Mark scheme
June 2003

GCE

Environmental Science

Unit ESC5

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

Question 1

(a)   1.20 to 1.25 (ppm) or 1.30 to 1.40;   1

(b)   Lead paint;
        (inhaled) when dust/vapours produced/ingested;
        [**R** lead in pencils]
        [**R** fishing weights]
        OR
        Lead water pipes;
        in drinking water;
        OR
        Mine drainage;
        leachates/in water/drinking/irrigation water/food chain;
        OR
        Lead dust in industry;
        absorbed through skin/dissolved in sweat/inhaled;
        OR
        (Lead from) petrol;
        inhaled/drinking water/flood;   2

(c)   Neurotoxin;
        enzyme inhibitor/inactivator/reduces activity/changes 3D structure/active site;
        affects nerve function/brain damage/paralysis OWTTE;
        kidney failure;
        liver damage;
        teratogenic;
        blood cell manufacture/anaemia;
        vomiting/diarrhoea;   MAX 2

                                                                Total marks = 5
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Question 2

(a)

			½
		40 days;	

1

(b) Strontium 90 still a threat, iodine 131 no threat;
ref to comparison of half lives/persistence;
description of effects: Sr – bones/I – thyroid; 2

(c) Carried by wind/washed out by rain/settled on ground;
dissolved/suspended in water or air/absorbed by grass/into milk;
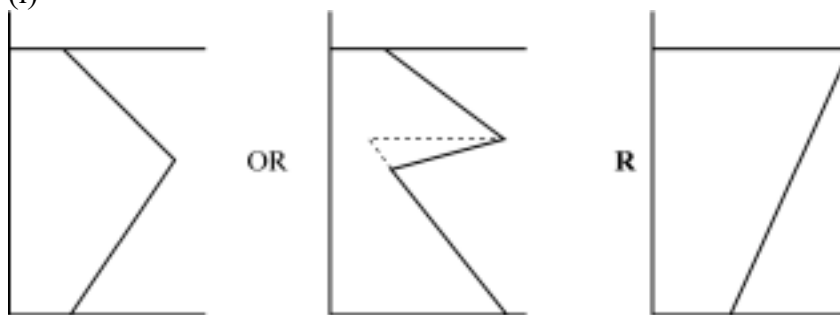ingested/swallowed/inhaled;
[**R** meat/crops] 3

Total marks = 6

Question 3

(a) (i) Oxides of nitrogen/NO$_x$;
AND
Hydrocarbons/VOCs/sunburnt vehicle fuel;
AND
ozone; 1

(ii) Solar energy/nuclear fusion/sunlight/sun; 1

(b) (i)

1

(ii) Emissions are cooled/lower are is colder;
become more dense/air is more dense;
less buoyant; (MAX 2) (MAX 1 if no ref to emissions)
(Cannot rise above inversion layer) into warmer layer/less dense air; MAX 3

Total marks = 6

4

Question 4

Nitrates/NO_3^-/phosphates/PO_4^{3-};
bloom/encourage/stimulate plant growth;
[**R** 'organisms']
[**R** nitrogen/phosphorus]
[**R** algae use O_2 with no ref to death/decomposition/respiration]
plants die with reason – shaded/nutrient depletion/seasonal change;
bacterial action/decomposition/respiration/increased BOD due to organic matter;
rate of oxygen consumption>production/anaerobic conditions;   MAX 4
[**R** BOD with no explanation]

Total marks = 4

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Question 5

(a)   Add lime/other alkali/raise pH;
        reduces solubility/precipitated as solids;

        suspended particles;
        tailing dams/sedimentation/centrifugation;

        reedbeds/bacteria;
        absorption/bioaccumulation;

        phosphoric acid;
        insoluble lead compound/lead phospate;

        ion exchange;
        adsorption;   MAX 2
        [**R** boiling/distillation]

(b)   River volume/cross sectional area and its ability to dilute;
        velocity/residence time and its ability to disperse;
        turbulence and its effect on dissolved oxygen;
        pH and its effect on pollutant activity;
        river organisms and their effect on biodegradation/pollutant activity;
        DO levels and their effect on pollutant degradation/reactions;
        temperature and its effect on pollutant activity;
        1 example of appropriate pollutant;   MAX 3

Total marks = 5

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Question 6

(a)   (i)   Line above and parallel to existing line and narrower range of frequencies;
           (within same range)   1

      (ii)   Inaudible/can't be heard/frequency below sensitivity of ear;   1

(b)   Any suitable example:
      name of method;
      how method works;

      Absorption/insulation/deflection/reflection of noise;
      example of technique: baffle mounds/embankments/double glazing/bund/fencing;
      [**R** soundproofing]

      Control flight paths/flight paths to reduce annoyance;
      away from residential areas;
      [**R** cavity wall insulation]
      [**R** airport location]

      Restrict timing of flights/times to reduce annoyance;
      not at night;

      Control of rate of climb to reduce annoyance;
      not too steep (to reduce noise level)/very steep (to reduce area affected);

      Restrictions on type of aircraft;
      ban noisy ones/larger but fewer aircraft/develop/use quieter engines;   2

Total marks = 4

Question 7

(a)   Distance from source;
           quantity released;
           wind direction/rainfall patterns/removal by rain;   MAX 2

(b)   Changing types/named species;
           reducing diversity;
           reducing abundance;
           reducing size/health;   MAX 2

(c)   (i)   Reduced survival with declining pH/increased acidity;
                 reference to values to illustrate rate of change/reference to changing rate of
                 change;   2

     (ii)   Reduced survival;
                 reference to values to illustrate rate of change/reference to changing rate of
                 change;   2

(d)   Denatures proteins/enzymes;
           example of damaged tissue; - leaf/root
           detail of specific damage; - chlorosis/photosynthesis/pathogens/herbivores

           Inhibits nutrient uptake;
           example of nutrient action;
           description of ion exchange/competition;
           [only credit one isolated factor with no description]

           Nutrient leaching;
           reference to Ca/Mg/other nutrient;
           reduced growth;
           named soil organisms harmed;
           how plants are affected;

           solubility/mobilisation of toxic ions;
           e.g. of toxic ion: Al^{3+}, Pb^{+};
           enzyme inhibition;   MAX 4

(e)   Sulphur dioxide/trioxide/SO_2/SO_3;
(wet flue-gas) desulphurisation/Wellman-Lord process/scrubbing;
dissolved/reacted with;
water/sodium sulphite solution;
sulphur/sulphuric acid recovered (as raw material)/recycled;
OR
Sulphur dioxide/trioxide/SO_2/SO_3;
(dry flue-gas) desulphurisation;
react with lime/limestone/calcium carbonate;
produce solid gypsum/calcium sulphate;
dumped/used to make building plaster;
OR
Oxides of nitrogen/NO_x or specific example;
catalytic converters;
example of catalyst/paladium/platinum;
chemical reduction of NO_x;
production of nitrogen (gas);
[**R** lean burn engines]
OR
Oxides of nitrogen/NO_xor specific example;
urea;
reduction of NO_x;
production of nitrogen gas;
OR
Ozone/O_3;
produced from breakdown of NO_x;
prevent release of NO_x;
name/detail of method above;
[**R** Alternative activities e.g. energy conservation, renewable resources]   MAX 4×2

Total marks = 20
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Question 8

(a)   Toxicity
       chemical form
       specificity
       persistence
       mobility
       bio-accumulation;
       bio-magnification/food-chain concentration
       synergism
       mutagenicity
       carcinogenicity
       teratogenicity
       direct/indirect effects
       degradability
       reactivity

              name of property;
              definition of property;
              examples of pollutant to illustrate;;
              how this property causes pollutant;;;

e.g.
Chemical form;
other elements with which the substance is combined;
Mercury – metal/inorganic/organic;
organic much more toxic;
more easily absorbed;
more liposoluble;
more effective bio-accumulation;
OR
Persistence;
period of time before decay/degradation/reactions to become safe;
affects time for concentration to increase;
affects distance of travel;
organochlorine insecticides;
PCBs;
dioxins;
CFCs;
example of accumulation over time;
example of long distance of travel;

Alternative method of gaining credit: use specific pollutant examples to illustrate
properties. Same mps apply.

Max 6 for each property

Total marks = 20

OR

(b)   Name of method;
        description/details of method;;
        advantages of method;;;
        disadvantages of method;;;

        Methods:
        Landfill
        incineration
        reuse
        recycling
        biological treatment
        chemical treatment   Up to 7 for each example

        e.g.
        <u>Name</u>:
        landfill;

        <u>Description:</u>
        wastes dumped on ground/in hole/valley/disused pit;
        use on liner;
        regular covering;
        segregation of wastes/dilutes and disperse;

        <u>Advantages:</u>
        cheap – little processing;
        little technology required;
        methane collection from organic wastes;

        <u>Disadvantages:</u>
        possible chemical reactions;
        land use;
        waste of usable materials;
        unsuitable for toxic/hazardous wastes;
        leachate;
        methane/explosive gases;

                                                                            MAX 20

                                                            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	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