OLD

2015

Part-I 3-Tier

CHEMISTRY

PAPER—II

(Honours)

Full Marks : 90

Time : 4 Hours

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answers wherever necessary.

Use separate answer scripts for Group–A and B

Group—A

(Physical)

[Marks : 45]

Group—A (a)

Answer any *one* of the following : 3×10

1. (a) Starting from Maxwell's expression for distribution of molecular speed, derive the expression for average kinetic energy of a molecule, define the average values

of the energies in terms of the distribution of component velocities, state their values and hence explain the principle of equipartition of energy. 4+2+2

(b) Establish the Clausius inequality and explain its significance in the context of the spontaneity of a process. 3

(c) For a certain liquid flowing through a cylindrical pipe of inside diameter 0·200 cm and length 24·0 cm, a volume of 148 cm^3 is discharged in 120s when the pressure drop between the pipe ends is 32·0 torr. The density of the liquid is 1·359 cm^{-3}. Find the viscosity of the liquid. 4

2. (a) Explain what is meant by Joule-Thomson coefficient and obtain its expression for a Van der Waals gas. Derive the expression for the inversion temperature from this expression and discuss its importance in the context of liquefaction of hydrogen. 2+4+2

(b) Define the term chemical potential and obtain the Gibbs-Duhem equation. 2+2

(c) Calculate the number of moles of chlorine produced in the reaction

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ when 1·00 mole of PCl_5 is heated at 250°C in a 10.0 dm^3 vessel. (Given K = 0.04)

Group—A (b)

Answer any *two* of the following :

3. (a) Develop the concept of entropy from the expression for the efficiency of a Carnot engine. 6

(b) Consider that two flasks (A) at 300K and (B) at 600K having equal volumes contain hydrogen and methane gas of equal mass respectively. Calculate (i) the ratio of gas pressures P_A/P_B and (ii) the ratio of the number of collisions Z_A/Z_B with the walls. (Assume ideal behaviour for both the gases). 2+2

4. (a) What do you mean by critical temperature of a gas? Obtain expressions for critical constants in terms of van der Waals' constant for a real gas. 1+6

(b) Consider a S – T diagram for a given ideal gas. Show that the ratio of the slopes of any isobaric line to any isochoric line at the same temperature is C_p/C_v. 3

5. (a) State the condition for Gibbs free energy change when any two phases of a pure substance are at equilibrium and hence derive the Clapeyron-Clausins equation. 1+5

(b) Calculate ΔG° for the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ at 400K using K_p and K_c. Comment on the results if these be different. (Given : $K_p = 1{\cdot}64 \times 10^{-4}$) 3+1

6. (a) Define the viscosity coefficient of a gas and derive its expression in term of the mean free path. 2+4

(b) For a certain reaction
$\Delta G = 13{,}580 + 8.0\ T \ln T - 36.0 \ln T$
Find ΔS and ΔH of the reaction at 27°C.

Group—A (c)

Answer any *five* of the following : 5×2

7. (a) The average speed of a certain gas at 27°C is 400 ms^{-1}. At what temperature the speed will be 800 ms^{-1} ?

(b) Derive the SI unit of viscosity coefficient.

(c) Discuss the effect of temperature on viscosity of a liquid and a gas.

(d) Consider two liquids A and B such that A has half the surface tension and twice the density of B. If liquid A rises to a height of 2·0 cm in a capillary, what

will be the height to which liquid B will rise in the *same capillary* ?

(e) What is meant by limiting density ?

(f) Calculate the high temperature limiting value of molar heat capacity of CO_2 at 1000 K.

(g) Consider the reaction

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$, $\Delta H = -188{\cdot}3$ kJ

what will happen if

(i) T is increased at constant V

(ii) Volume of the reaction flask is decreased at constant T.

Group—B

(Industrial)

[Marks : 45]

Group—B (a)

Answer any *one* question.

8. (a) Discuss the principle of thin layer chromatography. Describe one application of thin layer chromatography for separation and identification of the components in a mixture. 3+2+2

(b) What is crude oil ? Name important constituents of petroleum. Describe a process for atmospheric

pressure distillation of crude petroleum and mention different product's of distillation with approximate boiling ranges. 1+2+5

9. (a) Discuss the method of recovery of glycerine from Spent lye. 4

(b) Make a comparative study about the compositions and calorific values of producer gas, coal gas, natural gas and blue water gas. 6

(c) Discuss the effects of temperature, pressure and catalysts in the manufacture of sulphuric acid by the contact process so that percent conversion and percent yield are best utilised. 5

Group—B (b)

Answer any *two* questions.

10. (a) How will you purify the sewage water of municipalities and corporations. 4

(b) Define vitrification and devitrification of glass. 3

(c) Write down the differences between soap and detergent. 3

11. (a) Write down the chemical structure of repeat unit for the following polymers :
(i) Natural Rubber (ii) Bakelite (iii) Terylene. 3

(b) Describe the manufacture of PVC. 3

(c) How can you prepare urea from ammonia ? Mention two common uses of urea. 2+2

12. (a) Define Saponification value and iodine value of oils and fats and write their importance in the industrial oils and fats. 3+3

(b) What are the essential ingredients of paints ? 2

(c) Why methyl orange is used as an indicator but not as a dye ? 2

13. (a) Write down the names of the constituents of Portland Cement. 2

(b) Discuss the process of manufacture of Portland Cement with flow diagram. 3

(c) Starting from rock phosphate and sulphuric acid how is superphosphate of lime manufactured ? 3

(d) Explain the term octane number ? 2

Group—B (c)

Answer any *five* questions. 5×2

14. (a) What is Ziegler-Natta catalyst ? Write its uses.

(b) Mention the approximate composition of common glass.

(c) What is sequestering agent ?

(d) What is sulfonation ? Name two sulfonating agents.

(e) What is the difference between resin and plastic ?

(f) All zero hard water are not deionised water but all deionised water are zero hard water. — Explain.

(g) What is the difference between mortar and concrete ?

(h) Why are vegetable oils hydrogenated ?

(i) Why does photochromatic glass not function in the lamp light ?

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