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General Certificate of Education (A-level)
June 2012

Environmental Studies ENVS3

(Specification 2440)

Unit 3: Energy Resources and Environmental Pollution

Mark Scheme

Mark schemes are prepared by the Principal Examiner 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 examiners 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 examiner understands and applies it in the same correct way. As preparation for standardisation each examiner 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, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal 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.

Environmental Studies

June 2012   **ENVS3**

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

Question 1

		Answers							Mark
1			**Pollution impacts**						
		Pollutants	Depletion of stratospheric O_3	Global climate change	Acid rain	Photo-chemical smogs	Smoke smogs	Neurotoxic effects	
		Chlorine free radicals from CFCs	✔						
		SO_2, NO_x			✔				;
		SPM (PM10)					✔		;
		CO_2, CH_4, CFCs, NO_x, tropospheric O_3		✔					;
		NO_x, PANs, waste hydrocarbons, tropospheric O_3				✔			;
		Mercury						✔	; 5
Total									**5**

Question 2

		Answers	Mark
2(a)(i)		(Prediction of) routes a pollutant will take**;** [**R** distance of movement] movement by winds/water/biota/food chain**;** predict areas at risk/sink/target control**;**	MAX 2
2(a)(ii)		(Monitor) people/members of the public most at risk(of exposure)**;** [**R** pollutant-related workers, more sensitive groups eg children and elderly] lifestyle/occupation/outdoor recreation/location/source of food/source of water**;** (if critical group safe) others are safe**;**	MAX 2
2(b)		Sensitivity (of organisms) to pollution**;** named pollutant**;** named biotic index/Trent/BMWP**;** long timescale monitoring**;** range of species with different sensitivities/tolerance**;** lichens/aquatic invertebrates/named taxon**;** presence/absence**;** abundance (as indicator of pollution)**;** size/state of health/reproductive structures/appearance**;** easy to find/catch**;** normally abundant (if no pollution)**;** easy to identify**;** normally present**;** evenly distributed**;** standardised substrate/aspect**;** size of sample area**;** sample locations (range of pollution levels, above/below source)**;** calculation of scale/index**;**	MAX 6
Total			**10**

Question 3

	Answers	**Mark**

3(a)(i)	Change in fuel type**/**named fuel used/not used**;**
	    eg less coal, less wood, development of smokeless fuels,
	    more electricity/natural gas
	reason for change**;**
	    eg Clean Air Act, convenience, affluence
		2

3(a)(ii)	Change in fuel type/named fuel used/not used**;**
	    eg increased use of natural gas, renewable energy resources
	decline in (heavy) industry/change in type of industry**;**
	
	named pre-combustion desulfurisation method**;**
	    eg coal crushed and washed, oil desulfurisation, gas desulfurisation,
	    microbial removal, chemical oxidation
	named post-combustion desulfurisation**;**
	    eg (dry, wet) FGD, Wellman-lord, scrubbers, lime spray
	detail of desulfurisation method**;**
	    eg lime slurry, sodium sulfite, gypsum produced
	
	named legislation**;**
	    eg UN Convention on Long Range Transboundary Pollution, 30%
	    Club, NFFO (Non-Fossil Fuel Obligation), Clean Air Act
		MAX 2

3(b)	Named/same seed species**;**
	genetic uniformity of seeds**;**
	same (minimum 10 per sample)/large numbers of seeds**;**
	replicates so results suitable for statistical test/ high level of confidence**;**
	named suitable statistical test**;**
	range of pH;
	[**R** use of only 2 pHs]
	
	control of named variable**;;**
	    eg growth medium, temperature, water, light, age of seeds
	
	suitable timing of observations**;**
	    eg daily
	
	count numbers/percentage of germinated seeds**;**
		MAX 6

Total		**10**

Question 4

		Answers	Mark
4(a)(i)		Named technological improvement (for named fossil fuel); how more energy is made available; eg coal gasification/liquifaction access deep/thin/shattered seams secondary oil recovery maintain/increase pressure tertiary oil recovery solvents/steam/detergents/bacteria reduce oil viscosity deviation/snakehead drilling access small fields deep drilling access more reservoirs fracking increase gas flow named exploratory technique increase proven reserves [credit second mp if first mp is vague but not on own]	2
4(a)(ii)		Named technological improvement; how more energy is made available; eg named improvement in photovoltaic cells stated increase in efficiency heliostats track sun to increase energy harnessed parabolic reflectors increase light intensity/focus light insulation of photothermal panels reduce heat loss sun pipe/light tube/light pipe/light tunnel/light well light to interior rooms improved storage/secondary fuel solve intermittency problem [credit only once in **4(a)(ii)** or **(4)(a)(iii)**] [credit second mp if first mp is vague but not on own]	2

Question 4 continued

	Answers	**Mark**
4(a)(iii)	named technological improvement; how more energy is made available; eg blade tip fins reduce turbulence energy losses blades fit tightly to nacelle reduced wind loss through gap direct drive/to gearbox reduced energy loss/friction stronger blades stress problems solved longer blades doubling length increases energy harnessed four-fold lighter blades generate at lower wind speeds vertical axis wind from any direction/more efficient at lower wind speed/more suitable locations helical blades more even rotation improved storage/secondary fuel solve intermittency problem [credit only once in 4(a)(ii) or (4)(a)(iii)] [credit second mp if first mp is vague but not on own]	2
4(b)	(Short term) velocity fluctuations; seasonal fluctuations; long term fluctuations; wind direction (changes); slower wind speed in lee of (behind) hill; difficulty making measurements at turbine height; friction with ground/vegetation; turbulence (caused by ground); soil stability/erosion/unsuitable geology; access difficulties;	MAX 4
Total		**10**

Question 5

	Answers	**Mark**
5(a)	Air/gas/vacuum poor conductor; no/reduced convection/static air; reduced temperature gradient/warm air in room does not touch cold external glass;	MAX 2
5(b)(i)	Poor(er) conductor;	1
5(b)(ii)	No conduction/convection;	1
5(c)	Higher at start and end, lower in middle;	1
5(d)	South facing/facing the Sun; large(r)/angled windows; [**R** more/increased number of windows]	2
5(e)	Heat exchange/transfer/recovery; piped (through heat exchanger); counter-current; use of good conductor for pipe/named good conductor eg copper aluminium; large surface area of pipe; thin pipe wall; insulation round chamber; steam/electricity generation; space/water heating;	MAX 3
Total		**10**

Question 6

		Answers	Mark

6(a)		Named environmental condition**;;;**
		linked way condition affects breakdown**;**
		
		   eg
		   (high) light levels/intensity
		   increased photo degradation
		
		   (high) temperature
		   increased rate of chemical reaction/enzyme action
		
		   (high) oxygen level
		   increased rate of oxidation/increased bacterial growth
		
		   action/presence of bacteria/biota
		   biodegradation/decomposition/enzyme action
		
		   low/high pH/pH extremes [**R** lower pH, higher pH]
		   increased rate of hydrolysis
		
		   turbulence
		   increased surface area
		
		   presence of water
		   increased rate of hydrolysis/chemical reactions in solution
		
		(allow **1 mark** only for reference to bacteria as condition or effect)
			MAX 3

Question 6 continued

6(b)	Property	
	persistence/chemical stability/degradability;	
	Impact	
	length of time to disperse/move;	
	length of time to have effect/build up;	
	Property	
	liposoluble/lipophilic/hydrophobic;	
	Impact	
	bioaccumulation;	
	biomagnification;	
	dermal absorption/systemic;	
	Property	
	low water solubility;	
	Impact	
	(low mobility) retain local concentrations;	
	Property	
	toxicity;	
	Impact	
	enzyme inhibition;	
	neurotoxin/damage to immune system/reproductive organs/thyroid;	
	carcinogen/mutagen;	
	teratogen;	
	other named physiological impact;	
	Property	
	selectivity/specificity;	
	Impact	
	different impacts on different species/different concentrations to have impact;	
	belief that only mosquitoes would be killed/humans unaffected;	
	kills non-target species;	MAX 7
Total		**10**

Question 7

	Answers	**Mark**
7	Standardised light source; in dark room/no other light source; standardised water container; standard distance between light source and water container; (electronic) light meter; calibration of meter/turbidimeter; measure transmission/scatter/reflection; [**R** penetration] production/use of range of turbidities; [**R** use of only 2 turbidities] method of controlling turbidity; replicates for statistical test/confidence level; choice of suitable statistical test; **OR** Secchi disc/turbidity tube/bottle; light and dark segments/cross; lowered into water/water added; measure depth when segments/cross become indistinct/count number of visible segments/when disc cannot be seen; subjectivity of judgement; importance/difficulty of variable light levels; method of measuring Total Suspended Solids; production/use of range of turbidities; [**R** use of only 2 turbidities] method of controlling turbidity; replicates for statistical test/confidence level; choice of suitable statistical test;	 MAX 5
Total		**5**

Question 8

		Answers	Mark

8(a)		Difficulties of:
		    resource features
		        eg intermittency, unreliability, energy density, suitability for purpose
		    changes needed to energy use infrastructure
		        eg transport systems
		    stage of development of new technologies
		        eg wave power, tidal power
		    other technologies needed
		        eg storage from unreliable sources
		    economic constraints
		        eg high start-up costs
		    public acceptability
		        eg 'noisy' windfarms
		    installation impact/land use change
		        eg tidal barrage, HEP reservoirs, biofuel crops
			20

8(b)		Legislation that bans/controls
		    activities/alternatives
		    emission/waste controls
		
		details of:
		Kyoto
		Montreal
		Clean Air Act
		EPA
		Landfill Directive (Landfill Tax)
		vehicle emission control/MOT
		water supply (water quality) regulations
		Bathing Water Directive
		Sulfur Protocols
			20

Question 8 continued

	Answers	Mark

8(c)	Details of pollution problems
	        CO_2
	        CO
	        SO_x
	        NO_x
	        smoke/PM10
	        oil
	        waste hydrocarbons
	        noise
	        radioactive wastes
	        aesthetics
	        habitat damage
	        resource usage to manufacture equipment
	
	    details of pollution control
	    details of alternative resource use
	    energy conservation
		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 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.

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