



## General Certificate of Education

# Environmental Science 6441

### *ESC5 Pollution and Physical Resource Management*

## Mark Scheme

### *2006 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.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' 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 Science**

**June 2006**

**ESC 5**

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

**Question 1**

Synergism;

a measure of the length of time before a pollutant breaks down;

[A description of high persistence]

bioaccumulation;

carcinogenic/cancer;

[A mutagenic]

increasing concentration along a food chain;

5

**Total marks = 5**

**Question 2**

(a) (i) Reduction in the use of open fires/coal/wood/use of new fuels/more efficient combustion; 1

(ii) Fewer compost heaps/ more wasteful preparation/more wasteful society/fewer domestic livestock/more time now for gardening hence more waste; 1  
[R food packaging]

(b) (i) Excess growth/eutrophication/high BOD;  
action of bacteria/blue-green algae/decay/decomposition;  
deoxygenation/death of aerobic aquatic organisms;  
low pH;  
enzyme inhibition;  
increased turbidity;  
reduced light/reduced photosynthesis;  
pathogens;  
disease/named disease; MAX 2

(ii) Named method;  
how it works;  
eg aeration (tank)/trickling filter bed/reed bed;  
aerobic action/respiration/bacteria;  
breakdown/decay/decomposition;  
**OR**  
neutralization;  
addition of lime/high pH material;  
**OR**  
sedimentation;  
static (to allow settling);  
**OR**  
flocculation;  
joining/charge neutralization/settling;  
**OR**  
sterilization;  
use of chlorine/ozone/UV; MAX 2

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- (iii) Explosion/fire risk/flammable;  
global climate change/enhanced greenhouse effect/global warming;      MAX 1
- (c) Difficulties;;  
description of difficulty;
- contamination due to mixing;  
eg of contaminating/contaminated material;
- lower quality of product;  
limited use of product/example of less useful product;
- small quantities;  
high cost:income;
- transport costs;  
high due to small amounts/scattered sources;
- sorting costs;  
labour intensive;
- energy costs;  
stated reason for high costs;  
eg small quantities
- contains/produces toxins/hazardous materials;  
named example;  
eg heavy metal, dioxin
- public acceptance of recycled goods;  
example of material perceived as less desirable;  
eg recycled oil/paper  
[R NIMBY issues related to recycling centres]      MAX 3

**Total marks = 10**

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**Question 3**

- (a) Addition of named material/increase pH/alkalinity to raise pH(to make heavy metals insoluble)/bioremediation/phytoremediation/plant hyperaccumulators;      1  
[A Use low pH to remove heavy metals in solution]
- (b) Sensitivity;  
differing sensitivities of species;  
presence/absence/abundance;  
size/state of health;  
long term monitoring;      MAX 2

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- (c) Length of time for symptoms to appear;  
 effects within normal range of effects/symptoms/eg of effect/symptom;  
 sub-toxics levels;  
 alternative causes;  
 multiple causes/synergism;  
 lack of reporting/data collection;  
 ethical issues of testing on people; MAX 2
- (d) Leaching/increased solubility/of nutrients;  
 named nutrients eg Mg, Ca;  
 reduction/inhibition of nutrient uptake/availability/chlorosis (caused by nutrient deficiency);  
 reduced water uptake;  
 leaching/increased solubility of toxic metals;  
 named toxic metals eg Al, Pb;  
 enzyme inhibition;  
 root (membrane) damage;  
 (crown) dieback/reduced growth;  
 increased susceptibility to disease;  
 fewer soil organisms;  
 reduced decomposition/nutrient release rate;  
 deflocculation; MAX 5  
 [R stomata damage/atmospheric effects/cuticle damage/direct leaf damage]

**Total marks = 10**

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**Question 4**

- (a) 15 ( $\pm 1$ ); 1
- (b) Interaction with (unburnt) hydrocarbons/petrol/diesel/VOCs;  
 in presence/absorption of sunlight/UV;  
 production of ozone;  
 production of PANs; MAX 2  
 [R temperature inversions/climatic/topographical conditions]
- (c) Catalytic converter;  
 named catalyst eg platinum/palladium/rhodium;  
chemical reduction/separation of oxygen from nitrogen;  
 production of nitrogen and oxygen;  
**OR**  
 lean burn engine;  
 air:fuel ratio;  
**OR**  
 aquazole;  
 water-diesel mix; MAX 2  
 [R public transport/alternative transport etc]

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- (d) (Appropriate) named pollutants with;;;  
 explanation of scale of effect;;;  
 eg pollutant mobility related to:  
 solubility;  
 persistence/chemical/radioactive stability;  
 density/mass (of particles);  
 photo-degradation;  
 chemical reactions;  
 physical state: gas/liquid/solid;  
 chemical state: organic/inorganic sulphide/oxide; MAX 5
- Total marks = 10**
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**Question 5**

- (a) Underlying geology/granite/house construction/radon;  
 named occupation;  
 amount of air travel;  
 medical exposure;  
 proximity to named source; MAX 2
- (b) Named type(s) of radiation with explanation;  
 ease of absorption;  
 external/ingested sources;  
 reference to measurement Gy and Sv; MAX 2
- (c) Named method;  
 how it works;
- eg  
 named absorber/lead/concrete;  
 absorbs radiation;
- protective clothing;  
 absorbs radiation/prevents contamination;
- increased distance from source/remote handling;  
 reduces dose/inverse square law;
- reduced time period (of exposure);  
 reduces dose;
- named worker monitoring method/film badge/body monitor/air sampler/dosimeter;  
 knowledge of exposure/contamination/dose/risk;
- workplace monitoring;  
 detect leaks/contamination/exposure level;
- atmospheric monitoring;  
 detect airborne (radioactive) contaminants/dust/particles;
- closed rather than open sources;  
 reduced risk of contamination; 2 + 2 MAX 4
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- (d) Proximity to source;  
outdoors lifestyle;  
named (outdoor) activities which increase exposure;;  
source of drinking water;  
source of food;  
[R occupational exposure] MAX 3
- (e) Environmental factor with explanation;;;  
explanation of effect of environmental factor on pollutant pathway;;;  
  
wind/water (current) speed;  
distance travelled/rate of dispersal;  
  
wind/water (current) direction;  
affects destination;  
  
presence of water;  
dissolves in water;  
  
permeable soils/rocks;  
[A porous]  
allows flow through rock;  
  
food chains/webs;  
movement as organisms move/migrate;  
  
aerobic/anaerobic conditions;  
affect on degradation;  
  
pH;  
affects solubility;  
  
(sun)light/UV levels;  
affect on (photo)degradation/photochemical reactions;  
  
temperature;  
affect on rate of chemical reactions;  
  
presence of other chemicals/materials;  
chemical interactions/catalytic surfaces; MAX 4

**Total marks = 15**

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## Question 6

Main expected points:

(a) Extraction and harnessing:

noise/blasting  
dust  
toxic leachate  
acidic leachate  
turbid runoff  
methane  
oil  
ionising radiation

aesthetics

Processing:

atmosphere pollution

carbon dioxide

SO<sub>x</sub>

NO<sub>x</sub>

CO

smoke/dust/PM10

water pollution

oil

acids

ash

noise

Use:

atmospheric pollution

carbon dioxide

SO<sub>x</sub>

NO<sub>x</sub>

CO

smoke/dust/PM10

water pollution

oil

ash

noise

**OR**

(b) Educational:  
small cars  
switch it off  
refuse, reuse, recycle  
waste disposal choices

Legal:  
Montreal Protocol  
Kyoto  
Clean Air Act  
Dumping at Sea Convention  
COPA

Economic:  
landfill tax  
carbon credits  
petrol pricing  
cost-benefit analysis

Technological:  
any preventative/clean up technology

**Total marks = 20**

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## 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**