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Total number of printed pages – 8

B. Tech
BSCC 2101

First Year Supplementary Examination – 2007

CHEMISTRY – I

Full Marks – 70

Time : 3 Hours

*Answer Question No. 1 which is compulsory
and any five from the rest.*

The figures in the right-hand margin indicate marks.

($h = 6.626 \times 10^{-34}$ Js, Mass of electron = 9.1×10^{-31} kg, $e = 1.6 \times 10^{-19}$ C, $c = 3 \times 10^8$ m/s, $N = 6.023 \times 10^{23}$, $R = 8.314$ JK⁻¹/mol.)

✓ 1 Answer in brief : 2×10

✓ (a) What are the conditions a wave function must satisfy ?

P.T.O.

- ~~(b)~~ What are the bond orders of H_2 and H_2^+ ?
- (c) Write down the Arrhenius equation and explain the terms involved in it.
- ~~(d)~~ How is theory of absolute rate superior to collision theory ?
- ~~(e)~~ Why is quinhydrone electrode not suitable for pH measurement in strongly alkaline solution ?
- ~~(f)~~ $Al(OH)_3$ is precipitated by NH_3 and NH_4Cl but $Zn(OH)_2$ is not precipitated by the same reagents. Explain.
- ~~(g)~~ When is buffer capacity of a buffer maximum ?
- ~~(h)~~ Calculate the number of components and degree of freedom for $N_2(g) + O_2(g) \leftrightarrow 2NO(g)$.

- (i) NaCl has FCC structure. How many Na^+ and Cl^- ions are there in the unit cell ?
- (j) Calculate the velocity of an electron that has been accelerated by a potential difference of 1V.
2. (a) Write down the Schrodinger time independent wave equation and explain the terms involved. 2
- (b) What is photoelectric effect ? How did it help in explaining failure of classical mechanics ? A light of wavelength of 300 nm strikes a certain metal having a work function of 3.1 eV. Calculate the velocity of the ejected electron. 5
- (c) If the wavelength of an electron is 0.5 nm, calculate the velocity of the electron. 3

3.

(a)

Write down the molecular orbital configuration for O_2 , O_2^- and O_2^+ . Compare their bond length and magnetic characteristics.

4

(b)

Draw a neat diagram and discuss the water equilibrium system.

4

(c)

A eutectic mixture has definite composition and a sharp melting but it is not a compound. Explain.

2

4.

(a)

Explain why order of a reaction can not be predicted from overall stoichiometry ?

2

(b)

The rate constant of a reaction is found to be tripled when the temperature increased from 25°C to 60°C . Calculate the activation energy.

4

- (c) A first order reaction is 20% complete in 10 minutes, Calculate (i) rate constant and (ii) time taken for 75% completion.

4

- 5 ✓ (a) A solution contains a mixture of A^+ (0.1M) and B_2^{2+} (0.1M) ions which are to be separated. Calculate the minimum concentration of iodide ion at which one of them gets precipitated completely. Also calculate the percentage of that metal ion precipitated. ($K_{sp} : AI = 8.5 \times 10^{-17}$, $B_2I_2 = 2.5 \times 10^{-26}$).

4

- (b) Find out the pH and $[H_3O^+]$ of 0.5 M NH_4Br ($pK_b = 4.73$) at 298K.

4

- (c) What are the conditions for suitable yield of ammonia by Haber's process ?

2

6. (a) Write down the reactions involved in charging and discharging of lead storage cell. 3

(b) For the cell $\text{Mg}^{+2}(\text{s}) | \text{Mg}^{+2}(\text{aq}) || \text{Ag}^{+}(\text{aq}) | \text{Ag}(\text{s})$, calculate the equilibrium constant at 25°C and the maximum work that can be obtained by operating the cell. ($E^{\circ}: \text{Mg}^{+2}/\text{Mg} = -2.37\text{V}$, $\text{Ag}^{+}/\text{Ag} = 0.8\text{V}$) 4

(c) How pH is measured by a glass electrode? 3

7. (a) What are the Miller indices if the plane intersects the crystal axis at $2a$, b , $2c$? 2

(b) Silver has an atomic radius of 0.144 nm . Calculate the densities of silver if it crystallizes in (i) simple cube (ii) FCC structure, (at.wt. = 108 gm). 4

(c) Draw the (100), (110) and (111) planes of a simple cube. Also calculate the number of atoms per unit cell for a simple cube.

4

8. (a) Which of the following processes are /is spontaneous if fusion temperature is 269 K and why :



4

(b) Calculate the change in pH of 1 ltr. of buffer containing 0.1 mole of each NH_3 and NH_4Cl upon addition of

(i) 0.02 mole of dissolved gaseous HCl
and

(ii) 0.02 mole of dissolved NaOH.
Assume no change in volume.
(K_b for $\text{NH}_3 = 1.8 \times 10^{-5}$). 4

(b) Explain with example the function of catalytic promoter. 2



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