CAMBRIDGE
INTERNATIONAL EXAMINATIONS

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MARK SCHEME for the November 2003 question papers

8290 ENVIRONMENTAL SCIENCE

8290/01	**Paper 1**
8290/02	**Paper 2 (Options)**

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UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

CAMBRIDGE
INTERNATIONAL EXAMINATIONS

November 2003

GCE AS/A LEVEL

MARK SCHEME

MAXIMUM MARK: 100

SYLLABUS/COMPONENT: 8290/01

ENVIRONMENTAL SCIENCE
Paper 1

UNIVERSITY of CAMBRIDGE
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1 **Fig 1.1 shows how the velocities of P and S waves vary from the earth's surface to its centre.**

(a) **Explain why P and S waves accelerate as they travel from the earth's surface to a depth of 2900 kilometres.**

P waves accelerate from 8 to 13 km per second due to increasing rock density = 1
Granitic and Basaltic rocks in the crust and ultra-basic in the mantle = 1

Credit reference to mantle and crust only

= 2

(b) **Describe and explain the changes to the velocity of P waves at depths greater than 2900 kilometres.**

At 3000m P waves decelerate to 8m/sec and accelerate to 12.5 within the crust (perceptive candidates will see the change at 5000m (outer to inner core) = 1
The response is to increasing density and the change of density at 5000m =1

= 2

(c) **Explain why S waves do not travel to depths greater than 2900 kilometres.**

S waves are transverse (not longitudinal) = 1
They will fade out within the liquid outer core = 1

= 2

(d) **Fig 1.2 shows the distribution of those areas of the world likely to suffer from a combination of earthquake and volcanic activity. These areas lie over the boundaries of tectonic plates.**

What type of plate boundary occurs?

(i) at A = convergence or subduction zone or destructive.
(ii) at B = divergent or constructive.

= 2

(e) **Using Fig 1.2 outline the evidence for sea floor spreading and continental drift.**

Sea floor spreading = 2 and continental drift = 2

= 4

[12 Marks]

2 The triangular diagram in (Fig 2.1) serves as method of classifying soils according to texture.

(a) (i) Write the labels sand, clay and silt into the correct boxes in the diagram.

Clay (top), Silt (bottom right), Sand (bottom left)

= 3

(ii) On Fig 2.1 place a letter C to indicate a loam.

Loam in the area central lower part of the triangle

= 1

(b) Name and describe the role of one biotic and one abiotic soil component.

Biotic to include: bacteria, worms etc, humus, litter
Abiotic to include: rocks, minerals, water, temperature.
For each: name = 1, Role = 1

= 4

(c) The diagram below (Fig 2.2) is a profile of a soil which has formed under moist conditions in a tropical climate.

(i) Describe and explain the characteristics of the illuviated and eluviated horizons shown in the diagram.

Eluviated horizon sees the leaching of silica due to the downward movement of water leaving iron, magnesium and aluminium in upper layers (= 2/3)
Silica is redeposited in the illuviated lower horizon/some red or yellow

= 4

(ii) Explain why soils of this type are often regarded as infertile.

Rapid nutrient cycling puts most nutrients into the biomass not the soil = 1
Drying of upper iron rich horizon contributes to soil erosion or unworkable hard pan = 1

= 2

[14 marks]

3 **Fig 3.1 shows the temperature and rainfall characteristics for two cities. The cities are in different climatic regions but at similar latitudes in the southern hemisphere.**

(a) **State the temperature range for each station.**

A = 6/6.5 C or max of 19 and min of 13.5
B = 6 C or max of 27 and min of 21

= 2

(b) **Contrast the pattern of rainfall for the two cities.**

A has max during June to October of 1-3mm/month and no Rainfall for the remainder of the year
B Has a peak between Dec to March of 125mm per month with a minima of 35mm during July and August

Credit one mark only for vague statements such as … it is higher in; Figures are required

= 2

(c) **Suggest a location for each city.**

A = Southern Hemisphere tropical west coast desert or a place
B = Southern Hemisphere tropical east coast or place

= 2

(d) **Suggest reasons for the differences between the two cities in temperature and rainfall.**

Credit 3 marks for each station

A is a west coast desert. On shore winds are dry air and cool because of a cold ocean current
B is influenced by warm moist trade winds hence higher temperatures and summer rainfall

= 6

[12 marks]

4 Fig 4.1 shows how temperature varies with altitude in the atmosphere.

(a) Label Fig 4.1 to show the stratopause, mesopause and stratosphere.

Stratosphere is between 19km and 48/52km
Stratopause is at the top of the Stratosphere
Mesopause is at 80/90km

= 3

(b) Describe the variations in composition, temperature and density which occur between sea level and 100 km.

Description of the temperature graph = 2
Composition = 1
Density = 1

= 4

(c) (i) Using the following equation, explain how ozone is formed in the earth's stratosphere.

$$O_2 \rightarrow O + O, \quad O + O_2 \rightarrow O_3$$

UV radiation splits an oxygen molecule (O_2) into 2 oxygen atoms (O) = 1
then an O atom combines with an oxygen molecule (O_2) to form O_3 (Ozone) = 1

= 2

(ii) Explain the role of chlorofluorocarbons (CFC's) in the depletion of stratospheric ozone.

UV radiation splits up the CFC and releases chlorine; this causes two reactions: the chlorine combines with ozone to produce chlorine monoxide which in the second reaction combines with O to produce Chlorine again

Following this, the chlorine enters a further reaction with ozone…. thus ozone depletion

= 2

(c) Outline two damaging effects caused by the depletion of upper atmosphere.

Increased UV radiation reaches the earth's surface

For people, UVB triggers a natural suntan but excessive UVB leads to skin cancer = 1
Effects on plants are that growth and photosynthesis of certain plants can be inhibited (rye, sunflower and maize) = 1

Credit other valid examples and descriptions

= 2

[13 marks]

5 **Fig 5.1 shows the electromagnetic radiation that is received from the Sun and emitted from the Earth.**

(a) **What is *electromagnetic radiation*?**

EMRs are transverse waves consisting of oscillating electric and magnetic fields and have a wide range of frequencies = 1
Credit reference to short wave radiation (Gamma), Ultra-violet and Infra-red (long) or reference to the spectrum =1

= 2

(b) **Describe how incoming electromagnetic radiation is utilised to heat the troposphere.**

Radiated long wave energy is more easily stored in water vapour, dust, buildings, vegetation, etc. Process + e.g. needed

= 2

(c) **Explain the difference between incoming radiation and outgoing radiation shown in Fig 5.1.**

One mark for incoming short wave radiation/insolation
One mark for stored long wave radiation

= 2

(d) **Fig 5.2 shows the effect of latitude on incoming radiation.**

Use Fig 5.2 to explain why it is warmer at the equator than in polar regions.

Due to the curvature of the earth = 1, in contrast to the lower latitudes solar radiation is more widely dispersed in the higher latitudes = 1
The greater depth of the atmosphere in higher latitudes enables more reflection and absorption, therefore loss = 1

= 3

(e) **Describe and explain how the length of day and night differ during the year between the equator and polar regions.**

For 2 marks there must be reference to the curvature of the earth = 2 and that a wider surface area directly faces the sun than in the lower latitudes = 2
Also credit seasonal change

= 3

[12 marks]

6 Fig.6.1 shows a food web.

(a) Distinguish between a food web and a food chain.

Food Chain = Transfer of energy and matter in a sequence of trophic levels
Reference to a singe chain needed = 1
Food Web = the interconnection of organisms within several food chains = 1

= 2

(b) Explain how plants produce the energy needed to supply a food web.

The synthesis of organic compounds (= 1) by photosynthesising (= 1) plants or chemosynthetic bacteria. Credit use of autotrophs
One additional mark for use of e.g.s or points

= 3

(c) Use a single food chain from Fig 6.1 and complete the table below.

Any sequence starting with the Primary producer 'heather'
and ending with the Tertiary consumer 'eagle or adder'

= 4

(d) Fig 6.2 is a pyramid of biomass based on an oak tree.

Why does biomass decrease at each trophic level?

Energy transfer is inefficient = 1
Loss through egestion = 1
Only a proportion of plants are consumed/ the rest is left = 1
Loss through use as a fuel = 1
Also credit losses of 90% at each level

= 4

[13 Marks]

7 **Fig 7.1 shows how the interaction of birth rates and death rates can produce variations in population growth over a period of time.**

(a) **Which stage would represent (i) a developing nation, and (ii) a developed nation.**

(i) Stage 2

(ii) Stage 4: The developed world

= 2

(b) **Describe how the changes to the birth and death rates influence population growth.**

Description of growth curve = 1
Interaction with births and deaths = 2

= 3

(c) **State one factor other than birth and death rates, which would lead to population growth.**

Migration (immigration)

= 1

(d) **Describe two social or cultural factors which might hinder the regulation of the birth rate by family planning.**

The answer should focus on family planning and refer to such factors as: culture, tradition, religion, labour, inheritance etc.

Award 1 mark for each point.

= 2

(e) **Using information from Fig 7.1, sketch outlines of population pyramids which would be typical of a country in stage 2, and a country in stage 4. Use the axes given below for your sketches.**

'i' should have a wide base and taper (gradual or concave) to a narrow top
'ii' narrow base and straight sides to a higher peak
Credit shape = 1 and width of base

= 4

[12 Marks]

8 Fig 8.1 shows a part of the water cycle.

(a) (i) Name two areas in which water is stored.

Storage includes: clouds, sea, groundwater, swamp and lake.

= 2

(ii) Name two processes by which water flows between the stores.

Choice from: infiltration, transpiration, evaporation, runoff, river

= 2

(b) Outline two different processes which would lead to the formation of the rain in Fig 8.1.

Precipitation via: i. relief or orographic effects
ii convection

2 marks for each. Each answer must point out the mechanism by which air is forced to rise to produce condensation. Credit diagrams as long as they explain the process.

Do not credit frontal processes.

= 4

(c) Briefly describe two situations which would lead to an increase in surface runoff.

Two clearly outlined conditions will suffice for full marks
Saturated ground preventing further infiltration
Steep slopes encouraging surface run-off rather than infiltration
Heavy rainfall which because of the amount is not infiltrated
Impermeable rock (do not permit overlap with saturated ground)
Human influences: deforestation, compaction etc.
For each the condition = 1 and the explanation = 1

= 4

[12 marks]

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November 2003

GCE AS/A LEVEL

MARK SCHEME

MAXIMUM MARK: 80

SYLLABUS/COMPONENT: 8290/02

ENVIRONMENTAL SCIENCE
Paper 2

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

Mark Scheme

Section A

1 (a) (i) correct layer (under crust); 1

(ii) thicker area of crust; 1

(iii) thinner area of crust; 1

(b)

type	origin	example
		any appropriate;
	igneous/ sedimentary	any appropriate;
sedimentary	organic remains/e.g. eroded particles of other rock/precipitation of minerals from solution	any appropriate

6

Total 9

2 (a) visible light; 1

(b) (i) gamma rays shown as shorter wavelength; 1

(ii) radio waves shown as longer wavelength; 1

(c) wavelength decreases; 1

(d) absorbed by atmosphere; Ⓡ sunglasses; 1

(e) radiation reflected between buildings;
radiation trapped/less escapes than from rural areas;
(Ⓐ converse argument)
greater absorption by brick/stone/dark surfaces such as roads;

air pollution from traffic/industry;
absorbs long wave radiation from surfaces/reflects heat back to ground;

heating systems in buildings increase atmospheric temperature. max 3

Total 8

3 ref. to effect of CO_2 on greenhouse effect;
Short wave radiation passes through;
Long wave radiation from surface reflected back;
Heat trapped;
Surface temp. becomes very high;
462˚C;
Too hot for life;
Ozone acts as a barrier to UV radiation;
UV reaching surface very high without ozone;
Has damaging effect on life forms;
Any two examples;;. max 8

Total 8

Total marks for Section A – 25

Section B

Option 1

4 (a) (i) X – gas;
Y – oil. 2

(ii) A – impermeable, B – porus/permeable; 1

(b) decomposition of phytoplankton;
maturation;
high temp/pressure;
produces high carbon concn;
60 – 100 million years/formed in Tertiary/Crestaceous;
oil formed migrates;
from source rock;
to reservoir rock;
contained by impermeable/cap rock. max5

Total 8

5	**(a)**		oil used most/oil and coal used most, globally; hydro/nuclear have smallest use globally; developed countries use more energy than developing; oil is major source for developed countries; biomass is major source for developing; OVP.	max 3
	(b)		gas + coal + oil/17% + 26% + 32%; = 75%	2
	(c)		10/11/12;	1
	(d)		wood is important source of fuel; availability; cost	max 2
				Total 8
6	**(a)**		renewable resource; as crops can be grown repeatedly; oil-based fuel releases SO_2 when burnt/no S so no SO_2 pollution; increases acid rain/no acid rain pollution. advantage; + explanation; x 2	max 4
	(b)	**(i)**	little change between 1300 and late 1800s; rapid fall from late 1800's/1900 to present; signs of increase in present day.	max 2
		(ii)	increased industrialisation in late 1800s; increased burning of fossil fuels; increase in SO_2 released; increased acid deposition in lake/acid rain production.	max 2
				Total 8
7	**(a)**	**(i)**	splitting atom/fission;	1
		(ii)	uranium;	1
	(b)	**(i)**	D – neutron;	1
		(ii)	E – nucleus;	1
	(c)		uranium atom bombarded with neutrons; uranium atom splits releasing energy and more neutrons; which split more uranium atoms.	max 2
	(d)		fission releases heat; steam produced; turns turbines.	3

	(e)	concern about accidents/radiation leaks/difficulties of dealing with nuclear waste/OVP.	1
			Total 10
8	**(a)**	source; x 2 (e.g. solar/wind);	2
	(b)	advantage; x 2;	2
	(c)	disadvantage; x 2;	2
			Total 6
9	**(a)**	dam; potential energy of water in reservoir; controlled fall of water; ref. gravity; conversion to kinetic energy; turns turbines; generates electricity; use of tides; ref. effect of gravitational pull of moon/sun; construction of barrage; across estuary/AW; different water levels on either side; water through sluices turns turbines; ref. to tidal range; ebb generation; flood generation; two-way generation; waves; detail of generation of energy;;	max 8
	(b)	dams may prevent flooding; reservoir used for water supplies; irrigation; leisure use; creating reservoir destroys habitats; may cause displacement of communities; problems of siltation; changes local microclimate; possible cause of earthquakes; loss of land fertility with loss of silt deposits below dam; tidal barrages affect coastal erosion; slow flushing of pollutants;	

decrease salinity behind barrage;
change to ecosystems/impact on wildlife;
less sediment;
more light penetration;
greater plant growth;
lower oxygen content of water;
barrage is barrier to fish migration. max 7
For any example Ⓐ pollution;} once only in **(b)**
Ⓐ renewable;

Total 15

Total for Option 1 55

Option 2

10 **(a)** 100 – (43 + 25);
32%; 2

(b)(i),(ii), less vegetation;
(iii) less transpiration/evaporation from leaves/AW;
more ground covered with hard/impermeable surfaces;
such as buildings/roads;
less areas where rain can reach soil;
less infiltration/more/increased, run-off;
less water held in ground. 5

Total 7

11 **(a)** **(i)** A marked at any point before oxygen level drops; 1
(ii) B marked at any point after oxygen level drops and before it rises again; 1

(b) eutrophication; 1

(c) increase in nutrients in water;
increase in organic matter/plant growth/algal growth;
increased decomposition;
by aerobic bacteria;
reduces oxygen levels in water. max 4

(d) release of animal waste/slurry/fertiliser run-off drained from fields/OVP; 1

Total 8

12 **(a)** A – sand, B – silt, C – clay; 1

(b) raises pH/makes soil less acidic/flocculates clay particles; 1

(c) **(i)** nitrogen; Ⓐ nitrate 1

(ii) adding manure – improves, soil/drainage/water-holding/OVP;
synthetic fertiliser – quick action/known content/OVP; 2

(iii) nitrogen fixing bacteria;
in root nodules;
increase nitrate levels in soil. 3

Total 8

13 **(a)** **(i)** increased x 3.5; Ⓐ (i) increase ; if no 1

(ii) increases x 3; (ii) increase other 1

(iii) very large decrease/decrease by 96%/AW (iii) decrease mark given 1

(b) suitable reason for waste named;
(e.g. plastic – little produced/used in 1950/development of in 50's and 60's
paper – increase in packaging; 1
ash – decrease on use of solid fuels for domestic heating.)

(c) **(i)** type of waste – method (e.g. paper – recycling); 1

(ii) conserves finite resources;
reduces energy used in obtaining resources;
reduces land needed for landfill;
reduces pollution;
OVP; max 2

Total 7

14 (a) (i) non-metallic raw materials/minerals needed in large quantities; 1

(ii)

bulk material	use
sand;	concrete/glass production;
granite;	building;
limestone;	cement/other appropriate;

6

(b) (i) filling with water/too difficult/expensive to pump out water; 1

(ii) reclaimed/landfill;
landscaped for leisure use;
as wildlife habitat. max 2

Total 10

15 (a) need to remove salt;
ref. to distillation;
multi-flash distillation;
evaporation;
of hot brine;
condensation;
of freshwater;
in chambers of increasing pressure;
reverse osmosis;
definition of osmosis/description;
apply pressure higher than osmotic pressure;
on conc. soln.; max 8

(b) teeth stronger;
less dental caries/decay;
cost savings on dental treatment;
teeth may become discoloured;
fluoride toxic;
causes brittle bones;
difficulty of monitoring dosage;
compulsory medication/infringement of liberty;
OVP; max 7

Total 15

Total for Option 2 55

Option 3

16 **(a)** **(i)** A – DNA/chromosome; 1

B – protein/polypeptide; 1

(ii) three bases/triplet;
code for one amino acid;
sequence of triplets;
determines sequence of amino acids/type of protein produced; max 3

(b) **(i)** non-natural transfer of genetic material from organism;
to organism of different/unrelated species; 2

(ii) use of vector/bacterium/OVP; 1

(iii) advantage – conservation of oil/reduced energy use/OVP/biodegradable so reduces pollution; 1

disadvantage – very large amounts needed/monocropping increased/OVP; 1

Total 10

17 **(a)** crop plant cover less dense;
land left fallow at times;
no plant cover after harvest;
cultivation/ploughing loosens soil. max 2

(b) method 1;
method 2. 2

(c) description 1;; 2

description 2;; 2

(e.g.'s of methods – terraces/bunds/contour ploughing/windbreaks/mulches).

Total 8

18 **(a)** (60 000 + 300 + 8000) – (4000 + 5000);
59 300; 2

(b) **(i)** A; 1

(ii) A has much less of original mass/79% of original mass compared with 98% of original mass/B has almost all of original mass; 1

	(c)	1 control; description/explanation; 2 control; description/explanation; (e.g.'s of controls – restrict mesh size, restrict catching season, restrict number of days fishing, impose quotas)	4
			Total 8
19	**(a)**	overstocking; overgrazing; damage to grasses; bare soil; increased erosion.	max 3
	(b)	deforestation; increased erosion; other problems related to deforestation; shortage of fuel; loss of habitats.	max 3
			Total 6
20	**(a)**	e.g. longer season of growth; e.g. salinisation of soil;	2
	(b)	e.g. increases crop yield; e.g. eutrophication of water courses;	2
	(c)	e.g. more productive varieties of plants/animals; e.g. loss of genetic diversity;	2
	(d)	e.g. less crop losses; e.g. increased resistance;	2
			Total 8
21	**(a)**	loss of habitats; due to pressure on land use; poaching; hunting; plant collecting; commercial pressures; e.g.; e.g.; natural disasters;	

introduction of non-native species which compete;
isolation of populations;
reduced cross-breeding;
reduction of gene pool;
loss of adaptability to changing conditions;
individual populations die out;
eventual extinction;
OVP. max 8

(b) outlaw poaching/collecting; Ⓐ ref. to laws concerned with poaching/collecting

restrict hunting;
international agreements;
ref. CITES;
e.g. Plant or animal protected;
protect habitats;
reserves/national parks;
encourage wildlife tourism;
education;
role of zoos;
and botanic gardens;
gene banks;
seed banks;
captive breeding; max 7
OVP.

Total 15

Total for option 3 55