Benha University Faculty of Engineering- Shoubra Eng. Mathematics & Physics Department Preparatory Year		Final Term Exam Date: 16 – 1 – 2016 Course: Chemistry Duration: **3** hours

• Answer **All** questions • The Exam Consists of Two pages	• No. of questions: 4 • Total Mark: 90 Marks

Answer the following Questions

Notes : Atomic mass for H = 1 , C = 12 , O = 16 , N = 14 , Ca = 40 & Cl = 35.5

Q 1 (23 mark)

(a) Give a ratio between the Molarity (M) and molality (m) of a solution its density (d)

(b) Calculate the reduction in vapour pressure (Δ p) caused by the addition of 68.4 g of sucrose to 900 g of water . (vapour pressure of pure water = 24 mmHg , Molar mass of sucrose = 342 g , Molar mass of H_2O = 18 g)

(c) The freezing point of pure benzene is 5.7 ^oC and the molal freezing point depression constant is 4.90 ^oC /molal. When 4.20 g of an unknown solute (that improve as a fuel) is added to 100 g of benzene, the freezing point of the solution is 4.6 ^oC . What is the molecular weight of the unknown solute?

(d) Write short nots about main points in your report during first term.

Q 2 (22 mark)

(a) (i) What is meant by a state function?
Give two examples of quantities that are state functions and two that are not.

(ii) Write the mathematical statement for the following:

(1) Relation between the change in internal energy, heat and work.
(2) Using standard enthalpies of formation to calculate standard enthalpy change of a reaction.
(3) The work done by an expanding gas at constant pressure
(4) Heat exchange between a reaction and calorimeter.

(b) Comment on the value of ΔE and ΔH when one mole of liquid water vaporizes at 100℃ under constant pressure if the heat absorbed during the process is 2257.2 J/g $H_2O_{(l)} \rightarrow H_2O_{(g)}$.

(c) Calcium carbide, CaC_2, is the raw material for the production of acetylene (used in welding torches).When 1 mole of solid Calcium carbide reacts with liquid water to form acetylene and solid calcium hydroxide, 127.2 kJ of heat is evolved.

(i) Write a thermochemical equation for this reaction, is it exothermic or endothermic?
(ii) Draw an energy diagram showing the path of this reaction.
(iii) What is ΔH when 2.00 g of CaC_2 is reacted?

(d) The specific heat of Iron(III) oxide, Fe_2O_3 is 0.75 J/g.°C,

(i) What is the heat capacity of the 200 kg brick of Fe_2O_3.
(ii) How many Joules of energy is required to increase the temperature of 1.75 g of Fe_2O_3 from 25°C to 380 °C.

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Q 3 (22 mark)

(a) Deduce and explain Dalton's law of partial pressure of gases.

(b) Define each of the following :-

1-The equilibrium constant expressed in terms of concentration unites.

2 – The law of mass action.

3 – The standard chemical potential.

(c) Write the Van Der Waal's equation for a real gas, and explain the corrective terms for pressure and volume.

(d) Compare the values obtained for the pressure of 3 moles of ammonia (NH_3) at 27 ^{O}C occupied a volume of 5 liters bulb using:

1 –The ideal gas equation 2 – Van Der Waal's equation.

Where Van Der Waal's constants are a= 4.17 atm.lit^2 mole^{-2} b = 0.0371 lit.mole^{-1}

(e) Calculate K_C and K_P for the following reaction

$$N_{2(g)} + 3\,H_{2\,(g)} \leftrightarrow 2N\,H_{3(g)}$$

If the concentration of the gases in mixture in equilibrium are :

C_{NH3} = 0.302 mole / liter C_{H2} = 1.84 mole / liter C_{N2} = 1.06 mole / liter at 1200 ^{O}K

Q 4 (23 mark)

(a) Complete the following sentence: (12 marks)

1. Conductance is the reciprocal of ……
2. .....electrolyte is normally 100% ionized at ordinary temperature.
3. The unite of conductivity of the solution is ……..
4. The PH of 0.1 N H_2SO_4 is……
5. The sum of the two transport number of an electrolyte is equal….
6. The ionic mobility of an ion is defined as……
7. Acidic buffer solution consists of……..
8. The equation $\alpha = \lambda^c / \lambda\infty$ is valid only for…. electrolyte.
9. The conduction of electricity through metallic conductor is due to the movement of ……..
10. Buffer solution is a solution which…….
11. If λ_{H+} is 42.77 ohm^{-1} cm^2 equiv^{-1}, its ionic mobility will be……
12. The pH for a buffer solution consists of 0.05 M formic acid and 0.06 M sodium format (ka = 10^{-5}) equals……

(b) The solubility product of $Mg(OH)_2$ is 1.8 x 10^{-13}, calculate the solubility of this hydroxide in a buffer solution of pH = 8 **(3 marks)**

(c) The resistance of 0.01 M acetic acid solution when measured in a conductivity cell of cell constant 3.66 cm^{-1} is found to be 2220 Ohm. Calculate the ionization constant of acetic acid given that value of $\lambda^o_{H^+}$ and $\lambda^o_{CH3COO^-}$ are 349.1 and 40.9 ohm^{-1} cm^2 mol^{-1}. **(4 marks)**

(d) If the reduction potential of Cu^{+2}/ Cu and Ag^{+1}/Ag are 0.34 V and 0.8 V respectively, construct a galvanic cell using these E^o reduction values, write the cell reaction. And if concentration of Cu^{+2} is 0.01 M for what concentration of Ag^{+1} will EMF of the cell be zero at 25°C**. (4 marks)**

Examinars Board

Ass.Prof.Dr .Mahmoud Elkomy, Ass.Prof.Dr.Manal El Hefnawy, Dr. Fadwa Hashem, Dr. Shahera Shohyeb.

Model Answer

Answer Q 2 (22 mark)

(a) (i) Explain what is meant by a state function. Give two examples of quantities that are state functions and two that are not.

Answer

It's a certain quantity That the value of it depends on the present state of the system and not by the way this state is approached. The change in this quantity depends only on the initial and final states of the system being discussed

Internal energy and enthalpy are state function but work and heat are not state function.

(ii) Write the mathematical statement for the following:

(1) Relation between the change in internal energy, heat and work.
(2) Using standard enthalpies of formation to calculate standard enthalpy change of a reaction.
(3) The work done by an expanding gas at constant pressure
(4) Heat exchange between a reaction and calorimeter.

Answer

Relation between the change in internal energy, heat and work. $\Delta E = q + w$

Using standard enthalpies of formation to calculate standard enthalpy change of a reaction. $\Delta H°_{rxn} = \sum n\Delta H°_{f\ (products)} - \sum m\Delta H°_{f\ (reactants)}$

The work done by an expanding gas at constant pressure $w = -P\Delta V$

Heat exchange between a reaction and calorimeter $q_{rxn} = -C_{cal} \times \Delta T$

(b) Comment on the value of ΔE and ΔH when one mole of liquid water vaporizes at 100°C under constant pressure if the heat absorbed during the process is 2257.2 J/g $H_2O_{(l)} \rightarrow H_2O_{(g)}$.

Answer

$1\ gm \rightarrow 2257.2$

$1\ mole\ (18\ gm) \rightarrow 40629.2$

$\Delta H = \Delta E + \Delta nKT$

$40630 = \Delta E + 1 \times 8.31 \times 373$

$40630 = \Delta E + 3099.63$

$\Delta E = 37529.97 = 37530\ \ J$

$\Delta E = q - w$

The result shows that although the increase in enthalpy of the system ΔH is 40630 J.

The increase in the internal energy ΔE is only 37530 J. the difference is equivalent to the work done b the system during expansion against external force.

(c) Calcium carbide, CaC_2, is the raw material for the production of acetylene (used in welding torches).When 1 mole of solid Calcium carbide reacts with liquid water to form acetylene and solid calcium hydroxide, 127.2 kJ of heat is evolved.

(i) Write a thermochemical equation for this reaction, is it exothermic or endothermic?

(ii) Draw an energy diagram showing the path of this reaction.

(iii) What is ΔH when 2.00 g of CaC_2 is reacted?

Answer

$$CaC_{2\,(s)} + 2H_2O_{(l)} \rightarrow Ca(OH)_{2\,(s)} + C_2H_{2\,(g)} \quad \Delta H = -127.2 \text{ kJ}$$

The reaction is exothermic

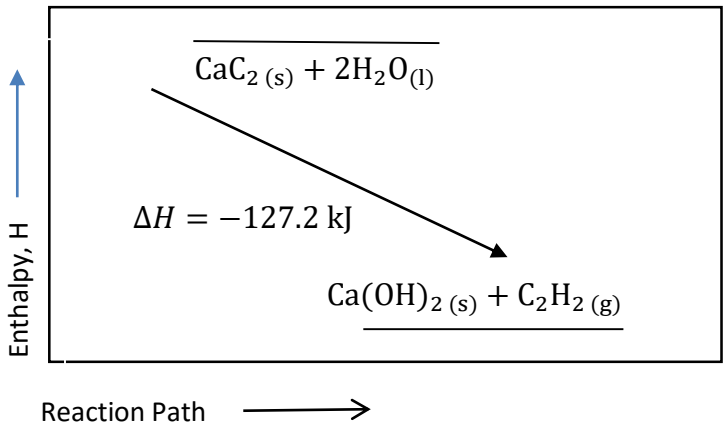
$1 \text{ mole } CaC_2 \rightarrow -127.2 \text{ kJ}$

$40 + 12 \rightarrow -127.2 \text{ kJ}$

$64 \text{ gm} \rightarrow -127.2 \text{ kJ}$

$2 \text{ gm} \rightarrow ??$

$\Delta H = 3.975 \text{ kJ}$



(d) The specific heat of Iron(III) oxide, Fe_2O_3 is 0.75 J/g.°C,

(iv) What is the heat capacity of the 200 kg brick of Fe_2O_3.

(v) How many Joules of energy is required to increase the temperature of 1.75 g of Fe_2O_3 from 25°C to 380 °C.

Answer

To obtain the total heat capacity of the brick we simply multiply its mass by its specific heat . Because 2.00 kg =2.00×10^3g we have

$$C = (2.00 \times 10^3\ g\ )(0.75\ \text{J/°C}) = 1.5 \times 10^3\ \text{J/°C}$$

$$q = (\text{mass of } Fe_2O_3)(\text{spesific heat of } Fe_2O_3) \times \Delta T$$
$$= (1.75\ g)(0.75\ \text{J/g.°C})(355) = 465.9\ \text{J}$$