

1. Please give brief explanation for three principal laws of thermodynamics. (10 pts)
2. A reaction took 143 s for 50.0% of a particular substance to decompose. If the initial concentration is 0.060 M and the decomposition reaction follows second-order kinetics, what is the value of the rate constant? (15 pts)
3. A first-order reaction is 42% complete at the end of 17 minutes. What is the value of the rate constant? (15 pts)
4. How many normal modes of vibration are there for the following molecules:
(a) H_2 , (b) CH_4 , (c) CO_2 (d) NH_3 ? (10 pts)
5. Please predict the electronic configurations of the following molecules. (15 pts)
 - (1) Na and O.
 - (2) Cr and Cu.
 - (3) Cr^{2+} and Cu^{2+} .
6. Please determine the following thermodynamic quantities extensive or intensive variables: (1) pressure; (2) entropy; (3) molar mass (4) chemical potential and (5) Gibbs free energy (20 pts)
7. Calculate the change in G_m for ice at $-10^\circ C$, with density 917 kg/m^3 , when the pressure is increased from 1.0 bar to 2.0 bar. (15 pts)