UNIVERSITY OF NORTH BENGAL
B.Sc. Honours 1st Semester Examination, 2023

CC1-CHEMISTRY

INORGANIC CHEMISTRY

NEW AND OLD SYLLABUS

Time Allotted: 2 Hours   Full Marks: 40

The figures in the margin indicate full marks.

GROUP-A

1. Answer any *five* questions from the following: $1 \times 5 = 5$

    (a) Is B_2 molecule paramagnetic or diamagnetic?   1

    (b) Arrange H_2^+, H_2 and He_2^{2+} according to their increasing stability.   1

    (c) What is the electronic configuration of Co^{3+}?   1

    (d) Arrange the following in the decreasing bond order: 1
    $$NO^+, \quad NO^- \quad and \quad NO$$

    (e) Write down the correct structure of S_2Cl_2.   1

    (f) Arrange Cl_2, F_2, Br_2 and I_2 according to their increasing bond energy order.   1

    (g) What is the structure and hybridization of $POCl_3$?   1

    (h) Which quantum number is not related to Schrödinger equation?   1

GROUP-B

2. Answer any *three* questions from the following: $5 \times 3 = 15$

    (a) (i)   What is Fajan's rule of polarisation?   2+2+1

        (ii) Write a note on NaCl structure.

        (iii) What is the shape of PF_5 molecule?

    (b) Explain the non linear shape of H_2S and non planar shape of PCl_3 using valence shell electron pair repulsion theory. $2\frac{1}{2} + 2\frac{1}{2}$

    (c) Calculate the radius of the second Bohr orbit for the hydrogen atom.   5

    (Planck's constant, $h = 6.626 \times 10^{-34}\,Js$; Mass of electron $= 9.1091 \times 10^{-31}\,kg$; Charge of electron $e = 1.60210 \times 10^{-19}\,C$; Permittivity of vacuum $\varepsilon_0 = 8.854185 \times 10^{-12}\,kg^{-1}\,m^{-3}A^2$)

    (d) (i)   Will the first ionization energy of calcium be higher or lower than that of potassium state with a reason?   2+3

        (ii) Deduce de-Broglie's equation.

(e) (i) Write down the mathematical expression for Schrödinger wave equation.   2+3

     (ii) Discuss important postulates of Bohr's theory.

GROUP-C

3.   Answer any *two* questions from the following: 10×2 = 20

   (a) (i) Describe the Heisenberg uncertainty principle and the Pauli exclusion principle with proper examples.   5

      (ii) Explain the wave particle duality.   3

      (iii) What are the four different quantum numbers?   2

   (b) (i) Draw the shapes of five d-orbitals.   3

      (ii) What is the Hund's rule of maximum multiplicity?   2

      (iii) Why a 4s-orbital is filled earlier than a 3d-orbital?   3

      (iv) What is the significance of ψ and ψ^2 ?   2

   (c) (i) Define van der Waals radius. Explain why van der Waals radius (1.40 Å) is greater than covalent radius (0.73 Å) for oxygen.   2+2

      (ii) Calculate effective nuclear charge felt by a 4s-electron of Cu.   2

      (iii) Mention the number of radial nodes in 4s, 4p and 3d.   2

      (iv) The second ionisation energy of sodium is very high as compared to its first ionisation energy — Give reason.   2

   (d) (i) Why is the bond angle in F_2O smaller than that in H_2O?   2

      (ii) What are the limitations of VSEPR theory?   3

      (iii) Write down the difference between atomic orbitals and molecular orbitals.   3

      (iv) Explain the structure of ClF_3.   2

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