2019

CHEMISTRY

[**Honours**]

PAPER –II

Full Marks : 90

Time : 4 hours

The figures in the right-hand margin indicate marks

GROUP – A

(*Physical*)

Subgroup – A(a)

Answer any **one** of the following from **Q. Nos. 1 & 2** : 15 × 1

1. (*a*) Show from Maxwell's speed distribution that the most probable speed of the gas is a function of temperature of the gas. 4

(*b*) Derive the integrated form of the Kirchhoff's equation to show the variation of ΔH° of a reaction with temperature. For a given reaction ΔC_p is zero. Interpret the result. 4

(*c*) Justify or criticize the following : 2 + 2

(*i*) Viscosity in gases has a different origin as compared to the same for liquids.

(*ii*) At the critical temperature, the surface tension of a liquid is zero.

(*d*) For an ionic reaction $A^- + B^+ \rightarrow C$, the rate constant changes with the progress of reaction. Justify or criticize the statement. 3

2. (*a*) Derive a relation between the van der Waals' constant *a* and the critical constants and hence explain why an ideal gas cannot be liquefied. 4

(*b*) Show that in a reversible adiabatic expansion of an ideal gas, increase in ΔS for the expansion of the gas in exactly balanced by the decrease in ΔS for the cooling of the gas. 4

(*c*) Write down at least three major distinguishing features between physical adsorption and chemisorption. 3

(*d*) Derive Michaelis-Menten equation for enzyme catalysis. How can you determine the michaelis constant experimentally ? 3 + 1

Subgroup – A(b)

Answer any **two** of the following questions : 10 × 2

3. (*a*) For two reactions, the frequency factor of the first reaction is 100 times that of the second. The activation energy of the first reaction is 4.6 kcal/mol higher than that of the second. What is the ratio of the rate constants for the reactions at 227°C ? 3

(*b*) Using the Maxwell's velocity distribution in one-dimension, derive an expression for the average value of the x-component of velocity and interpret your result. 4

(*c*) When pure liquids are boiled in lean and smooth vessels, there is occasional bumping. Why ? 3

4. (*a*) State the principle of equipartition of energy and apply it to calculate the ratio of heat capacities for an ideal gas composed of non -linear triatomic molecules. 4

(*b*) Draw and explain the product concentration versus time plot for an autocatalytic reaction. Under which conditions is the rate of reaction maximum ? 3

(*c*) At 27°C and at a pressure of 1 atm, only 25% of the total surface of an iron catalyst is covered by molecular nitrogen. What is the standard free energy change of adsorption at this temperature ? 3

5. (*a*) Prove that

$$\left[\frac{\partial(G/T)}{\partial(1/T)}\right]_P$$

is a state function. 3

(*b*) Derive (from a suitable starting point) an expression for the average time which a molecule of a gas requires to travel unit distance. 3

(*c*) State the values of the slope and intercept the following plots :

(*i*) Log (rate) versus log (reactant concentration) for an *n*th order reaction and

(*ii*) log(initial rate) versus log (substrate concentration) at low substrate concentration for an enzyme catalysed reaction. 2 + 2

6. (*a*) A gas obeys the equation of state $P(v - b) = RT$. Would it be possible to liquefy the gas ? Would it have a critical temperature ? Explain. 3

(*b*) The decomposition of 'A' (initial pressure 200 mm of Hg) is a second order process. If 25% of 'A' decomposes in 30 minutes, in what time will 50% of 'A' decompose ? Calculate the rate constant 'k'. 4

(*c*) Freundlich adsorption isotherm is a special case of Langmuir adsorption isotherm. Justify or criticise the statement. 3

Subgroup – A(c)

7. Answer any *five* questions : 2×5

(*a*) The equation $dH = Tds + VdP$ can be applied only to a reversible process, comment on the statement.

(*b*) At low temperature, the change in temperature has a greater effect on the rate constant as compared to high temperature. Justify or criticize the statement.

(*c*) Why do the raindrops assume a spherical shape ?

(*d*) The molar heat capacity at constant volume $\bar{C}_V$ of C_2N_2 is $77.82\ JK^{-1}\ mol^{-1}$. Assumming that all degrees of freedom contribute to the heat capacity, determine whether the molecule is linear or not.

(*e*) Under what condition does the BET equation get converted to the Langmuir equation ?

(*f*) Why do the colloids precipitate when they are heated ?

(*g*) The P – V work is usually very small in case of solids and liquids. Why is this so ?

(*h*) Comment on the statement that for any adiabatic process the entropy change in zero since in such a process no exchange of heat takes place.

GROUP – B

(*Industrial*)

Subgroup – B(a)

Answer any **one** question : 15 × 1

8. (*a*) What is GLC ? Discuss one application of GLC for separation and identification of the components in a mixture. 1 + 4

(*b*) Write a short note on proximate analysis of coal. 4

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

(*d*) What are the uses of deionised water ? 3

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

(*b*) Why nickel catalyst should be kept under oil during hydrogenation of oil ? 2

(*c*) What is meant by accuracy and precision ? Explain with examples. 3

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

(*e*) What is triple superphosphate ? 1

Subgroup – B(b)

Answer any **two** of the following questions : 10 × 2

10. (*a*) Distinguish between addition and condensation Polymerisation. 4

(*b*) How dodecyl benzene sulfonale can be prepared from dodecyl benzene ? 4

(*c*) Define winterization of oil. 2

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

(*b*) Write a short note on vulcanisation of rubber. 4

(*c*) Give examples of non-drying, semidrying and drying oils. Among the three which type of oil is used as vehicle point ? 2 + 1

12. (*a*) Write down the structure of the repeating units of (*i*) Nylon 66 and (*ii*) Natural rubber. 2

(*b*) What are pesticides ? Discuss the manufacture of BHC ? 1 + 3

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

(*d*) Write short note on Lithophone. 2

13. (*a*) Explain unsoundness of portland cement. 2

(*b*) State the purpose of annealing of glass. What is borosilicate glass ? 2 + 1

(*c*) Discuss the method of recovery of glycerine from spent lye. 4

(*d*) What is Bakelite ? 1

Subgroup – B(c)

14. Answer any *five* questions : 2 × 5

(*a*) What is an antiknock Compound ? Give an example of a non-lead antiknock compound.

(*b*) What is the difference between mortar and concrete ?

(*c*) Write down the composition of water gas and coal gas.

(*d*) What is the advantage of organophosphorous type pesticides over DDT ?

(*e*) How will you determine BOD of water sample ?

(*f*) Define saponifiction value of oils.

(*g*) Define cullet.

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

(*i*) What is ultramarine ? What is its use ?
