



## Concept Review

### Chapter 16

#### Summary of Terms

**Aerobic Bacteria** Bacteria able to decompose organic matter only in the presence of oxygen.

**Aerosol** A moisture-coated microscopic airborne particle up to 0.01 millimeter in diameter that is a site for many atmospheric chemical reactions.

**Anaerobic Bacteria** Bacteria able to decompose organic matter in the absence of oxygen.

**Aquifer** A soil layer in which groundwater may flow.

**Atmospheric Pressure** The pressure exerted on any object immersed in the atmosphere.

**Biochemical Oxygen Demand** A measure of the amount of oxygen consumed by aerobic bacteria in water.

**Eutrophication** The process whereby inorganic wastes in water fertilize algae and plants growing in the water and the resulting overgrowth reduces the dissolved oxygen concentration of the water.

**Greenhouse Effect** The process by which visible light from the sun is absorbed by the Earth, which then emits infrared energy that cannot escape and so warms the atmosphere.

**Hydrologic Cycle** The natural circulation of water throughout our planet.

**Industrial Smog** Visible airborne pollution containing large amounts of particulates and sulfur dioxide and

produced largely from the combustion of coal and oil.

**Leachate** A solution formed by water that has percolated through a solid-waste disposal site and picked up water-soluble substances.

**Nonpoint Source** A pollution source in which the pollutants originate at different and often nonspecific locations.

**Particulate** An airborne particle having a diameter greater than 0.01 millimeter.

**Point Source** A specific, well-defined location where pollutants enter a body of water.

**Photochemical Smog** Airborne pollution consisting of pollutants that participate in chemical reactions induced by sunlight.

**Stratosphere** The atmospheric layer that lies just above the troposphere and contains the ozone layer.

**Troposphere** The atmospheric layer closest to the Earth's surface, containing 90 percent of the atmosphere's mass and essentially all water vapor and clouds.

**Water Table** The upper boundary of a soil's zone of saturation, which is the area where every space between soil particles is filled with water.

#### Review Questions

##### 16.1 Water on the Move

1. In what form does most of the fresh water on our planet exist?
2. What two forces power the water cycle?
3. Where is it possible to see the water table above ground?

4. Is most of the liquid fresh water on our planet located above or below ground?

##### 16.2 The Water We Consume

5. When did the U.S. Geological Survey begin compiling national water-use data?
6. About how many liters of fresh water does the average American consume daily for personal use?

- Has annual water usage in the United States increased or decreased over the past couple of decades?
- What human activity consumes most of our fresh water?

### 16.3 How We Pollute Water

- Why does groundwater take so long to rid itself of contaminants?
- How can solid-waste disposal sites be designed to minimize the spread of leachates?
- What type of soil are pathogens not able to pass through?
- What did the Clean Water Act of 1972 shift?
- What are some of the main products of aerobic decomposition?
- What effect does organic matter in water have on the amount of oxygen dissolved in the water?

### 16.4 Wastewater Treatment

- What is the first step in treating raw sewage?
- What happens to the sludge collected from a wastewater treatment plant?
- Why don't all municipalities require third level tertiary treatment of wastewater?

### 16.5 The Earth's Atmosphere

- Why doesn't gravity flatten the atmosphere against the Earth's surface?
- Which elements make up today's atmosphere?
- Which chemical compounds make up today's atmosphere?
- In which atmospheric layer does all our weather occur?
- Does temperature increase or decrease as one moves upward in the troposphere?
- Does temperature increase or decrease as one moves upward in the stratosphere?

### 16.6 How We Pollute Air

- What is the difference between an aerosol and a particulate?
- What is a temperature inversion?
- What is the difference between industrial smog and photochemical smog?
- When is ozone useful and when is it harmful?
- How do unburned hydrocarbons contribute to air pollution?
- How does a catalytic converter reduce the output of air pollutants from an automobile?

### 16.7 Global Warming

- The atmosphere, like glass, is transparent to what and opaque to what?
- What is the number one gas emitted by human activities?
- How do scientists estimate the age of ancient air in bubbles trapped in an ice core?
- Why do scientists differ in their opinions about the potential effects of global warming?

### Quantitative Questions

- There are 1000 liters in 1 cubic meter and 1000 grams in 1 kilogram. How many grams of air are there in 1 liter of air? (Assume a density of 1.18 kg/m<sup>3</sup>.)
- Assume air has an average molar mass of 28.8 grams/mole and a density of 1.18 grams/liter. From this calculate the number of moles of air molecules in 1 liter of air. (See Section 9.3 for a review of this calculation.)
- There are about 25 trillion (25,000,000,000,000 =  $2.5 \times 10^{13}$ ) chlorofluorocarbon (CFC) molecules in every liter of air you breathe. How many moles of CFC molecules are there in every liter of air you breathe, and what percentage of air is this?



### Solutions (Odd-Numbered)

1. Most of the fresh water on our planet is found in polar ice caps and glaciers.
3. The water table can be seen above ground in the form of lakes and streams.
5. 1950.
7. Annual water use in the United States increased until 1980 and has decreased since then primarily due to improvements in agricultural irrigation methods.
9. Groundwater takes so long to rid itself of contaminants because it is inaccessible and the flow rate of many aquifers is slow.
11. Pathogens cannot pass through sand or underground sediments with small pore sizes.
13. Aerobic decomposition gives off carbon dioxide ( $\text{CO}_2$ ), water ( $\text{H}_2\text{O}$ ), nitrates ( $\text{NO}_3^-$ ), and sulfates ( $\text{SO}_4^{2-}$ ).
15. Raw sewage is first treated by screening out insoluble human waste products such as coffee grinds, tiny rocks, pebbles and balls of oil.
17. A third level of wastewater treatment is expensive and not all communities are in locations where this level of treatment is necessary.
19. The atmosphere is made up of nitrogen, oxygen, and small traces of argon and other materials such as carbon dioxide and water vapor.
21. Weather occurs in the troposphere.
23. The temperature increases as one goes higher in the stratosphere.
25. Temperature inversion is the reversal of the normal air flow where polluted warm air rises carrying pollutants away from the surface. Instead, polluted cool air settles below a body of warm air, which traps the cool air and the pollution at the surface.
27. Ozone is useful when found in the stratosphere where it protects us from harmful ultraviolet rays. Ozone is harmful when it enters the air we breathe down here at the bottom of the troposphere.
29. A catalytic converter provides a catalyst to increase the efficiency of the combustion of gasoline and lower the output of hydrocarbons.
31. Carbon dioxide.
33. Scientists differ in their opinions because there are many variables and the outcome is uncertain.
35.  $(1 \text{ L}) (1.18 \text{ g/L}) (1.00 \text{ mole}/28.8 \text{ grams}) = 0.0410 \text{ moles of air.}$