2015

CHEMISTRY

[**Honours**]

PAPER – II (Group-A + B)(New)

Full Marks : 90

Time : 4 hours

The figures in the right hand margin indicate 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 Group—B

GROUP – A

(*Physical*)

GROUP—A(a)

Answer any **one** of the following from **Q. Nos. 1 & 2**

1. (*a*) Obtain the expression for the most probable speed for a gas using Maxwell distribution in three dimension. 4

(*b*) Calculate the volume occupied by 1·00 mol N_2 using van der Waals equation in the form of a virial equation at (*i*) its critical temperature (*ii*) its Boyle temperature. Assume that the pressure is 1·0 atm throughout
(Given $T_c = 126{\cdot}3$ K, $a = 1{\cdot}352$ dm^6 atm mol^{-2} and $b = 0{\cdot}0387$ dm^3 mol^{-1}. 4

(*c*) The rate constant for the decomposition of a certain substance is $2{\cdot}80 \times 10^{-3}$ dm^3 mol^{-1}S^{-1} at 30° C and $1{\cdot}38 \times 10^{-2}$ dm^3 mol^{-1}S^{-1} at 50° C. Evaluate the Arrhenius parameters of the reaction. 4

(*d*) Draw the plot of logK versus pH for a homogeneous acid catalysed reaction. Comment on the intercept on logK axis. 1 + 1

(*e*) Define critical micelle concentration (CMC). 1

2. (*a*) Show that $\left[\frac{\partial\left(\frac{G}{T}\right)}{\partial\left(\frac{1}{T}\right)}\right]$ is a state function. 3

(*b*) (*i*) Explain with reason, an infinitely slow process is not necessarily a reversible process. 2

(*ii*) For a constant pressure $\Delta H = Q_p$. Does it follow that Q_p is a state function ? Give reason. 2

(*c*) Explain the term "contact angle" and indicate explicity the factors which govern its value when a liquid comes in contact with solid in a gaseaous atmosphere. 3

(*d*) A steel ball of density 7·90 gm/cc and 4 mm diamter requires 55 seconds to fall through a distance of 1 meter through a liquid of density 1·10 gm/cc. Calculate the viscosity of the liquid in poise. 3

(*e*) Define opposing reaction. 2

GROUP–A(b)

Answer any **two** of the following questions

3. (*a*) Determine the ratios of (*i*) the mean speeds (*ii*) the mean kinetic energies of H_2 molecules to Hg atom at 20° C.
[Atomic mass of Hg = 200·6] 4

(*b*) How is viscosity coefficient of a gas related to its mean free path ? How does the former change with temperature and pressure ? 4

(*c*) In a zeroth order reaction, the rate and rate constant are identical – Explain. 2

4. (*a*) Sufficient heat is supplied to double the volume and temperature of the gas (ideal) while maintaining an internal pressure at 1 atm. What is the change is internal energy ? How much work is done if the external pressure remains constant at 1 atm ? How much heat is added ? What is the enthalpy change ? 4

(*b*) What are "Protective Colloids" ? Explain how lyophilic colloid can be stabilized by a lyophobic colloid. 4

(*c*) An ideal gas is expanded under condition PV^{γ} = const. Will the entropy of the system increase, decrease or remain same?– Justify your answer. 2

5. (*a*) Derive Langmuir adsorption isotherm mentioning clearly the assumptions involved. Under what condition it behaves like Freundlich isotherm? 3+1

(*b*) The rate of formation of *C* in the reaction

$2A + B \rightarrow 2C + 3D$ is $1{\cdot}0$ mol $dm^{-3}S^{-1}$,

the rate law for this reaction is

$$\frac{d[C]}{dt} = K[A][B][C]$$

Express rate law in terms of reaction rate. What are the unit of K in each case? 3

(*c*) The enthalpy of neutralisation of HCN by NaOH is $-12{\cdot}13$ KJ/mol. Calculate the molar enthalpy of ionisation of HCN.
(given enthalpy of reaction $H^+ + OH^- = H_2O$ is $-57{\cdot}54$ KJ/mol) 3

6. (*a*) A certain reaction obey the following differential rate law 4

$$-\frac{dc}{dt} = K[C]^{1/2}$$

(*i*) Integrate the above equation if initial conc^n is $[C]_0$. 2

(*ii*) How would you check the data graphically if the rate law follows 3/2 order reaction.

(*iii*) Obtain the expression for $t_{1/2}$.

(*b*) How many collisions does a single Ar atom make in 1·0 sec when the temperature is 25° C and the pressure is 10 atm ? 3

(*c*) What are meant by isoelectric point and thioxotropy ? 3

GROUP—A(c)

Answer any **five** questions 2×5

7. (*a*) Express the van der Waals constants $a = 0{\cdot}751$ atm dm^6 m^{-2} and $b = 0{\cdot}0226$ dm^3 mol^{-3} in SI base unit. 2

(*b*) What is meant by "laminar flow" ? 2

(*c*) The kinetics of a second order reaction changes into first order when one of the reactants is taken in large excess. 2

(*d*) Show that the condition for spontaneity of a process occuring in a closed system involving only expansion work $du_{S,V} < 0$. 2

(*e*) Show that "Joule Thomson expansion" is isoenthalpic in nature. 2

(*f*) What is 'Hardy-Schulze" rule ? 2

(*g*) What is "Michaelis constant" ? 2

(*h*) What are surface active agents ? Explain using Gibbs adsorption isotherm. 2

GROUP – B

(*Industrial*)

GROUP–B(a)

Answer any **one** question

8. (*a*) Discuss the basic principle of HPLC. What is R_f value ? Discuss its significance in chromatographic separation. 3 + 2 + 1

(*b*) Describe a process for the catalytic cracking of high boilling petroleum fractions. What are the objectives of cracking ? 4 + 2

(*c*) Liquid fuel having high cetane number is suitable for use in diesel engine but not in petrol engine. Explain. 3

9. (*a*) What are the raw materials for manufacture of portland cement ? Give the average composition of portland cement. 2 + 2

(*b*) Briefly describe a manufacturing method of portland cement. Explain unsoundness of portland cement. 5 + 2

(*c*) Define vitrification and devitrification of glass. 2

(*d*) What are the uses of deionised water ? 2

GROUP—B(b)

Answer any **two** questions

10. (*a*) Describe the process of manufacture of terylene with a flow chart. 4

(*b*) Write down the structure of the repeating units of (*i*) neoprene rubber (*ii*) bakelite. 2

(*c*) How dodecyl benzene sulfonate can be prepared from dodecyl benzene ? 4

11. (*a*) Describe a process for the manufacture of water gas ? What is carburetted water gas ? 4 + 1

(*b*) All zero hard water are not deionised water but all deionised water are zero hard water. Explain. 2

(*c*) What are the common ionic functional groups for a cation and anion exchanger resin ? State one application of a cation exchanger. 2 + 1

12. (*a*) What are pesticides ? Discuss the manufacture of BHC ? 1 + 3

(*b*) What are the differences between soap and synthetic detergent as cleaning agent ? 2

(*c*) Write notes on 'rancidification of oils and fats'. 2

(*d*) Why $(NH_4)_2SO_4$ is not suitable for acidic soil ? 2

13. (*a*) Discuss the manufacturing process of lithophone. 4

(*b*) Mention the differences between distilled and deionised water. 3

(*c*) What is natural gas ? Distinguish between dry and wet natural gas. 1 + 2

GROUP – B(c)

Answer any **five** questions 2×5

14. (*a*) What is the difference between mortart and concrete ?

(*b*) What do you mean by standard deviation ?

(*c*) Mention physical properties of rubber.

(*d*) What are the essential ingrediants of paints ?

(*e*) What is flash point ? What is its significance ?

(*f*) The manufacture of water gas is not a continuous process. Explain.

(*g*) What are permutil and zeolite ? Mention their uses.

(*h*) Distinguish between octane and cetane number.

(*i*) How will you determine BoD of water sample ?