

3. Approximately 350 coal-fired power plants in the United States are older than the 30-year anticipated life-span for a coal generator. One problem with these aging power plants is that many lack the necessary modern air pollution controls. Additionally, there are concerns about rising fuel costs, so many utility companies are planning to retire coal-fired plants and build new natural-gas power plants.

- (a) **Describe** why coal is considered a nonrenewable energy source.
- (b) **Describe** one potential environmental advantage of replacing a coal-fired power plant with a natural-gas power plant.
- (c) **Describe** one economic advantage of using natural gas, rather than coal, in producing electricity.
- (d) When natural gas is used to heat homes, it can produce carbon monoxide gas, which can lead to carbon monoxide poisoning in humans. **Propose** a solution to reduce the incidence of carbon monoxide poisoning in humans.

Particulate matter is another common pollutant in emissions from vehicles, coal-fired power plants, and various other sources. One size of particulates, $\text{PM}_{2.5}$, presents a particular risk to human health.

ATMOSPHERIC CONCENTRATION OF PARTICULATE MATTER IN 1990 AND 2016

Year	Average Annual Atmospheric Concentration of $\text{PM}_{2.5}$ ($\mu\text{g}/\text{m}^3$)
1990	85
2016	188

- (e) **Calculate** the percent change in the average annual $\text{PM}_{2.5}$ concentration in the air from 1990 to 2016. **Show** your work.
- (f) Trees can remove $\text{PM}_{2.5}$ from the atmosphere when particulates settle on the leaves and are subsequently washed onto soil by rain. The average annual removal of $\text{PM}_{2.5}$ is 2.3 kilograms per hectare. **Calculate** the decrease in $\text{PM}_{2.5}$ removal in kilograms if logging reduced a forested area from 50,000 hectares to 43,000 hectares. **Show** your work.
- (g) Research has shown that hospital admissions for cardiovascular problems increase 1% with every 10% increase in $\text{PM}_{2.5}$ concentration. A city experienced a 23% increase in $\text{PM}_{2.5}$ concentration and had 7,390 hospital admissions for cardiovascular issues over a one-year period. **Calculate** the anticipated increase in the number of hospital admissions for cardiovascular issues during the next year if the $\text{PM}_{2.5}$ concentration continues to rise at an identical rate. **Show** your work.

Begin your response to this question at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number.

STOP

END OF EXAM

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