Final Exam. : 2nd Semester, (2017-2018)
Engineering Chemistry MTH 021
5/6/2018 Time: 2 hours
Total Mark: 50

Mansoura University
Faculty of Engineering
BME : Program
Level: 000

يجب مراعاة الترتيب فى الإجابة وعدم تداخل الإجابات (كل جزئية فى صفحة منفردة)

Answer the following questions: **(الامتحان من صفحتان)** **أجب عن الأسئلة الآتية:**

(C=12, N=14, H=1, and O=16)

Question No. (1) (15Marks)

(a): The metabolic oxidation of glucose, $C_6H_{12}O_6$, in our bodies produces CO_2, which is expelled from our lungs as a gas, according to the following combustion reaction:

$C_6H_{12}O_{6\,(aq)} + 6\,O_{2\,(g)} \longrightarrow 6\,CO_{2\,(g)} + 6\,H_2O_{\,(g)}$ Calculate the volume of air you would need at 1 atm. and 298 K, to completely oxidize 50 g of glucose. (given air contains %O2 =21% by volume)? **(5)**

(b): Predict the behavior of 80.5 gm of a gas analyzing (as% by volume): of 25% CO_2 , 10% CO, 5% O_2 and 60% N_2 at the following specified conditions. **(5)**

i. Pressure of 2 atm. and occupying a volume of 50 lit. at a temperature of 17 °C?

ii. Pressure of 405.3 k pa. and occupying a volume of 0.005 m^3 at a temperature of 27 °C?

iii. Occupying a volume of 56035 cm^3 at standard conditions (S.T.P)?

(c): By applying van der Waals equation of state predict the molar volume of CO_2 gas, at a temperature of 27 °C and pressure of 15 atm. Neglect the effect of the intermolecular attractive forces and considering the volume of gas molecules whose diameter = 4 x 10^{-7} mm, and Avogadro's Number = 6 x 10^{23} molecule per mole. **(5)**

Question No. (2): (14Marks)

(a): Calculate the change in internal energy, (ΔE) and ΔH when 28 gm of methane gas (CH_4), are compressed isobarically at 7.749 atm. from 15 liters to 5 liters by coling the gas,? (consider methane behaves as an ideal gas during this process and the specific heat of CH4 at constant pressure Cp=5.34+0.0115T cal/mol. k). **(5)**

(b): Referring to the information of thermodynamic data at 25°C in the table for the following reaction

$Fe_2O_{3\,(s)} + 2Al_{\,(s)} \longrightarrow 2Fe_{\,(s)} + Al_2O_{3\,(s)}$

predict whether the given reaction would be:

(i) Exothermic or endothermic at 25°C.

(ii) Natural and possible or not.

(iii) Takes place as written at the standard state conditions at 25°C. **(5)**

ompound	$\Delta H°_f$ kcal/mole	S° cal/mole.deg.
Fe(s)	000.00	6.490
Al(s)	000.00	6.770
Fe_2O_3(s)	-196.50	21.500
Al_2O_3(s)	-399.092	12.185

(c): Express the free-energy change in a process in terms of the changes that occur in the enthalpy and entropy of the system? and Indicate the effect of temperature on spontaneity for the following reactions : **(4)**

(i) $KClO_{3\,(s)} \rightarrow KCl_{\,(s)} + 1.5\,O_{2\,(g)}$, $\Delta H° = -44.7$ kJ;

(ii) $2Al_{\,(s)} + 3Cl_{2\,(g)} \rightarrow 2AlCl_{3\,(s)}$ $\Delta H° = -332$ kJ;

(iii) $NOCl_{\,(g)} \rightarrow NO_{\,(g)} + 0.5\,Cl_{2\,(g)}$ $\Delta H° = 37.6$ kJ;

(iv) $2H_2O_{\,(l)} \rightarrow 2H_{2\,(g)} + O_{2\,(g)}$, $\Delta H° = 572$ kJ;

Question No. (3): (13Marks)

(a): Benzene and toluene form solutions that are nearly ideal. At 80°C, the vapor pressures of pure benzene and pure toluene are 753 torr and 290 torr respectively. Calculate the total vapor pressure of a solution and the composition of vapor at 80°C above a solution made by mixing 100 gm benzene, (C_6H_6), with 100 gm toluene, ($C_6H_5CH_3$). **(5)**

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(b): When 0.555 gm of a solute, (molecular weight = 110 gm/mole), is dissolved in 100 gm. of a solvent , (molecular weight = 94.10 gm/mole and normal freezing point= 318.1 K), a freezing point lowering for the solvent of 0.382°C occurs. **Calculate:**

(i) $\mathbf{K_f}$, the molal freezing point lowering constant..

(ii) The enthalpy of fusion ($\Delta H°_{fus}$) for the solvent. **(5)**

(c): The osmotic pressure of 0.2 g of hemoglobin in 20 mL of solution is 2.88 mm Hg at 25°C. Calculate the molecular weight of hemoglobin **(3)**

Question No. (4): **(10Marks)**

(a): Based on the relation between electrode potentials and free energy change, derive the Nernst equation? (2)

(b): Calculate Ksp for AgCl, at 25°C from the E° values.

if you are given: $\mathbf{Ag_{(s)} = Ag^+ + e^-}$, $\mathbf{E°_1 = -0.799\ V}$ $\mathbf{AgCl_{(s)} + e^- = Ag_{(s)} + Cl^-}$, $\mathbf{E°_2 = 0.222\ V}$ (3)

(c): Calculate the electrode potential, **E**, **ΔG** and the equilibrium constant ($\mathbf{K_{eq.}}$) for the reaction:

$\mathbf{Pb_{(s)} + 2H^+ = Pb^{++} + H_{2\,(g)}}$ under the condition that, $[H^+]$ =0.01 molar, $[Pb^{++}]$ = 0.1 molar and $PH_2=10^{-6}$ atm and at temperature of 25°C. if you are given:

$\mathbf{Pb^{++} + 2e^- \longrightarrow Pb_{(s)}}$ $\mathbf{E°_1 = -0.126\ volt}$ $\mathbf{H_{2\,(g)} \longrightarrow 2H^+ + 2\,e^-}$ $\mathbf{E°_2 = 0.0\ volt}$ **(5)**

With My Best Regards and Good Luck

Prof. Dr. Ahmed Ahmed Al sarawy