

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

**SET
A**

Duration: 3 hrs.

Full Marks: 70

Time: 30 min.

Marks: 20

(Objective)

Choose the correct answer from the following:

1X20=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. ΔH° 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 $\Delta H = 100 \text{ kJ}$ and $\Delta S = 100 \text{ J K}^{-1}$ at 400 K. The value of ΔG will be
 - a. Zero
 - b. 100 kJ
 - c. 50 kJ
 - d. 60 kJ

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

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

b. $\left(\frac{\partial V}{\partial S}\right)_P$
d. None of these

10. Which of the following is true for a spontaneous process

a. $\Delta G = 0$
c. $\Delta G = -7.5 \text{ kJ mol}^{-1}$

b. $\Delta G = 7.5 \text{ kJ mol}^{-1}$
d. $\Delta G = 75 \text{ kJ mol}^{-1}$

11. For an exothermic reaction, increase in temperature of the reactant favour

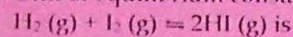
- a. Forward reaction
c. Both forward and backward reaction
- b. Backward reaction
d. None of the above

12. Choose the correct one

a. $K_p = K_c (RT)^{\Delta n}$
c. $K_p = K_c / (RT)^{\Delta n}$

b. $K_p = K_c (RT)^{-\Delta n}$
d. $K_p = K_c / RT$

13. Unit of equilibrium constant for the reaction



- a. No unit
c. $\text{dm}^3 \text{ Mol}^{-1}$
- b. Mol dm^{-3}
d. None of these

14. For an equilibrium reaction, $K_p = K_c = K_x$ when

- a. $\Delta n = 1$
c. $\Delta n > 1$
- b. $\Delta n < 1$
d. $\Delta n = 0$

15. Chemical potential is

a. $(\delta G / \delta P)_{T, n_1, n_2, \dots, n_j}$
c. $(\delta G / \delta T)_{P, n_1, n_2, \dots, n_j}$

b. $(\delta G / \delta P)_{T, n_1, n_2, \dots, n_j}$
d. $(\delta G / \delta n_i)_{T, P, n_1, n_2, \dots, n_j}$

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
c. 0.005 M
- b. 0.008 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
c. 0.72
- b. 0.56
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
c. 106 g of Na_2CO_3 per litre of the solution
- b. Two gram equivalents 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.
- Molarity
 - Normality
 - Molality
 - Mole fraction
20. Which of the following is not a colligative property
- Surface tension
 - Osmotic pressure
 - Relative lowering of vapour pressure
 - 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]

- State Le-Chatelier's principle. With the help of this principle what would be the favourable condition for formation of ammonia

$$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g}), \Delta H = -92.35 \text{ KJ}$$
 - What is a spontaneous reaction? Derive the condition of spontaneity and equilibrium in terms of Gibb's free energy change and entropy change.

5+5=10
- State Euler's reciprocity relation. Show that the pressure is a state function of a gas obeying $\left(p + \frac{a}{V^2}\right)V = RT$. The symbols have their usual meanings.
 - Derive an expression for the work done by a gas in isothermal reversible expansion of an ideal gas.

10
- Derive Kirchoff's equation thermodynamically.
 - Calculate the enthalpy of formation of ethane from the following data:

$$\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}); \quad \Delta H = -393.4 \text{ kJ}$$

10
- Derive an expression for Van't Hoff equation.
 - Determine the relation between K_p and K_c .

6+4=10
- What do you mean by partial molar quantities. What is chemical potential. Derive an expression for Gibb's Duhem equation.

2+2+6=10

6. a. For a homogeneous gaseous reaction
 $2AB_2(g) \rightleftharpoons 2AB(g) + B_2(g)$, derive an expression for K_p if the degree of dissociation is α and total pressure is P . 5+5=10
- 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 reaction and say whether it is feasible at standard state or not. 5+5=10
 $\frac{1}{2} H_2(g) + \frac{1}{2} I_2(g) \rightleftharpoons HI(g)$; Given $\Delta H^\circ = 25.95 \text{ kJ}$, S°_{HI} , $S^\circ_{H_2}$ and $S^\circ_{I_2}$ are 206.27, 130.60, 116.73 $\text{JK}^{-1}\text{mol}^{-1}$ 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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