B.Sc. CHEMISTRY
SECOND SEMESTER
PHYSICAL CHEMISTRY II
BSC - 202 [REPEAT]
[USE OMR FOR OBJECTIVE PART]

SET
A

Duration: 3 hrs.

Full Marks: 70

(**Objective**)

Time: 30 min.

Marks: 20

Choose the correct answer from the following:

$1 X 20 = 20$

1. An intensive property does not depend upon
   a. Nature of the substance
   b. Quantity of matter
   c. External temperature
   d. Atmospheric pressure

2. The enthalpy change, ΔH of a process is given by the relation
   a. $\Delta H = \Delta E + \Delta nRT$
   b. $\Delta H = \Delta E + p\Delta v$
   c. $\Delta H = \Delta E + w$
   d. All of these

3. For an adiabatic process, according to the first law of thermodynamics is
   a. $\Delta E = -w$
   b. $\Delta E = w$
   c. $\Delta E = q - w$
   d. None of these

4. By convention, the standard heat of formation of all elements is assumed to be
   a. Zero
   b. negative
   c. Positive
   d. Infinity

5. The heat of neutralization of a strong acid and a strong base is always
   a. Zero
   b. constant
   c. Positive
   d. Changing

6. $\Delta H°$ represent the enthalpy change
   a. At $0°$ C and 1 atm pressure
   b. At 0 k and 1 atm pressure
   c. At 25 K and 1 atm pressure
   d. None of these

7. For a spontaneous process
   a. $\Delta G > 0$
   b. $\Delta G < 0$
   c. $\Delta G = 0$
   d. None of these

8. In a process $\Delta H = 100\ kJ$ and $\Delta S = 100\ JK^{-1}$ at 400 K. The value of ΔG will be
   a. Zero
   b. 100 kJ
   c. 50 kJ
   d. 60 kJ

[1]

9. The correct relation of $\left(\frac{\partial H}{\partial P}\right)_T$ is

    a. $\left(\frac{\partial S}{\partial V}\right)_T$
                                         b. $\left(\frac{\partial V}{\partial S}\right)_P$

    c. $-\left(\frac{\partial V}{\partial T}\right)_P$
                                     d. None of these

10. Which of the following is true for a spontaneous process
    a. $\Delta G = 0$
                                           b. $\Delta G = 7.5 \ kJ \ mol^{-1}$
    c. $\Delta G = -7.5 \ kJ \ mol^{-1}$
                       d. $\Delta G = 75 \ kJ \ mol^{-1}$

11. For an exothermic reaction, increase in temperature of the reactant favour
    a. Forward reaction
                                 b. Backward reaction
    c. Both forward and backward reaction
                 d. None of the above

12. Choose the correct one
    a. $K_p = K_c \ (RT)^{\Delta n}$
                                 b. $K_p = K_c \ (RT)^{-\Delta n}$
    c. $K_p = K_c \ /(RT)^{\Delta n}$
                                 d. $K_p = K_c \ / \ RT$

13. Unit of equilibrium constant for the reaction
$H_2 \ (g) + I_2 \ (g) \rightleftharpoons 2HI \ (g)$ is
    a. No unit
                                    b. $Mol \ dm^{-3}$
    c. $dm^3 \ Mol^{-1}$
                             d. None of these

14. For an equilibrium reaction, $K_p = K_c = K_x$ when
    a. $\Delta n = 1$
                                    b. $\Delta n < 1$
    c. $\Delta n > 1$
                             d. $\Delta n = 0$

15. Chemical potential is
    a. $(\delta G/\delta P)_{V, n1, n2, \ldots nj}$
                                 b. $(\delta G/\delta P)_{T, n1, n2, \ldots nj}$
    c. $(\delta G/\delta T)_{P, n1, n2, \ldots nj}$
                             d. $(\delta G/\delta n_i)_{T, P, n1, n2, \ldots nj}$

16. 0.212 g of Na_2CO_3 with molar mass 106 is dissolved in 250 mL of a solution. The molarity of Na_2CO_3 in the solution is
    a. $0.01 \ M$
                                    b. $0.008 \ M$
    c. $0.005 \ M$
                             d. $0.002 \ M$

17. A solution contains 50% water and 50% ethanol by mass. The mole fraction of water in the solution is
    a. 0.28
                                    b. 0.56
    c. 0.72
                             d. 0.44

18. $1 \ N \ Na_2CO_3$ solution means a solution containing
    a. One gram equivalent of 'Na_2CO_3 per litre of the solution
                 b. Two gram equivalents of Na_2CO_3 per litre of the solution
    c. 106 g of Na_2CO_3 per litre of the solution
                 d. One gram equivalent of Na_2CO_3 per kg of the solution

19. The relative lowering of vapour pressure of a solution containing a non-volatile solute is equal to the _____ of the solute in the solution.

    a. Molarity   **b.** Normality

    c. Molality   **d.** Mole fraction

20. Which of the following is not a colligative property

    a. Surface tension   **b.** Osmotic pressure

    c. Relative lowering of vapour pressure   **d.** Elevation of boiling point

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(Descriptive)

Time : 2 hrs. 30 mins.   **Marks : 50**

[Answer question no.1 & any four (4) from the rest]

1.   **a.** State Le-Chatelier's principle. With the help of this principle what   5+5=10
       would be the favourable condition for formation of ammonia
       N_2 (g) + H_2 (g) $\rightleftharpoons$ $2NH_3$ (g), ΔH = - 92.35 Kj

    b. What is a spontaneous reaction? Derive the condition of spontaneity
       and equilibrium in terms of Gibb's free energy change and entropy
       change.

2.   **a.** State Euler's reciprocity relation. Show that the pressure is a state   10
       function of a gas obeying $\left(p + \frac{a}{V^2}\right)V = RT$. The symbols have their usual
       meanings.

    b. Derive an expression for the work done by a gas in isothermal
       reversible expansion of an ideal gas.

3.   **a.** Derive Kirchoff's equation thermodynamically.   10
    b. Calculate the enthalpy of formation of ethane from the following data:
       C (s) + O_2 (g) $\rightarrow$ CO_2 (g); ΔH=-393.4 kj

4.   **a.** Derive an expression for Van't Hoff equation.   6+4=10
    b. Determine the relation between K_p and K_c.

5.   What do you mean by partial molar quantities. What is chemical potential.   2+2+6
    Derive an expression for Gibb's Duhem equation.   =10

[3]

6. a. For a homogeneous gaseous reaction   5+5=10
$2AB_2$ (g) $\rightleftharpoons$ 2AB (g) + B_2 (g), derive an expression for K_p if the degree of dissociation is α and total pressure is P.

    b. What is Joule-Thomson effect? Prove that Joule-Thomson experiment takes place at constant enthalpy.

7. a. Calculate the standard free energy change (ΔG°) of the following   5+5=10
reaction and say whether it is feasible at standard state or not.
$\frac{1}{2} H_2$ (g) + $\frac{1}{2} I_2$ (g) $\rightleftharpoons$ HI (g); Given $\Delta H^\circ = 25.95$ kJ, S°_{HI}, S°_{H2} and S°_{I2} are 206.27, 130.60, 116.73 $JK^{-1}mol^{-1}$ at 25 °C.

    b. What is Gibb's free energy? Find the variation of Gibb's free energy with temperature and pressure?

8. a. State and explain Raoult's law.   4+3+3
    b. What are the factors that affect the solubility of a gas in a liquid?   =10
    c. Give two limitations of Henry's law.

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[4]