FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN PBS-17, UNDER THE FEDERAL GOVERNMENT, 2003

CHEMISTRY, PAPER-I

TIME ALLOWED: THREE HOURS **MAXIMUM MARKS: 100**

NOTE: Attempt **FIVE** questions in all, including **QUESTION NO.8** which is **COMPULSORY**. All questions carry **EQUAL** marks.

Q.No.		Question	Marks
1.	(a)	Discuss the usefulness of Schrodinger wave equation in describing the hydrogen atom.	05
	(b)	What is the significance of atomic numbers?	05
	(c)	What are general features of the metallic bond? Discuss general theories put forward to explain the nature of the metallic bond.	07
	(d)	How many possible orientations are there in three-dimensional space for s, p, d and f orbitals?	03
2.	(a)	'Lewis Theory of Acids and bases is a more generalized concept than the earlier concepts'. Give your views on this statement.	08
	(b)	What is pH? How is it commonly measured?	06
	(c)	What is pH and pOH of 5.0×10^{-2} as solution of NaOH?	06
3.	(a)	What is the role of oxides and oxyacids of nitrogen in environmental pollution?	08
	(b)	How is ammonia manufactured by Haber.	07
	(c)	Complete the following equations:	05
		(i) $H_4P_2O_7 + H_2O \rightarrow$	
		(ii) $NH_3 + NaOH \rightarrow$	
		(iii) $H_2S + HNO_3 \rightarrow$	
		(iv) $Ca(OH)_2 + Cl_2 \rightarrow$	
		(v) $Br_2 + NaOH \rightarrow$	
4.	(a)	What are silicones? How are these manufactured?	06
	(b)	How is pure silicon produced for solar energy cells and silicon chips?	06
	(c)	How is Chlorine manufactured electrolytically?	05
	(d)	Discuss industrial uses of chlorine	03
5.	(a)	What do you understand by fixation of nitrogen?	05
	(b)	What are fertilizers? How is urea manufactured?	06
	(c)	What is water glass?	04
	(d)	What are the raw materials used for the manufacture of glass?	05
6.	(a)	What are the general characteristics of transition elements?	06
	(b)	Describe the blast furnace for manufacture of iron.	07
	(c)	Discuss the theoretical basis and use fullness of Semi-Conductor devices.	07
7.	(a)	Discuss the postulates of Werner's Theory as applied to explain the structure of coordination compounds?	06
	(b)	How is Valence Bond Theory applied to exfplain the structure of complex compounds? What are its limitations?	07
	(c)	How is Crystal Field Theory applied to explain the colour and absorption Spectra of complexes?	07

CHEMISTRY, PAPER-I

COMPULSORY QUESTION

1. Write only the correct answer in the Answer Book. Do not reproduce the question.

(1) What is the most likely reason for suggestion being made?
(a) O and Xe have similar atomic radii.
(b) O and Xe have similar electron affinities.
(c) O and Xe have similar electronic configurations.
(d) O_2 and Xe have similar first ionization energies.
(e) None of these.

(2) In which of the following substances does sulpher exhibit its highest Oxidation State?
(a) SO_2 (b) SO_2Cl_2
(c) $Na_2S_2O_3$ (d) Na_2SO_3.
(e) None of these.

(3) The electronic configuration of four elements are given below. Which of these elements has the highest first ionization energy?
(a) $1s^2\ 2s^2\ 2p^3$ (b) $1s^2\ 2s^2\ 2p^4$
(c) $1s^2\ 2s^2\ 2p^6\ 3s^1$ (d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$
(e) None of these.

(4) Which of the following ions contains five unpaired d-electrons?
(a) Cr (iii) (b) Fe (iii)
(c) Mn (iii) (d) Ni (ii)
(e) None of these.

(5) Which of the following equations is used to define the first ionization of bromine?
(a) $Br(g) \rightarrow Br^-(g) - e^-$ (b) $Br(g) \rightarrow Br^+(g) + e^-$
(c) $\frac{1}{2}Br_2(g) \rightarrow Br^-(g) - e^-$ (d) $\frac{1}{2}Br_2(g) \rightarrow Br^+(g) + e^-$
(e) None of these.

(6) Identify the atoms with the following electronic configurations:
(a) $1s^2\ 2s^1$ (b) $1s^2\ 2s^2\ 2p^4$
(c) $1s^2\ 2s^2\ 2p^6\ 3s^2$ (d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$
(e) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^2\ 4s^2$ (f) None of these.

(7) Classify the following acids as either weak or strong:
(a) HI (b) H_2CO_3
(c) H_3BO_3 (d) H_2S.
(e) None of these.

(8) Predict the most common oxidation states for each of the following elements:
(a) Sn (b) S
(c) P (d) Cl
(e) None of these.

(9) Which of the following gases would have the largest Cv and which would have the smallest?
(a) Xe(g) (b) $CF_3CF_3(g)$
(c) $S_2Cl_2(g)$ (d) None of these.

(10) From each pair of substances listed below, select the one having the largest standard molar entropy at 25°c:
(a) Ga(s) or Ga(l) (b) Na F(s) or Mg O(s)
(c) $H_2O_{(g)}$ or $H_2S_{(g)}$ (d) $CH_3OH(l)$ or $C_2H_5OH(l)$
(e) None of these.

(11) For each type of commercial cell listed below, write the shorthand cell notation and the cell reaction:
(a) Laclanche Cell (b) Lead Storage Cell
(c) Ni – Cd battery (d) None of these.

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(12) Which of the following Oxides has a molar structure as distinct from a giant structure?
(a) MgO (b) Al_2O_3
(c) SiO_2 (d) Cl_2O_7
(e) None of these.

(13) Fruit juices are often sold in aluminium cans. What is the most important reason?
(a) Aluminium can be recycled
(b) Aluminium is light.
(c) Aluminium is cheap
(d) Aluminium is resistant to corrosion.
(e) None of these.

(14) Which of the following compounds is most likely to produce Chlorine when concentrated hydrochloric acid is added to it?
(a) Al_2O_3 (b) CuO (c) PbO_2 (d) Fe_2O_3
(e) None of these.

(15) In hospitals, barium sulphate is used in taking X-ray photographs of the alimentary canal. It is given to the patient prior to the photographs being taken. Why is the sulphate used rather than other compounds of barium?
(a) Other barium compounds are poisonous.
(b) Barium sulphate forms sulphuric acid with acid in the stomach.
(c) Barium sulphate reacts with organic matter in the body.
(d) Barium sulphate is insoluble.
(e) None of these.

(16) Why is it difficult to form nitrogen compounds from gaseous nitrogen?
(a) All reactions of nitrogen are endothermic.
(b) The bond dissociation energy of N_2 is very high.
(c) The first ionization energy of nitrogen atom is very high.
(d) The triple bond in nitrogen is three times as strong as N – N single bond.
(e) None of these.

(17) Nitrogen dioxide and sulphur dioxide have some common properties. Which of the following properties is shown by one of these compounds but not by the other?
(a) Forms 'acid rain'. (b) is a reducing agent.
(c) is insoluble in water (d) is used as a food preservative.
(e) None of these.

(18) A precipitate of copper(ii) hydroxide dissolves in concentrated aqueous ammonia due to the formation of a complex ion. Which complex is formed?
(a) $[Cu(NH_3)_2]^{2+}$ (b) $[Cu(NH_3)_4]^{2+}$
(c) $Cu(NH_3)_4(OH)_2$ (d) $[Cu(NH^+_4)_4]^{2+}$
(e) None of these.

(19) Silver chloride precipitates when silver nitrate is added to sodium chloride solution. The precipitate of silver chloride is soluble in ammonia due to the formation of:
(a) $Ag(OH)_2$ (b) $[Ag(NH_4)]Cl$
(c) $[Ag(NH_3)_2]Cl$ (d) $[Ag(NH_3)_4]Cl$
(e) None of these.

(20) Which of the following compounds is an ionic solid at room temperature. It is present as ions in aqueous solution and decomposes into covalent compounds when heated in solid state.
(a) Barium Sulphate (b) Lead (iv) chloride
(c) Ammonium chloride (d) Sodium chloride
(e) None of these.

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CHEMISTRY, PAPER-II

TIME ALLOWED: THREE HOURS **MAXIMUM MARKS: 100**

NOTE: Attempt **FIVE** questions in all, including **QUESTION NO.8** which is **COMPULSORY**. All questions carry **EQUAL** marks.

Q.No.		Question	Marks
1.	(a)	Define catalyst and co-catalysts giving suitable examples in each case.	04
	(b)	Give classification and mechanism of action of catalysts.	4+6
	(c)	What is Bakelite? How it is produced?	06
2.	(a)	What is meant by "Order of reaction".	02
	(b)	Describe important methods to determine Order of reaction.	12
	(c)	In terms of Kinetics, explain why each of the following speeds up a chemical reaction? (i) Catalysts (ii) Increase in temperature. (iii) Increase in concentration.	06
3.	(a)	Discuss principle involve in Valence Bond Theory.	05
	(b)	How this theory is applied to explain the formation of chemical bond.	05
	(c)	Describe preparation of Anti-Biotics.	06
	(d)	What is meant by Fermentation.	04
4.	(a)	Give synthesis of Benzene diazonium salt.	05
	(b)	How will you prove that this salt is electrophilic?	04
	(c)	Give synthetic application of Diazonium salt.	07
	(d)	How acetanilide is prepared from aniline?	04
5.	(a)	How would you prepare the following compounds using Grignard's reagent of your own choice. (i) Prim alcohol. (ii) Carboxylic acid. (iii) PhD. (iv) Ketone. (v) Aldehyde.	10
	(b)	Why racemic mixture is optically inactive? How can this be resolved into optically active compounds.	07
	(c)	How knocking problem of Fuel Engine can be solved?	03
6.	(a)	Draw the π molecular orbitals of the following: (i) 1, 3 – pentadiene (ii) Benzene (iii) Allylic cation.	04.5

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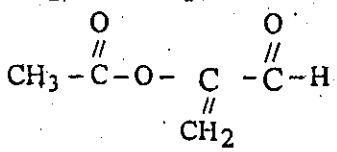
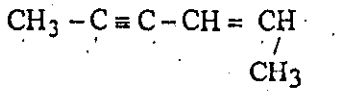
	(b)	What is the hybridization of carbon and oxygen atom in the following: (i) $CH_2 = C = CH_2$ (ii)  (iii) 	09
	(c)	Write note on role of Vitamin-A in the Chemistry of vision.	05
	(d)	Nacl is soluble in water but not in pentane.	01.5
7.	(a)	How sulphonation of Benzene is carried out? Give mechanism.	05
	(b)	Give oxidation reactions of Aldehyde and ketone.	09
	(c)	Explain why: (i) Ionization constant of 2,6 – dihydroxy benzoic acid is ~ 10 thousand times as great as that of its isomer 3, 5 – dihydroxy benzoic acid. (ii) Boiling point of acetic acid is 118 °C and of Methyl formate is only 31 °C.	04 02

COMPULSORY QUESTION

1. Write only the correct answer in the Answer Book. Do not reproduce the question.

(A) Choose the suitable answer from the given options:

(1) Butter yellow was used in Margarine. Butter yellow is:
(a) An Alkaloid (b) Azo Dye (c) Carbohydrate
(d) Ketone (e) None of these.

(2) Heroin is an Organic Compound. It is:
(a) Derivative of Benzene (b) Derivative of Aniline
(c) Derivative of an alkaloid (d) Carbohydrate
(e) None of these.

(3) The structure of ClO_3F is:
(a) Tetrahedral (b) Trigonal-planar
(c) Square planar (d) Trigonal bipyramidal
(e) Linear (f) None of these.

(4) The compound $CH_3 - CH = CH_2$ has a bond formed by the overlap of which of the following hybrid orbital:
(a) $SP^3 - SP^3$ (b) $SP - SP^2$ (c) $SP - SP^3$
(d) $SP^2 - SP^3$ (d) None of these.

(5) Which of the following oxidizing titrant would most likely be used as its own indicator in acid solution?
(a) H_2O_2 (b) $(NH_4)_2 Ce (NO_3)_6$ (c) $K_2Cr_2O_7$
(d) $KMnO_4$ (e) I_2 (f) None of these.

(6) $CH_3 - \overset{O}{\overset{\|}{C}} -$ (methyl ketone) can be checked by one of the following:

(a) Reimer Tiemann reaction (b) Haloform reaction
(c) Kolbs reaction (d) Aromatization
(e) Chugaev reaction (f) None of these.

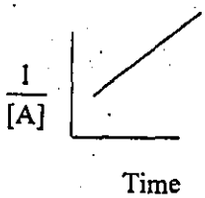
(7) Which of the following is not a polymer:

(a) Plastic (b) Petroleum
(c) Starch (d) Natural rubber
(e) Glycogen (f) None of these.

(8) One would expect to find the term isotactic used in connection with one of the following:

(a) Crystals (b) Textiles
(c) Dyes (d) Metals
(e) Polymers (f) None of these.

(9) For the reaction A + B → C the change in [A] with time is shown in the graph. What is the rate law for this reaction?

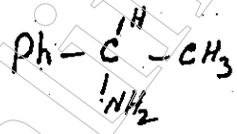


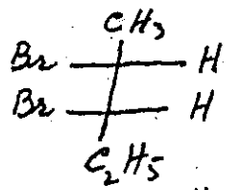
(a) $\frac{-d[A]}{dt} = K[A]$ (b) $\frac{-d[A]}{dt} = K[A]^2$

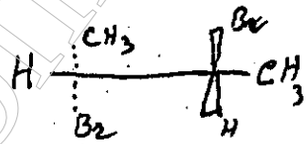
(c) $\frac{-d[A]}{dt} = K[A]^2[B]$ (d) $\frac{-d[A]}{dt} = K[A][B]$

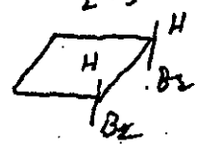
(e) $\frac{-d[A]}{dt} = K[A][B]^2$ (f) None of these.

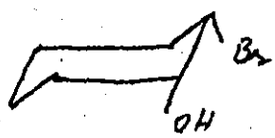
(10) Which of the following structures does not represent an optically active compound?

(a) 

(b) 

(c) 

(d) 

(e) 

(f) None of these.

(B) Write only True or False in the Answer Book. Do not reproduce the statement:

(11) Bond length of $C = C$ double bond is longer than $C - C$ single bond.

(a) True (b) False

(12) Grignard's reagent can be prepared from a compound containing acidic hydrogen.
(a) True (b) False

(13) Vitamin "E" is recognized for its biological role as an antioxidant
(a) True (b) False

(14) Meso tartaric acid is optically inactive.
(a) True (b) False

(15) Boiling point of water is more than Hydrogen sulfide due to hydrogen bonding.
(a) True (b) False

(16) Halogen's are m – directing in electrophilic aromatic substitution because they are inductively electron with drawing and deactivating the ring.
(a) True (b) False

(C) Suggest the most suitable word for each of the following statement.

(17) Saccharides in which 2 to 10 mono saccharides are present

(18) Benzene, Toluene, naphthalene etc are obtained from petroleum. These chemicals are called

(19) Organic compounds, resistant to addition reactions, gives electrophilic substitution reaction, follow or obey Huckle rule and burns with smoky flame.

(20) Isomers, optically active, related to each other as object and non-superimposable mirror image.

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