Final Exam. : 2018/ 2019	**Mansoura University**
Engineering Chemistry MTH 021	**Faculty of Engineering**
29/12/2018 Time: 2 hours	**BME: Programs**
Total Mark: 50	**Level: 000**

يجب مراعاة الترتيب فى الاجابة وعدم تداخل الاجابات (كل جزئية فى صفحة منفردة)

Answer the following questions: **(Required 50 Marks out of 56 Marks)** أجب عن الأسئلة الآتية:

(Na=23, C=12, He=4, H=1, N=14, and O=16)

Question No. (1) (12Marks)

(a): A 1.42 gm sample of helium **(He)** and an unknown mass of oxygen **(O_2)** are mixed in a flask at room temperature. The partial pressure of the helium is 42.5 torr. , and that of the oxygen is 158 mm Hg. **Calculate the mass of the oxygen? (4)**

(b): The vapor pressure of water vapor is 200 mmHg. in a mixture of dry air and water vapor. The total pressure is 740 mmHg. and temperature is 71.1°C. **What is the density of the gaseous mixture in gm/lit.** (Assuming dry air has the following composition by volume CO_2=0.03%, O_2=20.97% and N_2=79%) **(4)**

(c): Automobile air bags are inflated by nitrogen gas generated by the rapid decomposition of sodium azide, **(NaN_3)** : **Rxn.** $2NaN_{3(s)} \longrightarrow 2Na_{(s)} + 3N_{3(g)}$ If an air bag has a volume of 36 L and is to be filled with nitrogen gas at 874 mmHg and 26 °C, how many grams of NaN_3 must be decomposed? **(4)**

Question No. (2): (12Marks)

(a): For a system of 32.55 gm of natural gas (NG) whose composition (as % by volume): 84% CH_4, 10 % C_2H_6, 3% C_3H_8 and 3 % N_2 by volume, **Calculate the change in internal energy (ΔE) for this system,** when it is expanded isobarically at pressure of 8.6184 atm from a volume of 5liters to15 liters by raising its temperature (Consider NG behaves as an ideal gas and its specific heats as Cp = (6+0012T) cal/mole. K **(6)**

(b): The information in the table at 25°C:

(i) Calculate **$\Delta G°_r$** at 25°C for the reaction:
$CH_3OH_{(l)} = CO_{(g)} + 2H_{2(g)}$

(ii) Calculate **$\Delta G°_f$** for $CH_3OH_{(l)}$ at 25°C.

(ii) Discuss the effect of temperature on the spontaneity of the reaction **(6)**

Compound	$\Delta H°_f$ kcal/mole	$\Delta G°_f$ kcal/mole	$S°$ cal/mole K
$H_{2(g)}$	0.00	0.00	31.21
$CO_{(g)}$	-26.42	-32.81	47.30
$CH_3OH_{(l)}$	-57.04	----------	30.26

Question No. (3): (12 Marks)

(a): A 6 gm of $NaHSO_4$ dissolved in 500 gm of water lowers the freezing point of water by 0.426 °C. Assuming that $NaHSO_4$ dissociates completely into Na^+ and $HSO4^-$.i.e$NaHSO_{4(aq)} \longrightarrow Na^+ + HSO4^-$ and that the weak acid $HSO4^-$ dissociates partially to H^+ and $SO4^{--}$, according to the following reversible reaction: $HSO4^- \longrightarrow H^+ + SO4^{--}$ Calculate from the observed freezing point lowering the molality of $SO4^{--}$ **ions** in solution and the **P^H** of this solution. (**for water T^0_f=273K, and $\Delta H_{fus.}$=1436 cal/mol**) **(5)**

(b): How many grams of O_2 are dissolved in a round lake that is 1.6093 km in diameter and an average of 6.096 m deep. Assume that O_2 obeys Henry's law when dissolved in water at 25°C and the atmospheric pressure is 760 torr and the composition of air is 21% oxygen and 79% nitrogen by volume.

. (Assume that **Henre's constant of oxygen at 25°C=33.3x10^6 torr./mole fraction and the density of water =1 gm/cm^3**). **(4)**

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

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Question No. (4): **(8Marks)**

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

(b): Calculate the electrode potential, **E**, **ΔG** and the equilibrium constant (Keq.) for the reaction:

$Pb_{(s)} + 2H^+ = Pb^{++} + H_{2(g)}$ 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:

$Pb^{++} + 2e^- \longrightarrow Pb_{(s)}$ $E°_1 = -0.126$ volt $H_2(g) \longrightarrow 2H^+ + 2e^-$ $E°_2 = 0.0$ volt **(6)**

Question No. (5): **(12Marks)**

(a): In a simplified flow sheet diagram, explain the main steps of Portland cement manufacture? **(3)**

(b): What are the factors that have to be considered in proportionating raw materials for cement clinker? **(2)**

(c): Identify the main stages of setting and hardening of Portland cement according to the modern theory?**(3)**

(d): What are the most common cathodic reactions encountered in metallic corrosion? **(2)**

(e): Explain the phenomena of activation polarization? **(2)**

With My Best Regards and Good Luck
Prof. Dr. Ahmed Ahmed Al sarawy