

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

MARK SCHEME for the June 2004 question papers

8290 ENVIRONMENTAL SCIENCE

8290/01

Paper 1, maximum mark 100

8290/02

Paper 2 (Options), maximum mark 80

These mark schemes are published as an aid to teachers and students, to indicate the requirements of the examination. They show the basis on which Examiners were initially instructed to award marks. They do not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

- CIE will not enter into discussion or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the June 2004 question papers for most IGCSE and GCE Advanced Level syllabuses.



Grade thresholds taken for Syllabus 8290 (Environmental Science) in the June 2004 examination.

	maximum mark available	minimum mark required for grade:		
		A	B	E
Component 1	100	67	60	38
Component 2	80	50	45	26

The thresholds (minimum marks) for Grades C and D are normally set by dividing the mark range between the B and the E thresholds into three. For example, if the difference between the B and the E threshold is 24 marks, the C threshold is set 8 marks below the B threshold and the D threshold is set another 8 marks down. If dividing the interval by three results in a fraction of a mark, then the threshold is normally rounded down.

June 2004

GCE AS/A LEVEL

MARKING SCHEME

MAXIMUM MARK: 100

SYLLABUS/COMPONENT: 8290/01

ENVIRONMENTAL SCIENCE

Paper 1



Page 1	Mark Scheme	Syllabus	Paper
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Answer all questions

- 1 (a) Distinguish between a *biome* and an *ecosystem*.**

Biome = a naturally occurring organic community of plants and animals; it derives its name from the dominant type of vegetation e.g. TRF. Ecosystem = a community of plants and animals within a physical environment; its components; soils, vegetation, climate and animals are inter-related / energy flow within the system. (4)

- (b) Fig 1.1 shows the location of four of the world's biomes.**

- (i) Complete Table 4.1 to show the relationship between four of the world's biomes and their climate. The first line has been completed.**

Although specific details are given accept generalised reference to seasonality, temperature and rainfall for full marks. Max 3 marks for any single climate.

Savanna = Seasonal rainfall with a winter minimum and summer maximum = 2
 Type of rainfall is also creditworthy
 Tundra = Winters long averaging -20°C = 1
 Summers short (4 months) average 5°C = 1
 TRF = Rainfall = high ($>2000\text{mm}$) in each month = 1
 Temperatures = constantly high 26°C to 28°C = 1 (6)

- (ii) For one of the biomes in Fig 1.1 describe how its vegetation is related to the climate of the region.**

Credit 2 marks for accurately describing the vegetation and 2 for how it has adapted to the climate (4)

- (c) Fig 1.2 is a model of a plant succession. Use the model (Fig 1.2) to describe a plant succession you have studied.**

Pioneer community = 1
 Priseres = 1
 Climax vegetation = 1 (3)

Total [17]

Page 2	Mark Scheme	Syllabus	Paper
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2 Fig 2.1 shows the rock cycle. This can be used to show how rocks form and change.

- (a) Write the following labels in their correct position on Fig 2.1: sedimentary rock, heat and pressure, weathering and erosion.**

One mark for each. **(3)**

- (b) Fig 2.2 shows photographs of limestone and granite. Describe one feature of each type of rock. Explain how this feature indicates how the rock was formed.**

Credit 2 marks for two well developed points, e.g:

Limestone , fossiliferous = 1

Formed by deposition within coral reefs, fauna within warm clear environments etc =1

Granite, crystalline matrix = 1

Minerals crystallize as the rock cools from a liquid state = 1 **(4)**

- (c) Fig 2.3 shows two profiles:
A is typical of a limestone region.
B is typical of a granite moorland.
Describe the formation of the two soils in terms of the progressive weathering of the parent rock.**

For each credit 2 marks for each of two well developed points.

(i) Limestone is less resistant and subject to chemical weathering; deeper soil with limestone fragments; pH = 8 reflecting the composition of the limestone. **(4)**

(ii) Granite is siliceous and crystalline with erosion at a slower rate. More acid pH = 4.5 reflects the silica rich content of the granite. **(4)**

Total [15]

Page 3	Mark Scheme	Syllabus	Paper
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3 Fig 3.1 shows the global pattern of horizontal air movement.

(a) Explain why air moves in the directions shown in Fig 3.1.

There are two parts to this answer: Pressure = 2 and deflection = 2
 Air moves from high to low pressure areas = 1, example = 1
 The earth's rotation deflects air to the right as it move down the
 pressure gradient = 1, example = 1 **(4)**

(b) (i) Draw a simple weather chart to show the pattern of pressure and wind direction for either a northern or southern hemisphere anticyclone. Label your diagram clearly to show whether it is in the southern or northern hemisphere.

Credit 2 marks for pressure and 2 marks for wind direction **(4)**

(ii) Describe and explain the types of weather associated with either a winter or summer anticyclone.

For each credit temperature, wind, precipitation and stability.
 Credit a maximum of three for either a description or an explanation **(4)**

Total [12]

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- 4 (a) Fig 4.1 shows the structural divisions of the Earth.
Describe how the behaviour of seismic waves can be used to explain the structure of the Earth.

Two marks for each of three valid points, well developed. e.g:
P waves are longitudinal and whilst refracted will pass through the liquid core =2

S waves are transverse and will not = 2

Both shock waves accelerate with increasing rock density ranging from ultra-basics through to the nickel/iron core = 2 (6)

- (b) (i) Label Fig 13 to show:
A. The convection currents which help drive the movement of the lithospheric plates.
B. A region of ocean floor spreading.
C. A subduction zone.

One mark for each (3)

- (ii) What contribution does the aesthenosphere make to the movement of the earth's plates?

A region below the lithosphere with plastic qualities = 1 which acts like a raft permitting the lithosphere to move = 1 (2)

- (c) Using one example explain how the palaeontological record provides evidence for continental drift.

Credit as follows: Naming a correct example = 1
The stability of the earth's climatic zones =1
A description of its original habitat = 1
Its current location =1
Credit other valid responses

The answer is concerned with the palaeontological record. (4)

Total [15]

Page 5	Mark Scheme	Syllabus	Paper
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5 Fig 5.1 shows the nitrogen cycle.

(a) State two natural sources of atmospheric nitrogen.

Farm animals, volcanic activity and denitrifying bacteria.
Credit other valid sources. (2)

(b) What is nitrogen fixation?

Credit the first two points then alternatives.
The process whereby nitrogen in the atmosphere is made available to plants = 1
The conversion of nitrogen gas into ammonia by nitrogen fixing bacteria = 1
The bacteria lives in leguminous plants, aerated soil anaerobic soils and wetlands (alternatively credit reference to actual bacteria) = 1
Atmospheric fixation and thunderstorms = 1 (3)

(c) What is meant by the term denitrification?

Free living bacteria in the soil = 1
Convert nitrates to atmospheric nitrogen = 1 (2)

(d) Describe the role of bacteria in the nitrogen cycle.

Credit 2 marks for one well developed point or single marks for less developed points. eg. for decomposition, fixation, in root nodules (2)

(e) State two sources of soil nitrogen.

Plants (leguminous), animal waste, plant waste and fertiliser (2)

(f) State and describe one factor which might reduce the amount of nitrogen in a soil.

One mark for the statement and one marks for the description (2)

Total [13]

Page 6	Mark Scheme	Syllabus	Paper
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6 Fig 6.1 shows what happens to incoming solar radiation.

(a) (i) Explain why only 45% of incoming radiation reaches the earth.

Absorption in clouds, troposphere and stratosphere = 1
 Reflection **from** clouds, earth's surface = 1 (2)

(ii) Explain why only 24% of this incoming radiation is received directly at the earth's surface.

21% of radiation may be diffused via reflection and scattering. (2)

(iii) Describe how the radiation emitted by the earth differs from that emitted by the sun.

Contrast incoming short wave radiation =1 with the earth emitting long wave radiation. (2)

(b) (i) Define the term *Albedo*.

The amount of incoming solar radiation that is reflected by the earth's surface and the atmosphere, expressed as a percentage. (1)

(ii) Account for the variations in ground level albedo values shown in Fig 6.2.

Credit three relevant points 3 x 2

Dark coloured areas (forest, water, urban areas) reflect very little and have low albedo's = 2

Deserts and grassland are intermediate and have albedos of 20%—35% = 2

Snow and ice are the most reflective and have albedo's exceeding 90% = 2

Some surfaces can vary in degrees of reflection have a degree of variability (urban, ploughed land, grassland and forest) =2 (6)

Total [13]

Page 7	Mark Scheme	Syllabus	Paper
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7 Fig 7.1 represents the size of the human population in a country.

- (a) (i) Using the information in Fig 7.1 construct an equation that shows how the total population could remain unchanged over a period of time.

$$B + I = D + E \quad (1)$$

- (ii) Outline one economic and one social factor which would lead to rapid population growth.

Credit the method = 1 and the reason = 1

Economic factors include: better standards of living derived from improvements to food production (Green Revolution) increase life expectancy, financial incentives (taxation, housing benefits) increase birth rates = 2

Social factors include reasons that combine falling death rates with high birth rates. e.g. cultural factors (religion, custom etc) keep the birth rate high whilst improved medical care reduce death rates.

Answers that review refugees can be economic and/or social and should be credited once. Only accept reference to significant rates of migration. (4)

- (b) Fig 7.2 plots the growth in population of a country X between 1950 and 2000. By how much did country X's population rise between 1950 and 2000:

1 1950 and 1970 = 25million

2 1990 and 2001 = 40 million (2)

- (c) One estimate places (X)'s population in 2050 at 338 million. Although X is rich in minerals (particularly oil), according to World Development reports its Gross National Product fell from \$320 in 1992 to \$260 in 1997. Currently, 45% of the population live below the poverty line and literacy is 51%.

- (i) Give two reasons why it is important for countries like X to reduce their rate of population growth.

Credit 2 marks for each of two well developed points.

Overpopulation will lead to a falling GDP, less investment in the social and economic fabric; therefore increasing poverty = 2

Population management including reduced BR's to accompany increased life expectancy = 1

(4)

- (ii) Suggest two reasons why countries such as X may find it difficult to reduce their birth rates.

Credit 2 marks for each of two developed points; one if less developed.

e.g. family tradition, labour, religion, economic etc

(4)

Total [15]

June 2004

GCE AS/A LEVEL

MARKING SCHEME

MAXIMUM MARK: 80

SYLLABUS/COMPONENT: 8290/02

ENVIRONMENTAL SCIENCE

Paper 2 (Options)

Page 1	Mark Scheme	Syllabus	Paper
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Section A

Question 1

(a) higher temperature during day over land compared to over ocean;

Ⓐ land warmer than water during the day

lower temperatures during night over land compared to over ocean

Ⓐ land cools quickly / ocean cools slowly

slow cooling of water means less temperature variation over ocean;

Ⓡ reference to sea breezes

3

(b) areas once close to water are now further away;

water absorbs (large amounts of) solar radiation / heat;

cools slowly;

reduces seasonal variation in temperature;

smaller area of lake reduces this effect;

smaller volume of water stores less heat;

for release in winter;

smaller area of lake so less evaporation;

drier summers / lower humidity / less rainfall;

} linked marks

**max. 5
Total [8]**

Question 2

(a) the Sun;

Ⓐ solar energy / radiation

1

(b) crops grow for only part of the year/some light misses plant/falls on soil / crops don't cover the whole surface

1

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- (c) some light reflected;
some light transmitted / passes through leaves / hits parts that do not photosynthesise;
only some wavelengths of visible light used;

Ⓐ reference to correct specific wavelengths, blue and red

3

- (d) second law of thermodynamics/AW;
products of photosynthesis used for other processes;
respiration;
growth;

max. 2
Total [7]

Question 3

- (a) pyramid A — little variation in percentage of population at different ages;
more females than males at age 75+ / between 0 – 19;
death rate slightly lower than birth rate;

pyramid B — high percentage/50% of population at ages 0 — 24;

- high(er) birth rate;
high(er) death rate; } Ⓐ converse arguments for A
lower life expectancy / more old people in A than in B;
very small percentage of population over 70;
equal number of males and females at each age group;

max. 4

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

(ii) improved medical health facilities;

improved health;

improved education;

greater survival rates;

greater longevity;

birth rate falls;

death rate falls;

max. 5

Total [10]

Total for Section A [25]

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Section B

Option 1

Question 4

- (a) fuels derived from organic materials;
deposited over geological time scales / AW; **2**
- (b) coal;
oil;
gas; **max. 2**
- (c) e.g. for coal – dead organic matter;
mainly land plants;
anaerobic conditions;
swamp;
material buried;
action of pressure;
time scale; **max. 4**
- Total [8]**

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Question 5

low-level / tropospheric ozone;

produced by photochemical reactions;

of NO_x and hydrocarbons from car emissions;

effect of tropospheric ozone;

NO_x involved in formation of photochemical smog;

tropospheric ozone;

and acid rain;

hydroxyl radicals change NO_x to N₂ and O₂;

which are harmless;

CO₂ emitted as product of combustion;

effects of tropospheric ozone (if not already given) / acid rain;
greenhouse gas;

increases greenhouse effect;

leads to global warming;

minimum 1 mark for each section to

max. 8

Total [8]

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Question 6

(a) fusion – two light / hydrogen atoms fuse;

at extreme temp. / pressure;

produced heavier element;

fission -- splitting of atom;

by bombarding with neutrons;

daughter / lighter element released;

with more neutrons;

2 elements produced;

less energy than fusion;

max. 4

(b) fusion - technical difficulties / costs;

to provide conditions needed;

} linked marks

and control energy release; (or converse arguments for fission)

max. 2

(c) advantages – low emissions of greenhouse gases / other example of polluting gas e.g. SO₂

long lifetime of nuclear fuel resources;

2

disadvantages – high cost of plant; ® “too expensive” unqualified

environmental problems of nuclear waste;

accident / security / weapons concerns;

max. 2

Total [10]

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Question 7

- (a) strength / constancy / reliability of wind;
availability of sufficient area of land;
visual impact;
access / electrical connection;
noise objections;
safety of site (e.g. re. shipping for offshore sites);
interference with radio signals;
specific environmental concern e.g. SSSI, bird migrating route; **max. 4**
- (b) renewable;
clean / no pollution / greenhouse gases;
land can be returned to agriculture / not contaminated; **max. 2**
- (c) less environmental impact / objection to visual impact / objections to noise/
greater wind reliability; **max. 1**
- Total [7]**

Question 8

- (a) (i) joules; **1**
- (ii) $(E =) mgh$; **1**
- (iii) friction in pipes;
water still has some kinetic energy;
losses via sound energy;
losses in turbines; **max. 2**

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(b) earthquakes / instability;

environmental impact of flooding land for reservoir;

siltation;

effects on local climate;

spread of water-borne pests / diseases;

max. 3

Total [7]

Question 9

(a) gravitational pull;

of Moon (and Sun);

Earth's rotation means high tide occurs twice in just over 24 hours;

when Moon and Sun are in line tides are higher / spring tides;

ref. To Coriolis force;

geomorphology of sea-bed;

OVP;

max. 5

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(b) (i) barrage constructed across estuary;

contains sluice gates;

and turbines;

tide produces difference in water levels on either side of barrage;

energy produced is proportional to difference in levels;

water turns turbines when released;

flow through sluice gates is controlled;

max. 5

(ii) renewable energy;

no greenhouse gas emissions / toxic waste;

regularity of tides is reliable;

reduced wave velocity may reduce coastal erosion;

loss of / damage to, coastal habitats;

effects on flora and fauna;

effects on water quality;

only small number of suitable locations with sufficient tidal rise and fall / AW;

max. 5

Total [15]

Total for Option 1 [55]

Option 2

Question 10

(a) $\frac{5580 - 219}{5580}$;

x 100 ;

96%

3

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(b) acts as strainer / screen to remove particles;
micro-organisms (on sand grains);
decompose organic matter; 2

(c) does not affect taste of water; 1

Total [6]

Question 11

(a) tree roots bind / stabilize soil;
tree canopy reduces rain impact;
trees slow flow of surface water;
trees reduce wind impact;
effect of leaves / debris on soil surface;
removal of trees allows rain / flowing water / wind to erode soil; max. 4

(b) (i) enrichment of fresh water;
by excess nutrients;
usually nitrates / phosphates; max. 2

(ii) plant debris enriches nutrient levels as it rots;
increase in microscopic photosynthetic organisms / algae / algal bloom;
large numbers of algae die;
broken down by bacterial action;
uses O₂/O₂ levels fall;
other organisms die from lack of oxygen; max. 4

Total [10]

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Question 12

(a) tropical / hot and wet / drying out;

trees and grass;

2

(b) leaching;

removes minerals;

except iron / aluminium;

very high bacterial activity / rapid decomposition of organic matter;

removes humus;

max. 4

(c) very hard when dried;

red colour;

little humus;

max. 2

Total [8]

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Question 13

(a) (i) rain seeps through landfill;

substances from waste dissolve in water;

liquid;

seeps through base of landfill;

likely to be toxic;

max. 2

(ii) leachate – may enter water supplies;

toxic materials contaminate ground which may be developed at a later date;

landfill gas – flammable;

so fire hazard;

greenhouse gas;

contributes to enhanced greenhouse effect;

max.3 for either leachate or landfill gas to max. 4

(iii) use of impermeable liners prevent escape of leachate;

leachate drained;

and treated to make harmless;

landfill gas piped / collected;

burned off;

may be used for energy supplies

max. 3

(b) vermin / smell / large areas of land needed / OVP;

1

Total [10]

Question 14

(a) $(0.4 + 1.6 + 0.7) - (0.2 + 1.1 + 0.6) = 2.7 - 1.9;$

0.8 kWh;

2

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- (b) (i) transport of raw materials and bottle factory and transport to bottling plant; 1
- (ii) energy used per trip after second trip is $3.6 \div 2 = 1.8$ kWh;
for non-refillable bottle one trip uses 1.9 kWh; 2
- (iii) transport back to bottling plant for re-filling (as well as to shop); 1
- Total [6]**

Question 15

- (a) (i) tanker accidents at sea;
washing tanks at sea;
spillage when unloading;
other losses from refineries / industries;
drilling platform blow-outs; **max. 4**
- (ii) oil washed up on coastline;
affects plants / animals in this habitat;
example of effect;
damage tourism;
oil slicks result in seals / sea-birds covered with oil;
which is toxic;
bird animals ingest this when they preen;
affects buoyancy / flight / insulation; **max. 5**

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- (b) use of dispersants / detergents;
to break up slick;
detergents are toxic;
use of booms;
which float;
contain slick;
which can be removed by suction;
skimmers / nylon “fur”;
remove oil from surface;

max. 6

Total [15]

Total for Option 2 [55]

Option 3

Question 16

- (a) mechanism for evolutionary change;
variation within a population;
over-production of offspring;
competition / selection pressure / survival of the fittest;
differential survival / mortality of variants;
selective advantage of feature / e.g.;
ref. to changes in allele frequency;
ref. to passing on alleles;

max. 5

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- (b) (i) all seedlings survived in batch B but not in A; 1
- (ii) the mean height was greater at all distances in batch B; 1
- (iii) soil close to mine has high Cu content;
- seeds surviving here have allele for Cu tolerance;
- selection has favoured these in this environment;
- reproduce and pass on allele;
- become more numerous;
- plant from further away less likely to have this allele; max. 3
- Total [10]**

Question 17

- (a) larger population produces increases demand / more urban
- development leads to less agricultural land so greater production
- from land remaining / more production for export required to generate foreign exchange; 1

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- (b) (i) growing a single crop on the same land year after year; 1
- (ii) same nutrients used each year by the crop must be replaced; 1
- (iii) resistant pests / residues in soil / residues on crops / build up in animals at end of food chain; 1
- (iv) machinery is heavy;
soil particles pressed together;
reduces air spaces; max. 2
- (v) contour ploughing;
terracing;
grass bunds;
cover cropping;
mulching;
windbreaks;
any other valid method; max. 2
- Total [8]**

Question 18

- (a) more people so more areas cleared;
regeneration period between cultivations on given area is reduced; 2
- (b) fertility declines; 1
- (c) time for fertility to recover is reduced;
regeneration of forest is less;
so less ash when cleared again; max. 2
- Total [5]**

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Question 19

- (a) (i) rate of catch exceeds rate of replacement 1
- (ii) smaller catch for same effort;
- fewer large / mature fish; 2
- (b) (i) larger mesh;
- only large fish caught / small / immature fish escape;
- to reach reproductive age; max. 2
- (ii) all species caught;
- plants damaged / destroyed;
- habitat damaged;
- effects on food chain;
- clouding caused by disturbing sea bed; max. 3
- Total [8]**

Question 20

- (a) ranching provides reliable supply from animals;
- more products available;
- domesticated animals are more productive;
- less energy expended;
- settled existence;
- higher stocking rate / better use of land;
- OVP; max. 3

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(b) (i) correct stocking rate for an area / area needed per animal to produce efficiently without damage to grazing land; 1

(ii) lower production;

overgrazing / degraded grassland;

soil erosion;

max. 2

(c) overgrazing occurs;

more trampling damages grass;

less grass / less nutritious grass, available;

starvation / malnutrition of livestock;

poor health;

reduced production;

max. 3

Total [9]

Question 21

(a) role of photosynthesis in carbon cycle / carbon sinks;

transpiration and water cycle;

use as fuel;

e.g. of other use;

e.g.'s of other forest products;

importance of habitat;

diversity of other species;

max. 5

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(b) (i) loss of habitats;

loss of species;

importance of biodiversity / e.g.;

loss of fuel supplies in rural areas;

local climate change;

increased run-off;

soil erosion;

danger of landslides;

danger of flooding;

max. 6

(ii) management plans / laws / international agreements;

in temperate forests – coppicing;

rotation;

selective felling;

replanting;

mixed planting;

in tropical forest – control of tropical wood sales;

max. 4

Total [15]

Total for Option 3 [55]

