

**Problem 1:** How will you describe the internal energy of a hot cup of coffee? What about a glass of cold water?

**Solution:** Since the internal energy is directly proportional to the temperature, the hot cup of coffee has higher internal energy compared to the glass of cold water.

**Problem 2:** Find the change in internal energy when 3500 J of work is done on the system and 1500 J of heat is added to the system.

**Solution:** We know that  $\Delta U = Q - W$ . Work is done on the system, so  $W = -3500$  J. Heat is absorbed, hence  $Q = 1500$  J. Performing the calculation, we will have  $\Delta U = 5000$  J.

**Problem 3:** Suppose you have three blocks (A, B, and C). Block A is in thermal equilibrium with block B, and block B is in thermal equilibrium with block C. How is block A related to block C?

**Solution:** Since block A is in thermal equilibrium with block B, both blocks have an equal temperature. Block B is also in thermal equilibrium with block C, so the temperature of block B is equal to that of block C. Hence, block A is also in thermal equilibrium with block C, and all three blocks have equal temperatures. This is exactly what the zeroth law of thermodynamics states.

**Problem 4:** In mechanics, we have discussed the law of conservation of energy. How is this different from the first law of thermodynamics?

**Solution:** The first law of thermodynamics is only concerned with the heat energy, while the law of conservation of energy is concerned with the energies of all kinds, such as kinetic and potential energy.

**Problem 5:** Explain using the concept of the second law of thermodynamics how beneficial it would be for you to take your periodical examinations on the specified day instead of moving it to another day. Assume that you have studied very well, and you are well-prepared for the examination day.

**Solution:** The second law of thermodynamics describes how the quality of energy tends to lose usefulness as time goes by. Relating this to your situation, the quality of the knowledge you have gained tends to decrease as your examination day is moved, hence it is best to take your examination on the original examination day.