ET-105(B)

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

Term-End Examination

00135

June, 2017

ET-105(B) : CHEMISTRY

Time : 3 hours   *Maximum Marks : 70*

Note : *Question no. 1 is* **compulsory**. *Attempt any* **six** *questions from questions number 2 to 11. Use of calculator is permitted.*

1. (a) The s and p block elements represent   1

    (i)   short transition series

    (ii)   representative elements

    (iii) inert elements

    (iv)   long transition series

    (b) An element has atomic number 26. The electronic configuration is represented by   2

    (i) $1s^2 \, 2s^2 \, 2p^6 \, 3s^2 \, 3p^6 \, 4s^2 \, 3d^6$

    (ii) $1s^2 \, 2s^2 \, 2p^6 \, 3s^2 \, 3p^6 \, 3d^6 \, 4s^2$

    (iii) $1s^2 \, 2s^2 \, 2p^6 \, 3s^2 \, 3p^6 \, 3d^8 \, 4s^0$

    (iv) $1s^2 \, 2s^2 \, 2p^6 \, 3s^2 \, 3p^6 \, 4s^1 \, 3d^7$

(c) Na^+ and Al^{3+} are isoelectronic. Which ion will have greater radius ? Justify your choice.   3

(d) Solvay process is used for the preparation of   1
   (i) Liquid air
   (ii) Nitric oxide
   (iii) Na_2CO_3
   (iv) Chlorine

(e) Write the anhydrides of the following compounds :   3
   (i) Malonic acid $[CH_2(COOH)_2]$
   (ii) Formic acid $[HCOOH]$
   (iii) Carbonic acid $[H_2CO_3]$

(f) An isomer of ethanol is   1
   (i) Methanol
   (ii) Diethyl ether
   (iii) Acetone
   (iv) Dimethyl ether

(g) If a reaction with $t_{1/2}$ = 69·3 seconds has a rate constant value of 10^{-2} per second, the order is   3
   (i) 0
   (ii) 1
   (iii) 2
   (iv) 3

(h) The first order reflection of a beam of X-rays of wavelength 1.54 Å from the (100) plane of a simple cubic crystal occurs at an angle of $11.29°$. Calculate the lattice parameter of the unit cell. 3

(i) The electronic configuration of element A is $1s^2\,2s^2\,2p^6\,3s^2$ while that of B is $1s^2\,2s^2\,2p^5$. The formula of the compound containing A and B will be 2

    (i) AB

    (ii) A_2B

    (iii) AB_2

    (iv) A_2B_6

(j) The pH of a 0.1 N solution of NH_4Cl is 5.4.

Find the hydrolysis constant if the degree of hydrolysis is very small. 3

2. (a) How many octahedral voids are there in a FCC unit cell ?

(b) Calculate the radius ratio of an octahedral void atom to a lattice iron atom in a FCC unit cell.

Given :

    'r' is the radius of iron atom.

    'R' is the radius of void atom.

    'a' is the lattice parameter of the FCC unit cell. 2+6=8

3. Name the following coordination compounds according to IUPAC nomenclature : $2+2+2+2=8$

   (a) $Na_3[CoF_6]$

   (b) $[Cr(NH_3)_4(NO_2)Br]Cl$

   (c) $K[Au(OH)_4]$

   (d) $[PtCl_6]^{2-}$

4. (a) What is the maximum amount of alum, $(K_2SO_4 \cdot (Al_2SO_4)_3 \cdot 24H_2O)$ that can be made from 100 g of K_2SO_4, 100 g of $Al_2(SO_4)_3$ and 100 g of H_2O ?
   [Mol. wt. : $K_2SO_4 = 174$; $Al_2(SO_4)_3 = 342$]

   (b) In the above, which compound is in excess and by how much (express in grams) ? $6+2=8$

5. (a) How many oxidation states are known for Mn ? Write the oxidation states.

   (b) According to the crystal field theory, distribute d^5 electrons in high and low spin states. (Represent an electron by '↑') $4+4=8$

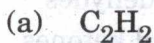6. (a) Why is iron called ferromagnetic and not paramagnetic ? Explain.

   (b) Write the electronic configuration for the following :

   (i) $_{64}Gd$

   (ii) $_{29}Cu^{2+}$ $\qquad 4+4=8$

7. How will you convert $CHCl_3$ into any **two** of the following ? Also give the names of the reagents and conditions used in each step. $4+4=8$

(a) C_2H_2

(b) CH_3COOH

(c) CH_4

(d) C_6H_6

8. Answer the following : $2+2+4=8$

(a) Isomers which can be interconverted through rotation around a single bond are called

(i) conformers

(ii) diastereomers

(iii) enantiomers

(iv) positional isomers

(b) Write down the tautomeric structure of phenol.

(c) Write down the structural isomers of butanol. Which of the isomers will show enantiomerism ?

9. Match the items given under X with the items given under Y and Z :   2+2+2+2=8

X	Y	Z
1. Isobars	(a) Two or more forms of the same element that differ in physical properties	(A) Aldehydes and ketones
2. Isomers	(b) Similar crystalline structure	(B) $_{19}K^{40}$ and $_{20}Ca^{40}$
3. Isomorphous	(c) Same mass number	(C) Graphite and diamond
4. Allotropes	(d) Different structural formulae	(D) $FeSO_4 . 7H_2O$ and $MgSO_4 . 7H_2O$

10. (a) The k_p value for the reaction

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$
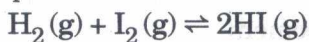
at 400°C is 49. If the partial pressures of H_2 and I_2 are 0·5 atm each, determine the partial pressure of each gas at equilibrium.

(b) Which of the following 0·1 M aqueous solutions will have the lowest freezing point ?

(i) K_2SO_4

(ii)   NaCl

(iii)   Urea

(iv)   Glucose   6+2=8

11. (a) In which case is a reaction possible at any temperature ?

(i) $\Delta H < 0, \Delta S > 0$

(ii) $\Delta H < 0, \Delta S < 0$

(b) The vapour pressure of pure benzene at 25°C is 640 mmHg. A non-volatile solid weighing 2·175 g is added to 39 g of benzene. The vapour pressure of the solution is 600 mmHg. What is the molecular weight of the solid substance ? *2+6=8*

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