

بسم الله الرحمن الرحيم

(000)

In the Name of Allah the Merciful the compassionate

Mansoura University - Faculty of Engineering,
Building & Construction Engineering. Program, (BCE),
Final Exam. Winter Semester (2016-2017),
Course Title: *Engineering Chemistry, (Level 000)*
Time: 120 minutes- Date: 15/ 01 / 2017

جامعة المنصورة - كلية الهندسة

برنامج هندسة التشييد والبناء

إمتحان نهاية الفصل - الفصل الشتوي (٢٠١٦-٢٠١٧) في الكيمياء الهندسية
تاريخ الإمتحان: الأحد ١٥ / ٠١ / ٢٠١٧ زمن الإمتحان ١٢٠ دقيقة

Answer from the following questions to collect 50 Marks of 70 Marks

(C=12 gm/atom, Ca = 40 gm/atom, Na = 23 gm/atom, Zn= 65 gm/atom, S =32 gm/atom, H₂ = 2 gm/mol, O₂ = 32 gm/mol, N₂ = 28 gm/mol)

- i. 1. A mixture of dry air and ammonia enters an absorption tower at a rate of 20 m³/min., the total pressure of the mixture is 750 mm Hg and the partial pressure of ammonia in the mixture is 37.5 mm Hg, the temperature of the entering gas is 27 °C.

Water enters the tower at the rate of 100 Kg/min. and absorbs part of the ammonia. Assume no water is vaporized in the tower. The gases leave the tower at total pressure of 725 mm Hg and temperature of 17 °C and contain 0.2% NH₃ by volume. **Calculate** the mass of ammonia absorbed in water per minute and the molality of ammonia in the liquid leaving the tower? (8 Marks).

2. It is required to store 199 kg of natural gas whose composition as volume %: methane 70 %, ethane 15 %, and nitrogen 15 %; at a temperature of 300 K and a pressure of 15 atm. **Predict** the volume of the required tank assuming real behavior and **van der Waals equation of state** is applied (van der Waals constants for natural gas are given as a = 3 lit² atm/mol², and b = 0.05 lit/mol). (8 Marks).

3. For the production of sulfuric acid by the contact process, iron pyrites, (FeS₂), is burned with air in 100% excess of that required to oxidize all iron to Fe₂O₃ and all sulfur to SO₂. It may be assumed that the combustion of the pyrites is complete to form these products and that no SO₃ is formed in the burner. The gases from the burner are cleaned and passed into a catalytic converter in which all SO₂ is oxidized to SO₃ by combination with the oxygen present in the gases. The gases enter the converter at a temperature of 400° C. Assuming that the heat lost to the surrounding equals to 20 % of the standard enthalpy of reaction at 298 K. **Calculate** the temperature of the gases leaving the converter? (14 Marks).

Specific heats as function of temperature, as follows [cal/ mol. K], as follows:

for O₂ = (8.27 + 0.000258 T), SO₂ = (7.70 + 0.0053 T), SO₃ = (6.66 + 0.0183 T), and
for N₂ = (6.50 + 0.001 T)

Standard enthalpy of combustion of sulfur dioxide at 298 K = - 24 k cal / mol.

Consider the reactions taking place in this process are as follows:

(In the burner) 4 FeS₂ + 11 O₂ → 2Fe₂O₃ + 8 SO₂, and (In converter) SO₂ + ½ O₂ → SO₃

4. If the solubility of Oxygen in water is an **exothermic process**, **predict** the effect of temperature on the solubility of oxygen gas in water liquid isobarically?

Then **calculate** the solubility of Oxygen of the air (at a total pressure = 1 atm) in water at 20 °C and at 35 °C in gm/lit, If Henry's Law constant is given as 30 x10⁶ mm Hg at 20 °C and 40 x10⁶ mm Hg at 35 °C?

Comment on the obtained results.

(8 Marks)

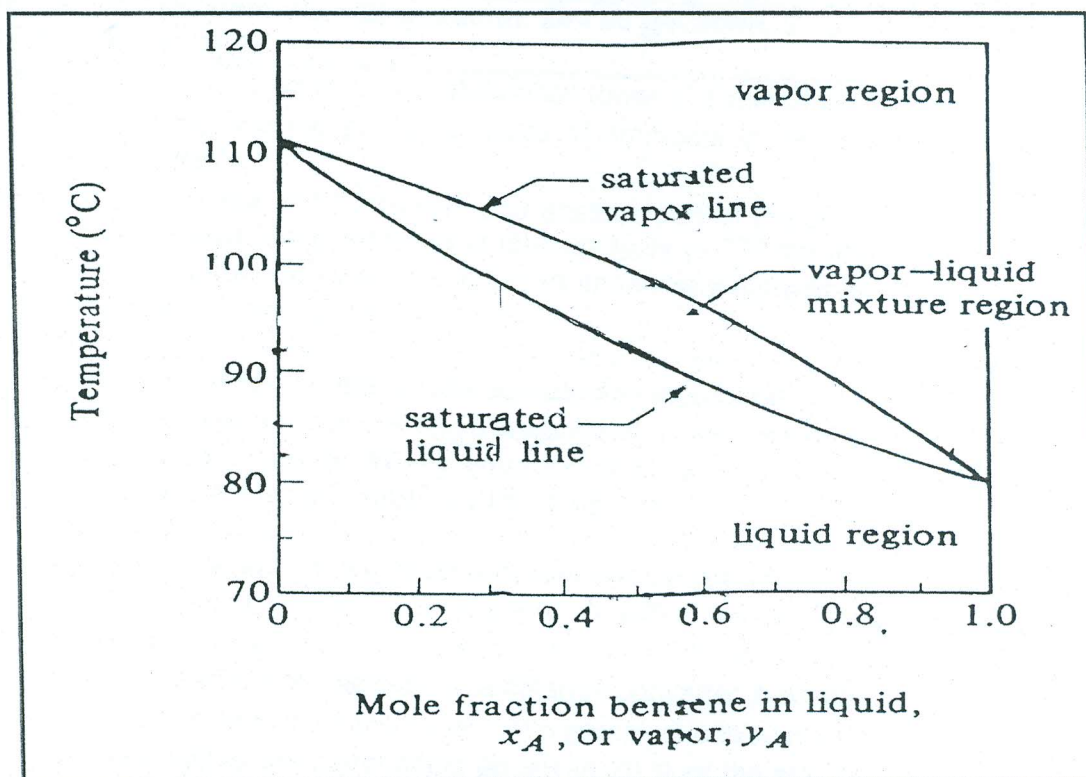
5. **Ethylene glycol** is the main component of antifreeze. It keeps the fluid in the cooling system of a car from freezing by lowering the freezing point of water. **Predict the colligative properties** of a solution composed of 100 gm of ethylene glycol (C₂H₆O₂) in 900 gm of H₂O, at a temperature of 27 °C. (Consider ethylene glycol is non-electrolyte and non- volatile solute and for water the enthalpy of freezing = 1440 cal/ mole, enthalpy of vaporization= 9720 cal /mole, normal freezing point =273 K, normal boiling point = 373 K, vapor pressure of water at 27 °C = 26.7 mm Hg, and the density of the solution at 27 °C = 1.05 gm /cm³.)

(12 Marks)

Turn Over Page

إقلب الصفحة، بقية الأسئلة في ظهر الصفحة

6. Use the following boiling point – composition diagram, for the system Benzene-Toluene, given below at atmospheric pressure to **predict**:
- The boiling point of a solution composed of 15.6 gm Benzene and 73.6 gm Toluene, and **locates** the composition of the vapor that would be in equilibrium with this liquid? (4 marks)
 - If the vapor resulting, from (a) above, is condensed what it would be its composition, and predict its boiling point and the composition of the vapor that it would be in equilibrium with it? (4marks)



Boiling-point diagram for the system benzene (A) -toluene (B) at a total pressure of 1atm

7. In a simplified flow sheet diagram, **demonstrate** the main steps of Portland cement manufacture?, Identify the main components in the final product and express them in clinker chemistry notation (4 Marks)
- Then:
- Explain** the main reactions occurring inside the kiln used for burning the raw mix to produce Portland cement? (2 Marks)
 - Explain** the crystallization theory describing the hardening of Portland cement? (2 Marks)
 - Explain** the main stages of setting and hardening of Portland cement according to the modern theory? and **identify** the main hydration reactions that occurs in setting and hardening of Portland cement? (4 Marks)

إنتهت الأسئلة ومع أطيب التمنيات بالتوفيق