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SARDAR PATEL UNIVERSITY
M. Sc. Applied Science (Semester – I) Examination
Saturday, 4th January 2014
10.30 a.m. to 1.30 p.m.
PET01CAS02 : Elements of Chemical Sciences

Total Marks : 70

Note : Figures to the right indicate full marks.

Q. 1 Select the correct answer from the alternatives given below to the each question; (08)

- [i] Working substance in Carnot engine consists of ;
 (a) Non-ideal gas (b) Ideal gas
 (c) Gas mixture (d) Gas dissolved in liquid
- [ii] The Stirling Approximation, $\ln N! =$ _____
 (a) $N \ln N$ (b) $N \ln N - N$
 (c) $N - \ln N$ (d) $N - N \ln N$
- [iii] The shape of a carbocation is
 (a) linear (b) planar
 (c) pyramidal (d) none of the above
- [iv] ClF_3 has "T-shaped" geometry. There are _____ non-bonding domains in this molecule.
 (a) 0 (b) 1 (c) 2 (d) 4
- [v] A 3d electron can have possible magnetic quantum number m_l , values of
 (a) $+\frac{1}{2}$ or $-\frac{1}{2}$ (b) 0, 1, and 2
 (c) -1, 0 and 1 (d) -2, -1, 0, 1 and 2
- [vi] A triple bond consists of _____.
 (a) one σ bond and one π bond (b) one σ bond and two π bonds
 (c) two σ bonds and one π bond (d) none of the above
- [vii] Half life of a reaction is inversely proportional to concentration, then the order of the reaction is ;
 (a) first (b) third (c) zero (d) second
- [viii] $a \neq b \neq c$, $\alpha = \beta = \gamma = 90^\circ$, the crystal system is ;
 (a) trigonal (b) triclinic
 (c) orthorhombic (d) monoclinic

Q. 2 Answer the following in short; (ANY SEVEN) (14)

- [a] State applications of Hess law.
- [b] Define partition function. Discuss its significance.
- [c] Dipole moment of O-H bond is 1.5 D and bond length is 0.96×10^{-8} cm. What is % Ionic Character of HCl bond?
- [d] Give the differences in the geometrical properties of CH_4 and H_2O ?
- [e] Define aromaticity and give any two typical characteristics of aromatic compounds.
- [f] Differentiate between singlet and triplet carbenes.

- [g] What is an equation of state ?
 [h] Prove that $V \propto T$ for an ideal gas.
 [i] Define hydrogen bonding and show it between ammonia and water molecules.

- Q.3 [a] State and explain Aufbau, Pauli exclusion principle and Hund's rule. (06)
 [b] [i] Write a brief note of quantum numbers. (03)
 [ii] Explain VSEPR Theory with examples. (03)

OR

- [b] [i] Write a note on Nodes. (03)
 [ii] Define Dipole moment. Which out of NH_3 and NF_3 has higher dipole moment and why? (03)
- Q.4 [a] What are charge transfer complexes? Discuss the nature of bonding and structure of these complexes. (06)
 [b] [i] In terms of hybridization of carbon atom, discuss briefly the shapes of CH_4 , C_2H_4 and C_2H_2 . (03)
 [ii] What are free radicals? Explain the factors effecting their stability. (03)

OR

- [b] [i] What are carbanions? Comment upon the statement, "Carbanions can be either planar or pyramidal." (03)
 [ii] Define and illustrate terms i) Electrophile, ii) Nucleophile (03)
- Q.5 [a] For Fermi-Dirac statistics, derive the following relation; (06)

$$\frac{N_j}{g_j - N_j} = e^{-\alpha} e^{-\beta \epsilon_j}$$

- [b] Discuss Kirchoff's equation considering ΔC_p is constant between T_1 and T_2 and it varies with temperature. (06)

OR

- [b] [i] Define : Fermions, Boltzons and Bosons (03)
 [ii] Discuss the condition under which all the three types of distributions are identical. (03)
- Q.6 [a] State and derive Bragg equation; $2d \sin\theta = n\lambda$. (06)
 [b] [i] Calculate the deviation in pressure for 1 mole of CO_2 at 0°C ($a / \text{L}^2 \cdot \text{atm} / \text{mol}^2 = 3.592$ and $b / \text{L} \cdot \text{mol}^{-1} = 0.04267$) filled in a 22.4 L container ($R = 0.08206 \text{ L} \cdot \text{atm} \cdot \text{mol}^{-1} \cdot \text{deg}^{-1}$). (03)
 [ii] What is activation energy ? How it can be calculated for any chemical reaction ? (03)

OR

- [b] [i] Work out the units of third order rate constant. (03)
 [ii] What is a Bravais lattice and How P , I and F type Bravais lattice differ from each other ? (03)

