AP® Environmental Service
1999 Scoring Guidelines

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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)

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Question 2

a. Describe what makes a resource renewable or nonrenewable. Give a specific example of a renewable resource and of a nonrenewable resource. (MAXIMUM 3 POINTS)

DESCRIPTION

Renewable Resources	Nonrenewable Resources
normally replenished by natural processes	NOT replenished by natural processes within a useful time scale
NOT depleted by moderate use	Depleted by use
Essentially inexhaustible on a human time scale	Exists in a fixed amount and is exhaustible

Description Point: 1 point for **any** description in 1, 2, or 3 above for either renewable or nonrenewable

EXAMPLES

RENEWABLE RESOURCES
Energy
Tidal
Solar
Wind
Geothermal
Hydroelectric
Biomass: wood, CH_4 from waste, etc.
Biological
Trees
Organisms: (specify type)
Soil/Topsoil
Chemical
H_2O
O_2
CO_2
N_2
H_2
Soil/Topsoil Etc.

NONRENEWABLE RESOURCES
Energy
Fossil fuels: oil, coal, natural gas
Uranium
Oil Shale
Metals
Iron
Copper
Aluminum
Gold
Silver
Platinum
Zinc
Etc.
Nonmetals
Clay
Limestone
Sand
Gravel
Salt
Phosphates
Etc.

Example Point: 1 point for a renewable example and 1 point for a nonrenewable example

b. Describe and compare total resource use per capita in developed and developing countries. (MAXIMUM 3 POINTS)

Comparison (1 point):

The two types of countries are not similar because the total resource use per capita is much greater in developed countries than in developing countries (the specific phrase "per capita" does not need to be used; however, it must be stated that the use being discussed is for an individual, or average individual, not an aggregate population.

Question 2 (cont.)

Description (2 points): 1 point for each choice, up to 2 points

DEVELOPED		DEVELOPING
Higher standard of living/higher per capita GNP with greater disposable income/money spent on luxury items	**OR**	Lower standard of living/lower per capita GNP with income/money spent primarily on necessities
extensive technology/more industry	**OR**	limited technology/less industry
20 - 21% of world population uses 80-90% of the world's resources	**OR**	79-80% of world's population use only 10-20% of the world's resources
Depend primarily on nonrenewable energy resources	**OR**	Make greater use of renewable energy resources than developed countries
As GNP increases, energy use per capita increases	**OR**	As GNP decreases, energy use per capita decreases

The average U.S. citizen consumes 35X as much resources as an average citizen in India
Water use in the U.S. is approximately 5400 L (1400 gal)/person/day whereas in developing countries water use is approximately 45 L (12 gal)/person/day

c. What is meant by sustainable resource use? Give an example. (MAXIMUM 3 POINTS)

Definition (1 point): the use of a resource at a rate that does not reduce its availability or its ability to be replenished on a long-term basis.

Example (2 points): the concept of sustainable resource USE must be indicated as opposed to just listing a sustainable resource (explain how its usage is sustainable)

- 1 point for the sustainable resource **and** use
- 1 point for elaboration (i.e., explain technical terms such as contour plowing, etc.)

1. **Sustainable Resource:**
Timber

Use:
harvest of timber not to exceed regeneration rate

Possible Elaboration/Explanation:
discussion of forestry practices

2. **Sustainable Resource:**
Water

Use:

a. groundwater usage not to exceed recharge rate

b. utilization of sewage, drinking water, or desalination treatment processes to restore water quality at a rate which replenishes the water supply required for use

c. Use of reclaimed water, gray water, or nonpotable water for irrigation

Possible Elaboration/Explanation:

d. water conservation or specific pollution control measures

e. water conservation or specific pollution control measures (i.e. improving tertiary treatment)

f. source of such water is from bathtubs, showers, bathroom sinks, clotheswashers, sewage treatment plants, etc.

3. **Sustainable Resource:**
   Soil/Topsoil

   Use:
   use regeneration farming techniques (such as contour plowing, strip farming, intercropping, terracing, reduced tillage, cover crops, etc.) to reduce topsoil disturbance and erosion

   Possible Elaboration/Explanation:
   explain technique

4. **Sustainable Resource:**
   Extractive Reserves

   Use:
   the harvest of nonwood products such as nuts, fruits, and rubber by local residents as a way to prevent deforestation

   Possible Elaboration/Explanation:
   by providing an alternative cash crop

5. **Sustainable Resource:**
   Fish

   Use:
   harvest must leave enough breeding stock to renew the species

   Possible Elaboration/Explanation:
   techniques: annual quotas, limit fishing seasons, regulate type of fishing gear, etc.

Question 2 (cont.)

6. **Sustainable Resource:**
   Energy

   Use:
   explain how the substitution of a specific renewable energy resource for a specific nonrenewable energy resource leads toward sustainability

   Possible Elaboration/Explanation:
   discussion of issues involved with making this transition

7. **Sustainable Resource:**
   Rangeland

   Use:
   use selective grazing to allow grasses to regrow.

   Possible Elaboration/Explanation:
   discuss connection between desertification and overgrazing

8. **Sustainable Resource:**
   Reuse and Recycling

   Use:
   the use and reuse of metals (such as aluminum), glass, plastics, etc. in a way that leads toward sustainability

Possible Elaboration/Explanation:

a. closed-loop vs. open-loop recycling

b. recycling reduces the mining of virgin resources

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. (MAXIMUM 3 POINTS)

3 Points - students must include ONE facilitating policy (1 point) **and** ONE impeding policy (1 point). The policies CANNOT be mere opposites of each other. (1 point) is available for a detailed discussion of the economic policy and how it can be implemented and affect use.

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Question 2 (cont.)

FACILITATES	IMPEDES
Remove government subsidies that encourage excessive use or production of fossil fuels, water, pesticides, minerals, agricultural products, and logging (or add subsidies that encourage use of renewable resources).	Continue government subsidies which encourage excessive use or production of fossil fuels, water, pesticides, minerals, agricultural products, and logging.
Increase the tax on a virgin resource to discourage its use.	Decrease the tax on a virgin resource to encourage its use.
Increase the cost of a virgin resource to discourage its use.	Decrease the cost of a virgin resource to encourage its use.
Provide tax deductions or rebates for implementation or use of alternative energy sources, conservation measures or renewable instead of nonrenewable resources (i.e. solar energy to heat homes, low-flow toilets, electric cars, insulation, thermal-pane windows, etc.).	Remove tax deductions or rebates. (for ideas in left column, #4).
Internalizing external costs of products (polluter pays concept to discourage overproduction and excessive use of resource).	Do not implement full-cost pricing.
Companies or individuals must pay significant royalties or fees for use of public land to extract or remove resources (applies to mining companies, hunters, fisherman, ranchers, etc.).	Charge little or no royalties or fees to remove resources from public lands. OR Continue to have cleanup of mines paid by taxpayers.
Fines for excessive use or waste or misuse (pollution) of a resource (including failure to recycle).	Charge little or no fines for excessive use or misuse of a resource.
Provide rebates/subsidies to encourage recycling.	Do not provide rebates/subsidies for recycling programs.
Approve bank loans or provide low-interest loans for projects that implement sustainable resource use (debt for nature swap).	Approve bank loans or provide low-interest loans regardless of resource use.
Provide research grants to develop technologies/techniques that foster sustainable resource use.	Do not provide research grants to develop technologies/techniques that foster sustainable resource use.
Promote demand for environmentally friendly products through advertising, labeling, pricing, etc.	Promote demand for items produced from unsustainable practices.
Electric companies purchase energy from a business or private individual who produces energy using renewable energy sources.	

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Question 3

A. Describe and compare the concentration **trends** for ozone and lead. Calculate the percentage change in each from 1978 to 1988 (maximum of 4 points)

1 point:

Ozone - remains fairly high/constant OR **minimal** or **slight** decrease OR fluctuates around a mean. NO point for "fluctuates", "slight fluctuation", "no trend"

as compared to lead, which had the following trend:

1 point:

Lead - dramatically reduced OR falls consistently OR constant decline OR decreases OR drops

STUDENTS MUST SET UP THE PROBLEMS CORRECTLY AND AT LEAST SHOW CONCENTRATIONS USED FOR 1978 AND 1988 (OR A DIFFERENCE) AND HOW THEY CALCULATE THE PERCENTAGE

NO CREDIT FOR JUST A PERCENTAGE WITHOUT SHOWING WORK

1 point:

- Ozone - acceptable 1978 range between 0.155 to 0.145; (mid-point is about 0.157)
- Acceptable 1988 range between 0.135 to 0.142; mid-point is about 0.140
- Acceptable percentage range is about 1.5 - 13.5%

For example:

i. ozone in 1978 was 0.155, in 1988 ozone was about 0.140

ii. 0.155 - 0.140 = 0.015

iii. 0.015/0.155 x 100 = 9.7%

1 point:

- Lead - acceptable 1978 range between 1.55 to 1.35; mid-point is about 1.5
- Acceptable 1988 range between 0.12 to 0.08; mid-point is about 0.1
- Acceptable percentage range of about 90 - 95%

For example:

iv. lead in 1978 was 1.55; lead in 1988 was 0.12

v. 1.55 - 0.12 = 1.43

vi. 1.43/1.55 x 100 = 92.3%

In each case, either steps i and iii OR steps ii and iii must be shown for credit.

ALTERNATIVELY, THE PROBLEMS COULD BE SOLVED BY SETTING UP THE PROBLEM IN THE FOLLOWING WAY:

100 - [(1988 concentration/1978 concentration) x 100] = % change

In this case, if it is clear that the student has taken a ratio of the '88/'78 concentrations AND that they understand that the % change is calculated by subtracting this from 100, they do not have to explicitly show the subtraction step. For example, some students set the problem up in the following way:

$$\frac{\text{1988 concentration}}{\text{1978 concentration}} = \frac{x}{100}$$

This equation by itself is NOT worth the point, as this would not give the correct CHANGE in the pollutant. Students must then also show (either explicitly or by a number) that they have subtracted x from 100

IF the problems are set up correctly, a maximum of 1 additional point can be given if the correct percentages are calculated for BOTH ozone AND lead

B. For either ozone or lead, identify the major source(s) of that pollutant and describe the main physiological effects in humans (maximum of 3 points).

SOURCES (maximum of 2 points)

Ozone

Secondary pollutant - major source is from photochemical reactions (1 point)

(1 elaboration point if significant details are given - e.g. sunlight/uv reacting with NOx released by vehicles, causing O to react with O_2,

and in the presence of VOCs/hydrocarbons (HCs) allow O_3 to build up. Details can be given as a set of equations or extended description)

e.g.,
NO_2 + sunlight/uv --> NO + O
O + O_2 --> O_3
Without VOCs/HCs NO + O_3 --> NO_2 + O_2
With VOCs/HCs
NO + VOCs/HCs --> PANs+etc

(VOCs/HCs limit the NO/O_3 reaction, causing O_3 to build up)

Reactions may also be written in a cyclic form

Lead

1 point for each major source, up to a maximum of 2 points

1. Major source was/is leaded gasoline
2. Mining/smelters
3. Municipal waste incineration (not just incineration)

If only 1 source is given, 1 elaboration point is possible for an expansion on a single source. For example, connecting the source to the reason for a drop in atmospheric concentration, discussing the connection of the source to the trend seen in the graph

PHYSIOLOGICAL EFFECTS (1 point for each example, with a maximum of 2 points)

Ozone

4. Chronic inhalation causes inflammation leading to fibrosis of the lungs (damages lung tissue; may also note that damage is irreparable)
5. An irritant; irritates eyes, nose, throat, lungs, and/or respiratory tract which can cause chest discomfort, shortness of breath, coughing(may also note that effects are irreparable)
6. Loss of lung capacity, loss of elasticity
7. Aggravates asthma, chronic bronchitis, emphysema, and heart disease
8. Suppresses immune system; lowers resistance to colds and pneumonia
9. Synergistic effect - smokers are at higher risk of ozone effects

Lead

10. Causes brain damage/mental retardation/impaired cognitive function

11. Learning disabilities

12. High blood pressure/hypertension

13. Death (even at relatively low concentrations)

14. Accumulates in the body and impairs tissues and organs, (inhibits synthesis of hemoglobin, causes enzymes to become inactive, can act as an endocrine disruptor)

15. Anemia

16. Miscarriage/premature birth

NO credit for just "birth defects" or "cancer"

NO credit for stratospheric ozone and linking UV light and skin cancer. Source and physiological effects must be consistent, i.e., sources **and** physiological effects of ozone, **or** sources **and** physiological effects of lead.

C. For either particulates or carbon monoxide, identify the major source(s) of that pollutant **and** describe the most effective method of reducing the concentration of the pollutant in the atmosphere. (maximum of 3 points)

SOURCES (maximum of 2 points)

Particulates (max of 2)

1 point for each source, with a maximum of 2

1. Smokestacks, for example from coal-burning power plants

2. Industry such as stone & rock crushing, iron & steel

3. production, smelting, transportation and storage of grain, manufacture of cement, lime, pulp, and paper factories, mining, rock quarries (must give example)

4. Soil-eroded land disturbed by agriculture, desertification (by overgrazing, deforestation, etc), construction sites, unpaved roads

Question 3 (cont.)

5. Refuse-burning incinerators, fireplaces, wood-burning stoves, leaf burning

6. Diesel fuel combustion

7. Natural sources - volcanoes, wind erosion, forest fires, pollen, salt spray, grass fires,etc

8. Incomplete combustion

NO credit for single terms such as "industry", "cars", "agriculture", etc.

OR

Carbon monoxide (max of 2)

1 point can be given for one of any of the following (max of 1 point):

9. Description of a source, such as exhaust from cars, other transportation or industry (must give an example of what kind of industry, i.e., Where is the CO coming from? No point for just a word like “cars”, “industry”, etc.)

10. Biomass burning (fireplaces, wood stoves, coal, etc)

11. Natural source - oxidation of methane; volcanoes

An additional (elaboration) point can be received for

12. Incomplete combustion

NO point for simply saying "CO comes from fossil fuels". However, "burning", "use", or "combustion of fossil fuels" would receive 1 pt

METHOD OF REDUCTION (1 point for a reduction method; 1

elaboration point if they then go on to discuss HOW this method will result in a reduction)

Particulates (max of 2)

13. Reduce smokestack emissions by filtering (bag house); cyclone precipitators, or electrostatic precipitators; scrubbers

14. Conserve electricity - which reduces demand on coal burning

15. More use of alternation energy sources such as solar, wind, or even nuclear power, which would reduce reliance on “dirty” fuels

16. Reduce or recycle materials which reduce refuse incineration and reduces industrial demand

17. Introduction of soil conservation practices, use ground cover, BMPs, limit deforestation and/or grazing

18. Watering down or spraying of tailing piles, unpaved roads

19. Ban outdoor burning, fireplace burning, wood-burning stoves

20. Fines for excess pollution; economic incentives to encourage less pollution

21. Limit population growth, which will limit demand for energy

OR

Carbon monoxide (max of 2)

22. Catalytic converters - convert CO to CO_2

23. Mandating emission standards; requiring inspections; fees or fines

24. More efficient fuel/engine technology

25. More public transportation/less private vehicle use/ carpooling/walking/biking etc. OR overall reduction in fossil fuel use

26. Oxygenation of fuels

27. Control of population growth would result in fewer cars, thus less CO

Sources and method of reduction must be consistent, i.e., sources **and** method of reduction for particulates, **or** sources **and** method of reduction for carbon monoxide

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Question 4

Part A Maximum 8 points

For each of the 4 people selected (maximum of 2 points per person)

- 1 point for each concise argument based on scientific principle
- 1 point for a supporting example

students do not receive credit for rewording the statements provided or for simple agree/disagree

general arguments/scientific principles:
human health

Pro Pesticide

- eliminates or reduces pest, less disease, saves lives
- pesticides used according to manufactures directions are safer
- lack of proper scientific evidence linking pesticide use to leukemia
- pesticide use below acceptable or threshold levels is considered safe
- pesticide use safer with improvements in technology for application

Con Pesticide

- pesticides linked to cancer, birth defects, mutations, respiratory problems, allergic rxns, low sperm count
- implications of lifetime dosage
- toxic effects on agricultural workers
- pesticide data may be presented in a biased or incorrect manner

general arguments/scientific principles:
food resource/agricultural production

Pro Pesticide

- farmers who use pesticides have less crop loss in the short term (an application of pesticide may save a specific season's crop)

  Con Pesticide

- problem with distribution, not agricultural production
- efficient use of available food resources
- eat at lower trophic level (must indicate connection with lower pesticide use)
- market exists for organic products because of concern about pesticide use/residues
- pesticides use not profitable if all costs are internalized (ex. - health care)
- no clear evidence that pesticide use improves crop yield (long term increase in crop yield primarily due to fertilizers/new strains)
- population grows exponentially, while crop yield increases arithmetically
- due to improved biodegradability, newer pesticides require more frequent application, therefore increasing the cost
- increased expense of pesticide use due to pesticide treadmill (treadmill explained in this section or elsewhere)

  general arguments/scientific principles:
  chemical

  Pro Pesticide

- more testing than in past
- ore regulations than in past
- bans on DDT
- improved pesticides are less persistent, narrow spectrum
- FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) of 1972 provides specific Guidelines for testing

  Con Pesticide

- unexpected effects of inert ingredients, reactions with other chemicals
- problems with manufacture, handling, transport of pesticides
- lack of testing on humans
- lack of testing in nature
- new pesticides more toxic to humans (ex. Organophosphates)
- more testing than in past, but still too many new pesticides to allow for proper testing

general arguments/scientific principles:
migration of pesticides (movement from site of application)

Pro Pesticide

Con Pesticide

- movement in soil, water
- movement in air by wind
- goundwater/aquifer contamination by leaching
- runoff, irrigation increases movement
- pulse effect

general arguments/scientific principles:
genetics

Pro Pesticide

- use of genetically engineered crops is not well tested; until risks are understood, stick with the known risks of pesticides
- rotating the use of existing pesticides will decrease the chances of pest developing resistance

Con Pesticide

- genetic resistance with explanation, pesticide as selective agent natural selection, pass trait to offspring

- reproductive strategies of pest: high birth rate, large population, r-strategist
- pesticide treadmill with explanation

general arguments/scientific principles:
alternatives to pesticides

Pro Pesticide

- Integrated Pest Management (IPM) (needs explanation) incorporates the responsible use of pesticides

Con Pesticide

- Integrated Pest Management (IPM) (needs explanation) incorporates a variety of alternative control techniques with responsible use of pesticides
- use of natural predators (provide specific)
- interruption of reproduction: irradiation, hormones, sterile males
- others: hot water, soaps, vacuuming, traps, diatom powder, etc.

note: see detailed list at end of rubric

general arguments/scientific principles:
characteristics of pesticides

Pro Pesticide

- biodegradablity
- improve specificity using narrow spectrum

Con Pesticide

- persistence
- toxicity

- broad spectrum pesticides kill non-targeted species

  general arguments/scientific principles:
  ecosystem

  Pro Pesticide

  Con Pesticide

- biological magnification movement in food chain, trophic levels
- reduces biodiversity

- resurgence of target pest
- secondary pest outbreaks
- elimination of natural predator

  samples of examples useful in part "A"

- explanation of DDT and genetic resistance or biological magnification
- use of a specific pest and its natural predator
- details of contamination of a specific location (Ogallala aquifer)
- organic rice farming in Indonesia (crop yield increased after use of DDT eliminated)
- carcinogenic and/or health effects of Agent Orange
- FIFRA as example of regulation to improve toxicity testing

Question 4 (cont.)

The following control methods may be found in either part "A" or part "B".

*note - alternative control methods (must be possible to work for the specific named pest)

natural predators
natural repellents
attracting traps
insect repellents
live traps
physical removal
diatom powder
eggshell (snails)
Bt (Bacillus thuringensis)
introduce competing species
intercropping
killing traps
interrupt reproductive cycle
hormones
crop rotation
sterile males
alternative sprays (soaps)
hot water (steam)
boric acid
biopesticides
pheromones
electric zappers
a vaccine that eliminates disease
botanicals
pest specific fungus
adjust planting times
(pest no longer a pest)
trangenics
Integrated Pest Management (IPM)
pest-resistant varieties
virus (Australian rabbit)
quarantine
eliminate habitat of pest (ex. - drain standing water for mosquito)
physical barrier
border inspection
increase natural habitat of pest / reduce habitat destruction (ex. - increase space available for deer population)
companion plants (ex. - marigold) - exudes airborne repellent (pyrethrums)
allelopathic plants (ex. - Mexican marigold) - exudes soil repellents
sacrificial plants (ex. -) - pest eats instead of crop

Part B (maximum 4 points)

- *ID specific pest - 1 point
- adverse effects - 1 point per accurate effect (max 2 points)
- describe control method - 1 point
- elaboration of control method - 1 point

note:
correct statements applying to part ‘A’ found in part ‘B’ only receive credit if correctly referenced

Question 4 (cont.)

The following two lists include examples commonly used by students. There were many other correct possibilities that received full credit.

examples of a specific pest (1pt)	adverse effect (1pt) (must be accurate agric. or health)	alternative control (1pt) (possible to work for named pest)
gypsy moth	feeds on tree leaves	parasitic wasp, pest specific fungus
Anopheles mosquito	transmits malaria	drain standing water
fire ant	stings, allergic rxn	interrupt reproductive cycle
Africanized bee (killer OK)	stings, allergic rxn	hormones
aphid	feeds on crops	ladybird beetles (ladybugs)
tobacco hornworm/budworm	eats tobacco	remove by hand
Mediterranean fruit fly	eats crops	sterile males
kudzu	competes with crops	remove by hand
screwworm fly	harms cattle	sterile males
white flies	destroys citrus crop	soapy water
tomato hornworm/sphinx moth	eats tomatoes	braconid wasp
leafhopper/planthoppers	feeds on cotton, soybeans	natural predator
boll weevil	Cotton	parasitic wasp
deer tick	transmits Lyme/spotted fever	protective clothing, repellent
purple loostrife	competes with aquatic crops	discover natural predator

*the following are appropriate only if a specific indication is given of why it is a pest (adverse effect point only given if adverse effect is agricultural or human health)

explanation:	ant	0 pts	
	ant eating food in house	1 pt	(indicates why organism is a pest)

examples:

- bees that sting
- fleas biting, carrying disease
- weeds competing with crops
- deer eating garden plants
- mosquito transmits specific disease (malaria, dengue fever, yellow fever, meningitis, encephalitis)
- locust eating crops
- rabbits eating crops
- rodents eating grain
- snails eating garden crops