2012

CHEMISTRY (Optional)

रसायनशास्त्र (वैकल्पिक)

100276

Time : 3 hours   **Maximum Marks : 200**

Note :

(i) *Answers must be written in English.*

(ii) *Question No. 1 is* **compulsory***. Of the remaining questions, attempt* **any Four** *selecting one question from* **each section***.*

(iii) *Figure to the* **RIGHT** *indicates marks of the respective question.*

(iv) *Use of log table, Non-Programmable calculator is permitted but any other Table/Code/Reference book is not permitted.*

(v) *Make suitable assumptions, wherever necessary and state the same.*

(vi) *Number of optional questions upto the prescribed number in the order in which they have been solved will only be assessed. Excess answers will not be assessed.*

(vii) *Credit will be given for orderly, concise and effective writing.*

(viii) *Candidates should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise they will be penalised.*

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1. Attempt **any four** of the following :

    (a) Give an account of :

        (i) Shapes of atomic orbitals as s, p and d   5

        (ii) Heisenberg's uncertainty principle   5

    (b) (i) What are colligative properties ?   5

        (ii) A protein weighing 1.10 g was dissolved in 100 cm^3 (100×10^{-6} m^3) of   5
    solution. The osmotic pressure at 25°C was measured at 1.15 kPa
    i.e. 1150 Nm^{-2}. What was the molar mass of the protein ?

    (c) Using the MO theory, explain the difference in bond strength and magnetic   10
    properties of species as O_2^+, O_2, O_2^- and O_2^{2-}.

    (d) Write a note on 'benzynes'.   10

    (e) Write in brief about Auf bau principle, Pauli's exclusion principle and quantum   10
    numbers.

P.T.O.

SECTION - A

2. (a) Give in brief about :   10

     (i) Silicones

     (ii) Borazine

     (iii) Glass transition temperature

     (iv) Cross link density   -

     (v) Hexachlorocyclotriphosphazene.

  (b) (i) (A) Describe the processes which may lead to electronic spectrum of a transition metal complex.   5

        (B) Write in short about levelling and differentiating solvents.   5

     (ii) (A) Describe the terms "absorption spectroscopy" and "emission spectroscopy".   5

        (B) Explain the concepts "vibrational spectroscopy" and "rotational spectroscopy".   5

  (c) (i) Explain the "Green House Effect".   5

     (ii) What is London smog ? How is it different from Los Angeles smog ?   5

3. (a) Discuss the structural aspects of different types of silicates.   10

  (b) (i) Write in brief about chemical shift in nmr spectra and the factors affecting it. Give the significance of coupling constant in NMR spectroscopy.   10

     (ii) (A) Describe briefly the following with reference to Bronsted - Lowry concept : acid, conjugate acid, neutralization, amphiprotic solvent, and autoprotolysis   6

        (B) Explain Lux-Flood theory of acids and bases with suitable examples.   4

  (c) (i) What is a fertilizer ? What are the requirements of a fertilizer ? Write in brief about NPK fertilizer.   6

     (ii) Superphosphate of lime is [$Ca(H_2PO_4)_2.H_2O + 2(CaSO_4.2H_2O)$]. Find the phosphorus rating of this fertilizer. [Given : Atomic masses : H 1.008 ; O, 16.000 ; P, 31.000 ; S, 32.000 ; Ca, 40.080]   4

SECTION - B

4. (a) Give the characteristics of an ideal gas and the ideal gas law. Of the pair of gases — N_2 and CO — which member is more likely to deviate from the ideal gas behaviour ? How is the ideal gas equation modified for such a deviation ?   **10**

(b) (i) (A) Explain the Hess's Law of heat summation and its usefulness.   **5**

(B) Given the following reactions :   **5**

$$S(s) + O_2(g) \rightarrow SO_2(g) \qquad \Delta H = -297.14 \text{ kJ}$$

$$SO_2(g) + \frac{1}{2}O_2(g) \rightarrow SO_3(g) \qquad \Delta H = -98.38 \text{ kJ}$$

Calculate ΔH for the reaction :

$$S(s) + 1\frac{1}{2}O_2(g) \rightarrow SO_3(g)$$

(ii) (A) Explain the terms : Calorimetry, Heat capacity, State function, Internal energy and Gibb's free energy.   **5**

(B) A mass of 0.509 g of magnesium was burned in oxygen atmosphere in a bomb calorimeter, and the temperature rise was 2.012 K. Find the internal energy change for this reaction. [Given : Atomic mass for Mg = 24.30 ; Energy required for increase in temperature of exactly 1 K = 6.267 kJ].   **5**

(c) (i) Assume that an A molecule reacts with two B molecules in a one-step process to give AB_2.   **6**

(A) Write a rate law for this reaction.

(B) If the initial rate of formation of AB_2 is 2.0×10^{-5} M/sec and the initial concentrations of A and B are 0.30 M, what is the value of the specific rate constant ?

(C) What is the overall order of this rate equation ?

(ii) Give Arrhenius equation and its significance.   **4**

5. (a) (i) Write notes on : Standard hydrogen electrode, Electrochemical series.   **5**

(ii) Give in brief about : Degree of dissociation, Ostwald's dilution law.   **5**

(b) (i) Write in brief about three laws of thermodynamics and about Kirchoff's equation.   **10**

(ii) (A) Describe the terms : Thermodynamics, Thermochemistry, Intensive properties, Extensive properties, Heat of reaction.   **5**

(B) Calculate the enthalpy change in the following reaction :   **5**
$$3C_2H_2(g) \rightarrow C_6H_6(g)$$
[Given : Enthalpy of combustion of $C_2H_2(g) = -1.300$ MJ mol^{-1}; Enthalpy of combustion of $C_6H_6(g) = -3.302$ MJ mol^{-1}].

(c) Define the terms : catalyst, catalyst cycle and turn-over frequency. Explain with the help of representative examples homogeneous and heterogeneous catalysis.   **10**

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SECTION - C

6. (a) (i) Justify the inclusion of zinc group of elements as transition metals. 5
   (ii) Comment on : Lanthanide contraction and its significance. 5
   (b) (i) (A) The complex $[NiCl_4]^{2-}$ is paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic. Explain. 5
       (B) Why does pink coloured salt of CO^{2+} turn blue on warming ? 5
   (ii) What are metallo-enzymes ? Explain in context with them the terms - epoenzyme, prosthatic group, coenzyme, and cofactor with the help of information about catalases. 10
   (c) What is corrosion ? Why is iron galvanised ? Why is it that, given enough time, corrosion will always defeat the protection applied to the object ? 10

7. (a) (i) Write about non-stoichiometric oxides of transition metals. 5
   (ii) Why is uranium considered the key metal in nuclear industry ? 5
   (b) (i) Explain the following terms : 10
       (A) Coordination compound
       (B) Chelate
       (C) Chelate effect
       (D) EAN
       (E) Stability constant
   (ii) Discuss the function of haemoglobin and myoglobin in biological systems. 10
   (c) Give various methods used to prevent corrosion of iron. 10

SECTION - D

8. (a) (i) Discuss S_N1 and S_N2 reactions with one example of each. 10
   (ii) Describe Wittig reaction with mechanism. 10
   (b) Discuss Fries rearrangement reaction with mechanism. 10
   (c) Distinguish between a soap and a detergent. How does a soap clean ? Explain the function of phosphate in a detergent. 10

9. (a) (i) (A) Explain : Reformatsky reaction 5
       (B) Write in brief about 'Stobbe condensation'. 5
   (ii) Write in brief about rearrangements as Fries and Claisen, which are the derivatives of phenol. 10
   (b) Give an account of electrophilic addition to C=C in alkenes. 10
   (c) (i) What are fats and oils ? 6
   (ii) Explain the terms "saponification" and "salting out" which are related to manufacture of soap. 4

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