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A-LEVEL

# Environmental Studies

ENVS3: Energy Resources and Environmental Pollution  
Mark scheme

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2440  
June 2016

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Version/Stage: 1.0 Final Mark Scheme

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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](http://aqa.org.uk)

## Environmental Studies

June 2016

ENVS3

Instructions: ; = 1 mark / = alternative response A = accept R = reject

AO = Assessment Objective

Question	Answers	Mark	AO / Spec. Ref.
1	<p><b>A</b> – sewage/manure/silage fluid/DOM/named organic nutrient pollutant; [R thermal pollution, heat, fertiliser, oil]</p> <p><b>B</b> – smoke/SPM/PM10/named atmospheric pollutant particles; [R smog, photochemical smog, smoke smog]</p> <p><b>C</b> – SO<sub>2</sub>/SO<sub>3</sub>/sulfuric acid/ NO<sub>x</sub>/nitric acid/named acidic pollutant; [R acid rain, acid mine drainage]</p> <p><b>D</b> – lead/mercury/cadmium/organochloride/organophosphate/ named neurotoxin;</p> <p><b>E</b> – CFC/halons/chlorine/named ODS;</p>	5	AO2 3.3.2
<b>Total</b>		<b>5</b>	

Question	Answers	Mark	AO / Spec. Ref.
2(a)	food (chain impacts), loss of food; food (chain impacts), toxin in food; deoxygenation, loss of (aerobic) process/ (aerobic) taxon; chemolocation problems, cannot find other organisms/food; reduced light penetration affects photosynthesis; oil obscures prey, predators cannot see food;  [R impact of oil spill clean-up]	max 2	AO1 3.3.2
2(b)(i)	Most statistically significant : Mantis shrimp;	1	AO3 3.3.2
2(b)(ii)	Least statistically significant : Bivalve mollusc <i>Paphia</i> sp;	1	AO3 3.3.2
2(c)	method;;; how it reduces risk;;; eg double hull inner hull may remain intact in accident  double rudder, engine, fuel tank [credit one only] spare equipment  more hydrodynamic rudder greater manoeuvrability  tanks for waste oily water/separate ballast and oil tanks storage on board/not dumped  shipping routes to avoid hazards/offshore longer time after problem before hitting shore/more margin for navigation error  better navigation system eg AIS tracking, radar, GPS, use of tugs smaller navigation errors  loading on top less oily waste produced  inert gas systems reduced fire/explosion risk  waste water management stored on board/discharged at oil terminal  even unloading of tanks prevent hull failure because of uneven buoyancy	6	AO1 3.3.2
<b>Total</b>		<b>10</b>	

Question	Answers	Mark	AO / Spec. Ref.
3(a)	lead/mercury/organochloride/DDT/dieldrin/aldrin/PCB/dioxin/ named liposoluble pollutant; able to cross cell membranes/enter cells/ stored in lipids/bioaccumulates in lipids;	2	AO2 3.3.2
3(b)	<p><b>similarity –</b> both cause birth abnormalities/both can cause enzyme inhibition;</p> <p><b>difference –</b> mutagenic effects may be inherited/teratogenic effects are not inherited; <b>OR</b> mutagens change DNA/can cause cancer/teratogens do not change DNA; <b>OR</b> mutations can occur at any time/teratogenic effect always before birth;</p>	1  1	AO2 3.3.2
3(c)	identify members of public most at risk due to lifestyle/named feature of lifestyle; if they are safe, so is everyone else; [R non-human effects, reference to workers]	2	AO2 3.3.2
3(d)	environmental feature and how it affects pathway;;; eg wind velocity – distance travelled wind direction – dispersal temperature – rate of degradation precipitation/humidity – pollutants dissolved/agglomerated/hygroscopic nuclei presence of other pollutants – chemical reactions/synergism presence of UV light/sunlight – photodegradation/chemical reactions topography/basin shape/temperature inversion – reduce movement away from source/shelter presence of vegetation – interaction with cuticles/bark	4	AO3 3.3.2
<b>Total</b>		<b>10</b>	

Question	Answers	Mark	AO / Spec. Ref.
4(a)	<b>W</b> – sulfur dioxide/sulfur trioxide/SO <sub>x</sub> ; <b>X</b> – NO <sub>x</sub> /carbon monoxide/hydrocarbons; <b>Y</b> – smoke/ash/soot/SPM/PM10/dust; [R particulates] <b>Z</b> – oil;	4	AO2 3.3.2
4(b)	Methane;	1	AO1 3.3.2
4(c)	formed by reactions of other pollutant(s); (tropospheric O <sub>3</sub> ) formed by breakdown of NO <sub>x</sub> to release monatomic O <b>and</b> reaction with O <sub>2</sub> / interaction of NO <sub>x</sub> and O <sub>2</sub> ; <b>OR</b> formed by reactions of other pollutant(s); NO <sub>2</sub> → NO + O <b>and</b> O + O <sub>2</sub> → O <sub>3</sub> / NO <sub>2</sub> + O <sub>2</sub> → NO + O <sub>3</sub> ; <b>OR</b> formed by reactions of other pollutant(s); O <sub>3</sub> forms PANs; <b>OR</b> formed by reactions of other pollutant(s); oxidation of SO <sub>2</sub> to form SO <sub>3</sub> <b>OR</b> formed by reactions of other pollutant(s); SO <sub>2</sub> + O <sub>3</sub> → SO <sub>3</sub> + O <sub>2</sub> ;	2	AO1 3.3.2

Question	Answers	Mark	AO / Spec. Ref.
<b>4(d)</b>	synergistic action; ozone damages wax/cuticle/stomata; exposes leaf to other acidic pollutant;  reacts with sulfur dioxide/produces sulfur trioxide; SO <sub>3</sub> produces (stronger) sulfuric acid; named increased damage caused (by sulfuric acid); eg corrosion/weathering (of buildings/rocks) leaching of toxic metals lake acidification damage to metal structures impact on named taxon	max 3	AO1 3.3.2
<b>Total</b>		<b>10</b>	

Question	Answers	Mark	AO / Spec. Ref.
<b>5(a)</b>	nuclear – no (significant) change; gas – change related to specific times/values;	2	AO1 3.3.1
<b>5(b)</b>	storage of surplus energy; use in times of shortage/pumped storage HEP/ description of pumped storage HEP/hydrogen economy/ description of hydrogen economy;	2	AO2 3.3.1
<b>5(c)</b>	360 x 6 or 2160 and 4 x 75 x 9.5 or 2850 (MWh); 75.8/76; [R 75.79]  one ecf for one mark award both marks for correct final answer	2	AO3 3.3.1
<b>5(d)</b>	chemical; [R fossil fuel]  potential; [R gravitational potential] [A kinetic potential]	2	AO2 3.3.1
<b>5(e)</b>	heat recovery/heat exchanger/Combined Heat and Power; named use of hot water; eg greenhouse heating fish farm heating district heating space heating cleaning	2	AO2 3.3.1
<b>Total</b>		<b>10</b>	



Question	Answers	Mark	AO / Spec. Ref.
6(a)	extraction/processing/manufacture/transport of materials/ named way embodied energy is used; named linked impact of energy use on the environment;	2	AO1/2 3.3.1
6(b)	feature of wall with explanation of heat loss reduction:  named material – low (thermal) conductivity; building design – reduce surface area (:vol ratio); earth – sheltered building – reduce contact with cold air/convection; reduced internal temperature – reduce temperature gradient/difference; fill wall cavity – reduce convection; named reflective material – reduced radiation;	max 2	AO1/2 3.3.1
6(c)	renewable: replaces itself quickly/within a human lifetime; non-depletable: exploitation rate cannot reduce supply;	2	AO1/2 3.3.1
6(d)	named low-energy appliance; how appliance reduces energy use; eg low heated water use lower temperature use improved conversion efficiency of light bulbs condensing boilers reduce evaporative loss named high energy technology replaced	2	AO2 3.3.1
6(e)	changes;; eg turning off appliances/lights when not needed turning down thermostat cooking with less water/lids/pressure cooker less cooked food/use microwave use shower instead of bath purchasing choices that affect household energy use	2	AO2 3.3.1

Question	Answers	Mark	AO / Spec. Ref.
<b>6(f)</b>	range of fluid/container volumes (min 3); same container shape; containers filled to same position; same container material/thickness/colour/texture; same (higher) starting temperature (minimum of 40 °C); regular/named time interval of temperature measurement/time taken to reach same temperature; standardised method of measuring temperature; detail of graph/calculation of heat loss; same named environmental conditions;; eg temperature air flow humidity sources of heat gain/loss  repeats for reliability (min 3);	max 5	AO3 3.3.3
<b>Total</b>		<b>15</b>	

Question	Answers	Mark	AO / Spec. Ref.
7(a)	<p>Photothermal heat pumps parabolic reflector</p> <p>Photovoltaic multijunction anti-reflective coating heliostat</p> <p>Wind floating turbines VAWT helical VAWT blade aerodynamics – blade tip fins, fit to nacelle wind lens no gearbox</p> <p>Biofuels hydrogen from algae anaerobic digestion marine algae</p> <p>Wave any designs eg point absorber buoy surface attenuator oscillating water column overtopping device</p> <p>HEP Archimedes screw turbine</p> <p>Tidal tidal lagoons in-stream turbines</p> <p>Geothermal fluids that boil at lower temperatures district heating</p> <p>Related technologies storage fuel cells</p> <p><b>For 'good' : details of how new technologies increase energy supply</b></p>	20	AO1/2 3.3.1

Question	Answers	Mark	AO / Spec. Ref.
7(b)	extraction transport processing gaseous emissions liquid effluent solid waste aesthetics noise habitat loss habitat change  <b>For 'good' : structure that highlights similarities and differences, not just a string of resources and their impacts</b>	20	AO1/2 3.3.1
7(c)	<b>Inorganic</b> Use of nitrate fertilisers nitrate control areas time of ploughing low-solubility fertilisers eg urea buffer strips  Phosphates tertiary sewage treatment - phosphate stripping – iron sulphate treatment  <b>Organic</b> Control of manure spreading timing re rain buffer strips  Sewage primary treatment – sedimentation sludge digestion sludge disposal secondary treatment digestion reed beds  <b>For 'good' : inclusion of names, purposes and principles of processes</b>	20	AO1/2 3.3.2
<b>Total</b>		<b>20</b>	

## Essay Questions

The essay questions are marked using the following marking criteria.

### Scientific content

(maximum 14 marks)

Category	Mark	Descriptor
	14	
Good	12	Most of the material is of a high standard reflecting a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors, but there may be minor errors which detract from the overall accuracy.
	10	
	9	
Average	7	A significant amount of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate with few, if any, fundamental errors. Shows a sound understanding of most of the principles involved.
	5	
	4	
Poor	2	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, there are many fundamental errors.
	0	

### Breadth of Knowledge

(maximum 2 marks)

Mark	Descriptor
2	A balanced account making reference to most, if not all areas that might realistically be covered by an A-level course of study.
1	A number of aspects covered, but a lack of balance. Some topics essential to an understanding at this level not covered.
0	Unbalanced account with all or almost all material based on a single aspect.

**Relevance**

(maximum 2 marks)

Mark	Descriptor
2	All material present is clearly relevant to the title. Allowance should be made for judicious use of introductory material.
1	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
0	Some attempt made to relate material to the title but considerable amounts largely irrelevant.

**Quality of Written Communication**

(maximum 2 marks)

Mark	Descriptor
2	All material is logically presented in clear, scientific English and continuous prose. Spelling, punctuation and grammar are almost always correct. Technical terminology has been used effectively and accurately throughout. At least one page of material is presented.
1	Account is logical and generally presented in clear, scientific English and continuous prose. Minor errors occur in spelling, punctuation and grammar. Technical terminology has been used effectively, but may contain minor errors. At least one page of material is presented.
0	The account is generally poorly constructed and often fails to use an appropriate scientific style to express ideas. Continuous prose is not used. Spelling, punctuation and grammar contain a range of errors. Little technical terminology is used. Less than one page of material is presented.