



Register Number:

Date:

ST. JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE-27

B. Sc. CHEMISTRY - I SEMESTER

SEMESTER EXAMINATION: OCTOBER 2019

CH 118 : CHEMISTRY

Time- 2 ½ hrs

Max Marks-70

This paper contains 4 printed pages, 3 parts and 21 questions. All parts are compulsory

Instructions:

Periodic table has been provided. Clarke's Tables are not to be used.

Useful Information: $h = 6.626 \times 10^{-34} \text{Js}$; $R = 0.0821 \text{LatmK}^{-1} \text{mol}^{-1}$ or $8.314 \text{JK}^{-1} \text{mol}^{-1}$;

$Z =$ atomic number of atom; $1 \text{Latm} = 101.3 \text{J}$.

PART A

Answer any 6 out of 8 questions. Each question carries 2 marks. 6 x 2 = 12

1. Give the Schrodinger wave equation for Hydrogen atom in Cartesian co-ordinates.
2. What are isoelectric ions? Give examples.
3. Which of the following has more atoms: 1.10 g of hydrogen atoms or 14.7g of chromium atoms?
4. State Pauli's exclusion principle.
5. Define Grand canonical ensemble.
6. Sketch the π - molecular orbitals formed by the overlap of two p orbitals.
7. Calculate the formal charge of N in NH_3 .
8. State first law of thermodynamics, and write the mathematical expression for the same.

PART B

Answer any 8 out of 10 questions. Each question carries 6 marks. 8 x 6 = 48

9. a) State Hund's rule of maximum multiplicity. Apply this rule to write the electronic configuration of nitrogen ($Z=7$).
b) What is the physical significance of Ψ^2 . Give the Born interpretation of $|\Psi|^2$

(3 + 3)

10. a) Define covalent radius. How does the covalent radius of elements vary down a group. Give reason
b) Define electronegativity. Write the equation to determine electronegativity by Pauling's method. Mention what the terms signify in the equation.

(3 + 3)

11. Using the concept of hybridization explain the structure of PCl_5 and predict bond angles (Z of P = 15 and Cl = 17)

12. What is the greatest amount of AlCl_3 (in grams) that can be made with 114g of Al and 186g of Cl_2 ? Which is the limiting reactant? Which reactant is in excess, and how many grams of it are left over at the end of the reaction.

13. a) Plot the radial distribution curve of 1s and 3s orbitals.
b) The $3d^5 4s^1$ electronic configuration of Cr ($Z=24$) is more stable than the $3d^4 4s^2$ configuration. Explain with the help of relevant energy factors.

(3 + 3)

14. Set up the molecular orbital energy level diagram of CO. Calculate its bond order, and predict its magnetic property (Z of C = 6 and O = 8).

15. a) Calculate the number of ways of distributing 20 identical objects into 6 boxes, with the arrangement (1,0,3,5,10,1)
b) Give the equation for the relation between total energy (E) and partition function (q). Explain the terms in the equation.

(3 + 3)

16. a) Prove that $C_p - C_v = R$ for one mole of an ideal gas.
b) What are exact and inexact differentials? Give an example for each.

(3 + 3)

17. a) On the basis of band theory, briefly explain the electrical conductivity of Lithium.
b) Give the resonance structures and the resonance hybrid of the CO_3^{2-} ion

(3 + 3)

18. Set up Born – Haber cycle for and calculate the lattice energy of $\text{KCl}_{(s)}$ using the following data.

$$\Delta H^{\circ}_{\text{sublimation}} \text{ of } \text{K}_{(s)} = + 91 \text{ KJmol}^{-1}$$

$$\text{Electron affinity of } \text{Cl}_{(g)} = -348.8 \text{ KJmol}^{-1}$$

$$\Delta H^{\circ}_{\text{dissociation}} \text{ of } \text{Cl}_{2(g)} = + 242.8 \text{ KJmol}^{-1}$$

$$\Delta H^{\circ}_{\text{f}} \text{ of } \text{KCl}_{(s)} = - 440.6 \text{ KJmol}^{-1}$$

$$\Delta H^{\circ}_{\text{ionisation}} \text{ of } \text{K}_{(g)} = + 418.9 \text{ KJmol}^{-1}$$

PART C

Answer any 2 out of 3 questions. Each question carries 5 marks (2 x 5 = 10)

19. a) Calculate the uncertainty in velocity of a cricket ball (mass = 150g), if the uncertainty in its position is of the order $1 \times 10^{-10} \text{m}$.

b) Which set of orbitals is defined by the quantum numbers $n = 4$ and $l = 1$. How many orbitals are there in this set?

(3 + 2)

20. Calculate q , w , ΔU and ΔH for the isothermal reversible expansion of 5 moles of an ideal gas from an initial pressure of 1atm to a final pressure of 10atm, at a constant temperature of 350K.

21. a) Predict the shape of the following ions by VSEPR theory

(Z of B = 5, F = 9, I = 53, P = 15)

(i) BF_4^-

(ii) I_3^-

b) Is the octet rule obeyed by the central atom in PF_3 and PF_5 ? If not justify.

(3 + 2)

-----End of questions-----