MARKSCHEME

November 1999

ENVIRONMENTAL SYSTEMS

Standard Level

Paper 2

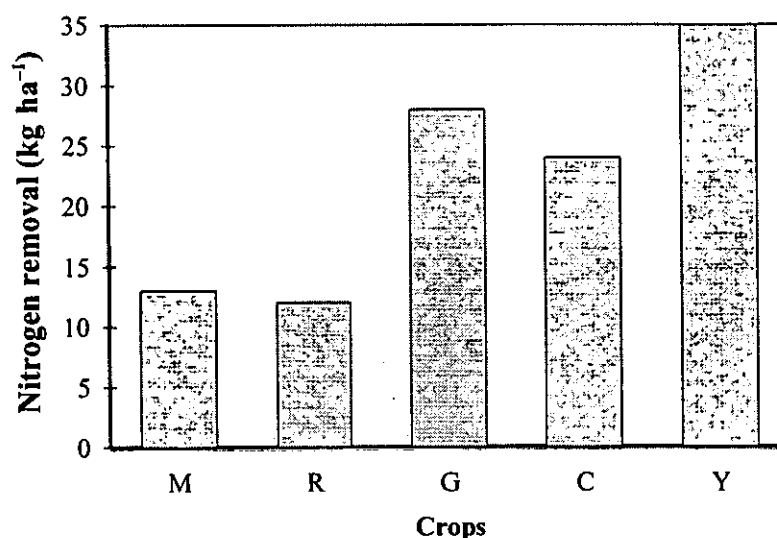11 pages

Section A

1. (a) Proteins contain nitrogen and are required by organisms for growth and repair *[1]* / nitrogen
        content relates to protein / amino acid content *[1]*.   *[1]*

    (b) 900 x 15/1000 = 13.5 kg ha^{-1}
         1000 x 12/1000 = 12 kg ha^{-1}
         700 x 40/1000 = 28 kg ha^{-1}
         10 000 x 2.4/1000 = 24 kg ha^{-1}
         10 000 x 3.5/1000 = 35 kg ha^{-1}
         *Award [1 mark] for 1-3 correct answers, [2 marks] for 4 correct, [3 marks] for all 5
         correct. Single consistent error.*
         e.g. forgetting to convert to kg, award [2 marks].   *[3]*

    (c)

**Bar Chart to Compare Nitrogen Removal
by crops**

         Effectiveness of presentation *i.e.* clarity, accuracy *[1]*;
         Correct choice of graph style *[1]*;
         Correct selection of axes and scales *[1]*;
         Correct labelling of axes, units, title *[1]*.   *[4]*

    (d) groundnut   *[1]*

    (e) yam   *[1]*

(f)   (i)   increased by decomposition of remaining organic matter in soil *[1]* / release of further
nitrates from the soil *[1]*; precipitation containing nitrates *[1]*   *[2]*

       (ii)   roots of Stargrass brought up nitrates from lower soil levels *[1]* / decomposition of
Stargrass roots and leaves *[1]* / aeration of soil by roots so increased nitrification *[1]* /
increased rain infiltration as roots made channels *[1]*   *[2]*

       (iii)   kudzu has a (symbiotic) relationship with *Rhizobium* / nitrogen-fixing bacteria *[1]* /
fixes nitrogen from the air to nitrates *[1]* / nitrates fixed are released as plant dies *[1]*
('Symbiotic' not essential for [1 mark])   *[2]*

(g)   1 year of kudzu brings 140 N ha⁻¹ to soil. Groundnuts remove 28 kg ha⁻¹ per year. Therefore
kudzu would have to be grown for 1 year every 140/28 = 5 years of groundnuts
Award [1 mark] for correct principle, [1 mark] for correct arithmetic. Use follow on if (b)
is incorrect.   *[2]*

(h)   removal of other components in crops may not be sustainable -
e.g. removal of water *[1]* / other nutrients *[1]*; increase of salinisation through irrigation *[1]* /
change to soil texture *[1]* / any reasonable statement *[1]*   *[2]*

Total 20 marks

SECTION B

> **General Essay Markscheme**
> Each essay is marked out of 20 of which 3 are for expression and development of ideas.
>
> 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.

2. (a) minimum of six genuinely interrelating species *[2]*

correct construction of food web (arrows in direction of energy flow, appropriate links, clear layout) *[1]*;
name the ecosystem and brief description *[1]*   *[4]*

(b) must make some reference to the concept of ecological niche
e.g. 'a species share of a habitat and the resources in it' (from programme guide) *[1]*;
not only where a species lives but what it does - includes its feeding, structural and behavioural niches *[1]* /
relate to the herbivore species *[1]*.   *[2]*

Native species at same trophic level:
will be in competition *[1]*;
because they may share the same food sources *[1]* / may lead to decline in population of either native or the introduced species *[1]* / cannot become established *[1]*;   *[2]*

Native species at other trophic level: species at higher trophic levels may benefit *[1]*;
as additional food source *[1]* /
lower levels (producers) may decline *[1]*; as increased feeding *[1]* / insufficient defence to a new feeder *[1]*;   *[3]*

Introduced species: may either benefit *[1]*; because it has resistance to predators / parasites / disease *[1]* / be better able to digest local vegetation *[1]*; or may fail to establish itself *[1]*; because of poor adaptation to climatic conditions *[1]* / poor defence against local predators / parasites / disease *[1]* /
lack of suitable food that it can digest *[1]* /
lack of suitable breeding sites *[1]*;
[up to [2 marks] for increase or decrease and reason and additional mark if discuss both increase and decrease]   *[3]*

Equilibrium: likely to be disturbed *[1]*; from a steady state / stable one *[1]* / to either a new equilibrium including the introduced species *[1]* / or return to the original if the species becomes locally extinct. *[1]*   *[3]*

expression and development of ideas **max 3 marks**

Total 20 marks

3. (a) *Candidates may either give detailed description and comment on two types of storage or less information on more. Both are equally valid and award marks appropriately. Award marks for appropriate diagrams. (Clouds and atmospheric moisture are NOT in or on the earth's surface so do not merit any marks as storages.)*
e.g.
storages - any of:
groundwater / aquifers / rivers and streams / lakes and ponds / snowfields, icecaps and glaciers / *[3]*
Award [2 marks] for 2 or 3 storages, [3 marks] for 4 or more storages.
Processes of replenishment - any of:
infiltration or seepage into ground water / direct precipitation into lakes or rivers / run-off into lakes or rivers / groundwater flows into rivers and lakes / compaction of snow in snowfields into ice / icecaps / gravitational movement from icecaps into glaciers.

Award [3 marks] for 2-3 correct processes, [4 marks] for 4 correct or more detail of 1 or 2. Processes must relate to storages named. *[4]*

(b) discussion to include definition of sustainable / unsustainable
e.g.
to be sustainable there must be no long-term depletion of storages *[1]*; and no deterioration of water quality *[1]*; unsustainable extraction practices might include; extraction of water from fossil aquifers (non-renewable) *[1]* / rates of extraction from storages greater than rates of replenishment *[1]* / pollution of storages by leakage or disposal of agricultural / industrial pollutants *[1]* / saline intrusion of aquifers through over-pumping excessive irrigation in semi arid agricultural areas leading to salinisation *[1]* / any other reasonable suggestion *[1]* / named example *e.g.* depletion of aquifer at Palm Springs, USA *[1]*
3 methods: 1 mark for outline, 1 mark for evaluation x 3 *[4]*
e.g.
reduce leaks in transmission system *[1]*; significant in older systems mainly in developed world *[1]* /

reduce rate of water usage *[1]*; only practical in developed world, where water use is often excessive *[1]* / may lead to health problems *[1]* / in developing world, increasing water use correlates with improved health *[1]* /

more storage of water at times of high river flow *[1]*; building of reservoirs inevitably disrupts existing ecosystems *[1]* / damming of rivers to store water is even more destructive *[1]* /

collection of rainwater *[1]*; can normally only be done on a small scale, but if done by many is significant *[1]* /

monitoring of water levels *[1]*; could reduce environmental damage by controlling excessive extraction at particularly sensitive sites *[1]* /

encourage recycling of 'grey water' for non-drinking purposes *[1]*; again probably only relevant to developed countries *[1]* / but could reduce unsustainable extraction by reducing overall demand *[1]* /

Any other reasonable suggestion *[1]*; suitably evaluated *[1]* *[6]*

expression and development of ideas **max 3 marks**

Total 20 marks

4.   (a)   Troposphere:
             burning of fossil fuels in vehicle engines results in release of nitrogen oxides *[1]*;
             photolysis of NO_2 to NO and O which combines with O_2 to form ozone *[1]* / photochemical
             reaction of NO_2 and hydrocarbons to form ozone *[1]*; increase of ozone in troposphere *[1]*.   *[3]*

             Stratosphere: gases released - CFCs, HCFCs from refrigerants and aerosols, methyl bromide
             from pesticides, halons from fire extinguishers, *etc. [1]*;
             all liberate Cl atoms in presence of UV light which combine with O_3 to form O_2 *[1]* / chain
             reaction *[1]*;
             decrease in stratospheric ozone *[1]*.   *[3]*

      (b)   Tropospheric ozone: eye irritant / irritates lungs / leaf damage / damage to unsaturated
             polymers (plastics / rubber) / contributes to greenhouse effect *[2]*;

             Stratospheric ozone: depletion allows more UV light through / skin cancer / cataracts in
             animals / decrease in productivity of phytoplankton *[2]*;

             Tropospheric ozone increases are fairly local so relatively low impact on stability of
             biosphere *[1]*;

             Stratospheric ozone depletion has a potentially significant global impact - reduction of
             productivity of marine food webs *[1]*   *[6]*

      (c)   *Award up to 4 marks for full treatment of either international or local alone. (Full 5 marks
             cannot be given unless both are at least mentioned.)*
             Vienna Convention signed by some UN countries in mid-80s *[1]* / Montreal Protocol 1987,
             agreement to half CFC production by 2000 *[1]*;
             London Amendment 1989, agreed to stop all CFC, halogen and CCl_4 production by 2000 *[1]* /
             Also fund to help LDC's switch to eco-friendly technology *[1]*;
             campaigns by Greenpeace and similar conservation organisations *[1]*;
             Local - national / state legislation to implement international agreements as appropriate to
             local conditions / name of statute / regulations on disposal of fridges / aircons / changing
             aerosol propellants *[1]*;
             Success:
             considerable - most signatories to agreements already met their commitment. *[1]*; but export of
             CFCs from MDCs to LDCs occurs *[1]*.   *[5]*

                                                          expression and development of ideas **max 3 marks**

                                                                                              Total 20 marks