

MARKSCHEME

November 2001

ENVIRONMENTAL SYSTEMS

Standard Level

Paper 3

SECTION I

1. (a) *Naming and describing the ecosystem studied is not awarded marks but is useful for the examiner in relating subsequent answers. For example, intertidal rock pool on rocky shore at Robin Hood's Bay, north-east coast of England.*

Stating both names **[1]**

(i) and (ii) common or scientific names are acceptable but 'fish', 'grass', 'frog' are not. E.g. accept Littorina littoralis / the flat periwinkle, but not 'shellfish'; 'Algae' allowed on the basis that identification at species level is difficult.

[1]

If only one species given, award no mark.

- (b) Measure abundance **[1]** / e.g. by quadrat / transect sampling if non-motile animal or plant **[1]** / by capture–mark–recapture if motile animal **[1]** / or reasonable method for the species named **[1]**;
determine changes in abundance; repeat sampling procedure **[1]**; over weeks / months / seasons / years **[1]**; ensure sampling is consistent and replicated **[1]**
[2 max] if no mention of measurement of changes in abundance over time

[3 max]

- (c) Biotic: e.g. competition / predation / disease
Abiotic: e.g. light / temperature / precipitation / salinity / tides
*Only award **[1]** if both are correct and relate to the selected ecosystem*

[1]

- (d) *Human activities will increase or decrease abundance depending on activity. Accept any reasoned arguments, **[1]** for each species and **[1]** for overall answer.*
*e.g. in the intertidal pool, sewage discharge by long-fall pipes into the sea **[1]**;
may increase nutrients in rock pool → increased algal growth **[1]**; → more flat periwinkles as grazing herbivores **[1]** /
Or increased predation by humans of periwinkles for food **[1]**; less periwinkles **[1]**; → more algae as less grazing **[1]***

[3 max]

- (e) Range of alleles present in the gene pool of a species **[1]** / variety of genotypes present in a population **[1]** / (*owtte*);
A species may be abundant / high number of individuals but its genetic diversity might be low, e.g. monoculture of a wheat crop **[1]** / small range of genotypes due to inbreeding, e.g. domesticated chickens **[1]**; in a wild, natural population, larger numbers may be associated with greater diversity **[1]**;
Decreased genetic diversity makes a species less adaptable if the environmental conditions change **[1]** / less scope in the genotype for adaptation **[1]** / abundance does not necessarily mean a species will survive **[1]** /
A species that has been close to extinction and then recovered, may have impoverished genetic diversity e.g. buffalo, some seal species. **[1]**

[3 max]

(f) *Allow [2] for each ecosystem.*

e.g. bathyal zone vs. intertidal rock pool

bathyal – no light [1]; no green plants as producers [1] / low temperature [1];

material inputs from dead organisms above [1]; little variation [1];

rock pool – light input [1]; producers are brown or green algae [1]; tidal

range means pool is refreshed with nutrients twice a day [1]; desiccation

possible [1]

[4 max]

SECTION II

Option D

2. (a) Coal use has decreased proportionally → better for environment as less sulfur / acid rain / less smog [1]; oil use has increased → oil spills in oceans [1] / carbon dioxide released to atmosphere as in coal and natural gas combustion [1]; proportional increase in ‘cleaner’ fuels of hydro-electric and nuclear is small [1]; credit any reasonable explanation [1] [3 max]
- (b) Allow [2] for advantages and [2] for disadvantages.
 e.g. nuclear: advantages – cheap electricity [1]; no release of carbon dioxide [1] /
 disadvantages – possibility of radioactivity release [1]; expensive to build nuclear power stations [1]; danger of acquisition of nuclear material by terrorist groups [1]; problems of waste disposal [1]; expense of eventual decommissioning [1] [4 max]
- (c) Name [1]; evaluation [2]
 e.g. wood [1]; can replant trees that are felled [1] / to provide a sustainable yield [1] / large volume required [1] / heat of combustion is not as high as fossil fuels [1] / seldom used to generate electricity [1] / any reasonable points [1] [3 max]
- (d) Ecological footprint of a population is the area of land that would be required to provide all its resources and assimilate all its wastes (*from the subject guide*) [1]; land in the same vicinity as the population [1] / is the inverse of carrying capacity [1]; for Singapore, the population requires 264 times the land area of Singapore to maintain it [1]; Singapore is not self-sustaining [1] / Singapore imports most requirements and exports wastes [1] [3 max]
- (e) Ecological footprint will decrease in size [1]; because vegetables require less energy input than meat [1] / eating meat adds another link in the food chain – energy is lost at each trophic level [1] [2 max]

Option E

3. (a) *Description [1]; explanation [2].* Number of species inversely proportional to altitude [1] / Lower the altitude, more bird species [1]; at higher altitudes, temperature decreases so less NPP and so less food for birds [1]; less species at 3000 m and over as there is less land at these heights [1] / less ecological niches at altitude so less diversity [1] / low biological productivity of high altitude ecosystems [1] 0-500 m may include sea birds [1] / any reasonable explanation [1] [3 max]
- (b) Habitat diversity – the range of different habitats per unit area [1];
Species diversity – the heterogeneity of species in a given area [1] [2]
- (c) *Award [1] for each of two reasons.*
e.g. because it is morally right to do so / aesthetic reasons / because humans use other species for medicine / crops / food / drugs / resources / because the gene pool is reduced if species become extinct / some uses of species not yet discovered [2 max]
- (d) *Award [1] for each of three reasonable characteristics.*
e.g. large enough area for a viable population of top carnivores [1] / in one block of land / water that is not spread out but compact in shape [1] / minimise edge:area ratio [1] / corridors between smaller areas [1] / legislation / purchase of land to protect it [1] / agreement of humans living in or around the area [1] / minimise harmful edge effects [1] / variety of habitats [1] [3 max]
- (e) *Award marks for any reasonable changes described (positive or negative).*
e.g. increase in landscape variation to increase range of habitats [1] / planting of more trees / bushes [1] / digging of ponds [1] / active management to prevent deterioration [1] / education of humans living nearby [1]
- or**
- spreading of exotic species from cultivated areas / towns nearby (e.g. weeds, feral cats) [1] / farm land runoff causing water pollution [1] / disturbance of wildlife by humans [1] / contamination of forest ecosystems by pesticide [1] / burning and development of fire-tolerant species and ecosystems [1]. [2 max]
- (f) *Award [1] for brief description of named area and up to [2] for management strategies.* [3]

Option F

4. (a) (i) Twin peaks corresponding to times of maximum traffic / vehicles on road [1]; as people go to and from work / school at beginning and end of day [1] / lowest after midnight when traffic very light [1] [2 max]
- (ii) Combines with haemoglobin in blood in place of oxygen [1] / replaces oxygen in blood [1] / forms carboxyhaemoglobin [1] / suffocates humans [1] [1]
- (iii) *Description* [1]; *evaluation* [2]
e.g.: better and / or cheaper public transport [1]; encouraging people to leave cars at home [1]; but this requires massive investment [1] / taxes on cars entering city [1]; but this discriminates in favour of richer people [1]; still have emissions from public transport / more use of electric or alternative fuelled vehicles to reduce emissions [1]; but this may just move source of pollution to power station [1]; not reduce some toxic emissions significantly [1]; encourage use of catalytic converters [1] [3 max]
- (b) The addition to the natural environment of any substance or agent at a rate higher than the environment can render harmless [1] (*owtte*) [1]
- (c) *Require both definition and example for* [1].
 Biodegradable – those which are broken down by natural decay processes, *e.g.* food scraps, garden refuse [1]
 Recyclable – those which are recovered from waste for reprocessing into new resources, *e.g.* metals, glass [1] [2]
- (d) *Process of assessment* [3]; *problems* [3]
e.g.: assessment: carry out EIA (Environmental Impact Assessment) EIS (Environmental Impact Statement) [1]; make a baseline study of what is present beforehand [1]; measure *e.g.* species diversity / air quality / soil types / run-off water analysis [1]; long-term monitoring if site is established [1]; Problems: methane release from decomposing landfill [1]; smells [1]; rodents [1]; increased traffic to landfill site [1]; leaching of materials in run-off from site [1]; pollution of groundwater [1]; seagull population increase [1]; any reasonable suggestions [1] [6 max]
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