



Registration number:

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ST. JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE -27
SEMESTER EXAMINATION, OCTOBER 2019
B.Sc. CHEMISTRY- I SEMESTER
CH118 – CHEMISTRY

This question paper has three parts and 21 questions. All parts are compulsory.
Useful informations: $h = 6.626 \times 10^{-34} \text{Js}$; $R = 0.0821 \text{LatmK}^{-1} \text{mol}^{-1}$ or $8.314 \text{JK}^{-1} \text{mol}^{-1}$;
 $Z =$ atomic number of atom; $1 \text{Latm} = 101.3 \text{J}$.

Time : 2.5 hrs

Maximum marks : 70

PART -A

Answer any six of the following:

6 x 2 = 12 marks

1. If velocity of the electron in first Bohr's orbit is $2.19 \times 10^8 \text{ms}^{-1}$, calculate the de Broglie wavelength associated with it. Mass of an electron is $9.1 \times 10^{-31} \text{kg}$.
2. Write the electronic configuration of Fe^{+3} ion. (Z of Fe = 26) .
3. Write the Lewis structure for O_3 and calculate formal charge on each oxygen atom.
4. What is lattice energy? What role does it play in the stability of Ionic compounds?
5. How many Zn atoms are present in 26g of pure Zn sample. Molar mass of Zn is 64.56g.
6. A gas expands and does P – V work on the surroundings which is equal to 279J. At the same time it absorbs 216J of heat from the surroundings. What is the internal energy change of the system?
7. Calculate the number of ways of distributing 11 identical objects into 4 boxes with the arrangement 1,0,3,7.
8. Among the following pairs of orbitals which orbital will experience the larger effective nuclear charge? i) 2s and 3s ii) 4d and 4f.

PART -B

Answer any eight of the following

8 x 6 = 48 marks

9. a) Define electronegativity. How does it vary across a period and down a group? Explain the general trends.
b) How does metallic character vary across a period and down a group? Relate this trend to their ionization energy. (3 + 3)
10. Draw the molecular orbital energy level diagram for O_2^- ($Z = 8$). Calculate its bond order and predict whether it is paramagnetic or diamagnetic.
11. Discuss the structure of SF_6 based on hybridisation concept (Z of S = 16 and F = 9) and predict the bond angle.
12. With proper reasoning predict the geometries of the following using VSEPR theory.:
i) BF_3 ii) BF_4^- iii) ClF_3 Note: Z of B = 5, F = 9 and Cl = 17 (3 + 3)
13. a) Write Schrodinger equation for H – atom in spherical polar coordinates and explain the terms.
b) Draw the radial distribution curves for 2s and 2p orbitals and indicate the node(s) if any. (3 + 3)
14. a) What are Bosons and Fermions? Give an example each.
b) How is partition function related to internal energy and entropy of a monoatomic gas? Give the mathematical expression for the same. (3 + 3)
15. a) What are exact and inexact differentials? Give an example each.
b) Derive the Kirchoff equation to account for the variation of enthalpy of a reaction with temperature by assuming that the temperature range is small. (3 + 3)
16. a) $2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$. How many kilograms of ammonia are needed to produce 1×10^5 kg of the fertilizer $(NH_4)_2SO_4$? Gram atomic masses of N, H, S and O are 14, 1, 32 and 16 respectively.
b) Deduce the relation between C_p and C_v in gaseous systems. (3 + 3)
17. a) Explain the electrical conductivity of Li based on band theory.
b) Set up the Born – Haber cycle for MgO. From this cycle arrive at an expression for lattice energy of MgO. (3 + 3)
18. a) State Pauli's exclusion principle and explain using a suitable example.
b) Write an expression for the allowed energy levels for a particle in three dimensional cubic box and explain the terms. (3 + 3)

PART -C

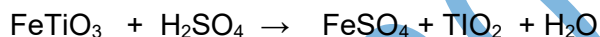
Answer any two of the following

2 x 5 = 10 marks

19. a) Calculate work done in J when 1.0 mole of water vapourises at 1 atmosphere and 100 °C. Assume that the volume of water is negligible compared to the volume of steam at 100 °C and ideal gas behavior.

b) Assume that a particle of mass m is confined to a cubic box and its energy is $25h^2/8ma^2$. What is the degeneracy of this level? (3 + 2)

20. TiO_2 is a white substance produced by the action of sulphuric acid on the mineral illumenite($FeTiO_3$).



Its opaque and nontoxic properties make it suitable as a pigment in plastics and paints.

In one process, 8.00×10^3 kg of $FeTiO_3$ yielded 3.67×10^3 kg of TiO_2 . What is the percent yield of the reaction? Gram atomic masses of Fe , Ti and O are 56, 48 and 16 respectively.

21. a) Draw three resonance structures for chlorate ion, ClO_3^- . Show formal charges.

b) What hybrid orbitals are used by N – atom in the following species?

i) NO_3^- ii) $H_2N - NH_2$ (3 + 2)

End of the question paper.
