

## THIRD SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2014

(UG-CCSS)

Core Course—Chemistry

## CH3 B05—PHYSICAL CHEMISTRY—I

Three Hours

Maximum : 30 Weightage

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 :

- The RMS velocity of  $\text{SO}_2$ ,  $\text{CH}_4$ ,  $\text{O}_2$  and  $\text{CO}_2$  at any temperature is in the order :
  - $\text{SO}_2 > \text{CO}_2 > \text{O}_2 > \text{CH}_4$ .
  - $\text{CH}_4 = \text{O}_2 > \text{CO}_2 > \text{SO}_2$ .
  - $\text{CH}_4 > \text{O}_2 > \text{CO}_2 > \text{SO}_2$ .
  - $\text{SO}_2 > \text{CO}_2 > \text{CH}_4 = \text{O}_2$ .
- The vapour pressure of a liquid is influenced by :
  - Temperature.
  - Surface area.
  - Intermolecular force.
  - All these.
- An extensive property among the following is :
  - Specific heat.
  - Surface tension.
  - Heat capacity.
  - Molality.
- Which among the following equilibria is not affected by pressure ?
  - $\text{N}_{2(\text{g})} + 3\text{H}_{2(\text{g})} \rightleftharpoons 2\text{NH}_{3(\text{g})}$ .
  - $\text{PCl}_{5(\text{g})} \rightleftharpoons \text{PCl}_{3(\text{g})} + \text{Cl}_{2(\text{g})}$ .
  - $\text{N}_{2(\text{g})} + \text{O}_{2(\text{g})} \rightleftharpoons 2\text{NO}_{(\text{g})}$ .
  - $2\text{SO}_{2(\text{g})} + \text{O}_{2(\text{g})} \rightleftharpoons 2\text{SO}_{3(\text{g})}$ .
- The value of equilibrium constant of a reaction is not affected by :
  - Temperature.
  - Initial amount of reactants.
  - Reacton stoichiometry.
  - Constancy of volume or pressure at which the value is measured.
- The temperature at which a real gas obeys ideal behaviour over a wide range of pressure is called \_\_\_\_\_.

Turn over

- 7 The work done by the system during free expansion is \_\_\_\_\_.
- 8 For a spontaneous process at any temperature and pressure, the value of Gibb's free energy change is \_\_\_\_\_.
- 9 Particles which obey Bose Einstein statistics are called \_\_\_\_\_.
- 10 According to Le Chatelier's principle endothermic reactions are favoured by \_\_\_\_\_.
- 11 Name a substance, which possesses residual entropy.
- 12 Give one example of heterogeneous equilibria.

(12 × ¼ = 3 weight)

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

- 13 Write the van der Waals' equation for  $n$  moles of a gas and explain the terms.
- 14 What is compressibility factor of a gas ?
- 15 Mention any two factors that affect the surface tension of a liquid.
- 16 What is meant by optical exaltation ?
- 17 Define inversion temperature of a gas.
- 18 Calculate the difference between  $\Delta H$  and  $\Delta E$  for the reaction  $\text{CH}_{4(g)} + 2\text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + 2\text{H}_2\text{O}_{(l)}$  at 300 K.
- 19 State the third law of thermodynamics.
- 20 The activity of 2.5 moles of a gas changes from 0.05 to 0.35 at 300 K. Calculate the change in Gibb's free energy.
- 21 The value of  $K_c$  for the equilibrium  $\text{N}_2\text{O}_{4(g)} \rightleftharpoons 2\text{NO}_{2(g)}$  is found to be  $6.45 \times 10^{-2} \text{ L}^{-1}$  at  $27^\circ \text{C}$ . Calculate the value of  $K_p$  at the same temperature.

(9 × 1 = 9 weight)

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

- 22 How will you derive an equation for most probable velocity of a gas from Maxwell-Boltzmann distribution law ?
- 23 What is parachor ? How is it used to elucidate molecular structure ?
- 24 Derive an equation for the work of isothermal reversible expansion of ' $n$ ' moles of an ideal gas from volume  $V_1$  to  $V_2$  at temperature  $T$ .
- 25 Heat supplied to a Carnot engine is 453.6 Kcal. How much useful work can be done by the engine which works between  $0^\circ \text{C}$  and  $100^\circ \text{C}$  ?
- 26 Explain Stirling's approximation.
- 27 Derive the relation between Partition function and Entropy.
- 28 State and explain Le-Chatelier's principle.

(5 × 2 = 10 weight)

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

- 29 What are critical constants ? How are they related to van der Waals' constant ? Write the Amagat's method of determining critical volume of a gas.
- 30 Derive the Clausius-Clapeyron equation for liquid-vapour equilibrium. Mention any two applications of the equation.
- 31 (a) Show that the entropy 'S' and probability 'W' are related as  $S = K \ln W$ .
- (b) Starting from Van't Hoff reaction isotherm, derive the integrated form of Van't Hoff equation.

(2 × 4 = 8 weightage)