



General Certificate of Education

Environmental Science 6441

**ESC5 Pollution and Physical Resource
Management**

Mark Scheme

2007 examination - June series

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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Environmental Science

June 2007

ESC5

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

Question 1

Measure of time to degrade/residence time/time remains in environment;
[R doesn't break down]

ability to produce non-inherited birth abnormalities/interferes with gene expression/birth abnormalities without changing DNA/genes/chromosomes;

ability to interact (with other substances) to give greatly increased effects/effects (of two pollutants) together is greater than the sum of the individual effects;

toxicity/poisonous/toxin/poison;

(ability to change) DNA/chromosomes/genes;
[R mutations without qualification/cancer]

5

Total marks = 5

Question 2

- (a) Change to low-sulphur fuels/named (low sulphur) fuel;
eg from coal/oil to natural gas, nuclear power, renewables

named method of reducing fossil fuel use;

named desulphurisation techniques/detail of process;
second named desulphurisation techniques/detail of process;

eg

coal bacterial/streaming/high temperature (fluidised bed) oxidation/gasification

crude oil hydrotreating/hydrogen sulphide removal

natural gas hydrogen sulphide removal

(wet) Flue-Gas Desulphurisation/scrubbing/Wellman-Lord process;

(dry) Flue-Gas Desulphurisation/gypsum;

[R catalytic converters]

2

- (b) (i) Named tissue affected/cell membrane/protein/enzyme/cuticle/gill/skin/egg/
stomata/leaf/root hair/exoskeleton damage/respiratory problems/nutrient leaching;

detail of damage/effect/denatured/reduced breeding/population decline/fear
shoots/crown dieback/low growth/reduced nutrient/water uptake/gaseous
exchange/photosynthesis;

2

- (ii) Corrosion/dissolving/weathering/erosion/leaching/mobilisation;
named material/metal/ion/limestone/sandstone/named structure/buildings;
(heavy) metal solubility;

MAX 2

- (c) Named taxon/lichens;
range of sensitivity/resistance;
state of health/size;
reproduction;
presence/absence/abundance;
species diversity;
long-term indicator;

ease of identification;

ease of finding;

normally present;

generally distributed;

named biotic index eg Trent;

reference to scoring system/scale;

named sampling method eg kick/Surber;

MAX 4

Total marks = 10

Question 3

- (a) (i) 83 km (± 2); 1
- (ii) 65% (± 2); 1
- (b) Bacterial respiration/digestion/decomposer action/aerobic bacteria; 1
[A bacteria use up oxygen]
[R eutrophication]
- (c) Reduced biodiversity/number of species;
range of tolerance/differing oxygen requirements;
aerobic/anaerobic conditions;
food chain effects;
named species/taxon; MAX 2
- (d) N and P/nitrates and phosphates/stimulate/increase growth of algae/algal bloom;
effect of shading on deeper plants/photosynthesis;
increased BOD/decay of dead algae/macrophytes;
eutrophication; MAX 2
- (e) (i) Named physiological effect/increased metabolism/death;
lower DO levels/reduced solubility;
O₂ exsolves/comes out of solution/more energy so escapes; MAX 2
- (ii) (Steam-thermal) power stations/electricity generation; 1

Total marks = 10

Question 4

- (a) (i) Spatial separation of two named activities/land uses; 1
- (ii) Time separation of two named activities; 1
 [A time zoning of two aspects of one activity eg bird shooting – breeding season]
- (b) (i) Any 2 named user groups;
 with associated environmental problem;
 [credit user groups if problem is wrong but plausible]
- eg:
 fishing and bass breeding protection area;
 bycatch;
OR
 shooting of wild ducks and geese and wild bird sanctuary;
 disturbance/accidental mortality;
OR
 any named recreation activity and wildlife conservation;
 disturbance/damage; MAX 2 + 2 4
- (c) Less dispersal/currents/enclosed/confined;
 less dilution/smaller volume;
 tides carry effluents (upstream);
 more sensitive ecosystem;
 sedimentation;
 adsorption onto sediments/washed onto shore;
 aerial pathway when tide is out;
 adds to pollution from upstream; MAX 2
- (d) Salt/salinity;
 cost of desalination/pollution treatment;
 use conflicts;
 pollution risk/named pollutant;
 barrage cost;
 habitat destruction; MAX 2

Total marks = 10

Question 5

- (a) Named method with how it works;
safety glasses physical barrier to eyes;
latex gloves physical barrier to skin;
cooled to reduce vapours which could be inhaled;
small samples to reduce possible dose;
use of fume cupboard reduces inhalation; MAX 2
- (b) Timescale of effects;
chronic – long, acute – short; 2
[R reference to size of dose]
- (c) Neorotoxin;
tingling fingers;
slurred speech;
reduced coordination;
reduced sensitivity;
reduced nerve action in brain;
enzyme inhibition;
muscular shaking;
balance;
eyesight; MAX 2
- (d) $50\mu\text{g kg}^{-1}$; 1
- (e) **bioaccumulation**
absorption;
increasing concentration within an organism;
due to storage of many small doses eg hatworkers;
Minamata – people ate local fish;
MAX 1 if context is food-chain concentration MAX 2
- biomagnification**
increased concentration;
along a foodchain;
ingestion in food and storage eg in Minamata; MAX 2
- liposolubility**
dissolves in fats/oils/lipids;
allows storage eg in fish, humans;
methyl mercury Minamata Bay; MAX 2

Max 1 for all three sections if the case study described is not from the text

- (f) Mercury low solubility;
mercury not absorbed by plants;
mercury not absorbed by grain;
mercury not stored in grain;
ref to liposolubility;

MAX 2

Total marks = 15

Essay Question

Question 6

- (a) Absorption
examples of absorbing materials
ease of absorption/penetration of α β γ radiation
distance
inverse square law
duration of exposure
open/closed sources
- waste storage methods;
high level waste, vitification, glass, stainless steel, cooled
intermediate level waste, stainless steel, cement
low level waste, steel drums, containers, concrete trench, filtered and released
locations of waste repositories
- waste reprocessing methods
dissolved and separated
- location of site
half lives
- radon ventilation
air extraction/filters
- worker monitoring
film badges
dosemeters
full body monitors
health checks
- critical pathway analysis
atmosphere, water
- critical group monitoring
members of public most at risk due to lifestyle
- environmental monitoring
dust, soil, water, grass, fish, milk, shellfish
- role of organisations
NII
ICRP
EA

OR

- (b) Toxic materials
heavy metals
acidic drainage water
leachate
public health
- dust/atmospheric particles
gases
methane
odours
- aesthetics
economic depression/reduced value of nearby land
derelict buildings
inappropriate land uses eg fly tipping
landslip
subsidence
safety of steep banks/shafts
- lack of soil
low nutrient availability
low moisture content
slow colonisation
- landscaping
compaction
stabilisation
leachate collection and treatment
pH control
topsoil/soil improvers
vegetation
hydroseeding
development of new use
economic/governmental incentives – brownfield sites

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	All material is logically presented in clear, scientific English and continuous prose. Technical terminology has been used effectively and accurately throughout. At least half a page of material is presented.
1	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate. Some minor errors. At least half a page of material is presented.
0	The account is generally poorly constructed and often fails to use an appropriate scientific style to express ideas.

Total marks = 20