

## 2001 AP<sup>®</sup> ENVIRONMENTAL SCIENCE FREE-RESPONSE QUESTIONS

3. In recent years, results from scientific studies have increased public awareness of the possible damage to human health from exposure to indoor air pollution.
- (a) Identify two specific indoor air pollutants and, for each, discuss the following.
- (i) The type of building most affected by the pollutant
  - (ii) Source(s) of the pollutant
  - (iii) The pollutant's effects on human health
  - (iv) The method(s) of prevention or cleanup of the pollutant
- (b) According to the Environmental Protection Agency, at least 17 percent of the four million commercial buildings in the United States can be considered "sick buildings."
- (i) Explain what is meant by the term "sick building."
  - (ii) Describe the criteria used for determining whether a building is "sick."

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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. = Improved Ventilation

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

Pollutant	Source(s)	Effect(s) on Health	Method(s) of Prevention or Clean-Up
<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</b> accept scarring or respiratory problems/irritant)	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