What is the First Law of Thermodynamics?

Worksheet

U = Q W: the change in internal energy equals heat absorbed minus work done by the system. Energy is conserved; none is created or destroyed.

@Delta U = Q - W

Questions

1. A gas absorbs 4,500 J and does 2,000 J of work. What is U?

A) +2,500 J
B) +6,500 J
C) 2,500 J
D) +4,500 J

2. What happens if Q = W?

A) U is maximum
B) U = 0 (no change in internal energy)
C) U is negative
D) U > 0 always

3. A piston compresses a gas (work done on gas = 800 J). Heat released = 500 J. U?

A) +300 J
B) +1300 J
C) 300 J
D) +800 J

4. In an adiabatic process (Q = 0), what is U?

A) Equal to W
B) W (negative W)
C) Zero always
D) Equal to T S

5. A gas absorbs 3,000 J of heat and does 1,200 J of work on surroundings. What is U?

6. A system releases 500 J of heat (Q = 500 J) and has 300 J of work done on it (W = 300 J). Find U.

7. If U = 400 J and the system does 600 J of work, how much heat is absorbed?

8. Define: State the first law of thermodynamics.

9. Define: What does U represent?

10. Define: Sign convention for Q (heat).

Answer Key

1. A) +2,500 J - U = 4500 2000 = +2500 J
2. B) U = 0 (no change in internal energy) - U = Q W = 0 when Q = W.
3. A) +300 J - W (on system) = 800 J (negative sign); Q (released) = 500 J. U = (500) (800) = +300 J
4. B) W (negative W) - U = 0 W = W. If work is done on the system, U > 0.
5. U = Q W U = 3000 1200 U = +1800 J (internal energy increases)
6. U = Q W U = (500) (300) U = 500 + 300 = 200 J (internal energy decreases)
7. U = Q W 400 = Q 600 Q = 400 + 600 = +1000 J
8. U = Q W. Change in internal energy = heat in work done by the system.
9. The change in internal energy of a system, related to temperature and molecular motion.
10. Q > 0: heat absorbed by system; Q < 0: heat released by system.