CHAPTER 10 Review

HEAT, WORK, AND INTERNAL ENERGY

Review Questions

1. Define a thermodynamic system and its environment.

2. In what two ways can the internal energy of a system be increased?

3. Which of the following expressions have units that are equivalent to the units of work?

a. mg
b. $\frac{1}{2}mv^2$
c. mgh
d. Fd
e. $P\Delta V$
f. $V\Delta T$

4. For each of the following, which thermodynamic quantities (ΔU, Q, and W) have values equal to zero?

a. an isothermal process
b. an adiabatic process
c. an isovolumetric process

Conceptual Questions

5. When an ideal gas expands adiabatically, it does work on its surroundings. Describe the various transfers of energy that take place.

6. In each of the following cases, trace the chain of energy transfers (as heat or as work) as well as changes in internal energy.

a. You rub your hands together to warm them on a cold day, and they soon become cold again.
b. A hole is drilled into a block of metal. When a small amount of water is placed in the drilled hole, steam rises from the hole.

7. Paint from an aerosol can is sprayed continuously for 30 s. The can was initially at room temperature, but now it feels cold to the touch. What type of thermodynamic process occurs for a small sample of gas as it leaves the high-pressure interior of the can and moves to the outside atmosphere?

8. The can of spray paint in item 7 is set aside for an hour. During this time the contents of the can return to room temperature. What type of thermodynamic process takes place in the can during the time the can is not in use?

Practice Problems

For problems 9–10, see Sample Problem A.

9. How much work is done when a tire's volume increases from 35.25×10^{-3} m^3 to 39.47×10^{-3} m^3 at a pressure of 2.55×10^5 Pa in excess of atmospheric pressure? Is work done on or by the gas?

10. Helium in a toy balloon does work on its surroundings as it expands with a constant pressure of 2.52×10^5 Pa in excess of atmospheric pressure. The balloon's initial volume is 1.1×10^{-4} m^3, and its final volume is 1.50×10^{-3} m^3. Determine the amount of work done by the gas in the balloon.

ENERGY CONSERVATION AND CYCLIC PROCESSES

Review Questions

11. Write the equation for the first law of thermodynamics, and explain why it is an expression of energy conservation.

12. Rewrite the equation for the first law of thermodynamics for each of the following special thermodynamic processes:

a. an isothermal process
b. an adiabatic process
c. an isovolumetric process

13. How is energy conserved if more energy is transferred as heat from a refrigerator to the outside air than is removed from the inside air of the refrigerator?