U.G. 1st Semester Examination - 2020
CHEMISTRY
[HONOURS]
Course Code : CHEM-H-CC-T-01

Full Marks : 40   Time : $2\frac{1}{2}$ 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.

GROUP–A
(Inorganic)
[Marks : 20]

1. Answer any **one** question: $1\times1=1$

    a) Determine the number of microstates associated with a d^5 electronic configuration.

    b) If the ionization energy of H atom is x then what will be the value of ionization energy of Li^{2+} ion?

2. Answer any **two** questions: $2\times2=4$

    a) On the basis of exchange energy explain why $3d^5 4s^1$ electronic configuration is more stable than $3d^4 4s^2$ electronic configuration.

b) Calculate Z* and σ for one valence electron of Fe.

c) Determine the kinetic energy of an electron whose de-Broglie wavelength is 10^{-10} m.

d) What do you mean by negative electron affinity? Does any element have a negative ionization potential?

3. Answer any **one** question: $5\times1=5$

    a) What is radial distribution function? Show diagrammatically the variation of radial distribution function with r for 3s, 3p and 3d–orbitals.   2+3

    b) Describe briefly the Pauling scale of electronegativity. Then calculate the electronegativity of fluorine (F) from the following data: D_{H-H} = 104.2 Kcal mol^{-1}; D_{F-F}=36.6 Kcal mol^{-1} and D_{H-F}=135.6Kcal mol^{-1}. Electronegativity of H is 2.1.   2+3

4. Answer any **one** question: $10\times1=10$

    a) i) Show that Bohr's postulate of quantized angular momentum for an electron moving in a circular orbit can be derived by the application of de-Broglie's hypothesis.

ii) Calculate the uncertainty in position of an electron whose velocity is 3.0×10^4 cms^{-1} accurate up to 0.001%. Mass of an electron is 9.1×10^{-28} g.

iii) What will be the largest and the smallest wavelength in the Paschen series of hydrogen atom?

iv) What is the precessional motion of electron according to Sommerfield theory?   2+3+2+3

b) i) Determine the ground state R-S term symbol Mn^{2+} ion.

ii) Discuss Pauling method for the determination of univalent ionic radii.

iii) Define secondary periodicity with example.

iv) Calculate the amount of energy released in Kcal when 2 g of chlorine is converted to Cl$^-$(g) ion. The electron affinity of chlorine is 3.7 ev. $2\frac{1}{2}+2\frac{1}{2}+2+3$

GROUP–B

(Physical)

[Marks : 20]

5. Answer any **one** question: $1 \times 1 = 1$

a) A gas obeys the equation of state P(V–b)=RT, where b is a constant. For the gas plot V vs T at constant P.

b) Compare between reversible isothermal and adiabatic expansions of an ideal gas.

6. Answer any **two** questions: $2 \times 2 = 4$

a) Show that $(\partial U/\partial V)_T = an^2/V^2$, where terms having usual significance.

b) How is the measured quantity $(\partial T/\partial V)_U = \mu_J$ is related to $(\partial U/\partial V)_T$? where μ_J = Joule's coefficient.

c) Using the principle of equipartition of energy, estimate the energy of:

i) N_2,

ii) CO_2.

7. Answer any **one** question: 5×1=5

a) i) Show that reversible isothermal work of expansion for an ideal gas is always greater than for a van der Waal's. 3

ii) What is the physical reason for the fact that C_p is not equal to C_v? 2

b) i) Find the units of van der Waal's constant a and b. 2

ii) Explain the behavior of real gases by van der Waal's equation. 3

8. Answer any **one** question: 10×1=10

a) i) Give an account of Maxwell's distribution of velocities. Explain graphically how the distribution change with temperature.

3+2

ii) Calculate the root mean square velocity, average velocity and most probable velocity of sulphurdioxide molecules at $427^{\circ}C$. 5

b) i) State Hess's law of constant heat summation and explain. 2

ii) What is the difference between Bond dissociation energy and Bond energy (enthalpy)? 2

iii) Derive Kirchoff's equation for a reaction at constant volume and at constant pressure. 3

iv) The enthalpy of fusion of water at 273K is 6.0 kJmol^{-1} at constant pressure of 1 atm. Calculate its value at 263K. Given $C_{p_{H_2O(l)}} = 74.46$ Jmol^{-1}K^{-1}, $C_{p_{H_2O(s)}} = 37.2$ Jmol^{-1}K^{-1}. (It is to be assumed that ΔC_p be independent of temperature) 3

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