

## Concept Review

### Chapter 17

#### Summary of Terms

**Biomass** A general term for plant material.

**Coal** A solid consisting of a tightly bound network of hydrocarbon chains and rings.

**Kilowatt-Hour** The amount of energy consumed in 1 hour at a rate of 1 kilowatt.

**Natural Gas** A mixture of methane plus small amounts of ethane and propane.

**Petroleum** A liquid mixture of loosely held hydrocarbon molecules containing not more than 30 carbon atoms each.

**Power** The rate at which energy is expended.

**Watt** A unit for measuring power, equal to 1 joule of energy expended per second.

#### Review Questions

##### 17.1 Energy through Electricity

1. What does an electric current generate?
2. What does an electrical wire moving through a magnetic field generate?
3. Is electricity a source of energy?
4. What's a watt?
5. What is the estimated total length of the North American electric power grid?

##### 17.2 Fossil Fuels

6. Why are fossil fuels such a popular energy resource?
7. Why is coal considered the filthiest fossil fuel?
8. How does a scrubber remove noxious gaseous effluents created in the combustion of coal?
9. Can coal be converted to cleaner-burning fuels?
10. About how many barrels of petroleum are consumed each day in the United States?
11. What chemical is the main component of natural gas?

##### 17.3 The Nuclear Industry

12. Why has the number of operating nuclear fission plants in the United States decreased over the past two decades?

13. Before what year were most currently operating nuclear power plants built?
14. Why was most of the radiation from the Chernobyl meltdown released into the environment?
15. Why did the backup generators at the Fukushima nuclear power plant fail in March 2011?
16. What was the leading source of energy for the production of electricity throughout the world in 2010?

##### 17.4 Sustainable Energy Sources

17. What is the ideal sustainable energy source?
18. What is the ultimate source of sustainable energy?

##### 17.5 Hydroelectricity

19. Why is Hawaii particularly well suited for generating electricity using OTEC technology?
20. Why are hydrothermal vents often quite smelly?
21. How are tides used to generate electricity?
22. What does OTEC stand for?

##### 17.6 Biomass Is Chemical Energy

23. In what sense is biomass a form of solar energy?
24. Which has a higher octane rating, ethyl alcohol or gasoline?

25. What country is the top producer of ethanol fuel?
26. What is the most efficient way to convert biomass to electricity?

### 17.7 Direct Solar Energy

27. Why are solar water heaters painted black?
28. Describe two technologies used to convert solar heat to electricity.
29. What salt is used in the Gemasolar thermal electric power plant?
30. What is a drawback of wind power?

### 17.8 Hydrogen Fuel

31. Why is hydrogen such an ideal fuel?
32. How might cars one day store hydrogen fuel?

### Quantitative Questions

33. How much money would you save per hour by replacing a 100-watt incandescent light bulb with an equally bright 10-watt LED lamp? Assume the cost for electricity to be 15 cents per kilowatt-hour.
34. In the year 2020, about 200,000,000 MW-hours of electricity were produced from the combustion of biomass. How much power is this in units of MW? (Hint: there are 8760 hours in a year.)



### Solutions (Odd-Numbered)

1. An electric current generates a magnetic field.
3. Electricity is a form of energy that requires a source.
5. About 450,000 miles.
7. Coal is the filthiest fuel because it contains large proportions of impurities such as sulfur, toxic heavy metals, and radioactive isotopes.
9. Yes, coal can be converted into cleaner burning fuels by treating it with pressurized steam and oxygen to produce hydrogen gas.
11. Methane,  $\text{CH}_4$ , is the main component of natural gas.
13. Most currently operating nuclear power plants were built before 1990.
15. The backup generators at the Fukushima power plant failed in March 2011 because they were placed in the lower levels of the power plant where they got flooded by the unusually high tsunami.
17. An ideal sustainable energy source is one that is inexhaustible and environmentally benign.
19. Hawaii is well-suited for generating electricity using OTEC technology with large differences between surface and deep water temperatures within a relatively short distance from the shore. Interestingly, the developers of OTEC technology in Hawaii are discovering that the “side benefits” of OTEC, such as the production of fresh water, air conditioning, and aquaculture, are proving more worthwhile than is the production of electricity.
21. Bays or estuaries may be closed in by dams and when tidal waters flow in and out of the dam, they rotate a paddle wheel or turbine to generate electricity.
23. Biomass is a form of solar energy in that it uses photosynthesis to convert solar energy to chemical energy.
25. The United States is currently the world’s leading producer of ethanol fuel.
27. Solar heaters are black to absorb and retain sunlight.
29. Salt peter—a blend of sodium and potassium nitrates.
31. Hydrogen is an ideal fuel because it packs more energy by weight than any other chemical fuel.
33. First calculate the cost of running the 100-watt light bulb for one hour, understanding that 100 watts is the same as 0.1 kilowatts:
 
$$0.1 \text{ kW} \times 1 \text{ h} = 0.1 \text{ kWh}$$

$$0.1 \text{ kWh} \times 15 \text{ cents/kWh} = 1.5 \text{ cents}$$
 Then calculate the cost of running the 10-watt LED lamp for one hour, understanding that 10 watts is the same as 0.01 kilowatts:
 
$$0.01 \text{ kWh} \times 1 \text{ h} = 0.01 \text{ kWh}$$

$$0.01 \text{ kWh} \times 15 \text{ cents/kWh} = 0.15 \text{ cents}$$
 The savings for each hour is the difference: 1.5 cents minus 0.15 cents equaling 1.35 cents per hour. This may not sound like much, but if 50 million households in the U.S. changed just one of their light bulbs from a 100 watt incandescent to a 10 watt LED, then the total annual savings would be on the order of 1.35 billion dollars.