淡江大學98學年度轉學生招生考試試題

系別：化學工程與材料工程學系三年級　科目：物　理　化　學

准帶項目請打「V」
V	計 算 機

本試題共 4 大題，1/2 頁

Problem One (25 points)

Calculate the expansion work done when 50 g of iron reacts with hydrochloric acid in (a) a closed vessel of fixed volume, and (b) an open beaker at 25 °C.

$$Fe_{(s)}+2HCl_{(aq)} \rightarrow FeCl_{2(aq)}+H_{2(g)}$$

The molar mass of iron is 55.85 $gmol^{-1}$. Gas constant R = 8.314 $JK^{-1}mol^{-1}$.

Atkin 8ed. P.36-37

Problem Two (25 points)

The Clapeyron equation is given in Eq.(1)

$$\frac{dP}{dT}=\frac{\Delta_{trs}S}{\Delta_{trs}V} \qquad (1)$$

(a) Show that the Clapetron equation for the liquid-vapor boundary is

$$\frac{dP}{dT}=\frac{\Delta_{vap}H}{T\Delta_{vap}V} \qquad (2)$$

(b) If the gas behaves perfectly, show that Eq.(2) can be rearranged into the Clausius-Clapeyron equation:

$$\frac{d\ln P}{dT}=\frac{\Delta_{vap}H}{RT^2} \qquad (3)$$

(c) Assuming that the enthalpy of vaporization is independent of temperature, show that Eq.(3) becomes:

$$P=P^{*}e^{-x} \qquad x=\frac{\Delta_{vap}H}{R}\left(\frac{1}{T}-\frac{1}{T^{*}}\right) \qquad (4)$$

where P^* is the vapor pressure when the temperature is T^*.

(d) The normal boiling point of benzene is 80 °C and $\Delta_{vap}H$ = 30.8 $kJmol^{-1}$, calculate the vapor pressure at 20 °C. 1 atm = 101 kPa.

Atkin 8ed. P.126-128

Problem Three (15 points)

Some reactions proceed through the formation of an intermediate, as in the consecutive uni-molecular reactions

$$A \xrightarrow{k_a} I \xrightarrow{k_b} P$$

Each step of the reaction is first order. It can be shown that the concentration of intermediate obeys:

$$[I]=\frac{k_a}{k_b-k_a}\left(e^{-k_a t}-e^{-k_b t}\right)[A]_0$$

At what time will [I] be at maximum?

Atkin 8ed. P.812

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Problem Four (35 points)

The ground-state wavefunction of a hydrogen atom is

$$\psi = \left(\frac{1}{\pi a_o^3}\right)^{1/2} e^{-r/a_o}$$

where a_o = 53 pm. Evaluate the root mean square distance, $\langle r^2 \rangle^{1/2}$ of the electron from the nucleus in the hydrogen atom in its state of lowest energy.

Atkin, 8ed., Self-test 8.9, p.269

Hint: $\int_0^\infty x^n e^{-ax} dx = \frac{n!}{a^{n+1}}$