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Name.....

Reg. No.....

**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  $\text{CO}_2$  is comparable with :
  - (a)  $\text{N}_2\text{O}$ .
  - (b)  $\text{C}_3\text{H}_8$ .
  - (c)  $\text{CO}$ .
  - (d) Both  $\text{N}_2\text{O}$  and  $\text{C}_3\text{H}_8$ .
- 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)  $\text{Nm}^{-1}$ .
  - (b)  $\text{Jm}^{-1}$ .
  - (c)  $\text{Nm}^{-2}$ .
  - (d)  $\text{Nm}$ .
- 4 The value of  $\Delta H$  at any temperature is equal to the value of  $\Delta E$ , for the reaction :
  - (a)  $2\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2\text{CO}(\text{g})$ .
  - (b)  $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$ .
  - (c)  $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$ .
  - (d)  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$ .
- 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.

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

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

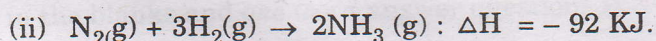
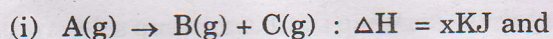
- 13 Write the Maxwell-Boltzmann equation for the distribution of molecular velocities and explain the terms.
- 14 Calculate the most probable velocity of  $O_2$  molecule at 300 K.
- 15 What is optical exaltation ?
- 16 Define parachor.
- 17 Distinguish between extensive and intensive properties.
- 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  $1 \times 10^5$  at 298 K. Calculate the value of  $\Delta G^\circ$ .

( $9 \times 1 = 9$  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  $0.789 \text{ g cm}^{-3}$ .
- 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  $24.4 \text{ dm}^3$ . 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.



(5 × 2 = 10 weightage)

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 × 4 = 8 weightage)