PRACTICE PAPER-3
CHEMISTRY THEORY (043)

MM:70 **SESSION:2020-21** **TIME: 3 HOURS**

GENERAL INSTRUCTIONS:

Read the following instructions carefully.

a) There are 33 questions in this question paper. All questions are compulsory.

b) Section A: Q. No. 1 to 16 are objective type questions. Q. No. 1 and 2 are passage based questions carrying 4 marks each while Q. No. 3 to 16 carry 1 mark each.

c) Section B: Q. No. 17 to 25 are short answer questions and carry 2 marks each.

d) Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each.

e) Section D: Q. No. 31 to 33 are long answer questions carrying 5 marks each.

f) There is no overall choice. However, internal choices have been provided.

g) Use of calculators and log tables is not permitted.

SECTION A (OBJECTIVE TYPE)

1. Read the passage given below and answer the following questions: **(1x4=4)**

In a hexagonal system of crystals, a frequently encountered arrangement of atoms is described as a hexagonal prism. Here, the top and bottom of the cell are regular hexagons, and three atoms are sandwiched between them. A space-filling model of this structure, called hexagonal close-packed, is constituted of a sphere on a flat surface surrounded in the same plane by six identical spheres as closely as possible. Three spheres are then placed over the first layer so that they touch each other and represent the second layer. Each one of the three spheres touches three spheres of the bottom layer. Finally the second layer is covered with third layer identical to the bottom layer in relative position.

(i) The coordination number of a metal crystallizing in a hexagonal close-packed structure is:
(a) 12 (b) 4 (c) 8 (d) 6

(ii) The percentage of empty space in hcp unit cell is:
(a) 74% (b) 48.6% (c) 32% (d) 26%

(iii) The number of atoms present in a hexagonal close packed unit cell is:
(a) 4 (b) 6 (c) 8 (d) 12

OR

Hexagonal close packing is represented as:
(a) ABCABC------ type packing
(b) ABABAB------- type packing
(c) AAAAAA------ type packing
(d) none of the above

(iv) The number of tetrahedral and octahedral holes in a hexagonal primitive unit cell are:
(a) 8,4 (b) 6,12 (c) 2,1 (d) 12,6

2.Read the passage given below and answer the following questions: (1x4=4)

Group 15 elements consist of N, P, As, Sb, Bi and Mc (Moscovium) with general electronic configuration ns^2np^3 and oxidation states +3 and +5. Nitrogen differs from rest of the elements. Phosphorus show allotropy and is more reactive than Nitrogen. Hydrides of group 15 elements show variation in bond angle, boiling point, basic character, stability and reducing character. Oxides of group 15 elements show decrease in acidic character on moving down the group. Nitrogen forms large number of oxides. Halides of group 15 elements are mostly covalent.

(i) Which of the following fluorides does not exist?
(a) NF_5 (b) SbF_5 (c) AsF_5 (d) PF_5

(ii) The most unstable hydride is:
(a) NH_3 (b) SbH_3 (c) BiH_3 (d) PH_3

OR

Which of the following is the strongest base?
(a) PH_3 (b) SbH_3 (c) AsH_3 (d) NH_3

(iii) Which of the following oxides is most acidic?
(a) Bi_2O_3 (b) P_2O_3 (c) As_2O_3 (d) Sb_2O_3

(iv) Which trihalide is most ionic among the following?
(a) NCl_3 (b) PCl_3 (c) BiF_3 (d) SbF_3

Following questions (No. 3 -11) are multiple choice questions carrying 1 mark each:

3. The value of Henry's constant K_H is _________.
(a) greater for gases with higher solubility.
(b) greater for gases with lower solubility.
(c) constant for all gases.
(d) not related to the solubility of gases.

OR

At a given temperature, osmotic pressure of a concentrated solution of a substance _________.
(a) is higher than that of a dilute solution.
(b) is lower than that of a dilute solution.
(c) is same as that of a dilute solution.
(d) cannot be compared with osmotic pressure of dilute solution.

4. An increase in molar conductance of a strong electrolyte with dilution is mainly due to:
(a) increase in both number of ions and ionic mobility of ions
(b) increase in number of ions
(c) increase in ionic mobility of ions
(d) 100% ionisation of electrolyte at normal dilution

5.In an electric field, the particles of a colloidal system move towards cathode. The coagulation of the same sol is studied using K_2SO_4 (I), Na_3PO_4 (II), $K_4[Fe(CN)_6]$ (III) and NaCl (IV). Their coagulating power should be:
(a) (I) > (II) > (III) > (IV)

(b) (III) > (II) > (I) > (IV)
(c) (III) > (I) > (II) > (IV)
(d) (IV) > (III) > (I) > (II)

OR

Which property of colloidal solution is independent of charge on the colloidal particles?
(a) Electro-osmosis
(b) Tyndall effect
(c) Coagulation
(d) Electrophoresis

6. The rate equation for a reaction a reaction $A \rightarrow B$ is Rate= $k[A]^0$. If the initial concentration of the reactant is a $molL^{-1}$, the half life period of the reaction is:
(a) k/a (b) a/k (c) 2a/k (d) a/2k

OR

Which one of the following statement is incorrect about order of reaction?
(a) Order of reaction is determined experimentally.
(b) Order of reaction is equal to the sum of the power of concentration terms in differential rate law.
(c) It is not affected with stoichiometric coefficient of the reactants
(d) Order cannot be fractional.

7. Out of TiF_6^{2-}, CoF_6^{3-}, Cu_2Cl_2 and $NiCl_4^{2-}$ (Atomic no.: Ti= 22, Co=27, Cu=29, Ni=28), the colourless species are:
(a) Cu_2Cl_2 and $NiCl_4^{2-}$
(b) TiF_6^{2-} and Cu_2Cl_2
(c) CoF_6^{3-} and $NiCl_4^{2-}$
(d) TiF_6^{2-} and CoF_6^{3-}

8. Both Co^{3+} and Pt^{4+} have a coordination number of six. Which of the following pair of complexes will show approximately the same electrical conductance for their 0.001 M aqueous solution?
(a) $CoCl_3.4NH_3$ and $PtCl_4.4NH_3$
(b) $CoCl_3.3NH_3$ and $PtCl_4.5NH_3$
(c) $CoCl_3.6NH_3$ and $PtCl_4.5NH_3$
(d) $CoCl_3.5NH_3$ and $PtCl_4.6NH_3$

OR

As per IUPAC nomenclature, the name of the complex $[Co(H_2O)_4(NH_3)_2]Cl_3$ is:
(a) tetraaquadiaminecobalt(III) chloride
(b) tetraaquadiamminecobalt(III) chloride
(c) diaminetetraaquacobalt(II) chloride
(d) diamminetetraaquacobalt(III) chloride

9. What is the major product in the following reaction?

$$CH_3-CH_2-\underset{\displaystyle CH_3}{\underset{|}{\overset{\displaystyle CH3}{\overset{|}{C}}}}-Br + KOH \xrightarrow[\text{Reflux}]{\text{Ethanol}}$$

(a) $$\begin{array}{c} \qquad\qquad\qquad\quad CH_3 \\ \qquad\qquad\qquad\quad | \\ CH_3—CH_2—C—OH \\ \qquad\qquad\qquad\quad | \\ \qquad\qquad\qquad\quad CH_3 \end{array}$$

(b) $$\begin{array}{l} CH_3—CH_2—C=CH_2 \\ \qquad\qquad\qquad\; | \\ \qquad\qquad\qquad\; CH_3 \end{array}$$

(c) $$\begin{array}{l} CH_3—CH=C\text{-}CH_3 \\ \qquad\qquad\quad\; | \\ \qquad\qquad\quad\; CH_3 \end{array}$$

(d) $$\begin{array}{ccccccccc} & & CH_3 & & CH_3 & & \\ & & | & & | & & \\ CH_3— & CH_2— & C— & O— & C— & CH_2— & CH_3 \\ & & | & & | & & \\ & & CH_3 & & CH_3 & & \end{array}$$

10. The best reagent for converting 2-Phenylpropanamide into 1-Phenylethanamine is:
(a) excess H_2/Pt
(b) $NaBH_4$/Methanol
(c) NaOH/ Br_2
(d) $LiAlH_4$/ether

11. Which of the following is not a pyrimidine base?
(a) Thymine (b) Cytosine (c) Uracil (d) Guanine

In the following questions (Q. No. 12 - 16) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.
a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
c) Assertion is correct statement but reason is wrong statement.
d) Assertion is wrong statement but reason is correct statement.

12. ASSERTION: $\Delta_{mix}H$ and $\Delta_{mix}V$ are zero for an ideal solution.
REASON: The interactions between the particles of the components of solution are almost identical as between the particles in pure liquids.

13. ASSERTION: The rate constant of a pseudo unimolecular reaction has the units of a second order reaction.
REASON: A pseudo unimolecular reaction is a reaction of second order in which one of the reactant is present in large excess.

14. ASSERTION: Transition metals show variable oxidation states.
REASON: Due to large energy difference between ns^2 and (n-1)d electrons.

15. ASSERTION: Phenol on reaction with aqueous solution of bromine yields a mixture of o- and p- bromophenols.
REASON: -OH group is ortho-para directing group.

OR

ASSERTION: Bond angle in ethers is slightly less than tetrahedral angle.
REASON: There is repulsion between two bulky alkyl (-R) groups.

16. ASSERTION: All monosaccharides are sweet in taste.
REASON: All monosaccharides have the general formula $C_6H_{12}O_6$.

SECTION:B

17. (i) What happens when a freshly precipitated $Fe(OH)_3$ is shaken with water containing a small quantity of $FeCl_3$?
(ii) Why is a finely divided substance more effective as an adsorbent?

OR

(i) Write one similarity between physisorption and chemisorption.
(ii) Out of $MgCl_2$ and $AlCl_3$, which on is more effective in causing coagulation of negatively charged sol and why?

18. (i) On the basis of crystal field theory, write the electronic configuration for d^4 ion if $\Delta_o > P$.
(ii) Write the hybridisation and shape of $[CoF_6]^{3-}$. (Atomic number of Co=27)

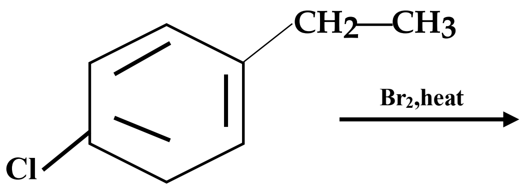
19. Assign suitable reason for the following:
(i) The Mn^{2+} compounds are more stable than Fe^{2+} towards oxidation to their +3 state.
(ii) The highest oxidation state is exhibited in oxo-anions of a metal.

OR

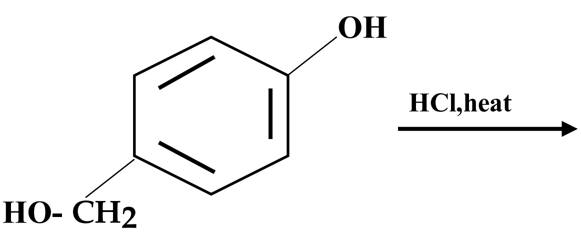
(i) Cu has exceptionally positive $E^0_{M2+/M}$ value. Why?
(ii) Calculate the magnetic moment of a divalent ion in aqueous solution if its atomic number is 25.

20. Draw the structures of the major monohalo product for each of the following reactions:

(i)



(ii)



21. Give reason:
(i) Relative ease of dehydration of alcohols is 3° >2° >1°.
(ii) o-Nitrophenol is more acidic than o-methoxyphenol.

22. Arrange the following compound in the order of the property indicated against them:
(i) CH_3CHO, CH_3CH_2OH, CH_3OCH_3, $CH_3CH_2CH_3$ – Increasing order of boiling points.
(ii) Ethanal, Propanal , Propanone, Butanone – Increasing order of reactivity towards nucleophilic addition.

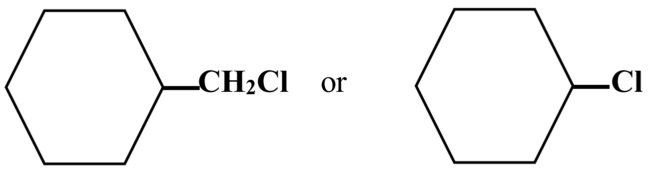
23. How will you convert the following:
(i) Ethanoic acid to methanamine
(ii) Benzyl chloride to 2-Phenylethanamine

24. (i) Write one difference between α-helix and β-pleated sheet structures of proteins.
(ii) What type of linkage is present in nucleic acids?

OR

(i) What do you understand by the term glycosidic linkage?
(ii) Give one example each of essential and non-essential amino acid.

25. (i) Which one in the following pair of substances undergoes S_N2 reaction faster and why?



(ii) The presence of nitro group ($-NO_2$) group at o/p positions increases the reactivity of haloarenes towards nucleophilic substitution reaction. Give reason.

SECTION:C

26.(i) At 300K, 36g of glucose $C_6H_{12}O_6$(molar mass = 180 $gmol^{-1}$) present per litre in its solution has an osmotic pressure of 4.98 bar. If the osmotic pressure of another glucose solution is 1.52 bar at the same temperature, calculate the concentration of other solution.
(ii) Blood cells are isotonic with 0.9% (w/v) sodium chloride solution. What happens if we place blood cells in a 1.2% (w/v) sodium chloride solution?

27.(i) Rate constant for a first order reaction has been found to be 2.54×10^{-3} s^{-1}.Calculate its three-fourth life. ($\log_{10}4=0.6021$)
(ii) State a condition in which a bimolecular reaction is kinetically first order.

28. How would you account for the following:
(i) The metallic radii of the third(5d) series of transition elements are virtually the same as those of the corresponding members of second series.
(ii) Highest fluoride of manganese is MnF_4 whereas the highest oxide is Mn_2O_7.
(iii) Sc^{3+} is colourless in aqueous solution while Ti^{3+} is coloured.

OR

Explain the following observations:

(i) The enthalpies of atomisation of transition metals are quite high.
(ii) Transition metals and their compounds show catalytic properties.
(iii) Though copper has completely filled d-orbitals (d^{10}) yet it is considered as a transition metal.

29. An organic compound 'A' having molecular formula C_3H_6 on treatment with aqueous H_2SO_4 gives 'B' which on treatment with $HCl/ZnCl_2$ gives 'C'. The compound 'C' on treatment with ethanolic KOH gives back compound 'A'. Identify the compounds A,B,C.

OR

Write the chemical reaction involved in the following :
(i) Kolbe's reaction (ii) Friedel-Craft alkylation of anisole (iii) Hydroboration oxidation

30. Give reason:
(i) Acetylation of aniline reduces its activation effect.
(ii) CH_3NH_2 is more basic than $C_6H_5NH_2$.
(iii) Although $-NH_2$ is o/p directing group, yet aniline on nitration gives a significant amount of m-Nitroaniline.

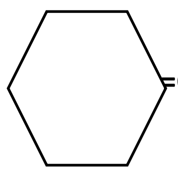
SECTION:D

31.(a) Arrange the following in the order of property indicated against each set: (2+3)
(i) HF, HCl, HBr, HI – Increasing bond dissociation enthalpy
(ii) H_2O, H_2S, H_2Se, H_2Te – Increasing acidic character
(b) X_2 is a greenish yellow gas with pungent smell and used in purification of water. On dissolving in water it gives a solution which turns blue litmus red. When it is passed through NaBr solution Br_2 is obtained.
(i) Identify the gas.
(ii) What are products obtained when X_2 reacts with excess of ammonia? Give chemical equation.
(iii) What happens when X_2 reacts with cold and dilute NaOH solution? Write chemical equation.

OR

(a) Account for the following:
(i) H_2S acts only as a reducing agent but SO_2 acts both as a reducing agent as well as an oxidising agent.
(ii) Despite having greater polarity, hydrogen fluoride boils at a lower temperature than water.
(iii) Sulphur in vapour state exhibits paramagnetism.
(b) Draw the structures of following:
(i) ClF_3 (ii) XeF_4

32. (a) Write the products of the following reactions: (3+2)

(i)  =O + NH_2OH $\xrightarrow{H^+}$

(ii) $2C_6H_5CHO$ + conc.NaOH $\longrightarrow$

(iii) $CH_3COOH \xrightarrow{Cl_2/P}$

(b) Give simple chemical tests to distinguish between the following pairs of compounds:
(i) Benzaldehyde and Benzoic acid (ii) Propanal and Propanone

OR

(a) Give reason for the following:
(i) Aldehydes and ketones undergo a number of nucleophilic addition reactions.
(ii) $(CH_3)_3C$-CHO does not undergo aldol condensation.
(iii) Carboxylic acids are higher boiling liquids than alcohols.
(b) Give a simple chemical test to distinguish between:
(i) Acetophenone and benzophenone (ii) Benzaldehyde and ethanal

33. (i)The conductivity of 0.001 molar solution of CH_3COOH is 3.905×10^{-5} Scm^{-1}. Calculate its molar conductivity and degree of dissociation (α). **(3+2)**
Given $\lambda°(H^+)$=349.6S cm^2 mol^{-1} and $\lambda°(CH_3COO^-)$=40.9S cm^2 mol^{-1}
(ii) Define electrochemical cell. What happens if external potential applied becomes greater than E°cell of electrochemical cell?

OR

(i) State the relationship amongst cell constant of cell, resistance of the solution in the cell and conductivity of the solution. How is molar conductivity of a solute related to conductivity of its solution? **(2+3)**
(ii) Calculate cell voltage for the following cell at 298K:
$Mg(s) | Mg^{2+}(0.01M) || Ag^+(0.0001M) | Ag(s)$
Given: $E°Mg^{2+}/Mg$= -2.37V, $E°Ag^+/Ag$ = +0.80V , log10=1