



General Certificate of Education

Environmental Science 5441

**ESC1 Energy, Atmosphere and
Hydrosphere**

Mark Scheme

2007 examination – January series

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Environmental Science

January 2007

ESC1

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

Question 1

Sedimentation/settling;

neutralisation of surface/repelling charges/particle aggregation/coagulation/
joins clay/fine particles together/addition of feral/polyelectrolytes/potato starch/alum etc;
[R floc formation without additional description]

(kill) pathogens/example of pathogen eg *E. coli*/cholera/typhoid/bacteria/micro-organisms/
prevent disease/sterilisation/disinfection;

toxic (to pathogens)/kills (pathogens);
[R addition of chlorine/sterilisation/disinfection]

fluoridation/fluorination/addition of fluorides/fluorine; 5

Total marks = 5

Question 2

- (a) (i) Stratosphere/ozone layer; 1
- (ii) Ozone/O₃/triatomic oxygen; 1
[A specific CFC]
- (b) Use of aerosols/fridges/AC/jet aircraft/
use of/ release of chlorofluorocarbons/CFCs/halons/freons/NO_x in stratosphere/other suitable
example;
persistence/mobility of chemical;
release of halogen/Cl/F/Br (in stratosphere);
ozone depletion/reduced concentration/amount;
described reaction/equation/ reaction of Cl with O/O₃;
reduced absorption of UV; MAX 3
- (c) Troposphere; 1
- (d) Named (counter-balancing) processes
eg photosynthesis-respiration/combustion-photosynthesis/dissolving – coming out of solution;
[R human activities]
balance/counteracting effect/negative feedback/(global) homeostasis; 2
- (e) Balance of growth/photosynthesis/absorption (with combustion/respiration/release);
timescale of reactions/release of the same C/CO₂; 2
[A CO₂ would have been released by decomposition]

Total marks = 10

Question 3

- (a) $0.30 \times 300 \times 100$;
= 9000 kg; 2
- (b) Empty bus/few passengers; 1
[A specific method of improved car fuel efficiency]
- (c) Any suitable design feature with explanation:
aerodynamics/streamlining;
reduce drag/friction/air resistance;
OR
specific fuel combustion design/electronic ignition/more cylinders/more valves/more spark
plugs/combustion chamber shape;
optimum spark timing/combustion efficiency;
OR
specific fuel delivery design/fuel injection/air-fuel ratio control/lean burn engine;
correct amount of fuel delivered;
OR
thermostatic cooling;
prevent over-cooling;
OR
specific wheel design/wheel size/tyre deformation;
rotational energy use/friction;
OR
hybrid fuels;
energy recovery/electricity;
OR
named fuel choice;
reason for reduced fuel consumption;
OR
smaller engine size;
less energy to move engine parts/lighter moving parts;
OR
lighter mass;
less KE needed;
OR
optimum engine:road speed ratio;
more gears/automatic/cruise control;
OR
fewer energy-consuming devices;
air conditioning;
OR
not 4×4 /one pair of wheels driven;
reduced friction/lighter moving parts;
[R car usage/driving description, catalytic converters] 2 + 2 MAX 4

- (d) Named fuel with reduced impact
eg: hydrogen/diesel/low sulphur fuel/unleaded fuel/biofuel/LPG/biodiesel/vegetable oil/alcohol/biogas/solar; 1
[A hybrid fuels if described]
[R electricity without source]
[R fuel without justification]
- named pollutant not released/C neutral;;
named environmental impact not caused/extraction damage;; MAX 2
[A reasonable description if fuel is vague eg 'renewables']

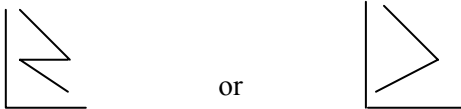
Total marks = 10

Question 4

- (a) (i) (Increased temperature causes) increased evaporation/transpiration;
increased water vapour/ condensation/clouds;
OR
change in wind patterns;
bringing more rain/humid air/cloud; 2
- (ii) Increased temperatures/heat;
water vapour fails to condense/lower relative humidity;
OR
change in wind pattern;
takes rain/humid air;
OR
specific reason for reduced evapotranspiration/reduced vegetation;
reduced evapotranspiration; 2
- (b) (i) Ref to range of tolerance/lack of adaptation/specific habitat change/specific physiological problem/changed species interrelationships – food/pollination/seed dispersal/evolution too slow; 1
- (ii) Ref to migration/colonisation with changed distribution of suitable conditions; 1
- (iii) Thermal expansion of seas/melting of land ice/glaciers/ice sheets/melting ice goes into sea/isostatic changes; 1
- (c) Land/water has lower albedo than ice/albedo reduced when ice melts;
less sunlight reflected/more sunlight absorbed/reaching the ground (since ice is not in the way);
[R UV]
more heat produced/increased temperature (from absorbed light);
more ice melts;
positive feedback/change in ocean currents; MAX 3

Total marks = 10

Question 5

- (a) (i) Arrows point into city from both sides/upwards over city;
[A converging arrows on diagram A] 1
- (ii) Inward airflow/rising air/winds converge over city; 1
- (iii) Named source of heat/hot material/
eg building heating/AC/vehicles/named combustion process;
reduced albedo/dark surface/absorbs more light/emits more heat;
named surface/material/structure (with reduced albedo);
high heat capacity;
large surface area (for absorption);
reduced wind speed;
reduces heat dispersal/loss; MAX 3
- (b) (i) Correct zig-zag;

 or 1
- (ii) Valley/surrounding hills;
cool/air collects/reduced wind/turbulence; 2
- (c) Greater volume flow due to reduced infiltration/absorption by ground;
faster runoff/flood peaks higher;
named impermeable surface;
OR
increased/reduced discharge;
water transfer/abstraction for use in city;
OR
specific change in evapotranspiration rate affecting discharge;
increased surface area/temperature for evaporation/changed amount of vegetation; MAX 2

Total marks = 10**Question 6**

- (a) Slow/fluctuating increase; 1
- (b) (i) (Increasing) costs of storage/fuel extraction/resource supplies/safety
procedures/waste disposal; 1
- (ii) Reduced manufacturing costs/economies of scale/number manufactured/turbine size/more
efficient design/technology; 1

- (c) Use of pump/nodding donkey;
increased pressure difference;

OR

secondary recovery;
increased pressure;
water/natural gas injection;

OR

tertiary recovery;
reduced viscosity;
solvents/steam/bacteria/detergents/hot water;

MAX 2

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

Two main approaches:

- descriptions of locational, technological and environmental factors with areas and resources to illustrate
- named energy resources with description of factors influencing their use

Up to **4** named energy resources;;;;

coal, oil, natural gas, tar sands, oil shales, nuclear power, solar, wind, biofuels, wave, ocean current, tidal, geothermal

Up to **3** named locational factors;;;;

description of availability of resource eg

fossil fuel deposits

windy/sunny/rough sea areas with reasons

distance to area of demand

cooling water

geological stability

rock permeability

precipitation

evaporation rate

water flow rate

large (construction) site

high tidal range

volcanic activity/hot rocks near surface

topography

Up to **3** named technological factors;;;;

costs/ability to afford;

level of development/complexity of technology;

infrastructure eg electricity grid, technical support

Up to **3** named environmental factors;;;;

specific land use conflict

specific pollutants

 sulphur dioxide

 smoke

 noise

 aesthetics

 hot water

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
