Roll No. .....

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(2034)

UG (CBCS) IInd Year Annual Examination

2801

B.Sc. CHEMISTRY

(Chemistry of Main Group Elements, Chemical Energetics and Equilibria)

(Core)

Paper : CHEM 202 TH

Time : 3 Hours] **[Maximum Marks : 50**

Note :– Attempt *five* questions in all, selecting *one* question from each Section. Section E is compulsory. Candidates are required to answer accurate and precise.

Section–A

1. (a) Discuss the unique position of hydrogen in periodic table.

   (b) What are metallic or interstitial hydrides ? How do they differ from molecular hydrides ?

   (c) What is heavy water ? Give its important uses. 4,3,3

2. (a) Why is LiF insoluble in water whereas other alkali metal fluorides are soluble ?

(b) NaOH is stronger base than that of $Ba(OH)_2$. Explain.

(c) Discuss the factors on which ionization enthalpy depends.

(d) Why alkali metals are stronger reducing agents ?

(e) Why salts of alkaline earth metals are colourless and diamagnetic ? Explain. 2×5=10

Section–B

3. (a) Explain and arrange the following in increasing order of their bond angle :

NH_3 PH_3 AsH_3 SbH_3 BiH_3

(b) Discuss the geometry of ICl_2^-.

(c) BF_3 can act as Lewis acid but CCl_4 cannot do so. Why ?

(d) Explain the following :

(i) PCl_5 is known but NCl_5 is not known

(ii) H_3PO_4 is triprotic in nature whereas H_3PO_3 is diprotic in nature. 3,2,2,3

4. (a) There is very little possibility of the formation of compounds of helium. Explain.

(b) What are clatharate compounds of noble gases ? What are the conditions for clatharate formation ?

(c) Discuss the structure of XeF_4. How does it react with water ?

(d) Complete the following reactions :

(i) $Xe + PtF_6 \longrightarrow ?$

(ii) $XeF_2 + 2SO_3 \longrightarrow ?$

(iii) $XeF_4 + H_2O \longrightarrow ?$ 2,2,3,3

Section–C

5. (a) What are extensive and intensive properties ? When does an extensive property become intensive property ?

(b) Derive an expression for ΔU and ΔH for adiabatic reversible expansion of an ideal gas.

(c) Differentiate between state function and path functions. Explain with suitable examples.

(d) Enthalpies of the formation of $CO_2(g)$, $CO(g)$ and $H_2O(l)$ are -393.5, -111.3 and -241.8 kJ/mole respectively. Calculate the ΔH^0 for the reaction :

$$CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(l)$$ 3,3,2,2

6. (a) State and explain Nernst heat theorem and prove that :

$$\lim_{T \to 0} (\Delta S) = \lim_{T \to 0} (\Delta C_p) = 0$$

(b) Calculate the enthalpy change in the reaction :

$$4NH_3(g) + 3O_2(g) \longrightarrow 2N_2(g) + 6H_2O(l)$$

at 298 K, given that the enthalpy of formation at 298 K for $NH_3(g)$ and $H_2O(l)$ are -46.0 and -286.0 kJ/mole respectively.

(c) Discuss the concept of residual entropy. How does it originate and how is it calculated ? 3,4,3

Section–D

7. (a) Define the law of chemical equilibrium. How it can be derived thermodynamically ?

(b) Calculate the standard free energy change of the reaction and predict its feasibility :

$$4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(l)$$

Given that the standard free energies of formation of $NH_3(g)$ and $NO(g)$ and $H_2O(l)$ are– 16.74, 86.61 and 237.32 kJ/mole respectively.

(c) State and explain Le-Chatelier's principle by applying it to the formation of ammonia by Haber's process. 4,3,3

8. (a) How does solubility product differ from ionic product ? Explain solubility product principle.

(b) 0.049g of H_2SO_4 is dissolved per liter of the given solution. Calculate the pH of solution.

(c) Discuss the effect of temperature on ionic product of water.

(d) What is a Buffer Solution ? Give an example of an acidic Buffer mixture and explain its Buffer action.

3,2,2,3

Section–E

(Compulsory Question)

9. Do as directed. Fill in the blanks/MCQ/True-False :

(i) Ortho and para hydrogen differ in :

(a) Atomic number

(b) Mass number

(c) Electron spin in two atoms

(d) Nuclear spin in two atoms

(ii) Water has maximum density at :

(a) 0°C

(b) 273°C

(c) 4°C

(d) −10°C

(iii) Which one is more reactive : K or Ca ?

(iv) $HClO_4$ is ..... acidic than that of $HClO_3$.

(v) What is inorganic benzene ?

(vi) XeO_3 molecule has pyramidal structure.

(True/False)

(vii) An aqueous solution of $CuCl_2$ is basic.

(True/False)

(viii) For cyclic system :

(a) $q = 0$

(b) $q = -w$

(c) $\Delta U > 0$

(d) $\Delta U < 0$

(ix) In complete Carnot cycle, the change in entropy of the universe is :

(a) Positive

(b) Negative

(c) Zero

(d) Infinite

(x) pH of water is 7 at 25°C. If water is heated at 80°C, then :

(a) pH will increase

(b) pH will decrease.

(c) pH will remain same

(d) H^+ ion conc. increases but OH^- ion conc. decreases

$1 \times 10 = 10$