(ln x = 2.303 log x, log 2.00 = 0.301, log 5.00 = 0.699)

1. Define and explain the following terms: (50%)
   (a) Extensive *vs.* intensive properties
   (b) The second law of thermodynamics
   (c) Boltzmann distribution law
   (d) Fourier's law of heat conduction
   (e) Newton's law of viscosity
   (f) Elementary reaction
   (g) Cage effect
   (h) Michaelis constant
   (i) Black body and black-body radiation
   (j) Photoelectric effect

2. What is a first-order reaction? Explain why the concentration of the reactant decreases exponentially with time. (10%)

3. A 1.00-g sample of ^{226}Ra emits 3.7×10^{10} alpha particles per second. Find the decay constant and the half-life. (10%)

4. Calculate the activation energy for a reaction whose rate at room temperature is doubled by a 10°C increase. (10%)

5. Find the osmotic pressure at 25°C and 1 atm of a solution of 1.8016 g of glucose ($C_6H_{12}O_6$) in 1000.0 g of water. The solution is contained in membrane equilibrium with pure water. ($R = 82.06\ cm^3\ atm\ mol^{-1}\ K^{-1}$) (10%)

6. A cylinder fitted with a piston contains 3.00 moles of He gas at 1.00 atm and is in a large constant-temperature bath at 400K. The pressure is reversibly increased to 5.00 atm. For this process, find the heat flow from the gas to the surrounding system and the internal energy change of the gas. (10%)