說明：1.請依序作答並標明題號
2.計算題必須寫出計算過程，只寫答案不予計分
3.R=8.314 J $mol^{-1}K^{-1}$=1.987 cal $mol^{-1}K^{-1}$

1. Why is the rate of a reaction affected by each of the following? (15%)
   a. frequency of collisions
   b. kinetic energy of collisions
   c. orientation of collisions

2. The rate constant for the decomposition of a certain substance is 2.8×10^{-3} $Lmol^{-1}s^{-1}$ at 30℃ and 1.38×10^{-2} $Lmol^{-1}s^{-1}$ at 50℃. Evaluate the Arrhenius parameters of the reaction. (15%)

3. In the reaction $2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$, when the NO concentration alone was doubled, the rate increased by a factor of 4; when both the NO and O2 concentrations were increased by a factor of 2, the rate increased by a factor of 8. What is the rate law for the reaction? (10%)

4. a. Please write a time-independent one-dimension Schrödinger equation. (5%)
   b. Please describe the commutator of the two operators in quantum mechanics. (5%)
   c. What is the correspondence principle in quantum mechanics? (5%)
   d. Give the possible term symbols for $Li[He]2s^1$. (5%)
   e. What atomic terms are possible for the electron configuration ns^1nd^1? Which term is likely to lie lowest in energy? (10%)
   f. Give the ground-state electron configurations of (a) CO and (b) CN^- (10%)

5. An ideal gas absorbs 9410 J of heat when it is expanded isothermally (at 25℃) and reversible from 1.5 dm^3 to 10 dm^3. How many moles of the gas are present? (10%)

6. If the ionization constant of a molecule could be described by the equation $\ln K = 7 - \frac{1850}{T} - 0.002T$ between 5℃ and 55℃. Calculate ΔG^o for the ionization at 50℃. (10%)