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ET-105(B)

02317

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

Term-End Examination

June, 2011

ET-105(B) : CHEMISTRY

Time : 3 hours *Maximum Marks : 70*

Note : *Answer **all** the questions. Use of calculator is allowed.*

1. Attempt *any two* of the followings : **2x5=10**

(a) Which of the following statements about H_2O_2 is/are correct ?

(i) H_2O_2 is a linear molecule.

(ii) Concentrated H_2O_2 in water is generally expressed as 20 or 30 volumes of H_2O_2.

(iii) H_2O_2 is an oxidising agent.

(iv) H_2O_2 is a reducing agent.

(b) For the reaction :

$$CO\ (g) + H_2O\ (g) \rightleftharpoons CO_2\ (g) + H_2\ (g)$$

at a given temperature, the equilibrium amount can be increased by :

(i) adding suitable catalyst.

(ii) adding an inert gas.

(iii) decreasing the volume of the container.

(iv) increasing the amount of CO (g).

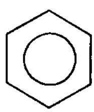
(c) Which of the following groups in aromatic compounds is/are electron releasing group(s) ?

(i) $-CH_3$ (ii) $-\overset{+}{N}H_3$

(iii) $-NO_2$ (iv) $-OCH_3$

2. Attempt *any three* of the following : **3x5=15**

(a) Complete and name the following reaction :

 $+ \; CH_3Cl \xrightarrow{Al\,Cl_3\text{ (anhydrous)}}$

(b) Haber – Bosch process for the manufacture of NH_3 is based on the reaction :

$$N_2(g) + 3H_2(g) \xrightleftharpoons{\text{Catalyst}} 2NH_3\,(g)\;;$$

$$\Delta_r H^\circ = -46.0 \text{ k Jmol}^{-1}$$

$$K^\circ_P = 14$$

Which of the following information regarding the above reaction is correct ?

(i) On adding N_2, the equilibrium is shifted to right side with an increase in entropy.

(ii) The equilibrium constat $k°_P$ increases with increase in temperature.

(iii) $2\ G_m\ (NH_3) = G_m(N_2) + 3\ G_m\ (H_2)$ – (at equilibrium) where G_m represents the molar Gibbs function of the species enclosed in brackets.

(iv) The use of catalyst helps increasing the rate of forward reaction more than that of backward reaction thereby increasing the yield of NH_3.

(c) A 0.004 M solution of K_2SO_4 is isotonic with a 0.010 M solution of glucose at the same temperature. The apparant percent degree of dissociation of K_2SO_4 is :

(i) 25% (ii) 50%

(iii) 75% (iv) 100%

(d) The reaction $A \rightarrow B$ proceeds through the following steps :

$A \rightarrow C \rightarrow D \rightarrow B$. If $\Delta S\ (A \rightarrow C) = 60$ eu, $\Delta S\ (C \rightarrow D) = 20$ eu and $\Delta S\ (B \rightarrow D) = 10$ eu, the entropy change for $A \rightarrow B$ would be

(i) 70 eu (ii) -70 eu

(iii) 90 eu (iv) -90 eu

3. Attempt *any three* of the followings : **3x5=15**

(a) Define a unit cell. How many types of crystals are known ? Name them.

(b) What percent is the void space present in a monoatomic FCC unit cell ? What is the coordination number of an atom in a FCC unit cell ?

(c) Given :

$[Ag\ (NH_3)_2]^+ \rightleftharpoons Ag\ (NH_3)^+ + NH_3$;

$K_1^\circ = 1.4 \times 10^{-4}$

$Ag\ (NH_3)^+ \rightleftharpoons Ag^+ + NH_3$;

$K_2^\circ = 4.3 \times 10^{-4}$

The instability constant of the complex :

$Ag\ (NH_3)_2^+ \rightleftharpoons Ag^+ + 2\ NH_3$ is equal to :

(i) 7.14×10^3 (ii) 2.33×10^3

(iii) 6.02×10^{-8} (iv) 1.66×10^7

(d) Calculate ΔG° and $\log_{10} K$ for the reaction $A \rightleftharpoons B$.

Given : $\Delta_r H^\circ_{298\,k} = -54.07$ k J mol^{-1}

$\Delta_r S^\circ_{298\,k} = 10\ JK^{-1}\ mol^{-1}$

$R = 8.314\ JK^{-1}\ mol^{-1}$

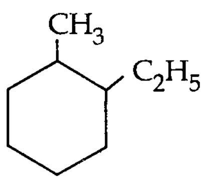
4. Attempt *any three* of the following : **3x5=15**

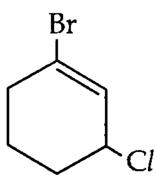
(a) What is an addition polymer ? How polyethylene forms from ethylene monomers ? Give relevant steps.

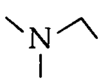
(b) Give IUPAC name of the following :

(i) HCOOH

(ii) $$\begin{array}{ccccccccc} CH_3 & - & CH & - & CH_2 & - & CH & - & CHO \\ & & | & & & & | & & \\ & & OH & & & & Cl & & \end{array}$$

(iii) 

(iv) 

(v) 

(c) Is O_2 paramagnetic or diamagnetic ? Justify your answer ? What is the bond order of O_2 ?

(d) The standard enthalpy and entropy of vaporization of a liquid are 25 kJ mol^{-1} and 100 JK^{-1} mol^{-1}. What will be the boiling point of the liquid ?

5. Attempt *any three* of the followings : **3x5=15**

Note : Each entry in column X in A, B, C and D is some way related to the entries in column Y and Z. Match the appropriate entries. As an example : In part-A, 'H_2O' in column X is related to 'high dielectric constant' in column Y and is also related to 'two pairs of electrons in column Z, so the answer will be A : (f) – (c) – (a)

A.

	X	Y	Z
(a)	NH_3	LCAO	two pairs of electrons
(b)	BCl_3	sp hybridization	polycentric
(c)	$BeCl_2$	high dielectric constant	triangular planar
(d)	H_3NBF_3	sp^3 hybridization	linear
(e)	Molecular orbital	sp^2 hybridization	one side sharing of electrons
(f)	H_2O	coordinate covalent bond	one lone pair of electrons

B.

	X	Y	Z
(a)	Animal charcoal	kJK^{-1}	watch spring
(b)	Invar	cm^{-1}	1.3805×10^{-26}
(c)	Nichrome	Co, Ni	sugar refining
(d)	Rydberg	Fe, Ni	cutlery
(e)	Stainless steel	Fe, Cr, Ni, C	109677
(f)	Boltzmann constant	C, $Ca_3(PO_4)_2$	heating element

C.

	X	Y	Z
(a)	Two water of crytallization	ferrous sulphate	styptic reagent
(b)	Five water of crystallization	Mohr's salt	washing soda
(c)	Seven water of crystallization	Sodium carbonate	green vitriol
(d)	Six water of crystallization	calcium sulphate	blue vitriol
(e)	Ten water of crystallization	Copper sulphate	stable salt of iron
(f)	Twelve water of crystallization	alum	gypsum

D.

	X	Y	Z
(a)	n-Butane	dimethyl ether	chiral carbon
(b)	n-Propyl alcohol	methyl propyl ether	chain isomers
(c)	Ethyl alcohol	trans-but-2-ene	metamerism
(d)	Diethyl ether	isobutane	functional isomers
(e)	cis-But-2-ene	optically active	positional isomers
(f)	$CH_3CH(OH)\,CH_2 - CH_3$	isopropyl alcohol	geometrical isomers