



## General Certificate of Education

# Environmental Science 5441/6441

### *ESC5 Pollution and Physical Resource Management*

## Mark Scheme

### *2005 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 2005**

**ESC5**

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

**Question 1**

**A** hot water/thermal pollution/organic matter/e.g. of organic pollutant/any reducing pollutant  
e.g. sulphide/iron;

**B** smoke/suspended particles/PM10/SPM/smog/dust/soot;

**C** acid pollutants/e.g. of acid/acidic gas e.g. SO<sub>x</sub>/HCl;

[**R** acid rain]

**D** lead/mercury/cadmium/other heavy metal/named neurotoxin e.g. organophosphate  
insecticide;

**E** CFCs/NO<sub>x</sub>;

5

**Total marks = 5**

**Question 2**

(a) Named financial penalty/incentive/aggregate tax/landfill tax/Agenda 21/  
waste minimisation targets/method to encourage recycling;

1

(b) Name of method;  
name of waste used;  
detail of energy production process;  
[**R** uses of energy]

combustion/incineration/pyrolysis;

flammable domestic/industrial waste/refuse derived fuel/plastics/forestry waste/tyres/other named  
waste;

hot water/steam/electricity;

**OR**

anaerobic digestion;

sewage/manure/named organic waste;

methane;

**OR**

landfill;

organic matter/domestic refuse;

anaerobic bacteria/anaerobic digestion/methane/archaeobacteria;

**OR**

decomposition;

named organic waste/forestry waste;

heat of respiration/heat recovery/hot water;      2 × MAX 2

MAX 4

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- (c) E.g. of cause;  
detail of pollution;  
**OR**  
e.g. increased energy use/transport for collection/processing;  
vehicle exhausts/process energy pollution/named pollutant released;  
**OR**  
de-inking of used paper;  
use of chlorine bleach produces dioxins;  
**OR**  
release/mobilisation of pollutants/contaminants from recycled materials;  
e.g. mercury from fluorescent tubes/cadmium from batteries/CFCs from fridges/  
other suitable example;  
[A visual pollution/noise of collection facilities]  
**OR**  
use of materials to clean/decontaminate;  
e.g. washing powder/named cleaning agent; 2
- (d) Vitrification/encapsulation;  
in (solid) glass;  
in stainless steel containers/cylinders;  
sealed;  
in cooled building;  
in concrete;  
shielding/radiation absorption;  
low seismic activity;  
impermeable rock;  
deep burial;  
low water movement;  
[R lead, disposal at sea, disposal in space]  
**OR**  
dry storage;  
CO<sub>2</sub> gas;  
corrosion control;  
no fire risk;  
convection/heat dissipation;  
no reprocessing;  
concrete;  
shielding/radiation absorption; MAX 3

**Total marks = 10**

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**Question 3**

- (a) (i) 1990; 1
- (ii) 80; 1
- (b) **Crop choice**  
 change of crop type;  
 e.g. of crop requiring irrigation;  
**OR**  
**Increased production**  
 increased yield/area of production;  
 e.g. of crop requiring irrigation/control of water as a limiting factor;  
**OR**  
**Climate change/weather fluctuations**  
 less precipitation/hotter/drier;  
 greater irrigation/drinking requirement;  
 more evaporation/evapotranspiration/sweating;  
**OR**  
**Soil properties**  
 (increased) soil compaction;  
 increased runoff/less infiltration;  
**OR**  
 reduced organic matter;  
 reduced water retention; MAX 2
- (c) Named change in type of industry/industrial activity/1° → 2° / 2° → 3°;  
 e.g. of way water use is reduced;  
 [A recycling/other conservation method]  
 [R alternative supplies e.g. rain water]  
**OR**  
 change in amount of named industry;  
 e.g. of way water use changes; MAX 2
- (d) E.g. of water conservation technique;  
 e.g. cistern bags/bricks, push-taps, low-use appliances, restrictions/legislation,  
 metering, showers vs baths;  
 detail of how method works; 2  
 [A grey water/recycling if related to reduced demand from public supply]  
 [R alternative supplies/rainwater]  
 [R education without method]
- (e) Expensive;  
 high energy use;  
 pressure/evaporation/boiling;  
 high pressure filtration/reverse osmosis/distillation; MAX 2

**Total marks = 10**

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**Question 4**

- (a) Appropriate land use positioning (related to noise level) e.g. residential/school/hospital in quieter areas;  
**OR**  
 industry/agriculture in noisier areas; MAX 1
- (b) Too quiet to cause annoyance/similar to other noises e.g. roads:  
 [R can't be heard/noticed] 1
- (c) 0/zero; 1
- (d) Any two examples:  
 stress/heart disease/high blood pressure (hypertension)/hearing loss/tinnitus/  
 behavioural changes (insomnia);; 2
- (e) Up to two for stated operational changes:  
 flight path (changes);  
 taxi areas;  
 angle of ascent/descent;  
 times of flights/day/night;  
 location of lowering landing gear;  
 fewer larger aircraft;  
 ear protection for workers;  
 up to two marks for explanatory details;; MAX 3  
 [R fewer aircraft]  
 [R low noise runway surfaces]
- (f) Name of method;  
 detail of how it works;  
 e.g.  
 baffle mounds/sound absorbing barriers/trees/walls/embankments;  
 around runways/taxi areas;  
 absorb/deflect sound;  
**OR**  
 quieter aircraft;  
 large diameter jets/reduced jet turbulence/ban noisy aircraft;  
**OR**  
 double/triple glazing;  
 absorb noise; MAX 2  
 [A additional answer from (e)]  
 [R ref. to new airport construction/location]

**Total marks = 10**

**Question 5**

- (a) Sulphide ores/pyrites;  
 exposure to air/oxygen/oxidation of ores/metals/displacement of sulphur;  
 sulphur dioxide;  
 sulphuric acid; MAX 2
- (b) Reduced amount of life;  
 reduced biodiversity/range of species;  
 example of sensitive species/taxon;  
 protein damage;  
 denature enzymes;  
 Ca skeleton;  
 increased infections;  
 mucous on gills;  
 named sensitive tissue/organ e.g. eggs/gills;  
 osmotic changes;  
 food chain effects;  
 other example of specific effect; MAX 2
- (c) Amount of lime/calcium (carbonate) present;  
 example of rock from acid sensitive/insensitive area e.g. granite/limestone/chalk;  
 neutralise (acids);  
 permeability/distance of travel/pathway effect; MAX 2
- (d) **Advantage**  
 named advantage/avoid prosecution/public image/customer acceptance/  
 increase sales/preparation for accident/incident/profit margin;  
 explanation of advantage;
- Disadvantage**  
 named disadvantage/prosecution/economic competitiveness/public image/  
 customer acceptance/profit margin;  
 explanation of disadvantage; 2 × 2 4  
 [A same factor for both with explanation]  
 [A factor without explanation (once only if same factor is used for both)]
- (e) Environment Agency; 1  
 [R EPA]

- (f) Bunds;  
drainage collection/tailings dam;  
(impermeable) liner;  
impermeable cap;  
evaporation to reduce volume;  
neutralisation/pH control;  
tolerant plants;  
turbidity control/sedimentation/settling/flocculation;  
filtration;  
reed bed/phytoremediation;  
oxidation to reduce solubility;  
extraction from drainage water/electrolysis/displacement/precipitation;

MAX 4

**Total marks = 15**

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## ESSAY QUESTION

### Question 6

(a) Nutrient pollution:

**Organic**

named e.g.s – sewage, manure, milk, food processing waste, slaughterhouse waste, paper mills, leather processing

**Bacterial action**

energy-rich compounds  
respiration  
deoxygenation  
death of aquatic aerobes  
growth of bacteria/sewage fungus  
other organisms covered and die  
BOD  
changed species diversity  
changed species abundance  
changed species present/absent  
release of inorganic nutrients  
causing eutrophication

**Details of organic effluent treatment works**

pre treatment  
    screens  
    grit traps  
primary treatment  
    sedimentation/settling  
sludge treatment  
    anaerobic digestion  
    drying beds  
    incineration  
    fertiliser  
    land fill  
secondary treatment  
    aeration/oxidation tanks  
    trickling filter beds  
tertiary treatment  
    phosphate stripping  
    micro filtration  
    chlorination  
other methods  
    filter beds  
    reed beds  
    bioremediation  
    bacterial decomposition  
    co-metabolism  
    land farming



**Inorganic**

named nutrients – nitrates, phosphates

algal blooms  
shading  
death of macrophytes  
blue-green algae release toxins  
death and decay of algae  
decay by bacteria  
deoxygenation  
leaching  
eutrophication  
changed species diversity  
changed species abundance  
changed species present/absent

details of phosphate stripping – iron sulphate, iron phosphate precipitation  
details of nitrate denitrification – action of denitrifying bacteria  
details of low fertiliser runoff methods  
    reduced tillage/ploughing  
    timing of ploughing/fertiliser application in dry weather  
    buffer zones  
    low solubility fertilisers  
    N/P control areas  
    reduced use

**OR**

(b) Properties of pollutants

state: gas/liquid/solid  
change in chemical form  
synergism  
liposolubility  
bioaccumulation  
biomagnification  
persistence  
solubility  
examples of pollutant to illustrate  
details of mobility atmosphere/hydrosphere/biosphere  
concentration/dispersal  
examples of effects  
ref. to local effects  
ref. to regional effects  
ref. to global effects

**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**