CAMBRIDGE
INTERNATIONAL EXAMINATIONS

June 2003

GCE AS/A LEVEL

MARKING SCHEME

MAXIMUM MARK: 100

SYLLABUS/COMPONENT: 8290/01

ENVIRONMENTAL SCIENCE

Paper 1

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

1 Fig 1.1 shows three areas A, B and C of different surface air pressure in the Northern Hemisphere.

(a) On Fig 1 indicate by using arrows the general directions of air movement between:

(i) areas A and B,

(ii) areas B and C.

Two arrows to be inserted directed from high pressure toward slow pressure (1 for each)

= 2

(b) Explain how the direction of air movement between these areas is influenced by the earth's rotation.

Rotation in west to east direction = 1

Deflection to the right of pressure gradient in Northern Hemisphere and left in the Southern Hemisphere = 1

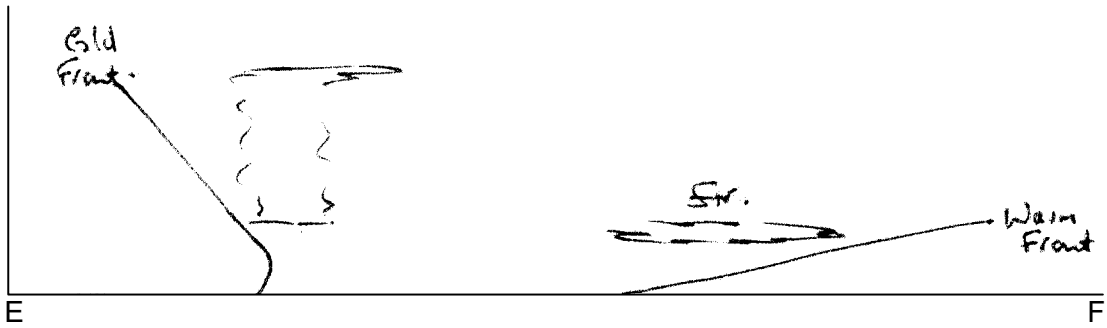
(also credit for correct explanation of the Coriolis force/differences in rotational velocity etc).

= 2

(c) Fig 1.2 shows an outline map of a typical frontal depression; also known as a cyclone. Line E to F on the Fig 1.2 is used in Fig 1.3.

Use the diagram to construct a cross section through the frontal depression.

Label: the warm front, the cold front, an area of stratus cloud and an area of cumulonimbus cloud.



One mark for each: only credit correct locations and front gradients.

= 4

(d) Describe the temperature, air pressure and rainfall pattern which would accompany the passage of the cyclonic system shown in Fig 1.2.

2 marks for each of temperature, pressure and rainfall.

There must be reference to changes caused by air masses (=1) and the effects of the fronts (=1). Do not expect a full coverage and award full marks for a general or part coverage.

= 6

[14 marks]

2 Fig 2.1 shows the Carbon Cycle.

(a) Explain the meaning of the arrows and labels in Fig 2.1.

Award for... Natural Cycling of carbon atoms = 1, sinks = 1, Flows = 1

= 3

(b) Describe how photosynthesis transfers carbon dioxide from the atmosphere to the biomass.

Autotrophic process whereby green plants = 1 use the suns energy = 1 to convert gaseous carbon dioxide into carbohydrates (=1); green plants remove carbon dioxide from the atmosphere (=1), (3 linked points)

= 3

(c) Give two reasons why it is important to understand the nature of '*carbon sinks*'.
Most carbon dioxide is locked up in carbon sinks (vegetation, rocks, oceans)
Uncertainty about how much is locked up.
Concerns over carbon dioxide level. Credit two valid points

= 2

(d) "One hundred and fifty of the worlds major governments met in Kyoto, Japan, to discuss agreements to cut emissions of carbon dioxide, methane, nitrogen oxide and sulphur hexaflouride, hydroflourocarbons, all important greenhouse gases. Industrialised nations agreed to reduce their emissions of greenhouse gases by, for example:

Canada 6%

EU 8%

Japan 6%

USA 7%

These must be achieved between 2001 and 2012.

The countries that really need to be involved said 'hell no' at Kyoto".

Suggest three reasons why many countries of the developed world have found it difficult to meet the requirements of the Kyoto protocol.
Three different reasons are needed; award 1 for the reason and 1 for a brief justification for each.
e.g. the %s may not yield significant reductions in greenhouse gases. Economic commitments to using fossil fuels. Political barriers to agreements.

= 6
[14 Marks]

3 Insert 1 (Fig 3.1) shows an area of tropical rain forest before and after burning. (a) (i) (a) (i) Describe the structure of vegetation shown in photograph.
Reference to each of 3 levels (Shrub, undercanopy, upper canopy); other structural terms may be used. Description only needed. Alternatives are: layered structure and examples.

= 3

(ii) Name and explain the role of one abiotic factor important to the vegetation cover shown in photograph A.
Abiotic to include: temperatures, moisture, soil. = 1, role = 2

= 3

(b) Photograph B shows the impact of burning on a former area of tropical rain forest. Describe three effects that forest burning could have on the area shown on photograph B.

3 effects are needed (1 mark for each). They refer to biodiversity, micro-climate, human/animal habitats etc.

= 3

(c) Table 3.1 contains some data about the production and recycling of plant biomass within two ecosystems.

Table 3.1

	total dry mass in kg m^{-2}		
ecosystem	**new plant biomass produced per year**	**plant litter produced per year**	**humus content of soil**
deciduous woodland	**0.9**	**0.5**	**4.5**
tropical rain forest	**3.3**	**2.5**	**0.2**

Explain the differences between the two ecosystems in the production of new plant material, plant litter and humus.

Plant material and litter relate to the prolific growth in hot moist conditions (= 1) whilst slower rates occur in the cooler deciduous forest (= 1).
Rapid decay in TRF produced little litter and slower rates in deciduous woodland produces more litter (= 1)
In cooler climates humus decays at a slower rate (deciduous woodland).

= 3

[12 marks]

4 Fig 4.1 shows 6 effects of the earth's land surface and atmosphere on incoming and outgoing radiation.

(a) Complete the table 4.1 below by matching the number with the description. (As guidance number 4 is completed).

2, radiation reflected back from the earth's surface, 5.

= 3

(b) Explain the processes which are occurring in effects 1 and 6 in Fig 4.1.

Energy radiated from the atmosphere (cloud) = 1, and in 6 absorbed energy radiated plus scattering or reflection by clouds = 2

= 3

(c) Suggest two reasons for the way in which the amount of solar radiation reaching the Earth's surface varies with latitude.

Incoming radiation is spread out at the poles (= 1) and spread out in lower latitudes (= 1) or reference to variations in the depth of the atmosphere linked to reflection.

= 2

(d) Explain the meaning of the term *albedo.*

The % of solar radiation reflected back from a surface.

= 1

(e) Explain why the Earth's albedo in high latitudes exceeds that in equatorial regions.
High Latitudes with ice and snow offer highly reflective surfaces = 1
Low Latitudes darker surfaces (ocean and forest) are less reflective = 1

= 2

[11 marks]

5 Fig 5.1 shows thin sections of two sedimentary rocks (A and B).
In both sections the white minerals are quartz and the black minerals are ferro-magnesian.
(a) Describe the texture of rock A
(b) Describe the texture of rock B.
A = sandstone =1
Large rounded grains of quartz in matrix of ferro-magnesian = 1

= 2

B = accept shale or mudstone = 1
Fine (0.01mm) grained with slightly coarser grains of quartz = 1

= 2

(c) Describe the types of environment which would produce Rocks A and B.
Sandstone = shallow water/rapid deposition thus the texture in (a)
Shale = quiet marine or lake environment/slow settling of sediment.

= 4

Fig 5.2 shows a granite intrusion into some sedimentary rocks.

(d) Describe the effect that the intrusion of the granite may have on the nearby sandstone.
Sandstone metamorphosed by heat and pressure into Quartzite.

= 2

(e) What effect will the dykes have had upon the limestone and shale in the contact zone either side of each intrusion?
Limestone into marble and Shale into slate.

= 2

[12 marks]

6 Fig 6.1 shows a cross section of an artesian basin.
(a) What is groundwater?
Water naturally stored beneath the water table derived from infiltration.

= 2

(b) Describe the geological conditions which have enabled the development of this Artesian Basin.
Alternating porous rocks in a synclinal structure. Impermeable strata prevent groundwater from escaping. Water drains from the highland to the east. 3 points needed.

= 3

(c) Why do springs occur in the areas labelled?
Porous rocks and the water table reach the surface.

= 2

(d) Give two reasons for the construction of boreholes in Fig 6.1
Arid climate and the need for water.
A well supplied reservoir of groundwater under pressure. **= 2**

(e) An artesian basin is one example of a water storage zone. State one other example.
Any one valid example = 1

= 1
[10 marks]

7 Fig 7.1 shows two ways in which population growth is related to the carrying capacity of an environment.

(a) What is meant by carrying capacity?
The number of organisms which a particular ecosystem, environment or area can support/sustain over a given period.
Full definition = 2, part or incomplete definition +1

= 2

(b) Describe the type of population or species shown by:

graph A Fast reproducing, short-lived species at lower trophic levels = 1
graph B Longer lived species inc. primates, people (few predators) = 1

= 2

Fig 7.2 is a model for the regulation of a population of fish.

(c) Describe the conditions under which the population of mature stock will remain stable.
When immigration + birth rate (= 2) are equal to emigration + predation + mortality (+2). This will probably be expressed in more general terms and 1 mark can be awarded for a corrected consideration of each component.

= 4

(d) The size of a population of a particular species is linked to the size of the predator population. Fig 7.3. shows this relationship. Using an example your have studied explain the relationship shown in Fig 7.3.
Some texts refer to lemmings and snowy owls; obviously a valid treatment of two adjacent trophic levels will suffice. Three linked points which use the diagram are needed. The best answers will refer to: prey (=1), predator (=1) and the time lag between each stage (=1).
Use of the model +1

= 4
[12 marks]

8 Fig 8.1 shows population pyramids for a developing country and a developed country.

(a) State which type of country is represented by each pyramid.
A = Developing, B = Developed

= 1

(b) Explain the differences between the two countries in the population structure for:
(i) The 0 to 14 age group.
(ii) The over 65 age group.
One reason for each but do not credit mirrored points.

= 2

One reason for each but do not credit mirrored points.

= 2

(c) Fig 8.2 shows three possible paths for future world population growth. State a possible reason for each path.
Path 1. World fertility declines: ageing populations, improved standards of living, response to overpopulation.
Path 2. World's population stabilizes. Levels off as a response to resources and development.
Path 3. World population continues to rise exponentially. Continuing high birth rates exceeding death rates.

= 6

(d) Using an example you have studied, state one adverse effect that a rapid increase in population has had upon its physical environment. Explain the effect.
Naming the effect and example = 1 (overgrazing, over-cultivation loss of land, increased pollution.
Explanation with reference to the case study = 3
An explanation without reference to an example = max 2

= 4
[15 marks]

CAMBRIDGE
INTERNATIONAL EXAMINATIONS

June 2003

GCE AS/A LEVEL

MARKING SCHEME

MAXIMUM MARK: 80

SYLLABUS/COMPONENT: 8290/02

ENVIRONMENTAL SCIENCE

Paper 2 (Options)

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

Section A

1 (a) water evaporates from muslin;
requires heat energy;

2

(b) higher atmospheric humidity/more water vapour in air;
rate of evaporation reduced;
so less difference in temp. readings;
(accept reverse argument)

3

Total 5

2 (a) (angle of) sun lower in winter;
able to strike windows;
overhanging roof shades windows in summer;
most windows on north side maximises light in s. hemisphere;

max 3

(b) angle of sun lower in morning and evening;
would hit windows in east/west walls;

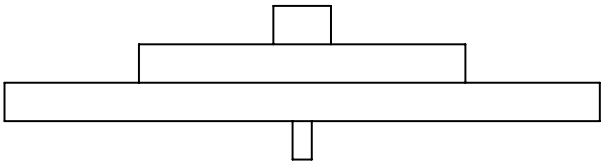
2

(c) warm air less dense than cold;
warm/hot air rises;
ref. to convection currents;
hot air vented through high-level window;
replaced by cooler air;

max 4

Total 9

3 (a) (i)



1

(ii)

1

(iii) pyramid of numbers - one tree/very few trees
a large organism;
many insects;
small organisms;
at subsequent levels organisms increase in size;
and decrease in number;

pyramid of energy - energy lost at each trophic level;

max 3

(b) (i) developing country - (very) high birth rate;
higher death rate;
life expectancy short(er);
much higher proportion of population under 15/young;
developed country - less variation between proportions of population in different age ranges;

max 3

(ii) developed country – medical/other facilities well developed;
little increase in longevity;

developing country – v. high proportion of young in population.;
so high birth rate continues;
medical/other facilities improved;
longevity increases/death rate decreases;

max 3

Total 11

Total for Section A 25

Section B

Option 1

4 (a) energy can neither be created nor destroyed;
but can be transformed from one form to another;

2

(b) joules;

1

(c) 60 x 5 x 60;
18 000 (J);

2

(d) energy transformations not 100% efficient/energy lost in transformation;
some electrical energy "lost" as/transformed to, heat;

2

Total 7

5 (a) source of stored energy;
originally derived from the sun;
dead/decomposition/conversion of, plant/animal/organic matter;
ref. to heat/pressure;
over geological time/millions of years
e.g.;

max 4

(b) (i) fossil fuels contain sulphur;
SO_2 released when burnt;
dissolves in rain water;
forms H_2SO_4/acidic solution;

max 3

(ii) outline of effects on - trees/forests;
crops;
lakes/water;
aquatic organisms;
buildings;

max 3

Total 10

6 (a) fission - splitting of atom;
uranium atom;
bombarded with neutrons;
produces daughter element/e.g.;
and more neutrons;

max 2

fusion - two atoms fuse;
<u>hydrogen</u> atoms fuse;
produce helium;
extremes of temperature and pressure needed;
takes place in the sun;
no neutrons produced;

max 2

(b) reduced CO_2/greenhouse gas emissions;
reduced SO_2 emissions;
large resource of uranium/nuclear fuel;
conserves fossil fuel supplies;

max 2

(c) danger from radiation leaks;
danger to wildlife/fisheries from discharge of radioactive waste;
danger of transporting spent fuel to/waste from plant;
safety/security of disposal;

max 2

Total 8

7 (a) reservoir is store of potential energy;
converted to kinetic energy;
mass of water m;
falls by force of gravity g;
through height h;
used to turn turbines;

max 4

(b) gravitational forces of sun and moon cause tides;
rise and fall of tide used to turn turbines/generate electricity;

2

Total 6

8 (a) oil reserves finite/investment in other sources of energy against oil reserves running out/image of company/OVP;

1

(b) (i) noise noticeable at night when other noise levels are lower/wind farms in quiet areas
so noise more noticeable/OVP;

1

(ii) disadvantage - visual appearance/unreliability/land use conflict/safety/radio and TV interference;

1

advantage - renewable energy/no pollution/land can still be used for farming/low cost once installed

1

(c) (i) energy generated within Earth's core;
by radioactive decay/rocks still cooling;

2

(ii) extraction of hot water from aquifer;
used to heat buildings;
or converted to steam;
to generate electricity/turn turbines

or

water injection;
into (fractured) hot rock;
hot water or steam removed;
via second borehole;
used to turn turbines

max 3

Total 9

9 (a) toxic fog;
caused by uv radiation;
acting on NO_X;
and hydrocarbons;
from motor traffic/industrial emissions;
ozone produced;
forms in, stable sunny conditions/clear skies and light winds;
over cities/industrial areas;
traps other pollutants/e.g.;
effect intensified by geography/bow-shaped relief;
ref. to adverse effects;

max 7

(b) reduce emissions from industrial processes;
use of scrubbers/other e.g.;
reduction in motor traffic;
improve public transport;
improve engine efficiency;
use of lean burn;
catalytic converters;
development of non-polluting energy sources;
e.g.;
research and development of cleaner alternatives;
OVP;

max 8

Total 15

Total for Option 1 55

Option 2

10 (a) interception;
by plants/leaves/canopy;
evaporation from plant surface;

max 2

(b) surface hardens;
infiltration reduced;

2

(c) soil erosion/silting of rivers/flooding/increased surface run-off;

1

Total 5

11 (a)

disease	causative agent	vector	method of control
		snail	drainage/control of snails
	Plasmodium	mosquito	
	Vibrio cholerae		vaccination/hygiene education

6

(b) (i) regular water supply;
fishery;
recreational use;
irrigation;
energy supply;

max 2

(ii) population displacement;
habitat destruction;
reduced fertility of land in lower reaches of river;
flooding if dam breaks;
ref. to earthquake risk;

max 2

Total 10

12 (a) enrichment of water by nutrients/nitrates/phosphates;

1

(b) phosphate in detergents;
nitrate in fertilisers;
slurry etc. from livestock;
erosion of soil into lakes/rivers;
OVP;

max 2

(c) greatly increased plant/algal growth/ref. to algal bloom;
increases quantities of dead plant material;
aerobic bacteria break it down;
O_2 levels fall;
other organisms die;
toxic gases/compounds may be produced;

max 3

Total 6

13 (a) prevent leachate escaping;

1

(b) (i) rain drains through site;
becomes contaminated with substances from waste;

2

(ii) gets into soil/water supplies;
contaminants may be poisonous;

2

(c) (i) control, pests/e.g./air pollution/smell;

1

(ii) reduces space for waste/fills site more quickly;

1

(d) low cost;
may be best method for hazardous waste;
methane produced can be used as energy source;

max 2

Total 9

14 (a)(i) bleached/light-coloured/AW;

1

(ii) leaching;
soil acidic/rain/water, draining through becomes acidic;
loss of/dissolves, minerals;

max 2

(iii) hard/iron, pan;

1

(iv) waterlogging/inhibits drainage;

1

(b) (i) salts concentrated in (top)soil;
prevents uptake of water;
ref. osmosis;
may result in soil waterlogging;

max 2

(ii) prevents losses/seepage of water before it reaches crops;

1

(iii) conversion of salts to harmless forms;
using gypsum;
chemical detail;

or

lower water table;
by pumping from aquifers;

max 2

Total 10

15 (a)hydrothermal deposition;
infilling of faults/fissures;
by precipitation;
from hydrothermal/hot water, solutions;
e.g.;
metasomatism;
replacement of one element with another;
so resulting mineral is changed;
e.g.;
magmatic segregation;
crystallization of magma;
heavier minerals sink;
bands formed in rocks;
e.g.;

max 7

(b) (i) non-metallic raw materials;
needed in large quantities;
e.g.;

max 2

(ii) methods include quarrying;
and dredging;
quarrying may leave water-filled pits;
become a hazard;
visual damage to environment;
derelict land when quarries abandoned;
problems associated with subsequent landfill;
noise;
dust;
traffic;
destruction of/damage to, habitats;

max 6

Total 15

Total for Option 2 55

Option 3

16 (a)(i) underfishing/stocks increased/AW;

1

(ii) each factor varies annually/difficult to measure/OVP;

1

(b) (i) limit mesh size;
impose limits on quantity/size/type of fish caught;
impose limits on fishing in breeding grounds;

max 2

(ii) difficulty of policing control/fish caught which are outside limits of size etc. thrown back dead/OVP;

1

(c) (i) reduces pressure on fish stocks/cheap protein production/OVP;

1

(ii) example of environmental impact, e.g. eutrophication/pesticides/escape;

1

Total 7

17 (a)(i) leaching;
run-off;
spray drift;

max 2

(ii) pesticide stored in tissue/not excreted;
e.g. (organochlorines, DDT);
fat soluble;
each level of food chain eats large numbers of level below;
insecticide accumulates at each level;

max 3

(b) (i) natural genetic variation in organisms of same species;
some Salmonella have resistant characteristic/characteristic may arise by chance mutation;
bacteria reproduce quickly;
resistant colonies produced from few survivors;
ref. natural selection;

max 4

(ii) antibiotics used for human infections may be ineffective;

1

Total 10

18 (a) milk;
cheese or other dairy product;
meat;
leather/skins;
bone/horn;
wool/hair;

4 x ½ round up to max 2

(b) overgrazing; soil compaction increased erosion; degradation of pasture;
undernourished animals; any consequence of this;

max 3

(c) (i) pasture degraded/less grass available/goats can find more sources of food;

1

(ii) goats able to eat wider range of material;

1

(iii) greater erosion/lower soil fertility;

1

Total 8

19 (a)(i) roots bind soil;
greater interception/reduction of force, of rain;
reduces speed of water flow down slope;

max 2

(ii) reduces speed of water flow/traps soil particles;

1

(iii) weeds provide soil cover/bind soil/reduce impact of rain;

1

(iv) fast growth for quick cover;
strong roots stabilise soil;

2

(b) less dung for use as manure/fertiliser available;
dung provides organic matter/soil nutrients;
improvement to soil structure lost;
soil less fertile;
greater erosion risk;

max 3

Total 9

20 (a) poaching;
loss of habitat/AW;
hunting/killing by farmers;

3

(b) (i) allows cross-breeding/inbreeding less likely;
increases genetic diversity/ref. to larger gene pool;
allows escape from adverse conditions/threat on a reserve;

max 1

(ii) inbreeding occurs;
loss of genetic diversity/small gene pool/little genetic variation;
greater chance of adverse characteristics being expressed;

max 2

Total 6

21 (a) transfer of genetic material;
use of vector;
from one organism to another of different type/species;
produces combinations of genetic material which do not occur naturally;
can be used to confer useful characteristic on organism;
by identifying gene/section of DNA which codes for specific characteristic;
examples of use (e.g. herbicide resistance, cold tolerance, nitrogen fixation, oil-production from oil seed rape, drought resistance, salinity resistance, pest/disease, resistance, transgenic fish such as salmon)

max 7

(b) increased food production;
crops developed to grow on otherwise unusable land;
animals developed to grow larger;
less reliance on herbicides and insecticides;
production of plant fuel oils to replace fossil fuel which is likely to run out;
growing crops on marginal land may destroy habitats;
herbicide resistance may lead to careless use of herbicides;
destroying native species;
continued loss of genetic diversity in crops/animals used for food;
escape of GM organisms into ecosystems may cause harm;
development of cold-tolerant tropical crops reduces export potential in developing countries;
modified oil crops encourage monoculture;
commercial exploitation of small farmers/ref. terminator technology;
OVP.

max 8

Total 15

Total for Option 3 55