淡江大學 97 學年度碩士班招生考試試題

系別：化學工程與材料工程學系　　科目：物　理　化　學

本試題雙面印製

25% 1. You are requested to design an effusion source for Br atoms from $Br_2(g)$. If the source is to operate at a total pressure of 20 Torr, what temperature is required to produce a degree of dissociation of 0.50? (20%)

What value of the pressure would increase the degree of dissociation to 0.65 at this temperature? (5%)

The standard enthalpies of formation of $Br(g)$ and $Br_2(g)$ are 111.9 and 30.9 KJ/mole, respectively.

The standard Gibbs free energies of formation of $Br(g)$ and $Br_2(g)$ are 82.4 and 3.1 KJ/mole, respectively.

25% 2. Consider the following sets of populations for four equally spaced energy levels:

| $\varepsilon / \kappa$ | set A | set B | set C |
|---|---|---|---|
| 300 K | 5 | 3 | 4 |
| 200 K | 7 | 9 | 8 |
| 100 K | 15 | 17 | 16 |
| 0 K | 33 | 31 | 32 |

where $\varepsilon$ is energy, $\kappa$ is the Boltzmann constant, and K is the absolute temperature.

(1) Calculate the total energies for set A, set B and set C, respectively. (5%)

(2) Which set is the most probable? (10%)

(3) For the most probable set, is the distribution of energy consistent with a Boltzmann distribution? (10%)

25% 3. A graduate student studied the following parallel reaction:

$$A \overset{k1}{\underset{k2}{\rightleftarrows}} \begin{matrix} B \\ C \end{matrix}$$
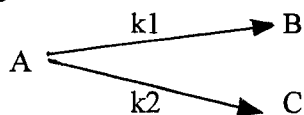
He reported that the yield for B at a given temperature was 0.3 and that the activation energies to B and C were 27 and 34 KJ/mole, respectively. He also claimed that the rate constants were described well by an Arrhenius expression and with

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| 准帶項目請打「V」 | |
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| V | 簡單型計算機 |

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identical preexponential factors. Demonstrate that his reported results are inconsistent with each other.

25% 4. Carbon tetrachloride melts at 255 K. The vapor pressure of $CCl_4$ is 10539 Pa at 290 K, 74518 Pa at 340 K, 270 Pa at 232 K and 1092 Pa at 250 K.

(1) Calculate the enthalpy of vaporization. (5%)

(2) Calculate the enthalpy of sublimation. (5%)

(3) Calculate the normal boiling point. (5%)

(4) Calculate the entropy of vaporization at the normal boiling point. (5%)

(5) Calculate the enthalpy of fusion. (5%)