



## AP Environmental Science 2001 Scoring Guidelines

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**Question 1**

**1. (a) Maximum 4 points total for (i) and (ii)**

**(i) 1 point** for correct setup (MUST include units)

**1 point** for correct answer (units not needed/ignore incorrect units)

$$(2,000 \text{ ft}^2) (80,000 \text{ BTU/ft}^2) (1 \text{ ft}^3/1000 \text{ BTU}) = \underline{160,000} \text{ ft}^3 \text{ natural gas}$$

**Note:** if 80% is calculated in part (i), then

$$.8 x = 160,000 \text{ ft}^3 \text{ and correct answer} = \underline{200,000} \text{ ft}^3 \text{ natural gas}$$

**OR**

$$.8 x = 80,000 \text{ BTU/ft}^2, x = 100,000 \text{ BTU/ft}^2, \\ \text{therefore } (2,000 \text{ ft}^2) (100,000 \text{ BTU/ft}^2) (1 \text{ ft}^3/1000 \text{ BTU}) = \underline{200,000} \text{ ft}^3$$

**OR**

$$(2000 \text{ ft}^2) (80,000 \text{ BTU/ft}^2) (1 \text{ ft}^3/1000 \text{ BTU}) (1 \text{ BTU (in)}/0.8 \text{ BTU (out)}) = \underline{200,000} \text{ ft}^3$$

**(ii) 1 point** for correct setup (MUST include units) and answer

$$(160,000 \text{ ft}^3) (\$5.00/1000 \text{ ft}^3) = \underline{\$800}$$

**OR**

$$(200,000 \text{ ft}^3) (\$5.00/1000 \text{ ft}^3) = \underline{\$1000}$$

**OR**

$$.8 x = \$800, \text{ therefore } x = \$1000$$

**1 point** for including the 80% calculation correctly in either part (i) or part (ii).

**Note:** if answer in part (i) is incorrect, yet calculations in part (ii) are done correctly using the answer in part (i), then the point for part (ii) is awarded.

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**Question 1 (cont.)**

**1. (b) Maximum 3 points**

Must **identify** action and **describe**.

- Use first three (3) responses given
- Responses must be tied to this house
- No credit for woodburning stove since it is given in part “c” unless it includes a more detailed description

**Examples of appropriate action and description:**

- Add thicker insulation or higher R-value insulation or “superinsulation”
- Add insulation to attic, exterior walls, ducts, or areas currently not insulated
- Install double, triple, low-E (low emissivity), or storm windows
- Cover exterior windows with plastic
- Caulk, seal, weather-strip around windows and doors, repair windows to seal leaks
- Lock/close windows and doors
- Use solar heating with a specific example
- Place windows on southern, eastern, and western exposures
- Open shades/blinds during the day and close at night
- Lower (turn off) thermostat during the day when no one is home
- Lower thermostat and wear layers of clothing and blankets
- Lower thermostat to remain a few degrees cooler to use less energy and save money
- Add carpet to improve insulation
- Install programmable thermostat (must give specific heat conserving use)
- Close off unused rooms/areas
- Install a higher efficiency furnace
- Install ceiling fan to more evenly distribute heat
- Install stone flooring/adobe or brick walls/trombe wall to absorb heat/redirect/act as a heat sink
- Plant windbreak or shelterbreak to guide wind over and around building
- Add straw bales between walls or outside exterior walls
- Install woodburning stove (fireplace) with additional vents for heat distribution
- Install darker roof tiles
- Change to darker exterior wall color
- Take thermal picture, IR picture to identify leaks
- Maintain furnace/change filters regularly
- Use residual heat from clothes dryer/oven
- Install insulation behind wall outlets/light switches
- Remove/avoid planting trees near south windows

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**Question 1 (cont.)**

**1. (c) Maximum 4 points**

Positive Impact	<b>1 point</b>	Consequence	<b>1 point</b>
Negative Impact	<b>1 point</b>	Consequence	<b>1 point</b>

**Note:**

- Use first positive and first negative given
- Discussion of other fossil fuels not appropriate
- Impact and consequence must be linked
- Some students may begin their discussion with consequences and receive a consequence point without the impact point

**Positive Impact**

**Examples of Appropriate Consequences**

Uses renewable resource as opposed to nonrenewable resource  
 Burning new carbon vs. old carbon  
 Use of local vs. transported fuel  
 Burning wood conserves natural gas (fossil fuels)

Specific impact of reduced extraction/processing  
 transport of natural gas  
 reduce pollutant infiltration to groundwater  
 less subsidence  
 less habitat loss (pipelines)  
 reduces methane leaks from pipeline

Ash residue used as fertilizer

Returns nutrients to the soil

**Negative Impact**

**Examples of Appropriate Consequences**

CO<sub>2</sub> released leading to global warming

Specific impact of increased global warming  
 shifting agricultural areas, change in sea level,  
 shifting biomes, weather extremes, loss of habitat

CO released leading to increased indoor air pollution

Specific impact of CO poisoning:  
 CO binds with hemoglobin,  
 unconsciousness, asphyxiation

Nitrogen Oxides released leading to acid deposition, photochemical smog

Specific impact of increased nitrogen oxides  
 adverse effects on trees, soils, aquatic life in lakes, respiratory problems

Particulates (ash) released leading to air pollution

Specific impact of increased air pollution  
 increased respiratory problems,  
 reduced visibility

Wood (trees) used non-sustainably or larger amounts of wood needed to produce same number of BTUs leading to deforestation

Specific impact of deforestation  
 habitat loss, soil erosion, increased CO<sub>2</sub> levels, decreased biodiversity, desertification, interruption of nutrient cycles

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Question 2

2. (a) 4 points possible, 3 points internal maximum

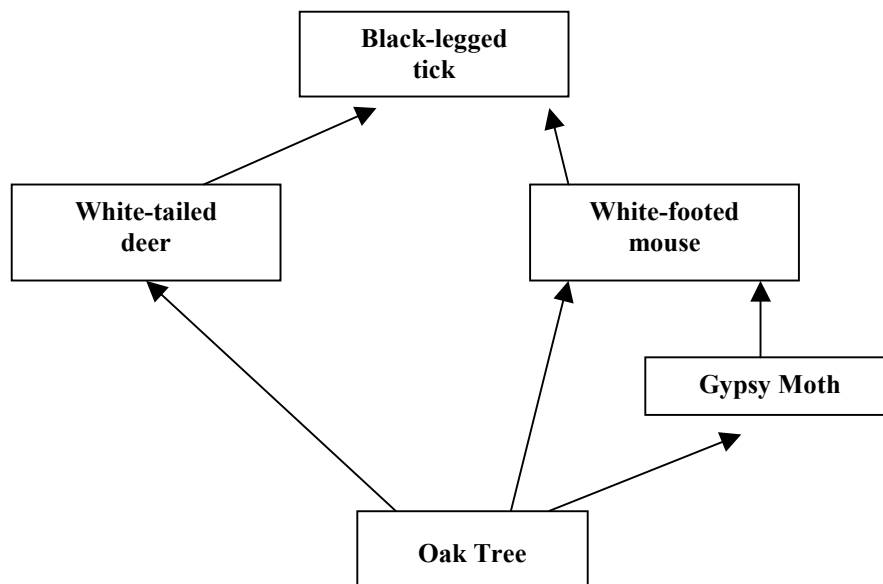
**2 points** for correctly identifying the five components (oak tree, gypsy moth, mice, deer, ticks) of the food web **AND** showing the proper connections (doesn't have to have arrows)

In this section, it is NOT acceptable to only specify "acorn" — gypsy moths do not eat acorns.

**1 point each** for the following:

- placing arrows in the direction of energy flow
- labeling trophic levels

**Note:** these points can be awarded even if the student missed one of the components or one of the connections in the food web.



The above is an example of a food web that would earn the student 3 points.

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**Question 2 (cont.)**

**2. (b) 4 points**

**1 point** for the hypothesis IF the hypothesis is **connected to the question AND the experiment**, and is stated in a hypothesis format (i.e., can't just restate the question).

Since this hypothesis is supposed to be an answer to the question “How are acorn production and moth population related?”, the student **must use the document** to formulate one of three hypothesis forms.

**Note:** these are general forms the hypothesis might take. In order to earn a point, the student must specify the direction of change, i.e., increasing or decreasing:

- (1) change in moths → change in acorns (moths eat leaves and reduce acorn production)
- (2) change in acorns → change in moths (this can only happen through the mouse connection, and this fact must be demonstrated in the hypothesis and/or the experiment in order to earn the hypothesis point)
- (3) null hypothesis (i.e., there is no relationship)

**Sample hypotheses:**

- If the number of gypsy moths increase then the number of acorns will decrease (due to defoliation and stress on the oak trees)
- If there is a decrease in gypsy moths, there will be an increase in acorns
- An increase in acorns will lead to increased mouse population which will decrease the moth population
- If acorns increase, then mice will preferentially eat the acorns, leading to an increase in gypsy moth population

Student may also state their hypothesis as a NULL hypothesis, i.e.:

- The number of gypsy moths in an oak forest will have no impact on the number of acorns produced
- The number of acorns produced will have no impact on the mouse population, and thus no impact on the number of gypsy moths
- Mice have no preferential food, therefore the number of acorns produced will not impact the mice's feeding habits and thus have no impact on the number of gypsy moths

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### Question 2 (cont.)

**Up to 3 points** for an experiment that addresses the question (does not necessarily have to be linked to the hypothesis):

- **1 point** for experiment which clearly indicates measurement over a “reasonable” amount of time (not acceptable: days or a few months; for a controlled experiment at least one full cycle of the oak trees is needed)
- **1 point** for a clear indication of a control (see “Examples of Experiment Design” below for more detail)
- **1 elaboration point** available
  - e.g., discussion of testing for significant correlation between organisms
  - e.g., types of graphs they will produce with the data gathered
  - e.g., an in-depth discussion of the technique of counting species by capture and release

#### Examples of Experiment Design

**Experimental** — in this type the student is doing a more traditional type of experiment where there is at least one control site and one experimental site designated, and a variable is manipulated in the experimental site.

- Need at least two sites and a true experimental control (i.e., the absence of the variable to be tested) at one of the sites (control point)
- Manipulate moths (must have a count!) — either natural or in lab — count acorns; over at least one cycle (measurement point)
- Manipulate acorns (must have a count!) — natural sites only — count mice and moths; over at least one cycle (measurement point)

**Observational** — in this type of experiment the student is not manipulating a variable, but making long-term measurements and doing statistical analysis to determine if there is any significant correlation between the populations.

- May involve a single site or multiple sites over a long period of time
- Needs specification of a “reasonable” amount of time, i.e., multiple oak cycles (control point) **OR**
- Specification that measurements will be made over at least one oak cycle **AND** then compared to a baseline data set (control point)
- Must count all relevant species (measurement point)

An elaboration point is **ONLY** given if the student demonstrates an in-depth knowledge of the material. That is, the student must answer the basic question correctly. They can then get an elaboration point if they give **ADDITIONAL** information, demonstrating that they truly understand the subject matter.

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**Question 2 (cont.)**

**2. (c) 5 points possible; 4 points internal maximum**

**Up to 3 points** for three different (acceptable) methods of control (see list below)

If students give at least two methods of control (indicating at least a basic understanding of IPM) they may earn:

**1 elaboration point each (up to 2 points) for** elaboration of a method of control

**Integrated Pest Management**

A combination of methods to control a pest. These may include limited and specific use of chemical, biological, and physical controls. The aim of IPM is long-term control (not eradication) of a pest, with minimal environmental impact.

**Legitimate IPM control for ticks**

**PHYSICAL CONTROLS**

**Habitat management:**

- Short grass, brush reduction (less than 6 inches in height)
- Rotation of pastures/ run areas
- Expose areas to more direct sunlight (higher soil temperature, lower soil moisture, lower humidity)
- Controlled burning (of brush)
- Introduce a tick-repellant plant



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**Question 2 (cont.)**

**BIOLOGICAL CONTROLS**

- Introduce a tick predator (e.g., birds, wasps, ants)
- Introduce a disease that will affect only ticks
- Introduce a competitor to the tick
- Interrupt tick breeding cycle, e.g., sterile male; pheromones
- Control host population by reasonable means, including (but not necessarily limited to) the following:
  - Decrease mouse and/or deer population by introduction of a predator
  - Lengthen the hunting season for deer
  - Inoculate the host (only reasonable for deer)
  - Introduce a tick controlling substance to the host (NOT a pesticide); e.g., hormone disrupter or type of medicine on acorns that will be ingested by mice and deer
    - Simply stating “control host population” is not an acceptable answer. Student must include some (general) method of control.
    - Controlling the host population by a method such as increasing the gypsy moth population, which will defoliate trees, reducing the acorn population and thus limit mice and deer populations is NOT a reasonable technique.
    - Likewise, genetic engineering of oak trees, deer, and/or mice is not a reasonable technique.

**CHEMICAL CONTROLS**

**Pesticide use:**

- Must show an understanding of restricted or judicious use of pesticides in IPM (e.g., should give some indication of timing, place, type, or amounts of pesticide to be used)
- It is not necessary to name a specific pesticide

**Herbicide use:**

- Must show an understanding of restricted or judicious use of herbicides in IPM (e.g., should give some indication of timing, place, type, or amounts of herbicide to be used)

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**Question 3**

**3. (a) 10 points possible — 9 points maximum**

**2 points** possible for identifying two indoor air pollutants: Students earn **1 point** for each specific indoor air pollutant identified *if* they have accurately discussed one or more of the items asked for in (i), (ii), (iii), or (iv).

**0 points** are earned for merely identifying one or two pollutants with no other information.

**(i) 2 points** possible

**1 point** for correctly identifying a building type appropriate for each pollutant identified. Type of building must be appropriately linked to source of pollutant.

For example:

“older buildings” for asbestos or lead

“newer buildings” for formaldehyde or VOC’s

“houses with wood-burning stoves” for carbon monoxide

**(ii) 2 points** possible

**1 point** each for correctly identifying a source for each pollutant identified (see chart).

If the source designated is exterior to the building, the respondent must provide an appropriate method of introducing the pollutant to the inside environment (see chart).

**(iii) 2 points** possible

**1 point** each for correctly identifying a human health effect for each pollutant identified (see chart).

**(iv) 2 points** possible

**1 point** each for correctly identifying a method of prevention or cleanup for each pollutant identified (see chart).

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**3. (b) 2 points maximum**

**(i) 1 point** earned for an explanation of term “sick building” such as:

- “sick building” is a term which refers to a building in which a number of people report adverse health effects that they believe are related to the time they spend in the building
- “sick building” refers to a building in which air pollution brings about/causes a number of debilitating health effects
- “sick building” is a term used to describe a building in which occupants suffer persistent symptoms that disappear when they go outside
- “sick building” refers to a building which contains unhealthy levels of indoor air pollutants

**(ii) 1 point** for one of the following:

- When people report relief of symptoms (adverse health effects) when outside the building).
- When 20% or more of the occupants report some adverse health effect when inside the building.
- When occupants report any of the following symptom(s). Students must specify a minimum of two symptoms for one point.
  - Chronic respiratory problems/irritation of mucous membranes
  - Sinus infection
  - Sore throat
  - Irritability
  - Forgetfulness
  - Asthma
  - Shortness of breath
  - Hypersensitivity and Pneumonitis
  - Humidifier fever
  - Depression
  - Nerve disorders
  - Kidney/Liver damage
  - Ear infections
  - Reduced lung function
  - Onset of chest pain
  - Allergic reactions/responses
  - Muscle twitching/tingling sensation
  - Headaches
  - Rashes/skin irritation
  - Eye irritation
  - Impaired vision
- When a student indicates a method to determine the criteria listed above. For example, determining the levels of chemicals present or percentage of people with health effects.

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**Question 3 (cont.)**

In the chart that follows on pages 12 through 19:

I.V. = I mproved Ventilation

TSRM = Tobacco Smoke Reduction Methods — Stop smoking, smoke outdoors, legislative measures (banning, taxing, etc.)

<b>Pollutant</b>	<b>Source(s)</b>	<b>Effect(s) on Health</b>	<b>Method(s) of Prevention or Clean-Up</b>
<b>Asbestos</b>	Insulation, floor and ceiling tiles, spray-on fire retardant, roof shingles, millboard	Lung cancer, lung disease, mesothelioma, asbestosis, respiratory problems	Removal, encapsulation, appropriate legislative measures
<b>Carbon Monoxide</b>	Woodburning stove/ fireplace, tobacco smoke, motor vehicles, kerosene, natural gas, fuel oil appliances <b>(must indicate a <u>combustion</u> source)</b>	Headaches, drowsiness, irregular heartbeat, fatigue, impaired vision, dizziness, confusion, nausea, flu-like symptoms, reduced oxygen carrying capacity of RBC's, death	Improved ventilation, maintenance of appliances, alternate heating method (i.e., electric), stop smoking, appropriate legislative measures
<b>Environmental Tobacco Smoke (ETS)</b>	Cigarettes, cigars, pipe smoking, etc. Must be a combustion of tobacco	Cancer (lung, mouth, throat, bladder), respiratory problems, heart disease, emphysema, ear infections	Stop smoking, smoke outdoors, improved ventilation, appropriate legislative measures
<b>Formaldehyde</b>	Furniture stuffing, paneling, particle board, fiberboard, foam insulation, chipboard, ceiling tile, new furniture, plywood, carpeting	Irritation of eyes, nose, throat, skin, and lungs, nasal and lung cancer, nausea and dizziness, asthma, impaired breathing	Improved ventilation, alternative building materials, control of temperature and humidity environment, appropriate legislative measures

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**Question 3 (cont.)**

<b>Radon</b>	Radioactive soil, rock foundations and building materials. Uranium deposits. Radioactive well water <b>(must mention radioactivity or uranium in source)</b>	Lung cancer or lung tissue damage as it relates to cancer effects <b>(do not accept scarring or respiratory problems/irritant)</b>	Improved ventilation, sealing cracks
<b>Ammonia</b>	Cleaning products	Respiratory irritant	Improved ventilation, alternate cleaning products, appropriate legislative measures
<b>Arsenic</b>	Smoking, pesticides, rodent poisons (rodenticides)	Toxic, carcinogen	Improved ventilation, stop smoking, alternative pest control, appropriate legislative measures
<b>Bacteria</b>	Air-handling systems, damp building materials, and furnishings	Bacterial diseases and infections (Legionnaires, strep, etc.)	Improved ventilation, humidity control, maintenance of filter systems, water treatment

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**Question 3 (cont.)**

<b>Benzene/Gasoline</b>	Gasoline/gasoline powered equipment	See VOC's	Improved ventilation, alternate energy source
<b>Benzo-<math>\alpha</math>-Pyrene</b>	Woodburning stove/fireplace, tobacco smoke	Lung cancer	Improved ventilation, stop smoking, proper maintenance of stove/fireplace, alternative heating source, appropriate legislative measures
<b>Cadmium</b>	Tobacco products, fungicides	Lung cancer and kidney damage	Improved ventilation, tobacco smoke reduction methods, appropriate legislative measures
<b>Chloroform</b>	Chlorine-treated water	Cancer	I.V., alternative disinfection methods
<b>Carbon Dioxide</b>	See carbon monoxide Also accept "people" ( <b>if</b> building type is designated as overcrowded and poorly ventilated)	Oxygen deficiency problems — Headaches, drowsiness, irregular heartbeat, fatigue, impaired vision, dizziness, confusion, nausea	See carbon monoxide

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**Question 3 (cont.)**

<b>Carbon Tetrachloride</b>	Solvent, paint stripper	See VOC's	I.V., alternate products
<b>Fiberglass</b>	Fiberboard products: awnings, tables, skateboards, tabletops, etc.	Potential carcinogen, respiratory irritant, skin irritant	I.V., alternate building materials, product maintenance
<b>Fungi</b>	Air-handling systems, damp building materials/furnishings	Respiratory irritant, aggravates asthma conditions, allergic reactions (watery eyes, sneezing, rashes, coughing)	I.V., humidity control, maintenance of air-handling systems
<b>Lead Particulates (<u>must be airborne</u>)</b>	Lead paint particulates (dust), smelters, contaminated soil, exhaust from leaded gasoline combustion.	Impaired mental and physical development, fatigue, headache, muscular tremor, clumsiness, loss of memory, convulsions, coma, high blood pressure, death, anemia, miscarriage/premature birth	I.V., alternate paints, indoor filtering systems, sealing of old paint, smelter filtering systems, alternative gasoline sources, appropriate legislative measures
<b>Mercury</b>	Fungicides, fossil fuel combustion, thermometers, thermostats	Damages nervous system, carcinogen	I.V., alternate fungicides, alternate energy sources, replacement of mercury-containing materials

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**Question 3 (cont.)**

<b>Methane/Propane</b>	Leaking natural gas lines and appliances, leakage from underground tanks or landfills, anaerobic sewer backup	Oxygen deficiency problems — Headaches, drowsiness, irregular heartbeat, fatigue, impaired vision, dizziness, confusion, nausea	I.V., sealing of leaks, sealing foundations, maintenance of sewer lines/drains
<b>Methylene Chloride</b>	Paint strippers and thinners	Nervous disorders, diabetes	I.V., alternate strippers and thinners, appropriate legislative measures
<b>Mold Spores</b>	See Fungi	See Fungi	See Fungi
<b>Moth Flakes/Balls (see Paradichlorobenzene)</b>			
<b>Nitrogen Dioxide</b>	See Carbon Monoxide	Respiratory irritant, headaches	I.V., alternate heating sources, proper maintenance of appliances, Appropriate legislative measures
<b>Ozone</b>	Photocopiers, electrostatic air cleaners, outdoor air, electrical equipment	Respiratory irritant, fatigue, mucous membrane irritant, aggravates asthma and chronic bronchitis	I.V., legislation – to reduce NO <sub>x</sub> and VOC's



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**Question 3 (cont.)**

<b>Paradichlorobenzene</b>	Air fresheners, moth control products (moth flakes/balls)	Lung cancer, mucous membrane irritant	I.V., alternate products, appropriate legislative measures
<b>Particulates</b>	Tobacco combustion, outdoor air, trash incineration, wood burning, dust, factories, smelters, coal-burning power plant, kerosene heaters, agriculture, unpaved roads and construction, pet dander	Respiratory irritant, mucous membrane irritant, respiratory infections, bronchitis, lung cancer, asthma, lung damage, aggravates allergic reactions	Improved air filtration, alternative energy sources, TSRM, alternate heating sources, paving roads and dust control methods, alternative tilling practices, alternate trash disposal methods, grooming pets, appropriate legislative measures
<b>Pesticides</b>	Pesticides — sprays and strips and outdoor air	Possible carcinogen, mucous membrane irritant, central nervous system and kidney/liver damage	I.V., alternative pest control methods. <i>If source is outdoor air — improved air filtration system.</i>

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**Question 3 (cont.)**

<b>Pollen</b>	Flowering plants	Allergic reactions, mucous membrane irritant, asthma	Improved air filtration, selective removal of problem plants
<b>Styrene</b>	Carpets, plastic products	Kidney and liver damage	Alternative flooring/plastic products, appropriate legislative measures
<b>Sulfur Dioxide</b>	Coal-burning power plants, coal and oil combustion, kerosene space heaters, outside air. If source is outside, must provide method of infiltration.	Restriction of airways, mucous membrane irritant, respiratory irritant, aggravation of asthma, emphysema, bronchitis	I.V., improved air filtration, alternate energy sources, low-sulfur coal, alternate heating sources, appropriate legislative measures
<b>Trichloroethane</b>	Aerosol sprays	Dizziness, irregular breathing	I.V., alternate products, appropriate legislative measures

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**Question 3 (cont.)**

<b>Tetrachloroethylene</b>	Dry cleaning fluid fumes	Nerve disorders, liver and kidney damage, possible cancer	I.V., alternate cleaning methods, appropriate legislative measures
<b>Virus</b>	Air handling systems, humans, outdoor air, animals	Viral diseases (colds, pneumonia, etc.)	Improved air filtration system, humidity control, sanitary health practices
<b>Volatile Organic Compounds (VOC's)</b>	Tobacco combustion, burned food products, paints, solvents, varnishes, cleaning products, carpets, building furnishings, draperies, clothing	Respiratory and mucous membrane irritant, weakened immune system, possible carcinogen.	I.V., TSRM, alternate products, air filtering system, appropriate legislative measures
<b>Vinyl Chloride</b>	Plastic plumbing, floor and wall coverings, countertops	Carcinogen	I.V., alternate products, appropriate legislative measures

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**Question 4**

**4. (a) 3 points maximum**

**1 point** for indicating that animal waste is likely to be contaminating the water **IF** it is supported by a rational explanation of the data.

**1 point** for linking the decrease in dissolved oxygen level to decomposition of animal waste and/or an increase in biochemical oxygen demand.

**1 point** for linking the increase in nitrate level and/or an increase in phosphate level to their presence in animal waste.

**1 point** for using the trend in stream recovery, in regard to the water quality results, as evidence of contamination by animal waste.

**4. (b) 3 points maximum**

**1 point** for stating **each** water test **and** an appropriate pattern expected from sites A through D for that test. Only the first **two** tests given are graded.

**1 point** only for a descriptive elaboration of the parameter, **OR** method of testing, of ONE or BOTH of the stated tests.

Examples of suitable water tests include:

Fecal Coliform/Coliform, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Temperature, Turbidity/Total Suspended Solids (TSS), Heavy metals, (e.g., lead, mercury, cadmium), Carbon dioxide, Nitrite, Salinity, Ammonia, Other macro or micronutrients (e.g., K, S), Chlorine, Iron, Selenium, Hardness, Sulfate, Sulfite, Methane, Conductivity/Total Dissolved Solids (TDS), Alkalinity/Acid Neutralizing Capacity (ANC), Color, Odor, Synthetic organics, (e.g., pesticides, PCBs), Qualitative Habitat Evaluation Index (e.g., stream substrate analysis), Biodiversity Index – the different numbers and types of species, (e.g., macroinvertebrates, bacteria, algae, amphibians, fish, plants).

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Question 4 (cont.)

4. (c) 3 points maximum

Only the **first** described sequence is graded. Credit will only be given for ecological changes that are **linked** to the presence of animal waste and are **connected** to a single sequence.

**0 points** would be awarded for simply stating that ‘eutrophication’ occurs.

An example of a suitable sequence could be:

**1 point** for indicating that as stream fertility increases due to higher nitrate/phosphate levels, an algal bloom occurs.

**1 point** for indicating that as the dead algae and/or organic materials are decomposed, a reduction in the level of dissolved oxygen occurs.

**1 point** for indicating that an increase in suspended solids could lead to an increase in temperature and/or a decrease in the rate of photosynthesis, resulting in lower dissolved oxygen levels.

**1 point** for indicating that a shift in benthic plants, phytoplankton, macroinvertebrates, and/or fish communities would result from a specific cause.

**1 elaboration point** is possible for identifying a suitable species as the example of a shift in biodiversity.

Suitable examples of an indicator species could be:

**Pollution sensitive**

caddisfly larvae  
hellgrammite  
mayfly nymphs  
gilled snails  
riffle beetle adult  
stonefly nymphs  
water penny larvae  
trout

**Somewhat pollution tolerant**

beetle larvae  
clams  
crane fly larvae  
crayfish  
damselfly nymphs  
dragonfly nymphs  
scuds  
sowbugs  
fishfly larvae  
alderfly larvae  
atherix  
bass

**Pollution tolerant**

aquatic worms  
blackfly larvae  
leeches  
midge larvae  
pouch (and other) snails  
catfish  
carp

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**Question 4 (cont.)**

Other acceptable species could include: duckweed, pfiesteria.

**1 point only** would be awarded for indicating that a human health effect could occur from the contaminated water. For example, if humans are exposed to water with high fecal coliform counts, from human or animal wastes, other organisms may also be present that could lead to diseases such as typhoid fever, hepatitis, gastroenteritis, dysentery, and ear infections.

**4. (d) 2 points maximum**

**1 point each** for describing any **two** of the following provisions of the Clean Water Act. Only the first **two** stated examples are graded.

The Clean Water Act serves to:

- regulate the discharge of pollutants into U.S. waterways
- attain water quality levels that make these waterways safe to fish and/or swim in
- restore and maintain the chemical, physical, and biological integrity of the nation's water
- set water quality standards to limit pollutants
- require states and tribes to complete an assessment of all state rivers impacted, or potentially impacted, by non-point pollution (Section 319)
- reduce polluted runoff from urban areas and animal feeding operations (Section 319)
- provide enforcement mechanisms (e.g. civil actions/criminal penalties) to ensure compliance
- develop management plans to address problems
- establish ongoing monitoring of local waterways
- require discharge permits for effluent emissions
- provide financial assistance to fund improvements/education/training
- prevent habitat destruction
- establish best practical control technology (BPT) to reduce pollution
- establish best available, economic achievable technology (BAT) to reduce toxics
- establish best management practices (BMPs) to reduce pollution.