IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
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MARKSCHEME

November 2005

ENVIRONMENTAL SYSTEMS

Standard Level

Paper 2

12 pages

If you do not have a copy of the current Environmental Systems guide,
please request one from IBCA.

Subject Details: Environmental Systems SL Paper 2 Markscheme

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- Each marking point has a separate line and the end is signified by means of a semicolon (;).

- An alternative answer or wording is indicated in the markscheme by a "/"; either wording can be accepted.

- Words in (…) in the markscheme are not necessary to gain the mark.

- The order of points does not have to be as written (unless stated otherwise).

- If the candidate's answer has the same "meaning" or can be clearly interpreted as being the same as that in the mark scheme then award the mark.

- Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalizing them for what they have not achieved or what they have got wrong.

- Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

- Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with **"ECF"**, error carried forward.

- Units should always be given where appropriate. Omission of units should only be penalized once. Indicate this by **"U-1"** at the first point it occurs. Ignore this, if marks for units are already specified in the markscheme.

- Do not penalize candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

SECTION A

1.   (a)   *Award [1] for each row but both numbers must be correct and must add up to 100 %.*

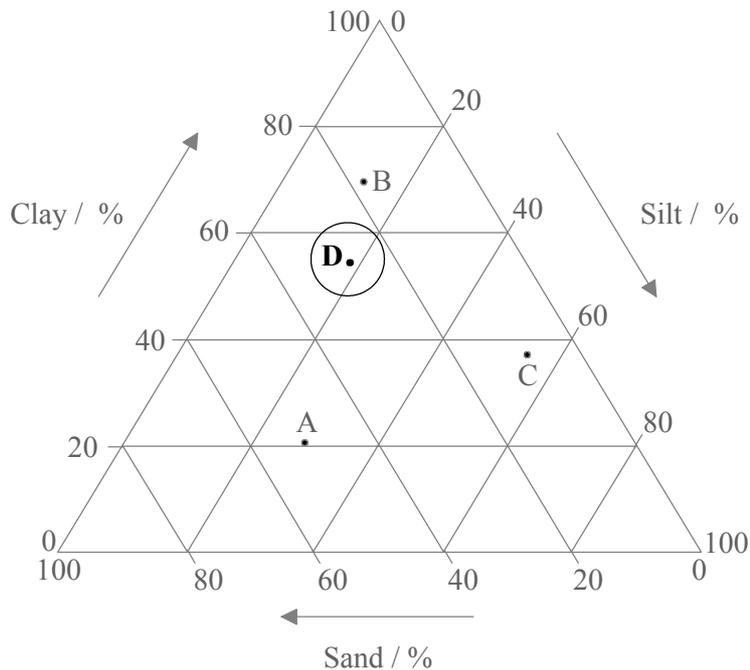| Sample name	Sand / %	Silt / %	Clay / %
A	51	28	21
B	**18** (± 2)	12	**70** (± 2) ;
C	8	**55** (± 2)	**37** (± 2) ;

[2 max]

(b)   (i)   sand: 27 % / 27.27 % $\left(\dfrac{33 \times 100}{121} \right)$;

silt: 19 % / 19.00 % $\left(\dfrac{23 \times 100}{121} \right)$;   *[2]*

(ii)   *Dot D must fall within the circle to receive the mark.*   *[1]*
Allow ECF from (i).

(c)   soil B has a high proportion of clay;
so particles are very small / closely packed / small pore spaces;
water cannot infiltrate/drain through soil (easily);   *[2]*

(d)   water retention increases;
increased fertility / productivity / nutrient content;
soil structure improves / becomes lighter to work / easier root penetration;
increase in biota / number of living organisms;   *[2 max]*

2.   (a)   (i)   increase;   *[1]*

           (ii)   1 240 thousand / 1 240 000 / 1.2(4) million / $1.2(4) \times 10^6$;   *[1]*
                Allow ± 100 000.

           (iii) in 2020, these females will all be of reproductive age;
                this helps to predict birth rate over next 20 years;
                affects number of births / *OWTTE*;   *[2 max]*

           (iv)   *Provision of*:
                health care;
                education;
                housing;
                water and sewage treatment;
                food;   *[2 max]*

    (b)   contraceptive advice / family planning clinics;
        free contraceptives;
        better female education;
        punitive measures against larger families *e.g.* Chinese one-child policy;
        better medical care for children / reduction in infant mortality;   *[3 max]*

    (c)   pyramid has straight sides, for younger ages;
        number of females in younger age groups is stabilizing;
        indicating population is no longer growing exponentially;   *[2 max]*

3. (a) (i)   transpiration from plants or respiration from plants / animals / living organisms transform water to water vapour (which is released to atmosphere);   *[1]*

(ii)   denitrifying bacteria change nitrates/nitrites/ammonia to nitrogen gas (in anaerobic environment);   *[1]*

(iii)   phosphate/phosphorus is leached from soils and rocks by run-off/percolation;   *[1]*

(iv)   carbon from living organisms is incorporated in soils by action of decomposers / incorporated in rocks by processes of sedimentation / fossilization / formation of fossil fuels;   *[1]*

(b)   water plant absorbs phosphates;
fish eats water plant and assimilates phosphate;
bird eats fish and assimilates phosphate;   *[2 max]*
Award [1] for two correct and [2] for three correct.

(c)   fish population decreases / disappears;
because acid causes fish gills to become clogged with mucus/fish to suffocate;
aluminium (ions) leached from soil / fish poisoned by aluminium   *[2]*

(d)   lime from rocks containing lime / calcium ions / chalk could be put in lake to neutralize acid;   *[1]*

(e)   the lake is an example of an open system because it has inputs and outputs of **both** materials and energy / *OWTTE*;   *[1]*
To receive the mark, an open system and suitable explanation are required.

SECTION B

General Essay Markscheme

Each essay is marked out of *[20]* of which *[3]* are for expression and development of ideas (EDI).

[0] No expression of relevant ideas.
[1] Expression and development of relevant ideas is limited.
[2] Ideas are relevant, satisfactorily expressed and reasonably well developed.
[3] Ideas are relevant, very well expressed and well developed.

4. (a) *methane*:
anaerobic respiration / decomposition in rice paddies;
anaerobic respiration / decomposition in landfill sites;
leakage of gas from pipes / wells / appliances;
fermentation in stomach / intestines of farm animals;

ozone:
formed by action of light on pollutants;
nitrogen dioxide from burning fossil fuels is broken down by light;
unburned hydrocarbons from vehicles / industry are broken down by light;

sulfur dioxide:
burning oil or coal (containing sulfur) in power stations / vehicles;
smelting of (sulfide) ores / metals;   *[7 max]*
For full credit, answers must describe at least one process for each pollutant gas.

(b) (i) *e.g.* sulfur dioxide forms aerosols which reflect heat back to space;
so reduces global temperature;
methane / ozone / sulfur dioxide are greenhouse gases;
so increase global temperature;

which may lead to:
increased incidence of hurricanes / extreme weather patterns;
changes in rainfall / cloud cover in some areas;
some areas becoming cooler and some warmer;   *[4 max]*
Do not credit melting of ice-caps / rising sea levels and other effects e.g. on vegetation which are not effects on global climate.

(ii) warmer temperatures may increase productivity in some areas / cooler temperatures may decrease productivity in some areas;
but available water / insolation may also limit changes in productivity;
sulfur dioxide aerosols may reduce global temperature/insolation and hence reduce productivity;
climatic zones favouring high productivity may migrate polewards so that they lie over infertile soils / oceans, reducing productivity;
ozone damages plants;   *[3 max]*
Reject reference to damage to living organisms by UV light resulting from ozone depletion.

(c)   flue gas desulfurisation / scrubbers;
        reduce impact of existing technology which cannot be replaced in short-term; (*e.g.*
        coal fired power stations);
        but exploit another natural resource (limestone);

        switching to low sulfur fuels;
        is often more expensive;
        so may not be an option in LEDCs;

        switching to alternative fuels (*e.g.* hydrogen, ethanol);
        involves conversion of engines which is expensive;
        new infrastructure needed to ensure reliable supply;

        reducing energy use;
        has advantage of reducing emissions of all pollutants produced by burning fossil
        fuels;

        changing to renewable energy sources;
        may still involve some pollution in production of solar panels *etc.*;

        international agreements;
        have global impact;
        but are hard to implement / police;   *[3 max]*
        *Credit other valid suggestions, but responses must contain an element of evaluation
        to gain full credit here.*

                                                            Expression of ideas [3 max]

                                                                    Total [20 max]

5.   (a)   *Although there is no credit allowed for naming a specific ecosystem, answers are*
expected to include consistent and correct examples from one system.
For full credit, answers must refer to all three-herbivores, parasites and predators.
herbivores feed only on plants;
e.g. emperor moth caterpillar eats heather;
predators are animals feeding on other animals by hunting them;
e.g. fox catching rabbit;
both plants and animals may host parasites;
e.g. mistletoe on apple trees or fleas on a rabbit;
parasites live in or on some part of their host;
so are generally smaller than their host *e.g.* tapeworm in fox;
predators usually kill their prey in order to feed;
parasites cause harm to host by feeding on it, but often do not kill it;   ***[8 max]***
*If no examples given award **[6 max]**.   Award **[3 max]** for good examples.*

   (b)   *Award **[3 max]** for graph.*
both graph axes labelled correctly *i.e.* population size on *y*-axis and time on *x*-axis,
and predator and prey lines identified by label or key;
fluctuations of populations shown with predator peaks lagging prey peaks;
predator line shown with lower average population size than prey;

Explanation (could be explained by annotations on graph and/or reference to
*examples) **[3 max]**.*
predator and prey populations fluctuate about an equilibrium position (carrying
capacity);
these fluctuations may be partly seasonal;
predator population fluctuations are similar to those of prey population;
predator peaks lag behind prey peaks, because predator population can only breed
after prey becomes plentiful;
predator populations are normally lower than prey populations because predators
feed at a high trophic level / are carnivores;   ***[6 max]***

   (c)   parasites (*e.g.* fleas on a rabbit);
spread more rapidly when host population is high;
because it is easier for parasite to locate a host at high densities / parasitic infection
is a density dependent factor;
large infections of parasites reduce reproductive success / kill host;
which reduces population to lower densities so parasites become less abundant;   ***[3 max]***
*Award **[2 max]** if both parasite and host are not named.*

*Expression of ideas **[3 max]***

Total [20 max]

6.   (a)   sustainability is the exploitation of natural income without causing long-term deterioration of natural capital / *OWTTE*;
sustainable yield is the rate of increase of natural capital which can be exploited without depleting the original stock / *OWTTE*;   *[2]*

   (b)   *food production*:
crops or animals are renewable resources;
food can be produced sustainably provided that farming procedures do not cause long-term damage to soil;
e.g. use of contour plowing techniques;
salinisation of soils can be caused by excessive irrigation;
restrictions on hunting/fishing of wild populations (*e.g.* fish) may be needed to conserve breeding stock;
lower density stocking of animals needed to minimize damage to soil/vegetation;
Any other appropriate examples.

fresh water:
fresh water resources are replenished by the water cycle;
fresh water is used sustainably if the rate of extraction is no greater than the rate of replenishment;
e.g. by aquifer recharge, rainfall *etc*.;
over-exploitation of aquifers in coastal areas can cause intrusion of salt water;
lowering of water table;
e.g. parts of coastal western Australia;
over-extraction of river water reduces flow downstream / affects ecosystems / affects fishing;
e.g. Murray River;
water can be used more sustainably by reducing wastage;
e.g. more water-efficient appliances (low flush toilets, water saving taps *etc*.);
use of grey or recycled water for purposes other than drinking and cooking;
mending leaks;
drip irrigation systems;   *[10 max]*
Allow any other valid points and examples.
Award [7 max] if only food or water are discussed.

   (c)   non-renewable resources cannot generate natural income;
examples include metals and aggregates (*e.g.* sand, gravel, lime, stone);
exploitation of non-renewables depletes natural capital;
non-renewables should be recycled;
e.g. aluminium cans to make new aluminium goods;
buildings / machines should be designed to minimize use of non-renewables;
buildings / machines should be designed to be easily repaired (avoid built in obsolescence);
redundant buildings / machines should be dismantled and their components re-used;
unwanted goods containing non-renewables should be relocated where they can be used *e.g.* bicycles / spectacles from developed world to Africa;   *[5 max]*

Expression of ideas [3 max]

Total [20 max]