

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: IMSC
BRANCH: CHEMISTRY

SEMESTER : 1st
SESSION: MO/2022

SUBJECT: CH103R1 INORGANIC CHEMISTRY-I (ATOMIC STRUCTURE AND CHEMICAL BONDING-I)
TIME: 3 Hours FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
 2. Attempt all questions.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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		CO	BL
Q.1(a) Write the postulates of Bohr's theory. Discuss the Schrodinger wave equation.	[5]	1	1
Q.1(b) For 1s and 2s orbitals, the maximum electron density is at nucleus. Draw the graph and explain. How it can be rectified in radial probability distribution function?	[5]	1	2
Q.2(a) What do you mean by effective nuclear charge? Transition metal atoms lose ns electron first than 3d electron during ionization. Explain with an example using Slater's rule. Calculate the Z _{eff} for 3s electron of (i) Na and (ii) Mg	[5]	2	2
Q.2(b) Write the general characteristics of d block elements.	[5]	2	1
Q.3(a) Draw the molecular orbital energy level diagram with electronic configurations and calculate Bond order, number of unpaired electrons and comments on magnetic properties for a) NO ⁺ ; b) O ₂ ²⁺	[4]	3	2
Q.3(b) What are rule Fajans' rules? Compare the ionic character of NaCl, MgCl ₂ , AlCl ₃ and SiCl ₄ based on Fajans' rule.	[3]	3	1
Q.3(c) What is Bent's rule? Explain the structure of PCl ₃ F ₂ based on Bent's rule.	[3]	3	3
Q.4(a) Derive the Born-Lande equation for calculating the lattice energy of an ionic solid. Also, discuss the significance of the Madelung constant (A) in the derived equation.	[5]	4	2
Q.4(b) Outline the Born-Hyber cycle for the formation of ionic solid Ca ₃ N ₂ and relate its lattice energy with other thermodynamic constraints.	[3]	4	3
Q.4(c) What is hydration energy? Calculate the lattice energy MgCl ₂ (s) in terms of x, y and z, if $\Delta H_{solvation} MgCl_2(s) = x$, $\Delta H_{hydration} Mg^{2+}(g) = y$, and $\Delta H_{hydration} Cl^-(g) = z$	[2]	4	3
Q.5(a) Derive Nernst equation for a redox reaction.	[5]	5	2
Q.5(b) Show by means of a diagram, and a simple calculation, the minimum value of radius ratio $\frac{r^+}{r^-}$ which permits a salt to adopt a caesium chloride (CsCl) type of structure.	[3]	5	2
Q.5(c) Use energy level diagrams and the band theory to explain the difference between conductors, insulators, and semiconductors.	[2]	5	1

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