

**B.Tech. Civil (Construction Management)/
B.Tech. Civil (Water Resources Engineering)**

Term-End Examination

June, 2016

00880

ET-105(B) : CHEMISTRY

Time : 3 hours

Maximum Marks : 70

Note : *Question no. 1 is compulsory. Attempt any five questions from the remaining. Use of calculator is permitted.*

1. Write the correct choice for the following :

(a) A hybrid orbital is obtained by taking a linear combination of atomic orbitals of an atom. What is the hybridization of C_2H_2 and BF_3 ? 2

(i) sp^3, sp^3

(ii) sp^2, sp

(iii) sp, sp^3

(iv) sp^3, sp^3d

(b) The fact that urea or boric acid are solids at room temperature is attributed to the formation of 2

(i) Covalent bonding

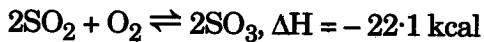
(ii) Ionic bonding

(iii) H-bonding

(iv) Co-ordinate bonding

- (c) Which of the following are extensive properties? 2
- (i) Viscosity, Weight
 - (ii) Weight, Mass
 - (iii) Temperature, Surface tension
 - (iv) Specific gravity, Refractive index
- (d) The first order rate constant for the decomposition of N_2O_5 is $6.2 \times 10^{-4} \text{ s}^{-1}$. What is the half-life for this decomposition? 2
- (i) 1062.8 s
 - (ii) 1117.7 s
 - (iii) 1000.5 s
 - (iv) 1120.7 s
- (e) There are several reactions in which an intermediate product is generated that catalyzes the reaction. Such products are called 2
- (i) Acid/Base catalysts
 - (ii) Biological catalysts
 - (iii) Autocatalysts
 - (iv) None of the above
- (f) Consider the system consisting of the three solids Fe_3O_4 , FeO and Fe_2O_3 . How many components are there? 2
- (i) Bivariant
 - (ii) Trivariant
 - (iii) Univariant
 - (iv) Invariant

- (g) Contact process for the manufacture of H_2SO_4 is an exothermic reaction and proceeds with a decrease in volume. Hence the formation of SO_3 is favoured by 2



- (i) Low temperature, High pressure
 - (ii) High temperature, High pressure
 - (iii) High temperature, Low pressure
 - (iv) Low temperature, Low pressure
- (h) In order to protect steel structures from corrosion, which of the following will be useful? 2

- (i) Ni, Na, Pb
- (ii) Zn, Mg, Al
- (iii) Na, Pb, Cd
- (iv) Ni, Pb, Cd

- (i) Sodium hydroxide flakes or pellets should not be exposed to air as they are deliquescent and absorb 2

- (i) O_2
- (ii) N_2
- (iii) SO_2
- (iv) CO_2

- (j) In zeolite method, Na^+ ions in the pores of the zeolite can be exchanged by 2

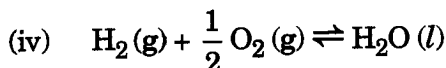
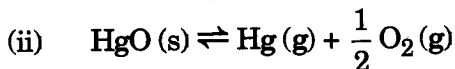
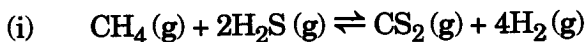
- (i) Al^{3+}
- (ii) OH^-
- (iii) Ca^{2+}
- (iv) H^+

2. (a) Write the balanced equation for the following reactions : 3
- (i) Al_2O_3 dissolved in a basic solution (NaOH).
 - (ii) Addition of NH_4Cl to the solution from (i) produces a white precipitate.
 - (iii) Thermal decomposition of the precipitate from (ii) restores Al_2O_3 .
- (b) Zirconium and Hafnium occur in group-4 (IV B) group, they belong to the fifth and the sixth periods respectively. Explain why their size is almost identical instead of Hf ($Z = 72$) being larger than Zr ($Z = 40$). 2
- (c) Predict the geometry of complexes formed by transition metal ions, using the following hybrid orbitals : 3
- (i) sp^3
 - (ii) d^2sp^3
 - (iii) dsp^2
- (d) Write the name of the following complexes : 2
- (i) $[\text{Cr}(\text{NH}_3)_3(\text{NO}_2)_3]$
 - (ii) $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl}$

3. (a) Give reasons for the following :
- (i) Instead of electrolysing water, an aqueous solution of an alkali is electrolysed to manufacture hydrogen. 2
 - (ii) In steam-hydrocarbon reforming process for hydrogen, excess of steam is used. 2
- (b) Describe the contact process with a flow chart for the manufacture of sulphuric acid. 6
4. (a) How would you prepare aspirin from ortho-hydroxybenzoic acid (salicylic acid)? 3
- (b) How would you convert 2-propanol to propene, propyne into 2-butene and 2-butene into butane? 3
- (c) Explain how methane is used in the synthesis of ammonia and methanol. 4
5. (a) Write a short note on thermosetting plastics. 5
- (b) What do you understand by Genetic Engineering? 5
6. (a) Draw and explain the phase diagram of one component system. 4
- (b) Benzene boils at 80°C and the entropy of vaporisation is $88 \text{ JK}^{-1} \text{ mol}^{-1}$. What is the vapour pressure of benzene at 27°C ? 2

- (c) Write the Mass law expression for the equilibrium constant for the following reactions :

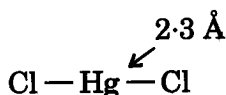
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7. (a) Atomic Al (atomic weight – 26.98 g/mol) crystallizes into an FCC structure with a density of 2698 kg/m³. X-rays of wavelength 0.1537 nm, when diffracted from (III) planes of this lattice, gave a maximum intensity at an angle of 19.2°. Calculate the Avogadro number, using the above information .
- (b) Draw the energy level diagram of XeF₂.
- (c) The geometry of HgCl₂ is

5

3



What is the electronic configuration of Hg ?
Which orbitals contribute to bonding in HgCl₂ ?

2

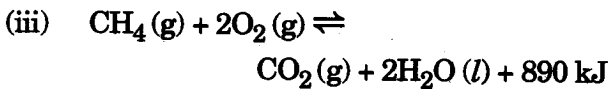
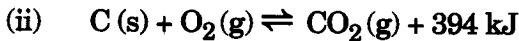
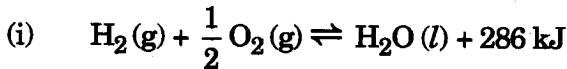
8. (a) Explain Heisenberg's uncertainty principle with relationship between energy and momentum.

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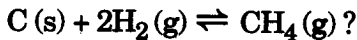
- (b) What is the probability of finding a particle in a 1-dimensional box in the state $n = 1$ in a small distance of 0.1 \AA at the centre of the box of length 10 \AA ?

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9. (a) Given the following data for reactions under the standard conditions, calculate the heat of formation of methane :



What is ΔH for the reaction



3

- (b) The half-life for a reaction between A and B varied with initial pressure as shown in the table below :

Assume $\text{A} + \text{B} \longrightarrow \text{Products}$

| | | | | |
|---------------|-----|-----|-----|-----|
| P_A mm | 500 | 125 | 250 | 250 |
| P_B mm | 10 | 15 | 10 | 20 |
| $t_{1/2}$ min | 80 | 213 | 160 | 80 |

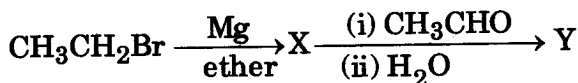
What is k for the reaction ?

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- (c) Write a short note on Acid/Base catalysis.

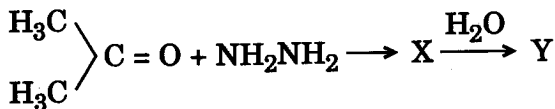
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10. (a) Complete the reaction sequence. 2

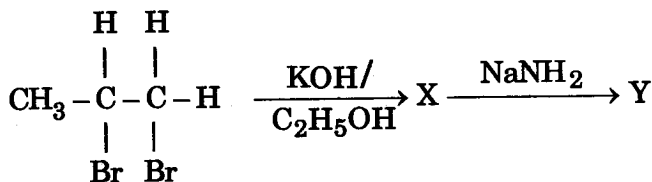


- (b) Draw the Newman projection of butane using the C-2 to C-3 bond as reference in the eclipsed form. 2

- (c) Complete the reaction sequence. 2



- (d) Complete the sequence. 2



- (e) Write the IUPAC name of

