A-LEVEL
ENVIRONMENTAL STUDIES

ENVS3: Energy Resources and Environmental Pollution
Mark scheme

2440
June 2014

Version: 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

Environmental Studies

June 2014 **ENVS3**

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

AO = Assessment Objective

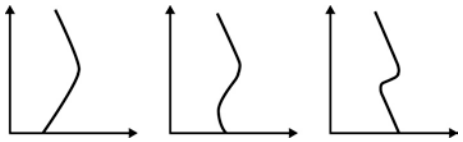
Question	Answers	Mark	AO / Spec. Ref.
1	oxides of nitrogen/named NO_x/NO_x **;** smoke/dust/PM10/(atmospheric) suspended particles/SPM/soot/ash**;** oil/hydrocarbons/organic matter/named organic material/ heavy metals**;** phosphates/ammonia/nitrates/bacteria/pathogens/ residual suspended organic matter**;** [**R** sewage] high level radioactive nuclear waste**;**	5	AO1 3.3.2
Total		**5**	

Question	Answers	Mark	AO / Spec. Ref.
2(a)	reduced viscosity**;** using solvents/named solvent/temperature increase/steam/ bacteria/microbes/*Xanthon* bacteria/detergent**;** [**R** increased pressure, increased mobility]	2	AO1+2 3.3.1
2(b)	greater number of possible sites/small scale/lower unit cost**;** [**R** unqualified cheaper] lower named environmental impact**;;** eg migration/movement barrier tidal range/loss of breeding/feeding areas flow rate turbidity/sedimentation pollution concentration barrage construction habitat loss material for barrage embodied energy aesthetics	Max 2	AO1+2 3.3.1
2(c)(i)	named design change**;** how output is changed**;** eg blade fin tips reduced friction/turbulence aerodynamics/blade shape (for energy capture) reduced stalling air leakage capture reduced energy/kinetic energy loss longer blades/larger diameter greater swept area carbon fibre/composite/lighter blades larger blades/spin at lower wind speeds stronger/neodymium/rare earth magnets more efficient generator direct drive/no gear box reduced friction use of VAWT wind from any direction/turbine does not need turning stiffer blades operate at higher wind speeds [**R** greater surface area of pipe]	2	AO1+2 3.3.1

Question	Answers	Mark	AO / Spec. Ref.
2(c)(ii)	named design change**;;;** how output is changed linked to design**;;;** eg heliostat [**A** track the sun] angle of incidence optimum/90^{o}/more intense insolation new panel materials/named material/surface/colour/low albedo more efficient light capture parabolic reflector increased intensity/focus self-cleaning surface reduced light loss from dust multilayer absorbers (photovoltaic) wider range of wavelengths greater internal reflection (photovoltaic) increased light absorption/reduced reflection vacuum (photothermal) reduced convection/conduction losses glass panels (photothermal) greenhouse effect good conductor/thin pipes (photothermal) more efficient/rapid/increased heat transfer low water volume/rapid flow/thermostatically operated pump (photothermal) increased thermal gradient greater proportion of panel covered by (water filled) pipe/ more piping per unit area more efficient/rapid/increased heat transfer	Max 4	AO1+2 3.3.1
Total		**10**	

Question	Answers	Mark	AO / Spec. Ref.
3(a)	3.8 +/- 0.1**;**	1	AO3 3.3.3
3(b)	accept answers in range 24.5 – 25.0**;** [**A** 25]	1	AO3 3.3.3
3(c)	cooling towers/heat exchangers/ combined heat and power/CHP**;** heat transfer to air/atmosphere/evaporation (in cooling tower)**;** [**R** reference to steam] hot water for named use/glasshouses/district heating/aquaculture**;** description of how method works**;**	Max 2	AO1 3.3.3
3(d)	**Similarities;;;;** Eutrophication [**R** ref to eutrophication due to organic matter only] nitrates/phosphates/nitrites/ammonium stimulate algal growth/bloom shading/inhibited macrophyte photosynthesis/growth/death food chain broken toxins released by algae deoxygenation during decay/decomposition **Differences;;;** **Sewage:** contains available DOM/carbohydrates/lipids/proteins/ named organic substance digestion/decomposition causes short term deoxygenation high turbidity toxins/cleaning chemicals medicines/antibiotics/hormones pathogens/named pathogen/waterborne disease/ named waterborne disease **Inorganic nutrients:** leads to named disease eg (nitrates) possible carcinogen (nitrates) methaemoglobinaemia/blue baby syndrome (nitrites) possible stomach cancer	Max 6	AO2 3.3.2
Total		**10**	

Question	Answers	Mark	AO / Spec. Ref.
4(a)	reducing/increasing distance (between sample sites) until results provide variation**;**	1	AO3 3.3.3
4(b)	volume/mass**;** depth**;** shape/core**;**	Max 2	AO3 3.3.3
4(c)(i)	spread of values/variation <u>about the mean</u>**;**	1	AO3 3.3.3
4(c)(ii)	t-test**;**	1	AO3 3.3.3
4(d)	acid mine drainage/leachate (containing the lead) /collection/bunding/tailings pond/pumping out mines/ (collection of) lead waste (spoil heaps)/vegetation buffer strips**;** treatment details**;;** eg add lime/named alkali/base increase pH/more alkaline precipitation/reduce solubility cap/impermeable seal electrolysis/precipitation/sedimentation bacteria reduce solubility change oxidation state absorption membrane adsorption	3	AO1 3.3.2
4(e)	bioaccumulation/biomagnification/liposoluble/persistent**;** neurotoxin/nervous system damage/enzyme inhibition/ named organ/tissue damage/immune system compromised/ effect on unborn child**;**	2	AO1 3.3.2
Total		**10**	

Question	Answers	Mark	AO / Spec. Ref.
5(a)	eg 	1	AO2 3.3.2
5(b)	anticyclonic system/high pressure**;** low wind speed**;** valley**;** clear sky**;** night time**;**	Max 3	AO1 3.3.2
5(c)	Differences: involvement of sunlight/UV in photochemical smog**;** incomplete combustion of named material for smoke smog eg fossil fuel, coal, oil, diesel, rubbish, wood**;** combustion/vaporisation of vehicle fuel for photochemical smog**;** details of process**;;** SPM/PM10/SO_2 mixed in fog (smoke smog) [**R** unqualified particles] (unburnt) hydrocarbons/NO_x (photochemical smog) secondary pollutants/ozone/PANs (photochemical smog) [**A** correct chemical equation for photochemical smog for 2 marks]	5	AO2 3.3.2
5(d)	CO_2/SO_2/NO_x/CO/HCs/radioactive waste/named pollutant not released [**R** smoke] **and** named secondary fuel (eg electricity, hydrogen) for named use**;**	1	AO2 3.3.2
Total		**10**	

Question	Answers	Mark	AO / Spec. Ref.
6	range of volumes (3+)**;** same/named shape**;** same substance/material inside**;** same type/material/same thickness of container/insulation**;** temperature control: same starting temperature/same air flow**;** standardised time/temperature drop**;** method of calculation of rate of heat loss**;**	Max 5	AO3 3.3.1
Total		**5**	

Question	Answers	Mark	AO / Spec. Ref.
7(a)(i)	to comply with government policy in carbon reduction/ Kyoto protocol**;** advantages of use of photovoltaic solar power**;** eg renewable low/no carbon emissions self-reliance/no need to import fuel/fuel security (subsidy needed to) improve competitiveness(compared with other energy sources)**;** overcomes high start-up/development costs**;** overcomes lack of economies of scale**;** linked supporting evidence from graphs/data**;** eg declining costs from 800 to 100 from 1980 – 2010 (Figure 7) increase PV solar power from about 10 to 250 between 2004 and 2012 (Figure 9) comparison of values/trends of Figures 7 **and** 9	Max 3	AO2 3.3.1
7(a)(ii)	cheaper than existing technologies/coal price increase/ carbon taxes**;** economies of scale means decrease in price/increased efficiency/ cost effective**;** start-up costs paid/no fuel to pay for**;** [**R** cheaper unqualified]	Max 1	AO2 3.3.1
7(b)	wind power is unreliable/uncontrollable/intermittent**;**	1	AO2 3.3.1
7(c)	named energy source**;** linked (economic) environmental impact**;;** economic cost of named treatment/named action to remedy (not paid by energy industry)/lost income**;;;** comparative comment on (changed) competitiveness of energy sources**;** [**A** fossil fuel if impact is general for all fossil fuels eg CO_2 but not acid rain]	Max 5	AO2 3.3.1
Total		**10**	

Question	Answers	Mark	AO / Spec. Ref.
8(a)	reduced extraction of virgin materials named environmental impact of extraction/habitat loss/dust/leachate/noise reduced raw material processing named pollutants produced by processing reduced energy use named impacts of energy use reduced waste disposal named disposal method/incineration/landfill named environmental problem	20	AO1+2 3.3.2
8(b)	aerodynamics fuel type catalytic converter/exhaust emission controls lightweight materials engine temperature control design for end of life ease of dismantling recyclability	20	AO1+2 3.3.2/3
8(c)	roof/wall/floor insulation named materials thermal conductivity/resistance double glazing conduction/convection/radiation passive energy gains windows/orientation solar cooling [**R** alternative sources of energy unless related to efficiency]	20	AO1+2 3.3.1
Total		**20**	

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 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.

UMS conversion calculator www.aqa.org.uk/umsconversion