

GCE 2004
June Series



Mark Scheme

Environmental Science – ESC5 (6441)

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 meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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Dr Michael Cresswell Director General

Environmental Science**June 2004****ESC5****Instructions: ; = 1 mark / = alternative response A = accept R = reject****Question 1****(a) Appliances**

low flush toilets/brick/hippo bag/low-water use appliances/repair leaks;

Re-use

grey-water use/recycling;

User behaviour

turn off taps/full washing machine/dishwasher/bucket not hose/shower not bath;

Economies/regulation

metering/supply restrictions/hosepipe bans;

MAX 2

- (b) (i)** (Very) expensive;
high energy/electricity use;
to produce high pressure;
[R salt disposal problems]

MAX 2

- (ii)** Source of contamination/activity causing contamination;
example of contaminant;
specific effect of contaminant;
high salinity;
loss of wildlife habitats;
interruption to shipping;

MAX 2

Total marks = 6

Question 2

(a)

Loudness/dB	Relative loudness 0 dB = 1	Exposure time limit for workers
	6.4×10^{10}	7.5 minutes
		30 minutes
	8×10^9	
80		

; both correct for 1 mark; both correct for 1 mark; 3

(b) Natural resonant frequency;
vibrations;
causing structural failure/(stress) cracks/fractures; MAX 1
[R ref to humans/hearing]

(c) Traffic calming/speed reduction;
sound-absorbing panels/fences/walls;
tree planting;
[R hedges]
double glazing;
quieter road surfaces;
embankments/baffle mounds;
sound insulation acoustic absorbers around engine;
quieter exhaust pipes/silencers;
traffic re-routing;
restrictions on horn usage;
vehicle choice – electric vehicles/public transport; MAX 2
[R quieter vehicles with no source of noise]
[R fewer vehicles]
[R building acoustic insulation]

Total marks = 6

Question 3

- (a) Sustainable/safeguarding environment;
development/needs of people; 2
- (b) Land-fill tax/budget 2002/reduce landfill;
reduced packaging;
waste minimisation/waste reduction targets;
better recycling collection point facilities;
road-side collection;
public information/education/local Agenda 21/encourage recycling;
producer/lifetime responsibility for waste; MAX 3

Total marks = 5**Question 4**

- (a) Valleys;
cold air drops down valley side;
anticyclone/high pressure;
low wind speed;
less cloud;
easy heat loss (at night);
mist/fog prevents heating (by sun) below inversion/albedo prevents (solar) heating; MAX 3
- (b) Cold air under warm/below inversion;
pollutants more dense than air above; 2
[R heavier]
- (c) Oxides of nitrogen;
hydrocarbons/unburnt fuel/VOCs;
ozone (tropospheric);
secondary oxides of nitrogen;
PANs;
sunlight/photochemical reactions;
[R UV]
examples of reactions;;
 $\text{NO}_2 \rightarrow \text{NO} + \text{O}$
 $\text{O}_2 + \text{O} \rightarrow \text{O}_3$
 $\text{O}_3 + \text{NO} + \text{R} \rightarrow \text{PAN}$ MAX 4
[R answers related to stratospheric ozone]

Total marks = 9

Question 5

- (a) (i) Lead no longer used as petrol additive; 1
- (ii) High vehicle use/inefficient engines/maintenance/lack of named pollution controls/catalytic converters; 1
- (iii) Use of wood/coal as fuel/inefficient combustion/lack of named pollution controls/electrostatic precipitators/cyclone separators; 1
[R lots of industry]
- (b) (i) Catalytic converters; 1
example of catalyst e.g. Pt;
chemical reduction/reaction equation;
to nitrogen; MAX 2
- (ii) Efficient combustion; 1
increased air supply;
electrostatic precipitator;
+ description;
cyclone separator;
+ description;
filters;
+ description;
scrubbers;
+ description; MAX 2
- (c) Synergism/combined effect greater than the sum of two individual effects; 1
e.g. of ozone-related effect and SO₂-related effect;
oxidation of sulphur dioxide to trioxide;
producing sulphuric acid/H₂SO₄;
nutrient leaching;
reduced nutrient uptake;
Al/heavy metal mobilisation; MAX 2
[R acid rain]

Total marks = 9

Question 6

- (a) Depth;
temperature;
water currents/tides;
distance from source/distance from shore;
distance from other wastes dumped in the area;
distance from location of fisheries;
distance from conservation areas/ecologically sensitive area;
distance from tourism areas/population centres;
distance from location of mineral extraction e.g. oil/sand dredging; MAX 3
- (b) Slower rate of decay by bacteria/slower biodegradation/reduced respiration rate of bacteria; 1
- (c) (i) Dissolved in water;
absorbed by organisms;
ingested by organisms;
bioaccumulation;
biomagnification/food chain concentration;
liposoluble/accumulation in fatty tissues;
ingested by humans; MAX 5
- (ii) Mutagenic – changes to DNA/chromosomes/genes;
[R cancer]
Teratogenic – interference with gene expression/(no DNA change) birth abnormalities/embryo deformation;
[R damage/congenital] 2
- (d) Differing sensitivities;
easy to find/catch;
normally common;
generally disturbed;
easy to identify;
normally present;
number/presence/absence/growth/state of health used to estimate pollution;
random/even dispersal/not in groups/shoals;
sample number/locations/timing;
ref to past pollution levels; MAX 4

Total marks = 15

Question 7

Essays – all the following points can be developed for several points each.

- (a) **Working practices:**
duration of exposure
distance of exposure
types of radiation and associated risks
barriers/absorbers
open/sealed sources
discharge reduction
equipment operations
role of organisations
worker education

Monitoring programmes:
worker monitoring
critical pathway analyses
critical group monitoring
environmental sampling
role of organisations

Credit for explanation of importance of each issue

Description of technique/process

Examples

- (b) Reduced material extraction and transportation
reduced material processing
reduced energy use
reduced pollution generation
reduced waste disposal

Credit for:

explanation of how reduction is achieved

explanation of benefit

explanation of why benefit occurs

examples

Total marks = 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, then 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	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
1	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate. Some minor errors.
0	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.

Total marks = 20