D 9861 (Pages 3) Name..............................

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THIRD SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2010

(CCSS)

Chemistry—Core Course

CH3 B05—PHYSICAL CHEMISTRY—I

Time : Three Hours — Maximum Weightage : 30

I. Answer all the questions. Each question carries a weightage of ¼. This section contains multiple choice, fill in the blank and one word answer questions :

1 The average distance between successive collisions between gas molecules is called.

2 The velocity possessed by largest number of molecules in a gas is ———

3 Give the SI unit of molar refraction.

4 Name the apparatus used to determine the surface tension of a liquid.

5 If the two systems are at thermal equilibrium, they will have same :

(a) temperature. (b) pressure.

(c) volume. (d) number of moles.

6 A process which occurs infinitesimally slowly and which is virtually at equilibrium at every stage of the process is a :

(a) spontaneous process. (b) isothermal process.

(c) reversible process. (d) isochoric process.

7 The temperature above which a gas is heated up when subjected to Joule-Thomson expansion is called

8 Which of the following is the criterion for equilibrium ?

(a) $AS_{T,P} = 0$. (b) $\Delta S_{P,V} = 0$.

(c) $\Delta S_{T,V} = a$ (d) $AS_{,V}$

9 A collection of a very large number of assemblies which are independent of each other but macroscopically identical is called ———

10 An electron is an example of :

(a) Boltzmannon. (b) Boson.

(c) Fermion. (d) Maxwellon.

Turn over

11 The equilibrium constant of a reaction increases with :

(a) increase in temperature if ΔH is positive.

(b) decreasae in temperature if ΔH is positive.

(c) cannot be predicted.

(d) can be predicted only with more data.

12 For the equilibrium,

$Ca\ CO_3\ (S) \quad CaO(s) + CO_2\ (g)$,

the equilibrium constant K_p is equal to ________

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

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

13 Account for the influence of pressure on the melting point of ice using the Le Chatlier principle.

14 What is Stirling's approximation ?

15 Classify the following properties into intensive and extensive :

Pressure, Volume, Enthalpy, Molar Heat capacity.

16 Calculate the work done when 14 g of nitrogen gas expands isothermally and reversibly from 2 L to 20 L at 27° C assuming ideal behaviour.

17 Name *two* substances for which the entropy is not zero to zero Kelvin. Explain the reason for the same in one of the substances.

18 Explain the use of viscosity measurements to determine the molecular mass of a substance.

19 What is optical exaltation ? Give an example.

20 Calculate the average velocity of SO_2 gas at 300 K.

21 What is compressibility factor of a gas ? How can it be used to study the non-ideal nature of the gas ?

(9 x 1= 9 weightage)

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

22 Derive the van der Waal's equation of state and show how it can expalin the PV-P graphs of real gas.

23 Define parachor. Discuss its use in structure elucidation with suitable examples.

24 Derive thermodynamically the relation between C_p and C_v. Show that it reduces to $C_p - C_V$ = R for an ideal gas.

25 The vapour pressure of ethanol at 40°C is 135 torr and at 70°C is 542 torr. Calculate the molar heat of vaporisation of ethanol.

26 Discuss the criteria of reversible and spontaneous processes.

27 Calculate the rotational partition function of hydrogen at 400 K if its moment of inertia is 4.6×100 kg m^2.

28 The equilibrium constant K for the dissociation of hydrogen iodide,

$\mathrm{HI}(g) \rightleftharpoons$ 1{2 (g) 12 (g),

is 0.134. Calculate the amount of HI remaining at equilibrium when started with 12.8g of HI.

(5 x 2 = 10 weightage)

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

29 (a) Derive the van't Hoff reaction isotherm. How can it be used to predict the feasibility of a reaction.

(b) Obtain the relation ; (i) between partition function and energy ; and (ii) between partition function and pressure.

30 Discuss the Carnot cycle and derive the expression for the efficiency of a reversible engine. State the Carnot theorem.

31 (a) Explain the use of limiting density method to determine the molecular mass of a gas. What is the advantage of the method ?

(b) Calculate the coefficient of viscosity of hydrogen gas at 273 K given that its density is 8.9×10^{-2} kg m^{-} and mean free path is 1.78×10^{-7} m.

(2 x 4 = 8 weightage)