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ET-105(B)

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

Term-End Examination

00880

June, 2016

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 $6{\cdot}2 \times 10^{-4}$ 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

$$2SO_2 + O_2 \rightleftharpoons 2SO_3, \Delta H = -22{\cdot}1 \text{ kcal}$$

(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) Through 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) $[Cr(NH_3)_3(NO_2)_3]$

(ii) $[Cr(H_2O)_4Cl_2]Cl$

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 JK^{-1} 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 : 4

(i) $CH_4(g) + 2H_2S(g) \rightleftharpoons CS_2(g) + 4H_2(g)$

(ii) $HgO(s) \rightleftharpoons Hg(g) + \frac{1}{2} O_2(g)$

(iii) $2FeSO_4(s) \rightleftharpoons Fe_2O_3(s) + SO_2(g) + SO_3(g)$

(iv) $H_2(g) + \frac{1}{2} O_2(g) \rightleftharpoons H_2O(l)$

7. (a) Atomic Al (atomic weight – 26·98 g/mol) crystallizes into an FCC structure with a density of 2698 kg/m^3. 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 . 5

(b) Draw the energy level diagram of XeF_2. 3

(c) The geometry of $HgCl_2$ is

$$Cl - Hg \overset{2\cdot3\ \text{Å}}{\swarrow} - Cl$$

What is the electronic configuration of Hg ? Which orbitals contribute to bonding in $HgCl_2$? 2

8. (a) Explain Heisenberg's uncertainty principle with relationship between energy and momentum. 5

(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 Å at the centre of the box of length 10 Å ? 5

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

(i) $H_2(g) + \frac{1}{2} O_2(g) \rightleftharpoons H_2O(l) + 286\ kJ$

(ii) $C(s) + O_2(g) \rightleftharpoons CO_2(g) + 394\ kJ$

(iii) $CH_4(g) + 2O_2(g) \rightleftharpoons CO_2(g) + 2H_2O(l) + 890\ kJ$

What is ΔH for the reaction

$C(s) + 2H_2(g) \rightleftharpoons CH_4(g)$? 3

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

Assume $A + B \longrightarrow$ 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 ? 4

(c) Write a short note on Acid/Base catalysis. 3

10. (a) Complete the reaction sequence. *2*

$$CH_3CH_2Br \xrightarrow[ether]{Mg} X \xrightarrow[(ii)\ H_2O]{(i)\ CH_3CHO} Y$$

(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*

$$\begin{matrix} H_3C \\ \\ H_3C \end{matrix}\!\!\rangle C = O + NH_2NH_2 \longrightarrow X \xrightarrow{H_2O} Y$$

(d) Complete the sequence. *2*

$$CH_3-\underset{\displaystyle Br}{\overset{\displaystyle H}{\underset{|}{\overset{|}{C}}}}-\underset{\displaystyle Br}{\overset{\displaystyle H}{\underset{|}{\overset{|}{C}}}}-H \xrightarrow[C_2H_5OH]{KOH/} X \xrightarrow{NaNH_2} Y$$

(e) Write the IUPAC name of

$$H_3C-\overset{\displaystyle O}{\overset{\|}{C}}-N\begin{matrix}\diagup CH_3 \\ \diagdown CH_3\end{matrix}$$

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