

Lower and upper range of readings from graph give 1500 or 1600.

Lower and upper range of readings from graph give either 31000/32000</td><td>2</td><td>AO2 = 2</td></tr>
<tr><td>02</td><td>2</td><td colspan="2">Any three from:
(Increased affluence so can afford to apply) low water use appliances and eg washing machine, dishwasher, spray taps, dual flush toilet
(more knowledge/education applied to) change human behaviour (to use less water per head)/ suitable example eg shower not bath, turn off tap during intermittent use
restricted use/suitable example eg pay per volume (metering), limited time access, banned named activity
better maintenance to reduce leaks/suitable example eg dripping taps, repair leaks, replacing pipework
increased recycling of water/grey water use (domestic/industrial setting)
decline in <u>named</u> industry/industrial use eg paper, metal ore processing, coolant
reduced irrigation and reason</td><td>3</td><td>AO3</td></tr>
</table>

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3	1	Any **two** from: • calibrated light meter • described standardised method of use eg orientation **number of readings**: • minimum 10 in each area Any **two** from: **location of readings**: • random/systematic [**R** stratified, transect] • avoid anomalous areas **timing of readings**: • same time of day/same time **number of areas sampled**: • range of coppice ages • reference to number of areas linked to data analysis/statistical test	4	**AO1 = 2** **AO2 = 2**

3	2	• coppicing causes increased light to reach the ground • colonisation/succession/different communities lead to decreasing light levels Any **two** from: • (increases photosynthesis) increased ground flora biodiversity • increased temperature/increased wind velocity/reduced humidity • reference to the range of tolerance of plant/invertebrate/ bird/mammal species • increased habitat diversity/niche diversity • increased biomass • increased food sources • more breeding sites for invertebrate/bird/mammal species • more <u>named</u> shade-tolerant organisms eg ferns/fungi/bluebells/wood anemone/named taxon **OR** • fewer <u>named</u> high light-requiring plants eg grasses/primroses/foxgloves/named taxon	4	**AO1 = 2** **AO2 = 2**

3	3	Any **two** from: • management agreement/scheme/advice • named designation eg SSSI/NNR/SPA/SAC/Ramsar **OR** named organisation eg Natural England/ Natural Resources Wales • provide compensation/grants for management • restriction on/must apply to carry out operations requiring consent/damaging activities • named example of ORC/OLD/damaging activity eg - change in grazing regime - change in mowing regime - removal of trees/plants/hedges - drainage - use of pesticides/fertilizers - burning • management notice/enforced action/fined for failing to comply [**R** damaging activities that are not linked to designated areas]	2	**AO1 = 2**

Qu	Part	Marking guidance	Comments	Total marks	AO
4	1	• **123 270** • **56** (yrs) ecf Award **two** marks for correct final answer **56 (yrs)** Award **one** mark for correct answer but incorrect significant figures	587 000/100 x 21 = 123 270 1 mark 123 270/2200 = 56.03	2	**AO2 = 2**
4	2	• **1496** • **1.8** [**A** 1.82 or 1.83] ecf Award **two** marks for correct answer 1.8 [**A** 1.82 or 1.83]	No. of known species in Madagascar x (Ratio of endemic to non-endemic species)= No. of endemic species in Madagascar 1870 x (4/5) = 1496 Number of endemic species dependent on TRF 83/100 x 1496 = 1241.68 (1242) % of world's vertebrate species made globally extinct if all Madagascar TRF lost 1241.68/68 045 x 100 = 1.8247 1242/68 045 x 100 = 1.8252	2	**AO2 = 2**

4	3	Up to **four** reasons for prioritisation Up to **three** linked explanations • red lists • categorise on level of threat of extinction/named categories eg EW,CE,E,V,NT,LC (minimum of 2) • level of threat of habitat loss • deforestation/urbanisation/climate change/named cause of habitat loss • evolutionary uniqueness/EDGE species • more genetically distinct/unique characteristics • endemic species/only found in one area • vulnerable to local change • degree of population dispersal/small population • isolated non-interbreeding populations/in-breeding problems/ re-colonisation difficulties • keystone species/interspecies relationships • support the survival of many other species • flagship species • raise support for conservation/other species in habitat protected	6	**AO1 = 6**

Qu	Part	Marking guidance	Comments	Total marks	AO
5	1	**One** mark for estimating both ranges from graph 1880-1935 = **33 to 44** 1940-2000 = **120 to 129** If only rates shown 1880-1935: 0.60-0.75 mm yr^{-1} 1940-2000: 2.02-2.15 mm yr^{-1} **ecf** **difference:** **1.20-1.55** mm yr^{-1} Award **two** marks for correct final answers Award **one** mark if final answer not given to 2 decimal places Accept calculations based on gradients	First mark: **From use of trend line** 1880-1935 -122 to -82 = **40** (accept 36 to 44 for reading values from graph ±2) 1940-2000 -72 to +52 = **124** (accept 120 to 128 for reading from graph ±2) **From use of points** 1880-1935 -124 to -87 = **37** (accept 33 to 41 for reading values from points ±2) 1940-2000 -71 to +54 = 125 (accept 121 to 129 for reading values from points ±2) Second mark: Calculate annual rates and difference **From use of trend line** 1880-1935 Change/55 = answer in range: 0.65 to 0.80 1940-2000 Change/60 = answer in range: 2.02 to 2.15 **From use of points** 1880-1935 Change/55 = answer in range: 0.60-0.75 1940-2000 Change/60 = answer in range: 2.02 to 2.15	1 1	**AO2 = 2**

5	2	Any **one** of: • increased named human activity that increases named greenhouse gas • increased use of fossil fuel/ named fuel that increases named greenhouse gas • positive feedback mechanism • increased temperature leading to Any **two** from the following: • increased melting of land ice • increased thermal expansion of sea water • melting ice shelves allows faster movement of land ice into the sea	3	**AO3 = 3**

5	3	Any **two** from (Change has allowed) • more observation/monitoring points/data • continuous monitoring • more accurate/precise instrumentation used, • eg satellite altimetry/LIDAR/ radar/named monitoring technology • more reliable mean/less variation around mean	2	**AO3 = 2**

5	4	**One** mark for: • gaps/uncertainty in past trends/historical data • unreliability of proxy data Any **two** from: lack of understanding of processes affecting global temperature: • rate of thermal expansion/melting of land ice • time-delay between cause and effect • impact of feedback mechanisms • other named natural fluctuation lack of knowledge of anthropogenic impacts: • change in human population • use of energy conservation • development of CCS/carbon sequestration • change in energy resources used • other activity affecting GHG emissions • development of other technologies eg geoengineering	3	**AO1 = 1** **AO2 = 1** **AO3 = 1**

Qu	Part	Marking guidance	Total marks	AO
6	1	**One** mark: 39x38/ (420+30+20+6+2) or 1482/478 ecf **Two** marks for correct answer: **3.10**	2	**AO2 = 2**
6	2	Any **two** from (representative): • large number (minimum of 10) of traps in each area • left out for long enough to sample population • (time of year/day) when mammals are active • location of traps suitable for species • marked so counted once Any **two** from (comparable): • same number traps in each area • same size of area sampled • same location method for traps • same type of traps/bait in each area • set out at same time/weather conditions • left for the same period of time • similar named habitat features, eg temperature/ proximity to water/other factor affecting mammals	4	**AO2 = 4**
6	3	Any **two** from: • more pellets at 40cm because more food available • stated reason for different abundance • eat field voles when available • if lack of field voles, eat others • ease of capture in different areas • ease of capture of different prey species [**R** higher diversity in 40cm area]	2	**AO3= 2**

6	4	Any **two** from: • nest/egg shells/burrows • fur/feathers • droppings • feeding marks/recognisable food items • tracks/footprints • stated territorial mark • eDNA/DNA	2	**AO1 = 2**

Qu	Part	Marking guidance	Comments	Total marks	AO
7	1	2 months	1989 Jul to Nov = 5 months 2011 Aug to Oct = 3 months 5 – 3 =2	1	**AO2 = 1**
7	2	93 DU [**A** answers in range 92-95] [**A** answers to 0.5 accuracy]	**2011** 205 DU **1989** 110-113 DU **Difference** 205 – 113/110 = 92-95	1	**AO2 = 1**
7	3	Antarctic atmospheric processes: • polar vortex (in winter) • CFCs/ODSs drawn to poles/isolated • much lower temperatures • leading to (Polar) Stratospheric Clouds (PSCs) • more formation of ice particles • that allow surface chemical reactions/storage of chlorine • increased UV/light causes more dissociation/loss of clouds/ ice crystals melting releasing more Cl to break down ozone (in spring/early summer) Maximum of **FOUR** if no seasonal change identified [**R** reference to CFCs freezing]		5	**AO1 = 5**
7	4	Any **three** from: • satellites collect data from all areas/globally • rapid collection of global/large data for comparisons • no disturbance of sensitive ground area • low cost per unit data collected • satellites not vulnerable to damage on ground		3	**AO2 = 3**

Qu	Part	Marking guidance	Comments	Total marks	AO
8	1	Any **one** named pollutant/problem (caused by drainage water) eg - suspended solids/turbidity - toxic metals/metal toxicity/toxic leachate - acidic particles/acidity Any **one** named treatment/containment method eg - settlement tanks - ponding lagoons - tailing pond - reed lagoons Any **one** principle of treatment method eg - static water allows settlement of suspended solids - use of limestone to raise pH/reduce solubility of metals - phytoremediation/plant uptake of heavy metals		1 1 1	**AO2 = 3**
8	2	amount of the resource that can be extracted economically now (using existing technology)		1	**AO1 = 1**
8	3	Jamaica's reserves 1930.6×10^6 **161** years [A 160.9 years] [Award **one** mark for 160.00]	27 800/360 x25 $1930.6 \times 10^6 / 12 \times 10^6$	1 1	**AO2 = 2**

8	4	Students should be able to explain how a factor affects a reserve and relate it to the 'lifetime' of the reserve. Indicative content The lifetime of a reserve will increase or decrease depending on the following factors: Change in demand: • more/less bauxite extracted as demand increases/decreases • increased recycling lowers demand Change in market price: • increases – lower grade deposits become more economic to mine • decreases – lower grade deposits become uneconomic to mine Change in cut-off ore grade: • increases – lower grade/smaller deposits become uneconomic to mine • decreases - lower grade/smaller deposits become economic to mine More reserves located: • improved exploratory techniques • named examples Improved extraction technologies: • lower grade deposits used • named examples Viability of mine: • associated geology • mining costs • environmental costs	9	**AO1 = 4** **AO2 = 3** **AO3 = 2**

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Level		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.
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	0	Nothing written worthy of credit.

Qu	Part	Marking guidance	Total marks	AO
9	1	• would suggest a higher estimation of population density [**A** under estimation if reference made to two quadrats] • because the mean is still fluctuating • correct use of data from graph	2	**AO3 = 2**
9	2	**One** mark for 12 ponies **One** mark for 17 cows **R** non-whole number answers	2	**AO3 = 2**
9	3	Any **two** reasons for differences: eg - cows are more selective grazers - more seed dispersal by cows - cows pull out tufts/produce uneven grass lengths - more compaction by cows, increasing soil moisture - qualified reference to effects of trampling - cows in herds/less mobile, some areas not grazed - more dog violets to begin with	2	**AO2 = 2**

9	4	9 mark levels of response synoptic answer **Physical resources – named example - evidence of benefit to society** • Biofuels - fossil fuel alternatives - GCC (3.2.1.1)/extends non-renewables/reduce impacts from mining (3.2.3) • New foods can be cultivated - higher nutritional content/ require less • fertilizers - eutrophication/fuel required in the Haber process(3.2.4.3) • Micro-organisms that are/can be used in the management of biological wastes (3.2.4.2) **Biomimetics - named example of species – evidence of benefit to society** • Whale fin shape has helped in the engineering of wind turbine blades which helps to provide energy alternatives to fossil fuels reducing GCC (3.2.1.1), extend the life of non-renewables & reduce environmental impacts from mining (3.2.3) **New Medicines - named example of species - evidence of benefit to society** • Yew is used in the treatment of breast cancer as it contains Taxol (3.1.2.1.2) **Physiological research - named example of species - evidence of benefit to society** • Squid is used in neurological research as they have wide nerve cells (3.1.2.1.2) **Pest control agents - named example of species - evidence of benefit to society** • Wasps reduce pests through parasitism reducing the need for harmful chemicals (3.1.2.1.2) **Genetic resources - example of how used - evidence of benefit to society** • Used in breeding programs or GM to increase tolerance to drought that is predicted to be more common with GCC (3.2.1.2) **Atmospheric composition regulation - example of organism/habitats that help to regulate a named gas – benefits to society** • Forests/phytoplankton absorb CO_2 regulating temperatures, helping negative feedbacks within GCC (3.2.1.1) • Forests/phytoplankton release O_2 helping maintain the ozone layer, harmful UV, ozone depletion (3.2.1.3)	9	**AO1 = 4** **AO2 = 3** **AO3 = 2**

		Maintenance of soil fertility - example of organism/habitats that help to maintain named aspects of soil fertility – evidence of benefit to society • *Temperate broadleaved woodlands/tropical forest canopies intercept rainfall & reducing erosion (3.1.2.3)* • *Mangroves help trap sediment reducing coastal turbidity* which will increase the abundance of fish that can be caught for food *Decomposers help to maintain soil nutrients (3.2.5.2)* allowing increased food production **Species inter-relationships – named examples – how benefits society** • successful practice of placing beehives round oilseed rape fields increases pollination where pollinator populations are low – higher food production		

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Qu	Part	Marking guidance	Total marks	AO
10	1	**C**	1	**AO1 = 1**
10	2	**C**	1	**AO1 = 1**
10	3	**A**	1	**AO1 = 1**
10	4	named method and how method works **Pathogens** • (fine) sand filters/membrane filtration/microstrainers - physical separation due to small particle/pore size **or** • disinfection/sterilisation/ozonation/chlorination/U.V irradiation - pathogens killed by using chlorine/ ozone/UV light **Heavy metals** • aeration – increases oxygen content so metal precipitates/ becomes insoluble **or** • ion exchange – metal ions (in water) replaced by non-toxic ions on surface of resin beads **or** • activated carbon filter/adsorption technologies – heavy metals ions bound/chelated/held on adsorbent material surface **or** • phytoremediation – harvest plants that have taken up heavy metal ions **or** • raised pH / addition of lime / named alkali - reduced solubility / precipitation **Litter** • screens/grills/meshes – physically separate/filter debris from water Award **one** mark for two methods without correct descriptions	3	**AO1 = 3**

10	5	9 mark levels of response **water resources** • rivers • reservoirs • aquifers • seawater **increasing water supply from** • borehole water/aquifer water (instead of rivers/ reservoirs/ seawater) **positive environmental impacts** • less treatment, less energy required • less water storage needed – reservoirs etc • less river abstraction, maintaining higher flow & dilution effects **negative environmental impacts** • aquifer depletion possible, loss of aquifer pressure, saltwater incursion, aquifer recharge necessary **increasing water supply from** • reservoirs **positive environmental impacts** • habitat creation • flood control **negative environmental impacts** • habitat loss • disruption to wildlife migration patterns • loss of downstream soil fertility **increasing water supply from** • rivers **positive environmental impacts** • access water locally, less energy, transportation needed **negative environmental impacts** • lower flow, dilution effects • habitat changes eg wetlands • increased treatment necessary, more energy used **increasing water supply from** • seawater **positive environmental impacts** • less energy for transport of water as located near large coastal conurbations **negative environmental impacts** • brine wastewater discharge and contaminants • energy intensive processes **increasing water supply from** • rainwater collection	9	**AO1 = 4** **AO2 = 3** **AO3 = 2**

		positive environmental impacts • reduced demand on public supply • less treatment, less energy required • less water storage needed – reservoirs • less aquifer abstraction, less river abstraction, maintaining higher flow & dilution effects • reduced storm water runoff • used for non-drinking purposes **negative environmental impacts** • increased maintenance and treatment if chemical seepage from certain roof types		

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11	1	Constant mass/ensures the soil is dry		1	**AO1 1b = 1**
11	2	26 – 18 = 8g OM 8/26 x 100 = **31%** [Accept 30.8%]		1	**AO2 = 1**
11	3	• Rosewood is significantly different from High Valley and Fairview • High Valley and Fairview are not significantly different		2	**AO2 = 1** **AO3 1b = 1**
11	4	**One** mark for: 120 x 0.32 x 0.40 x **0.35** x **0.50** OR **One** mark for: **6.14 x 0.5 x 0.35/0.40** **Two** marks for: **2.69** [Award **one** mark for 2.688]	Students should show their ability to rearrange the data used in the USLE formula to alter the results for different farming practices. Allow calculation starting with original erosion rate	2	**AO2 = 2**

11	5	Students should give a balanced account of activities that increase and decrease the rate of soil eroded with an explanation of how the activity results in a change in erosion. Evaluation can be made throughout resulting increase or decrease in soil eroded from each activity. At least one reference to how humans increase erosion for full marks Indicative content Activities that increase erosion • ploughing – breaks peds, smaller • vegetation removal – reduced interception, more rain splash • reducing organic matter content through harvest - less binding of soil particles • reducing soil biota by using pesticides - reduces aeration, infiltration • cultivating steep slope – greater water velocities, energy to transport • compaction by machinery – reducing infiltration, more overland flow • overgrazing – reduced interception • poaching – reduced infiltration – more overland flow Activities that decrease erosion • long term crops- increase interception, root binding • contour ploughing – reduces transport downslope • tied ridging – reduced transport • terracing – reduces gradient and retains water • windbreaks e.g. hedges or trees to slow wind velocities, less energy • multicropping – multiple species grown together, different harvest times, reduces bare soil • strip cropping • mulching – increasing interception, OM • increasing soil organic matter – use of organic fertilizers, manure, binds soil, food for detritivores	9	**AO1 = 4** **AO2 = 3** **AO3 = 2**

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