

**THIRD SEMESTER B.Sc. DEGREE (SUPPLEMENTARY/IMPROVEMENT)
EXAMINATION, NOVEMBER 2015**

(UG-CCSS)

Core Course—Chemistry

CH 3B 05—PHYSICAL CHEMISTRY-I

Time : Three Hours

Maximum : 30 Weightage

I. Answer all the *twelve* questions. Each question carries a **weightage** $\frac{1}{4}$. This section contains multiple choice, fill in the blanks and *one word* answer questions :

- 1** At a particular temperature, the RMS velocity of CO₂ is comparable with :

- (a) N_2O . (b) C_3H_8 .
(c) CO . (d) Both N_2O and C_3H_8 .

- 2 The deviation of a gas from ideal behaviour is maximum at :

- (a) High pressure and high temperature.
- (b) Low pressure and low temperature.
- (c) High pressure and low temperature.
- (d) Low pressure and high temperature.

- 3 The SI unit of surface tension is :

- (a) Nm^{-1} . (b) Jm^{-1} .
(c) Nm . (d) Nm .

- 4 The value of ΔH at any temperature is equal to the value of ΔE , for the reaction :

- (a) $2\text{C (s)} + \text{O}_2 \text{ (g)} \longrightarrow 2\text{CO (g)}$.
- (b) $\text{I}_2 \text{ (g)} + \text{I}_2 \text{ (g)} \longrightarrow 2\text{HI (g)}$.
- (c) $\text{PCl}_5 \longrightarrow \text{PCl}_3 \text{ (g)} + \text{Cl}_2 \text{ (g)}$.
- (d) $\text{N}_2 \text{ (g)} + 3\text{H}_2 \text{ (g)} \longrightarrow 2\text{NH}_3 \text{ (g)}$.**

- 5 The value of equilibrium constant of a reaction is independent of :

- (a) The initial amount of reactants.
- (b) The presence of a catalyst.
- (c) The direction from which the equilibrium is attained.
- (d) All these.

Turn over

- 6 A positive value for Joule Thomson coefficient of a gas shows _____ effect on adiabatic expansion.
- 7 The condition for reversibility coincides with the condition for _____
- 8 The ratio of the fugacity of a gas in any state to that in a reference state is called _____
- 9 Fermions are particles that obey _____
- 10 A chemical equilibrium in which, the substances are in different physical state is called _____
- 11 The degree of degeneracy of a particular energy level is expressed in terms of _____
- 12 Give the relation between K_p and K_x of a reaction.

(12 x $\frac{1}{4}$ = 3 weightage)

II. Answer all the *nine* questions. Each question carries a weightage of 1 :

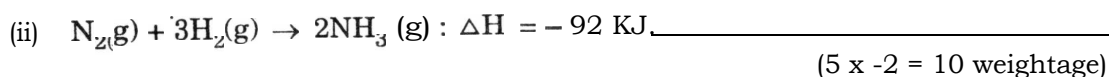
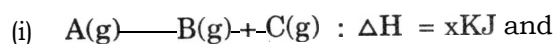
- 13 Write the Maxwell-Boltzmann equation for the distribution of molecular velocities and explain the terms.
- 14 Calculate the most probable velocity of O_2 molecule at 300 K.
- 15 What is optical exaltation ?
- 16 Define parachor.
- 17 Distinguish between extensive and intensive properties.
- 18 Write any *two* limitations of the first law of thermodynamics.
- 19 'Decrease in Gibb's free energy is a measure of the work other than that due to expansion' : Illustrate.
- 20 What is meant by residual entropy ?
- 21 The equilibrium constant for the reaction $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$ is 1×10^5 at 298 K. Calculate the value of ΔG° .

(9 x 1 = 9 weightage)

III. Answer any *five* questions. Each question carries a weightage of 2 :

- 22 Deduce the Virial equation of state from van der Waals' equation.
- 23 Calculate the molar refraction of C_2H_5OH for which the refractive index is 1.3611 and density is 0.789 g cm^{-3} .
- 24 Derive any *two* of the Maxwell's relations.

- 25 Calculate the entropy of mixing of one mole of oxygen and two moles of hydrogen, assuming no chemical change.
- 26 Derive the relation between entropy and probability.
- 27 Calculate the translational partition function of a molecule of O_2 gas at 1 atm and 298 K, moving in a vessel of volume 24.4 dm^3 . Given the value of 'm' as $5.3 \times 10^{-26} \text{ kg}$.
- 28 Explain the effect of temperature and pressure in the following equilibria, using Le-Chatelier's principle.



IV. Answer any *two* questions. Each question carries a weightage of 4 :

- 29 (i) What is mean free path of a gas ? How is it related to the coefficient of viscosity of the gas ?
- (ii) Explain the limiting density method for the determination of molecular mass of a gas
- 30 (i) Discuss the different steps involved in the working of Carnot cycle and derive an equation for the efficiency of a Carnot engine.
- (ii) The vapour pressure of a liquid increased from 630 mm to 760 mm, when the temperature increased from 368 K to 373 K. Calculate the molar enthalpy of vapourisation of the liquid in this temperature range.
- 31 (i) Write briefly on :
- (a) Partition function and
- (b) Statistical weight factor.
- (ii) Derive an equation to show the dependence of equilibrium constant on temperature.
(2 x 4 = 8 weightage)