



## General Certificate of Education

# Environmental Science 5441

*ESC1 Energy, Atmosphere and Hydrosphere*

## Mark Scheme

*2006 examination - January 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**

**January 2006**

**ESCI**

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

**Question 1**

79% ± 1%;  
 denitrification/ a named denitrifying bacteria eg pseudomonas/azotobacter/  
 nitrates in soil/atmosphere;  
 UV/ultraviolet/short wavelength;  
 anaerobic decomposition/respiration//ruminants/livestock (intestines)/rice paddies/landfill sites/  
 anaerobic bacteria/melting permafrost/fossil fuels/plants;  
 infra red/long wavelength; 5  
 [R faeces, excretion]

**Total marks = 5**

**Question 2**

- (a) Catchment area; 1
- (b) Store surplus; 2  
 release during shortage;
- (c) Any suitable landuse; (eg industry/agriculture/urban area/forestry/fish farm)  
 appropriate issue – land cost/named pollution problem/landuse conflict/  
 distance to customers/downhill to consumers/competition eg for irrigation; 2 + 2 4
- (d) Reduced in river due to sedimentation/collection by reservoir/reduced in river due  
 to reduced flow volume/reduced in river due to reduced flow velocity/reduced  
 in river due to reduced turbulence; 1
- (e) Effect; 1  
 explanation; 1  
 eg  
 increased humidity;  
 greater surface area for evaporation/increased evaporation;  
 increased cloud cover/fog/mist;  
 less insolation;  
 increased precipitation;  
  
 lower temperature range/warmer at night/in winter/cooler in day/in summer;  
 thermal capacity;  
 coastal breeze effect;  
  
 increased windspeed;  
 reduced surface friction;

increased albedo;  
reduced temperature;

reduced albedo;  
increased temperature;

**Total marks = 10**

**Question 3**

- (a) Any named energy using appliance/named activity related to affluence/  
conservation a low priority; 1
- (b) Creates shortage/reduced availability/supplies/depletion;  
price increased;  
can't afford to buy as much;  
**OR**  
overuse in more economically developed countries causes global climate change;  
restrictions for all countries; MAX 2
- (c) Secondary (oil) recovery;  
artificial increase in pressure/pressure difference;  
use of water/gas/CO<sub>2</sub>/exhaust gases/pump;  
forces oil out;  
**OR**  
tertiary (oil) recovery;  
use of steam/detergents/solvents/bacteria/thinning agent/high temperature material;  
reduces viscosity/oil flows more easily; MAX 2
- (d) Develop home produced energy/renewables;  
increase extraction efficiency;  
improve efficiency of use/recycling/energy conservation;  
examples of technology/energy resource/how it works;  
legal/financial strategies/carbon credits/legal restrictions/subsidies/incentives/  
non-fossil fuel obligation; MAX 3
- (e) How method may cause environmental damage  
eg visual intrusion/magnetic fields/habitat disturbance/named pollutants/  
pollution problem caused by named method eg pipes/cables/tankers/trains/trucks;  
  
how impact is reduced  
  
eg burial/location away from residential area/habitat restoration/monitoring/oil traps/  
fewer vehicles/pipes instead of vehicles/named pollution control technique/visible cable  
markers for birds; 2

**Total marks = 10**

**Question 4**

- (a) Method: house/roof/window/conservatory orientation;  
Effect/description: correct orientation/sunlight entering building/solar panel insolation;  
**OR**  
increased window area;  
increased sunlight entering building;  
**OR**  
solar panels fitted;  
method to produce heat;  
**OR**  
use of conservatory to absorb sunlight;  
warmed air warms house;  
**OR**  
low albedo/dark surfaces/Trombe wall;  
increased absorption of sunlight;
- MAX 3 for methods  
MAX 2 for description      MAX 4
- (b) Reflection;  
water droplets/dust;  
albedo/pale colour;
- absorption;  
by water droplets/dust;
- refraction/scattering (of parallel light rays);  
by water droplets/dust;
- MAX 2
- (c) Parallel light rays;  
sunlight reflected by mirror;  
[A deflect]  
focused on solar collector/one point;  
increased intensity;
- MAX 2
- (d) Advantage: more space/fewer land use conflicts/large area needed;      1  
Disadvantage: increased transport costs/distance to users/lack of local demand/  
lack of labour for construction/maintenance;      1

**Total marks = 10**

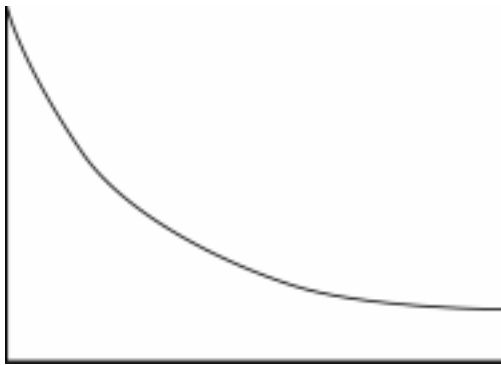
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**Question 5**

- (a) Name of method eg heat exchanger/Cowper's stove/heat recovery/combined heat and power;  
 large surface area/long pipes;  
 good conductor;  
 thin (heat exchange) surfaces;  
 counter-current flow;  
 transfer of heat/waste heat used to heat water/air; MAX 2

- (b) Reduced surface area (: volume ratio of larger container); 1

- (c) (i)



- [A straight line] 1

- (ii) Cost of insulation greater than money saved/energy used for heating/  
 increased payback period/law of diminishing returns; 1

- (d) Warm air (of room) doesn't touch cold glass (of outer pane);  
 reduced thermal gradient;  
 reduced heat conduction;  
 air poor conductor/good insulator;  
 no convection current/static air;  
 vacuum;  
 no conduction/convection;  
 use of named gas eg argon with low thermal conductivity; MAX 3

- (e) Named design feature;  
how it reduces energy use; 2
- eg aerodynamics/streamlining;  
reduced friction/air resistance;  
**OR**  
better temperature control;  
more efficient combustion;  
**OR**  
electronic ignition/lean burn engine;  
more efficient combustion;  
**OR**  
more valves per cylinder;  
better fuel input/exhaust gas removal;  
**OR**  
more efficient fuel;  
eg diesel;  
**OR**  
more gears;  
optimum engine power;  
**OR**  
reduced weight/named /lightweight material;  
reduced energy needed;  
**OR**  
low energy production methods;  
example/description of method;  
**OR**  
hybrid fuel;  
energy recovery/electricity/battery storage;  
[R catalytic converters]  
[R increased efficiency without explanation]

**Total marks = 10**

**Question 6**

- (a) (i) 2 reservoirs;  
2-way flow/reuse water;  
pumps;  
small catchment area; MAX 2
- (ii) Energy storage/avoid wastage of electricity from other power stations/  
rapid response time/match supply to demand; 1
- (b) Primary coolant/cool reactor/cool rods;  
secondary coolant/steam generation/turn turbines;  
moderator/slow neutrons;  
condenser coolant;  
cooling ponds/waste storage;  
source of fuel for fusion reactor; MAX 2  
[R effluent release]

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(c) *Quality of Written Communication is assessed in this answer.*

Up to 6 for treatment processes with description of purpose/principle:

screens;  
filter/bars/grills;  
remove large/floating/gross solids;

settling/sedimentation;  
static water;  
removes suspended solids;

flocculation/coagulation;  
alum/polyelectrolytes/neutralises electrical charges;  
removes clay/colloidal material;

aeration;  
reaction with oxygen;  
remove odours/some metals/organic matter;

(activated) carbon;  
adsorption;  
removes some organic compounds/pesticides;

disinfection/sterilisation;  
chlorine/UV/ozone;  
kills bacteria/pathogens;

fluoridation;  
less susceptible to acid attack;  
aids dental health;

water softening;  
ion exchange/distillation;  
remove lime/calcium ions;

demineralisation;  
distillation/ion exchange;  
remove named dissolved ions/chemicals;

pH control;  
add lime;  
neutralise acids;

MAX 2 for each method  
MAX 1 for process with no description  
[A AVPs]

Up to 6 for uses of water with reference to quality requirement:

drinking water/food processing;  
bacteria/odours/taste/toxins/pH/colour;;

irrigation water;  
salt content/pathogens/acids;;

steam turbine water;  
dissolved minerals corrosiveness;;

reactor primary coolant water;  
mineral content/corrosiveness/reactivity;;

condenser water;  
gross solids;

textile industry;  
hardness/turbidity;;  
MAX 1 for uses with no description  
[A AVPs]

MAX 8

*Quality of Written Communication*

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.

MAX 2

**Total marks = 15**

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