ENVIRONMENTAL SCIENCE

SECTION II

Time—90 minutes

4 Questions

Directions: Answer all four questions, which are weighted equally; the suggested time is about 22 minutes for answering each question. Write all your answers on the pages following the questions in the pink booklet, NOT on the green insert. Where calculations are required, clearly show how you arrived at your answer. Where explanation or discussion is required, support your answers with relevant information and/or specific examples.

1. On a field trip to two local ponds, a group of students observed a difference between the two ponds in the diversity of worms and insect larvae living in the mud and debris near the edges of the ponds. Numerous factors, both biotic and abiotic, influence the distribution of aquatic organisms.

   (a) The students decided that they would investigate some of the abiotic factors. List three water-quality tests that could be conducted and explain what information each test provides. Include in your answers a description of the impact of each factor on the distribution of aquatic organisms.

   (b) Larvae of a certain insect are found in pond *A* but not in pond *B*. Design a controlled experiment that would help explain the observed distribution of these insect larvae. Be sure to include the following in your design.

      1. Formulate a hypothesis.
      2. Identify the variable that will be manipulated.
      3. Outline the field and/or laboratory procedures that will be followed. Describe what data you will collect.
      4. Discuss the possible results and relate them to the distribution of the insect.

   (c) What are indicator species and how are they used to assess environmental quality? Give a specific example of such a species and its use.

2. The development of plans for long-term resource management depends on understanding the patterns and consequences of resource use.

   (a) Describe what makes a resource renewable or nonrenewable. Give a specific example of a renewable resource and of a nonrenewable resource.

   (b) Describe and compare total resource use per capita in developed and developing countries.

   (c) What is meant by sustainable resource use? Give an example.

   (d) Economic policies and practices affect society's progress toward achieving sustainable resource use. Discuss one policy or practice that facilitates this progress, and one that impedes it.

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AP® ENVIRONMENTAL SCIENCE
1999 SCORING GUIDELINES

Question 1

Part a (Max 5 points):1 point to be awarded for each abiotic test linked with a description of what it measures; for example the nitrate test measures the concentration of nitrates (maximum 3 tests). For each parameter an additional point to be awarded for an "impact" statement that links it to a specific effect on organisms. For example increased nitrate levels can lead to algal blooms and ultimately lower dissolved oxygen levels. No credit was given for stating an organism can only survive in a specific range of nitrates. Statements so general they could apply to numerous water quality tests were not accepted.

1 point		1 point
Water Quality Test	Information	Impact
Dissolved Oxygen	Amount of dissolved oxygen	Required for aerobic respiration (decomposition)
Heavy Metals e.g lead, mercury, cadmium	Level of the metal	Increased conc Decreased reproductive rates Bioaccumulation leads to stress Accumulation on gills of fish can cause deformities
Carbon Dioxide	Amount of carbon dioxide	Increased CO_2 –> Decreased pH Decreased CO_2 –> Decreased photosynthesis
Nitrate (NO_3^-) (N) Nitrites (NO_2^-) Phosphates (PO_4^{3-}) (P)	Level of nitrates Level of nitrites Level of phosphates	Increased nitrates and phosphates; –> Increased algae growth; algal bloom...–>...blocked sunlight; decomposition –> Decreased dissolved oxygen
Salinity	Level of total salts	Maintenance of osmotic pressure, Increased salinity –> Decreased DO and Decreased viability of eggs and larvae
Ammonia	Level of NH_3	Oxidized to NO_3^- and can lead to algal blooms
Other macro or Micronutrients (K,S)	Level of nutrient	Increased nutrient –> Increased plant growth... ...food chain impact
Chlorine	Level of chlorine	Increased chlorine interferes with hatching, embryo development, and reproduction Chlorinated hydrocarbons formed...some toxic
Selenium	Amount of selenium	Increased selenium; –> Increased birth defects (birds w/no eyes)
Hardness	Amount of Ca or Mg	Increased Ca/Mg –> Increased solubility of heavy metals Increased Ca/Mg –> Increased buffering capacity
Conductivity Turbidity (Secci disk) Suspended Solids	Amount of suspended solids (TDS), light penetration	Increased TDS –> Increased mortality of fish eggs and juveniles Decreased photosynthesis due to light penetration Increased temperature

Question 1 (cont.)

Biological Oxygen Demand (BOD) Chemical Oxygen Demand (COD)	Amount of oxygen needed	Increased BOD –> Decreased dissolved oxygen levels, DO required for respiration
pH		Decreased pH –> Increased solubility of heavy metals,
	Relative acid/base level H^+/OH^- concentrations	Increased mortality of eggs and juveniles, Increased decalcification of bones, plant cuticle damage, Increased stress with pH changes
Alkalinity	Measure of buffering capacity Acid Neutralizing Capacity (ANC)	Increased alkalinity –> Increased CO_2 & inorganic nutrients - photosynthesis Increased ANC –> Increased egg & fry survival
Temperature		Increased temp –> Increased rate of metabolism, Increased sensitivity to toxic waste and disease, Decrease in DO, Increased biological stress
Color	Dissolved and suspended matter	May decrease light penetration
Odor	Presence of chlorine, H_2S, sewage, etc.	Specific to smell
synthetic organics	presence of pesticides, aromatics, petroleum	specific to compound

Part b (Max 4 points)

1. Hypothesis (1 pt) - States a specific, testable explanation for the distribution of insect larvae.

2. Variable (1 pt) - Identifies one, specific independent variable

Not accepted as too general: chemicals, pollutants, chemicals, toxin(s), pesticides, a factor

Accepted: pesticide, fungicide, herbicide

Question 1 (cont.)

3. (Internal Max 3 points)

Procedures - Outlines experimental procedures for:

(1 pt) manipulates the independent variable
(1 pt control group(s) present.

Data (1 pt) - Describes quantifiable data related to the

dependent variable (number of larvae, size, movement, mortality).

Elaboration (1 pt) - repeated trials, description of how other variables are controlled, etc

4. Results/Discussion (1 pt) - Connection of the data collected to the larvae distribution in the two ponds

Part c (Max 3 points)

Definition of indicator species (1 pt) - Species whose presence or absence serves as an early warning sign of environmental change or degradation of a natural community.

Example (1 pt) - Specific example of an indicator species

"Use" (1 pt) – Species is linked to a specific environmental change (activity, community, physical property).

One point to be awarded if an atypical indicator species is used and an environmental change is indicated. Example: An algal bloom indicates an increased level of phosphates.

Indicator Species:

Accepted: songbirds, amphibians (frogs, salamanders, toads), trout, benthic invertebrates (mayfly, caddisfly, riffle beetle, dobson fly larvae) water bird, *E. coli* (fecal wastes), shell fish (tissues analyzed for pesticides, heavy metals), top level consumers (northern spotted owl, wolf, bear, mountain lion, great hornbill), *Elodea*, *Ceratophyllum*, eel grass, alligator, lichen, dinoflagellates, fathead minnow, salmon, oysters, water penny, water pollution tolerant organisms (sludge worms, aquatic worms, midge larvae, tubifex worms, pouch snails, blood midges). Note: "use" point was only awarded for this last category if student notes presence of these organisms is significance in the absence of other sensitive species.

Not Accepted: canary, elephant fish (test species not used in natural environment)