



General Certificate of Education

Environmental Science 5441

ESC1 Energy, Atmosphere and Hydrosphere

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

ESCI

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

Question 1

Transpiration;
 [A evapotranspiration]
 precipitation landing on leaves/vegetation;
 [A water if it is clear it is vegetation above ground]
 [R answers where water is taken into the plant]
 evaporation;
 water passing into the ground/soil;
 [R water passing through]
 water table;

5

Total marks = 5

Question 2

(a) Line goes down; 1

(b) Any suitable change;

plus expansion;
 eg
 increased affluence/standard of living;
 increased use of water-using appliances;
 example of appliance;

increased use in agriculture;
 irrigation;

increased industrial use;
 example of industry/use;

climate change;
 increased use (not previously used) eg washing/irrigation;

lifestyle/social changes;
 increased hygiene/health/recreational uses;
 [R non per-capita changes eg population increase]

MAX 2 + 2

MAX 4

(c) (i) Water-bearing rock (used as a source); 1

(ii) Balance of in/out; 1

- (iii) reduced support of water in pores;
 subsidence;
 lowered water table;
 reduced river flow;
 reduced springflow/baseflow/dry upstream;
 vegetation/habitat change;
 saltwater incursion/saltwater flows in/salination/increased salt concentration;
 due to pressure change;
 denser saltwater flows under freshwater;
 increased pollution concentration;

MAX 3

Total marks = 10**Question 3**

- (a) Any suitable geological condition;
 [R other factors eg surface landuse]
 explanation of importance;
 eg
 named formation conditions/high temperature/high pressure;
 effect on carbon content/oil grade;
- faulted strata;
 fragments coal/difficult to mine;
 allows oil to escape/collect;
- strata angle;
 difficult to mine coal if steep;
 anticline allows oil to collect;
- high porosity;
 increases oil reservoir volume;
- permeability;
 allows oil to collect in reservoir;
 prevents escape of oil through cap rock;
OR
 affects water inflow;
 increases drainage costs;
- depth;
 increased depth increases mining/drilling cost;
- pressure;
 increased pressure increases oil flow rate;
- seismic activity;
 earthquake risk;
- thickness of seams/reservoir rock;
 effect on income/cost:benefit;

overburden hardness;
difficult to drill through/remove if hard;

overburden stability;
collapse/subsidence risk;

MAX 2 + 2

MAX 4

(b) Any factor which changes usage or reserves;

eg

increased affluence/change in development;

more energy-using appliances;

increased population;

concern over environmental impact eg pollution/GCC/habitat loss;

new/better alternatives to fossil fuel use;

reserves were overestimated;

MAX 2

(c) New discoveries;

example of exploration technique eg seismic/trial drilling/gravimetry;

better extraction technologies;

example of extraction technology eg 2°, 3° oil recovery of oil, coal gasification;

reduced usage due to conservation/recycling/named more efficient technology;

example of conservation method/recycling method/how energy is saved;

[A public transport]

[R recycled material alone]

use of alternative energy resources;

named example of other energy resources;

reduced usage to control pollution;

named pollution issue/pollutant eg GCC/photochemical smogs/CO₂/NO_x;

economic restrictions/disincentives/legislation/agreements;

named example eg carbon tax/car tax/fuel tax/Kyoto/rationing for essential uses;

increased prices;

previously uneconomic reserves become economically viable;

MAX 4

Total marks = 10

Question 4

(a) (i) Removal of (suspended) solids/particles; 1
[R reference to filtration]

(ii) Removal/kill pathogens/bacteria/microorganisms; 1

(b) Addition of flocculant/coagulant/example of flocculant/alum/polyelectrolytes;
neutralisation of surface charges/particles coalesce/join/aggregate to form floc/larger
solids;

sedimentation/settling/deposition/clarification;

MAX 2

- (c) Any suitable examples
 eg
 maintenance/leak control/explanation of reduced use;
 repair of leaking water mains/repair of dripping taps;
- lower volume alternative technology/explanation of reduced use;
 low pressure supply/hippo bag/cistern brick/dual flush toilet/automatic taps/
 low water washing machine/dishwasher;
- behaviour choices/explanation of reduced use;
 turn off tap when brushing teeth/shower vs bath/full load washes/mulch garden to
 reduce watering;
- use waste water/grey water/recycle;
 eg of 1st/2nd use;
- use restrictions/metering/rationing/bans/increased prices;
 encourage awareness/conservation/named banned activity/hosepipe/sprinkler/car
 washing;
 public information/education/explanation of reduced use;
 named example of publicity medium eg newspaper/TV/leaflet; MAX 2 + 2 MAX 4
- (d) (i) Cause of dissolved oxygen level with explanation;
OR
 cause of dissolved oxygen level with effect on rivers/groundwater;
 eg
 turbulence/named aeration process/mixing air/O₂ into water/
 rivers more turbulent/named aeration process/mixing;
 photosynthesis/plants produce O₂/more photosynthesis/plants in rivers;
 oxidation of inorganic minerals/organic matter removes O₂/
 more inorganic minerals/organic matter in rivers;
 exposure to air allows O₂ to dissolve/rivers more exposed to air; MAX 1
- (ii) Cause of turbidity with explanation;
OR
 cause of turbidity with effect on rivers/groundwater;
 eg
 filtration by rocks removes suspended solids;
OR
 filtration by rocks/reduced turbidity in groundwater;
 turbulence in/erosion by/kinetic energy/movement of moving water increases
 turbidity;
OR
 turbulence in/erosion by/kinetic energy/movement of moving greatest in rivers;
 MAX 1

Total marks = 10

Question 5

- (a) (i) Barrage scheme/(a);
greater head/water velocity/water pressure/force/greater volume/
all water flows past turbines/barrage full width of estuary; 2
- (ii) Instream turbine/(b);
no barrier to wildlife/change in tide height/(significant)silting/current flow
rate/current flow route/less sea bed affected/less habitat damage/less visual
impact/no effect on drainage of surrounding land; 2
- (b) Hydro-Electric power/HEP/pumped storage HEP/water mill;
wave power; 2
[A named example of technology]
[R dam]
- (c) Suitable reason;
explanation;
eg
intermittency;
output not predictable;
- unreliability;
not always available (when required);
- energy density;
low output per unit fuel/appliance/high cost per unit output;
- energy form;
not in required form/liquid fuel/chemical energy;
- storability;
reason why storage is difficult eg form of energy which can't be stored;
- state of development of technology;
description of specific technological difficulty/high development costs;
- geographical/location limitations specific example;
eg areas with low wind velocity/rainfall/insolation/rock temperatures/tidal range;
- public acceptability;
specific acceptability problem eg aesthetics of windfarms;
- output of individual appliances/need for large number of appliances;
specific example eg wind turbines/solar panels; 2 + 2 4
[R 'less energy' without justification]

Total marks = 10

Question 6

- (a) Methane; 1
- named human activity/industry
combustion eg vehicle engine/exhaust/power station/furnace/
specific fossil fuel use/specific agricultural activity/use of nitrates/
fertiliser use/ploughing; 1
- (b) Atmosphere is transparent to visible light/short wave light;
absorb infra red light/long wavelength radiation;
[R heat/UV]
converted to heat;
delay escape of energy to space; MAX 2
[A prevent]
- (c) (i) Salinisation/increased salt content/salinity/
raised water table/increased volume; 1
- (ii) Increased/unreliable; 1
- (d) *Quality of Written Communication is assessed in this answer.*
- Up to 4 features of urban area causing microclimate
- how they change climate – up to 2 for each feature
- named material/structure;
darkness/absorption/albedo;
effect on temperature;
- gaps between buildings;
wind tunnel;
increased wind velocity/increased turbulence;
- buildings (create barrier);
wind shadow;
reduced wind velocity/increased turbulence;
- impermeable surfaces;
effect on evaporation;
effect on precipitation/humidity/cloud cover/insolation;
- reduced vegetation;
reduced interception/evapotranspiration;
effect on precipitation/humidity;
- named source of heat;
increased evaporation;
effect on precipitation/humidity/cloud cover/insolation;
- heat island;
convection;

effect on wind direction/velocity;
smoke/suspended particles/PM10;
condensation nuclei;
increased cloud cover/smog/precipitation;

changed light level;
absorption by named material;
reflection by named material;

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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
