

## 2018 AP<sup>®</sup> ENVIRONMENTAL SCIENCE FREE-RESPONSE QUESTIONS

4. In many parts of the world, biomass like peat, wood, and animal waste is burned indoors for cooking and home heating. Combustion of these fuels releases harmful household air pollutants that pose a health threat to billions of people, mostly in less developed countries.

- (a) Air pollutants are released during the burning of biomass indoors for cooking and heating.
- (i) **Identify** TWO air pollutants released during the burning of biomass indoors for cooking and heating.
- (ii) **Identify** a specific human respiratory illness that one of the pollutants you identified may cause.
- (b) **Identify** one realistic approach, other than banning the practice of burning biomass indoors, that could be used to reduce the impact of biomass combustion indoors on human respiratory health. **Describe** how this approach could reduce the incidence of respiratory illness.

In 2016 approximately four million people died from illnesses attributed to household air pollutants from burning biomass indoors. More than 10 percent of these deaths occurred in children under the age of five in less developed countries.

- (c) **Discuss** one reason children under the age of five are at a greater risk than adults for illnesses linked to household air pollutants.

In more developed countries, indoor air pollution is also a problem. Common indoor air pollutants in developed countries include:

- asbestos
- radon
- mold

- (d) Choose TWO of the three common indoor air pollutants (asbestos, radon, mold) listed above and complete the following table.

- (i) **Identify** a source for each indoor air pollutant.
- (ii) **Describe** a method for reducing exposure to each of the two pollutants you chose.

Indoor Air Pollutant	Source	Method for Reducing Exposure

**STOP**

**END OF EXAM**

# AP<sup>®</sup> ENVIRONMENTAL SCIENCE

## 2018 SCORING GUIDELINES

### Question 4

In many parts of the world, biomass like peat, wood, and animal waste is burned indoors for cooking and home heating. Combustion of these fuels releases harmful household air pollutants that pose a health threat to billions of people, mostly in less developed countries.

(a) Air pollutants are released during the burning of biomass indoors for cooking and heating.

- (i) **Identify** TWO air pollutants released during the burning of biomass indoors for cooking and heating.

(2 points; 1 point for each correct identification of an air pollutant released during the burning of biomass)

- (ii) **Identify** a specific human respiratory illness that one of the pollutants you identified may cause.

(1 point for correct identification of a specific respiratory illness linked to identified pollutant)

Identification of TWO air pollutants	Identification of a specific human respiratory illness linked to identified pollutant
<ul style="list-style-type: none"><li>Carbon monoxide (CO)</li></ul>	<ul style="list-style-type: none"><li>CO poisoning</li></ul>
<ul style="list-style-type: none"><li>Particulate matter (PM)</li></ul>	<ul style="list-style-type: none"><li>Asthma</li><li>Chronic obstructive pulmonary disease (COPD)</li><li>Emphysema</li><li>Bronchitis</li><li>Lung cancer</li></ul>
<ul style="list-style-type: none"><li>Nitrogen oxides (NO<sub>x</sub>)</li></ul>	<ul style="list-style-type: none"><li>Pneumonia</li><li>Asthma</li></ul>
<ul style="list-style-type: none"><li>Sulfur oxides (SO<sub>x</sub>)</li></ul>	<ul style="list-style-type: none"><li>Bronchitis</li><li>Emphysema</li><li>Asthma</li></ul>
<ul style="list-style-type: none"><li>Trace metals, such as lead, mercury, arsenic, and cadmium</li></ul>	<ul style="list-style-type: none"><li>Bronchitis</li></ul>
<ul style="list-style-type: none"><li>Methane (CH<sub>4</sub>)</li></ul>	<ul style="list-style-type: none"><li>Bronchitis</li></ul>
<ul style="list-style-type: none"><li>Volatile organic compounds (VOCs)</li></ul>	<ul style="list-style-type: none"><li>Bronchitis</li><li>Asthma</li></ul>

# AP<sup>®</sup> ENVIRONMENTAL SCIENCE

## 2018 SCORING GUIDELINES

### Question 4 (continued)

- (b) **Identify** one realistic approach, other than banning the practice of burning biomass indoors, which could be used to reduce the impact of biomass combustion indoors on human respiratory health. **Describe** how this approach could reduce the incidence of respiratory illness.

(2 points; 1 point for correct identification of a realistic approach to reducing the impact and 1 point for correct description of reduction of illness linked to identified approach)

<b>Identify</b> one realistic approach	<b>Describe</b> how this approach would reduce the incidence of respiratory illness
Ventilate through structural change (chimney construction, opening windows and doors)	Removes some or all of the air pollution from indoors/transfers pollutants out of the home, leading to less respiratory illness
Switch to cleaner-burning/more efficient cooking stove	Requires less fuel to be burned releasing fewer air pollutants into the home, leading to less respiratory illness
Switch to a different energy source (solar, natural gas, biogas, electric)	Produces less or no indoor air pollutants, leading to less respiratory illness
Cook outdoors	Move the source of the air pollutant outside/leads to less or no concentrated air pollution inside, leading to less respiratory illness

In 2016 approximately four million people died from illnesses attributed to household air pollutants from burning biomass indoors. More than 10 percent of these deaths occurred in children under the age of five in less developed countries.

- (c) **Discuss** one reason children under the age of five are at a greater risk than adults for illnesses linked to household air pollutants.

(1 point for correct discussion of why children under the age of five are at a greater risk)

- Children have an underdeveloped or less-developed immune systems leading to a greater risk of illness following exposure.
- Children have a lower body mass leading to a higher relative dose of air pollution.
- Children spend more time indoors leading to higher exposure to air pollution.
- Children have smaller respiratory systems (narrow airways) so mild inflammation may cause more severe respiratory distress.

# AP<sup>®</sup> ENVIRONMENTAL SCIENCE

## 2018 SCORING GUIDELINES

### Question 4 (continued)

In more developed countries, indoor air pollution is also a problem. Common indoor air pollutants in developed countries include:

- asbestos
- radon
- mold

(d) Choose TWO of the three common indoor air pollutants (asbestos, radon, or mold) listed above and complete the following table.

(i) **Identify** a source for each indoor air pollutant

(2 points; 1 point for correct identification of a source of each indoor air pollutant chosen)

(ii) **Describe** a method for reducing exposure to each of the two pollutants you chose.

(2 points; 1 point for correct description of method of reduction for each indoor air pollutant chosen)

	Identification of a source	Description of a method for reducing exposure
Asbestos	<ul style="list-style-type: none"><li>• Building materials (cement, floor tiles, ceiling panels, drywall, popcorn ceiling)</li><li>• Insulation</li><li>• Naturally occurring in soil and rocks in a dirt-floor basement or crawlspace</li></ul>	<ul style="list-style-type: none"><li>• Safely remove asbestos-containing materials/abatement</li><li>• Encapsulate/cover and seal materials/construct temporary enclosure</li><li>• Leave undisturbed</li></ul>
Radon	<ul style="list-style-type: none"><li>• Soil, rocks, Earth's crust</li><li>• Gas from uranium containing rocks</li><li>• Gas penetrates foundation</li></ul>	<ul style="list-style-type: none"><li>• Seal floors, walls, and joints</li><li>• Install structural exhaust venting</li><li>• Install subfloor depressurizing system</li></ul>
Mold	<ul style="list-style-type: none"><li>• Water from flooding, natural disasters, or leaks</li><li>• Poorly vented or maintained damp environments</li></ul>	<ul style="list-style-type: none"><li>• Replace or repair damaged surfaces/structures</li><li>• Clean and/or disinfect affected areas</li><li>• Dehumidify or ventilate inside air</li><li>• Improve drainage (from roof or yard, sump pump the basement)</li></ul>