FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BPS-17 UNDER THE FEDERAL GOVERNMENT, 2001.

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.

1.   (a)   What are the Lowry-Bronsted definitions of an acid and a base? Why this concept of acid base is less restrictive than the Arrhenius definition?

      (b)   Which is the stronger acid of the following pairs? Give reasons.

           H_2SO_4 or $HClO_3$

           H_3ASO_4 or H_3PO_4

           CH_3OH or CH_3SH

      (c)   Formic acid, HCOOH, has pka = 3.7 and picric acid, $C_6H_3N_3O_7$, has pka = 0.3, which is strong acid?

      (d)   Boron trichloride, BCl_3, reacts with diethyl ether, $(C_2H_5)_2O$, to form addition compound $Cl_3BO(C_2H_5)_2$. Identify Lewis acid and Lewis base.

      (e)   What do you understand by the following?
           (i) Soft base   (ii) Hard base   (iii) Soft acid   (iv) Hard acid

      (f)   What is symbiosis?

2.   (a)   What do you mean by thermodynamics? Discuss its scope and limitations

      (b)   What is meant by the following terms?
           (i)   Reversible and irreversible process
           (ii)   Isothermal and adiabatic process

      (c)   State the second law of thermodynamics and explain the condition under which heat can be Converted into work.

      (d)   What is Clausius clapeyron equation? Discuss its applications.

      (e)   Define and explain the terms, "Work Function" and "Free Energy" as used in Thermodynamics.

3.   (a)   Aluminum is not found in native form but in combination, why?

      (b)   What are the chief minerals of aluminum? Write down the impurities associated with it?

      (c)   How aluminum is extracted from its important ore by Hall's and Heroult process? Why chemical reduction is not suitable in this case?

      (d)   Write down major applications of aluminum

      (e)   What are ultramarines?

4.   (a)   What are the essentials of crystal field theory (CFT)?

      (b)   What is meant by crystal field splitting and crystal field stabilization energy of a Coordination compound?

      (c)   What do you understand by 10Dq? Write the units in which it's being expressed. What is Meant by D and q.

      (d)   How CFT can explain the violet colour of $[Ti(H_2O)_6]^{+3}$

      (e)   Is this d-d electronic transition in $[Ti(H_2O)_6]^{+3}$ allowed or forbidden? Give reasons.

      (f)   What is Jahn Teller effect? Show this Jahn Teller effect in the absorption spectra of $[Ti(H_2O)_6]^{+3}$

5.   (a)   Write down the similarities between carbon and silicon. Why silicon form complexes while carbon does not?

     (b)   What is allotropy? Write down the different allotropic forms of carbon.

     (c)   What are silicones? Give their important applications.

     (c)   Explain the difference in density and electrical conductivity between diamond and graphite.

6.   (a)   What is meant by corrosion?

     (b)   Discuss the mechanism of rusting of iron.

     (c)   How rusting process could be controlled?

     (d)   Aluminum is more reactive than iron, but corrosion is more serious problem with iron than with aluminum. What is the reason for it?

     (d)   The process of rusting is more pronounced in coastal regions. Explain why?

7.   Write notes on the following.

     (a)   Theories of metallic bonding. (b)   Glass industry.

     (c)   Water pollution problem in Pakistan.

COMPULSORY QUESTION

8.   Write only the correct answer in the answer book. Do not reproduce the question.

     (1)   Rutherford's scattering experiment showed that.
       (a) The nuclear charge is proportional to atomic number.
       (b) Electrons are small compared with the atom.
       (c) The nucleus is small as compared with the atom.   (d)   None of these.

     (2)   In photoemission of electron the energies of electron emitted depend on the:
       (a) Intensity.   (b) Wavelength.
       (c) Velocity of light.   (d) None of these.

     (3)   The charge density, due to an electron wave, at a point x at a time t is given by:
       (a) eA^2 (b) $e|\psi|^2$ (c) $e\psi$ (d) None of these.

     (4)   De broglie's relation between momentum and wavelength for an electron is:
       (a) $\lambda = h/p$ (b) $p = h\nu$ (c) $p = \lambda/h$ (d) None of these.

     (5)   The kinetic energy associated with plane electron wave is given by:
       (a) hk (b) $\frac{1}{2}mk^2$ (c) $h^2 k^2 / 8\pi^2 m$ (d) None of these.

     (6)   The total energy of the electron is:
       (a)   The difference between its kinetic and potential energy.
       (b)   The sum of its kinetic and potential energy.
       (c)   The product of its kinetic and potential energy.

     (7)   If the wavelength of an electron wave is infinite the electron must be stationary:
       (a)   True   (b)   False

     (8)   The quantization condition for the electron wave is that:
       (a)   The value of φ must not be discontinuous.
       (b)   The value of $d\varphi/dx$ must not be discontinuous.
       (c)   The value of φ and $d\varphi/dx$ must not be discontinuous.
       (d)   None of these.

     (9)   The energy differences between adjacent energy levels of the hydrogen atom:
       (a) Decrease with increasing energy. (b) Increase with increasing energy.
       (b) Are independent of energy.   (d) None of these.

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(10) When an electron jumps from an energy level to a lower one, the energy released is usually.
    (a) Emitted as heat.   (b) Emitted as light.
    (c) Emitted as photon.   (d) None of these.

(11) The spin quantum number of the electron determines.
    (a) The angular momentum about the nucleus.
    (b) The total angular momentum of the electron.
    (c) The angular momentum of electron about its own center of mass.
    (d) None of these.

(12) In the emission spectrum of hydrogen the effect of a magnetic field will be.
    (a) To increase the number of spectral lines.
    (b) To decrease the number of spectral lines.
    (c) To change the wavelength of the spectral lines without increasing their number.
    (d) None of these.

(13) Pauli's exclusion principle states that, within one atom.
    (a) No more than two electrons can have the same energy.
    (b) The spin of electrons interact so as to become parallel if possible.
    (c) No two electrons may have the same four quantum numbers.
    (d) None of these.

(14) The first series of transition elements in with the 3d shell is gradually filled, begins at atomic number.
    (a) 19   (b) 21   (c) 11   (d) None of these.

(15) Graphite is good lubricant because.
    (a) Sheet of atom are bonded together covalently.
    (b) The atom in sheet is bonded covalently to one another.
    (c) The sheets are bonded to one another by Vander Waal's forces.
    (d) None of these.

(16) The conductivity of a pure semiconductor is.
    (a) Proportional to temperature.
    (b) Rise exponentially with temperature.
    (c) Decrease exponentially with increasing temperature. (d) None of these.

(17) The charring action of H_2SO_4 is due to its being:
    (a) Dehydrating agent   (b) An oxidizing agent.
    (c) A reducing agent.   (d) None of these.

(18) Aqua regia is mixture of:
    (a) HCl & H_2SO_4 (b) HCl & HNO_3
    (c) HNO_3 & H_2SO_4 (d) None of these.

(19) The addition of a catalyst to a reaction:
    (a) Changes the enthalpy   (b) Changes the entropy.
    (c) Changes the activation energy.   (d) None of these.

(20) Of the visible spectrum shorter wavelength is:
    (a) Red.   (b) Green.   (c) Violet.   (d) None of these.

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FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BPS-17 UNDER THE FEDERAL GOVERNMENT, 2001.

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.

1.   (a)   On the basis of molecular orbital theory, explain the formation of molecules of O_2 and HF. Also give molecular orbital diagram and calculate the bond oder.   (08)

      (b)   Give example in each case and explain the phenomena of sp^3, sp^2 and sp hybridization.   (12)

2.   (a)   Explain the terms "Molecularity" and "Order of Reaction".   (04)

      (b)   Derive an expression for the rate constant for second order reaction assuming the initial concentration of reactants to be different.   (13)

      (c)   How does the increase in temperature effect equilibrium for an exothermic reaction.   (03)

3.   (a)   In the context of catalysis, discuss the following with specific examples:

         (i)   Intermediate compound formation theory.   (07)

         (ii)   Adsorption theory.   (07)

      (b)   Explain the terms: (2 x 3)

         (i)   Catalyst promotion.

         (ii)   Auto catalysis.

         (iii)   Catalyst poisoning.

4.   Using CH_3MgI as one of the starting material, how would you prepare: $(8 \times 2\frac{1}{2})$

         (i)   Acetone

         (ii)   1-Butane

         (iii)   Dimethyl Ether

         (iv)   Ethyl alcohol

         (v)   2-Butyne

         (vi)   Tertiary butyl alcohol.

         (vii)   Acetic Acid

         (viii)   Isopropyl alcohol.

5.   (a)   Why benzene undergoes electrophilic substitution reaction whereas alkenes undergo addition reactions?   (10)

(b) How will you synthesize the following compounds from benzene: (2 x 5)
- (i) Malice Anhydride
- (ii) Acetophenone.
- (iii) Chlorobenzene.
- (iv) Glyoxal.
- (v) Benzene Hexachloride.

6. (a) Give an account of replacement reactions of diazonium compounds.(12)
   (b) How will you prepare the following:
   - (i) Congo red. (02)
   - (ii) Bismark Brown. (03)
   - (iii) Malachite green. (03)

7. (a) Why some organic compounds can be polymerized easily, a few require stronger conditions for polymerization, while the others do not polymerize at all. (10)
   (b) What are the pre-requisites for a good fermentation process. (07)
   (c) Explain the following and give two examples in each case: (03)
   - (i) Thermoplastic.
   - (ii) Thermosetting plastic.

COMPULSORY QUESTION

8. (A) Write only the True or False in the Answer Book. Do not reproduce the statements:
   - (1) pk_a value for a stronger acid shall be comparatively high.
   - (2) Chloroacetic acid is weaker than acetic acid.
   - (3) An electron pair donor is an acid.
   - (4) Oxygen is diamagnetic compound as it possesses two odd electrons in its bonding orbitals.
   - (5) A tertiary carbonium ion is less stable than the secondary as well as primary carbonium ions.
   - (6) Nitrogen dioxide possesses an odd electron.
   - (7) Resonance decreases the stability of a molecule and increases its reactivity.
   - (8) Ionic Bonds are directional.
   - (9) CS_2 is a polar compound like H_2O.
   - (10) In addition Polymerization, the molecular weight of the polymer is not an integral multiple of the molecular weight of the monomers.

   (B) Write only the correct answer in the Answer Book. Do not reproduce the question.
   - (11) The PH of 0.1M solution approaches one for:
     - (a) HCL
     - (b) CH_3COOH
     - (c) H_2SO_4
     - (d) $HCLO_4$
     - (e) None of these.

(12) Primary alkyl halides undergo substitution by:
    (a) SN_2
    (b) SN_1
    (c)   both SN_1 and SN_2
    (d)   None of these.

(13) Compared to C – Cl bond is alkyl halides the C – Cl bond in vinyl chloride is:
    (a)   Stronger
    (b)   weaker
    (c)   None of these.

(14) Homolytic fission of C – C bond forms:
    (a)   Carbonium ion
    (b)   Free radical
    (c)   carbonion
    (d)   None of these.

(15) Aluminium Chloride:
    (a)   possesses high m. point.
    (b)   Sublimes on heating.
    (c)   Possesses low m. point
    (d)   None of these.

(16) Addition of an inhibitor in reaction system:
    (a)   Increases E_a
    (b)   Decreases E_a
    (d)   Has no effect on energy of activation.
    (e)   None of these.

(17) A double bond possesses:
    (a)   Two sigma bonds
    (b)   two pi-bonds
    (c)   one pi and one Sigma bond
    (d)   None of these.

(18) The normality of 0.5M solution of H_2SO_4 is:
    (a)   2.0
    (b)   1.0
    (c)   0.5
    (d)   None of these.

(19) A sp^3d^2 hybrid has:
    (a)   Square planner structure
    (b)   Linear structure
    (c)   Octahedral structure
    (d)   Tetra hedral structure
    (e)   None of these.

(20) The co-ordination sites available in EDTA for co-ordinate bond formation are:
    (a)   2
    (b)   6
    (c)   4
    (d)   None of these.

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FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN PBS-17 UNDER THE FEDERAL GOVERNMENT, 2002
CHEMISTRY, PAPER-I

(24)

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.

			Marks
1	(a)	Describe briefly open, isolated and closed systems	07
	(b)	Calculate the work done when 6 moles of hydrogen expand isothermally and reversibly at 30°C from 1 to 0.1 atmospheric pressure. $R = 8.31$ J K^{-1} mole^{-1}	05
	(c)	What is Kirchhoff's equation?	03
	(d)	Calculate the efficiency of a steam engine working between a hot reservoir at 130°C and a cold reservoir at 45°C	05
2	(a)	The passage of current for one hour through a dilute solution of sodium hydroxide with platinum electrode liberates 600 ml of mixed hydrogen and oxygen at STP. Calculate the strength of the current.	05
	(b)	What is buffer action? How a buffer solution of any desired PH is prepared?	05
	(c)	What is a revereable cell? Give an example of such a cell and explain its behavior.	05
	(d)	How would you determine the equivalent conductance of a solution of strong electrolyte.	05
3		Write NOTES on any **FOUR** of the followings:	
	(a)	Activated Carbon	05
	(b)	Manufacture of special glass.	05
	(c)	Portland cement and its types.	05
	(d)	Manufacture of wet-process Phosphoric Acid.	05
	(e)	Carbon Black and its uses.	05
4	(a)	What are the basic raw materials for manufacturing ordinary Portland cement and mention their sources.	05
	(b)	Write in brief the physical and chemical changes during heat treatment of ceramic wares.	06
	(c)	Write briefly about borosilicate, lead and soda lime glasses.	09
5	(a)	What is acid rain? What are its impact on plants and animals?	06
	(b)	Mention health effects of carbon monoxide and oxides of nitrogen.	06
	(c)	What are organic and inorganic pollutants? Define B.O.D., C.O.D. and T.D.S.	08
6		Write NOTES on the following:	
	(a)	Photochemical Effect. (b) Compton Effect.	5.5
	(c)	Hydrogen Bond. (d) Schrodinger Equation.	5.5
7	(a)	Discuss the role of Molecular Orbital and Crystal Field Theories to explain the structures of complex compounds.	08
	(b)	Explain the significance of sigma (σ) and pi (π) bonds.	06
	(c)	Discuss complex compounds and their importance.	06

COMPULSORY QUESTION

8. Write only the correct choice in the Answer Book. Don't reproduce the statement.

1. The energy associated with any quantum is proportional to the .... Of the radiation.

(a)	Frequency	(b)	Speed
(c)	Wave length	(d)	Wave number
(e)	None of these.		

2. According to Heisenberg's uncertainty principle the precise .... of a specific electron in an orbit can not be determined.

(a)	Position	(b)	Energy
(c)	Mass	(d)	None of these.

....tivated carbon is regenerated at the following temperatures (°C).

(a)	240°C	(b)	400°C
(c)	650°C	(d)	730°C
(e)	None of these.		

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4	95% of domestic carbon black is used in the following industry:			
	(a)	Leather	(b)	Rubber
	(c)	Textile	(d)	Soap
	(e)	None of these.		
5	Lead Glass contains ...... % of Lead:			
	(a)	20	(b)	40
	(c)	60	(d)	92
	(e)	None of these.		
6	The atmospheric air contains the following amount (in ppm):			
	(a)	0.6	(b)	1.5
	(c)	0.1	(d)	2.5
	(e)	None of these.		
7	Pollution strength of wastewater is determined by:			
	(a)	C.O.D.	(b)	PH
	(c)	B.O.D.	(d)	D.O.
	(e)	None of these.		
8	In secondary treatment of wastewater the dissolved and colloidal organic matters are removed by:			
	(a)	Sedimentation	(b)	Catalyst
	(c)	Bacteria	(d)	None of these.
9	Bomb calorimeter is used for measuring:			
	(a)	Heat of solution	(b)	Heat of Neutralization
	(c)	Heat of Precipitation	(d)	Heat of combustion.
	(e)	None of these.		
10	Intensive Property depends on:			
	(a)	Heat capacity	(b)	Enthalpy
	(c)	Internal Energy	(d)	Surface tension. (e) None of these.
11	The part of electrochemical cell at which oxidation occurs is called:			
	(a)	Cathode	(b)	Anode
	(c)	Cation	(d)	Electrolyte. (e) None of these.
12	According to Ostwalds dilution law, the degree of dissociation of weak electrolytes will reach a limiting value of:			
	(a)	Zero	(b)	1
	(c)	-1	(d)	α (e) None of these.
13	A substance which acts as an acid as well as a base in different situation is called:			
	(a)	Amorphous	(b)	General
	(c)	Amphoteric	(d)	Crystalline (e) None of these.
14	α-rays are fast nuclei of:			
	(a)	Hydrogen	(b)	Helium
	(c)	Neon	(d)	None of these.
15	There are ...... Orbitals in d sub-shell.			
	(a)	3	(b)	2
	(c)	5	(d)	4 (e) None of these.
16	The passage of electrical current through electrolytes is always accompanied by:			
	(a)	Cooling	(b)	Evolution of Hydrogen
	(c)	Chemical change	(d)	Vaporization. (e) None of these.
17	In the synthesis of Ammonia (a major raw material for nitrogenous fertilizer) the equilibrium yield is increased by:			
	(a)	Increase of temperature	(b)	Decrease of temperature
	(c)	Increase of pressure	(d)	Decrease of pressure.
	(e)	None of these.		
18	Borosilicate glass contains the following amount of silica (%):			
	(a)	20	(b)	40
	(c)	70	(d)	82 (e) None of these.
19	The process of removing all the ions in water is:			
	(a)	Sedimentation	(b)	Precipitation
	(c)	Distillation	(d)	Catalyst addition (e) None of these.
20	The process which occurs in nature on its own accord is termed as:			
	(a)	Irreversible	(b)	Equilibrium
	(c)	Spontaneous	(d)	Photoelectric. (e) None of these.

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FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN PBS-17, UNDER THE FEDERAL GOVERNMENT, 2002

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

Marks

1 (a) What is meant by Acid-Base catalysis? Explain, giving examples, the theories of Acid-Base catalysis. — 14

(b) Distinguish between physical adsorption and chemisorption giving suitable examples — 04

(c) How does the change in temperature affect adsorption. — 02

2 (a) What is rate law? Discuss its significance? — 04

(b) Derive the kinetic expression for the rate constant for a second order reaction with same initial concentrations of the reactions. — 10

(c) How surface area of an adsorbent is determined. — 06

3 (a) Compare Valence Bond Theory with Molecular Orbital Theory. — 08

(b) Draw the geometries of the following species on the basis of Vsepr Theory: — 08
   (i) ClF_3 (ii) IF_5 (iii) SF_6 (iv) $SnCl_2$

(c) Write a short note on heterogeneous catalysis. — 04

4 (a) What do you know about nucleophilic aromatic substitution reactions. Give their synthetic applications. — 08

(b) Comment on the limitations of friedel crafts reaction. — 06

(c) Classify Azo dyes on the basis of their applications, give at least two examples in each case. — 06

5 (a) What are Grignard's Reagents, discuss their synthetic importance. — 10

(b) What is the difference between basicity and nucleophilicity. Arrange H_2O, $\bar{N}_3$, OH, $R\bar{S}$, $C\bar{N}$ and Cl in their decreasing order of nucleophilicity. — 06

(c) Discuss four major industrial uses of alkyl halides other than as synthetic reagents. — 04

6   **Write comprehensive notes on ANY TWO of the following:**

   (a)   Conformational analysis   10

   (b)   Polymerization   10

   (c)   Alkaloids   10

7   (a)   How many chiral carbon atoms are there in a aldotetrose, give the fischer's formula and common names for the stereoisomers of an aldotetrose and classify them as D and L sugars.   02+04+02

   (b)   Why do aldoses react with fehling solution but not with sodium bisulphate.   04

   (c)   What is meant by lactose intolerance.   04

   (d)   Give a simple test for starch, is it affected by temperature.   02+02

COMPULSORY QUESTION

8.   Write only the correct choice in the Answer Book. Don't reproduce the statement.

A.   Choose the suitable answer from the given options.

1	According to Vsepr Theory, the shape of SF_4 Molecule is:		
(a)	Octahedral	(b)	Trigonal Planner
(c)	V-Shape	(d)	Tetrahedral
(e)	None of these.		

2	A dsp^2 Hybrid has structure as:		
(a)	Linear	(b)	Square planner
(c)	Square pyramidal	(d)	Octahedral
(e)	None of these.		

3	The large increase in rate of reaction on increase in temperature is due to:		
(a)	Lowering of activation energy	(b)	Decrease in mean free path
(c)	Increase in collision frequency	(d)	Decrease in collision frequency
(e)	Increase in the number of molecules having more than threshold energy.		

4	A substance that lowers the activity of a catalyst is called:		
(a)	Autocatalyst	(b)	Negative catalyst
(c)	Promoter	(d)	Poison
(e)	None of these.		

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(24)

5	PH of a 0.1 N NaOH is:			
	(a)	1	(b)	2
	(c)	3	(d)	4
	(e)	None of these.		

6	Cholicalciperol is a:			
	(a)	Steroid	(b)	Lipid
	(c)	Fat	(d)	Vitamin
	(e)	None of these.		

7	For molecules having n centers of chirality, the number of possible stereoisomers is:			
	(a)	2^n	(b)	Less than 2^n
	(c)	More than 2^n	(d)	None of these.

8	Reactions in which there are no intermediates are referred to as:			
	(a)	Free radical reactions	(b)	Addition reactions
	(c)	Concerted reactions	(d)	None of these.

9	Adsorption theory explains:			
	(a)	Enzyme catalysis	(b)	Acid-Base catalysis
	(c)	Homogeneous catalysis	(d)	Heterogeneous catalysis
	(e)	None of these.		

10	The substance on whose surface adsorption takes place is called:			
	(a)	Adsorbate	(b)	Active surface
	(c)	Porous substance	(d)	Adsorbent
	(e)	None of these.		

B.   Write only true of false in the Answer Book. Do not reproduce the statement.

11	Adsorption increases with rise in temperature.
12	The catalyst changes the position of equilibrium.
13	Order and molecularity of a reaction are always identical.
14	Hydrolysis of methylacetate is an example of a 2nd order reaction.
15	Glucose is the only sugar which mutarotates.

C.   Suggest the most suitable word for each of the following statements.

16	A cyclic form of a carbohydrate that has a five membered ring.
17	Structural isomers that differ only in the position of a hydrogen and a pi bond.
18	A stabilizing interaction of a sigma molecular orbital with an empty p orbital on an adjacent atom.
19	The result of a reaction that can produce two or more structural isomers.
20	The state in which the forward rate of an ideally reversible reaction is equal to the reverse rate.

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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

I. 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) $SO_2 Cl_2$
  (c) $Na_2 S_2 O_3$ (d) $Na_2 SO_3$.
  (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 $H_2 S(g)$ (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)

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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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FEDERAL PUBLIC SERVICE COMMISSION

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

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

	(b)	What is the hybridization of carbon and oxygen atom in the following: (i) $CH_2 = C = CH_2$ (ii) $CH_3 - \overset{\overset{O}{\|}}{C} - O - \underset{\underset{CH_2}{\|}}{C} - \overset{\overset{O}{\|}}{C} - H$ (iii) $CH_3 - C \equiv C - CH = \underset{\underset{CH_3}{\|}}{CH}$	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:	04
		(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.	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.

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(6) $CH_3 - \overset{\overset{O}{\|}}{C} -$ (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 $A + B \rightarrow C$ the change in [A] with time is shown in the graph. What is the rate law for this reaction?

$\frac{1}{[A]}$ Time
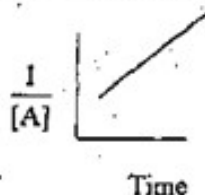
(a) $\frac{-d[A]}{dt} = K[A]$ (b) $\frac{-d[A]}{dt} = K[A]^2$

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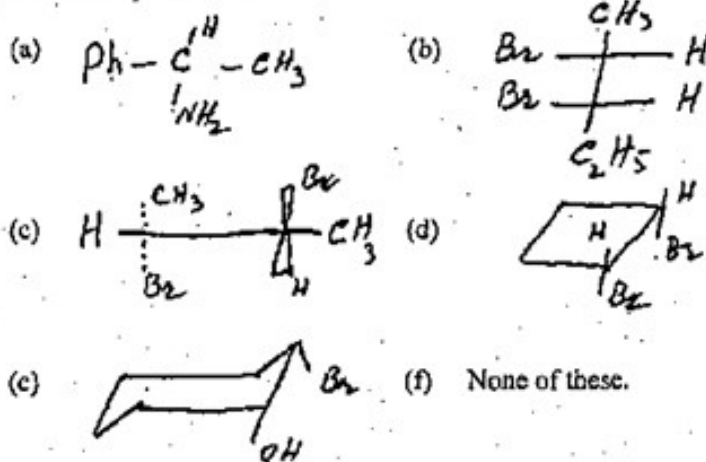
(B) Write only True or False in the Answer Book. Do not reproduce the statement:

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

(a) True   (b) False

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(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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FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BPS-17, UNDER THE FEDERAL GOVERNMENT, 2004

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.

1. (a) How is aluminum found in nature? (3)
    (b) Write an account of the chemistry associated with the conversion of Bauxite to aluminum. (8)
    (c) What are the main impurities present in bauxite? How are they eliminated? (4)
    (d) It is now said that we are now living in the aluminum age. Discuss the truth of this statement. (5)

2. (a) What is meant by air pollution? (3)
    (b) What are the common pollutants in our air? Describe their sources from which they originate? (5)
    (c) Discuss the effect of oxides of nitrogen and sulphur in the atmosphere on living organism. (6)
    (d) Name materials that acts as sink for the gases, what other measures would you suggest to control these gases in the atmosphere? (6)

3. (a) Nitrogen trifluoride, NF_3, boils at $-129^0 C$ and is devoid of Lewis basicity. (4) By contrast the lower molecular mass compound NH_3 boils at $33^0 C$ and is well know as Lewis base.
        (i) Describe the origin of this very large difference in volatility.
        (ii) Describe the probable origin of this difference in basicity.
    (b) Arrange H_2O, H_2S, H_2Se in order of (4)
        (i) Increasing acidity
        (ii) Increasing basicity towards a hard acid such as proton.
    Suggest suitable reasons for selecting your order.
    (c) Write balance chemical equations for the formation of pure silicon from crude silicon via silane (4)
    (d) Ammonia can be prepared by (4)
        (i) The Hydrolysis of Li_3N
        (ii) The high temperature, high pressure reduction of nitrogen by hydrogen.

    Give balanced equation in each method starting with nitrogen, lithium and hydrogen as appropriate and account for the lowest cost of the second method.
    (e) Solid PCl_5 is an ionic compound of PCl_4^+ cations and PCl_6 anions but the vapour is molecular.
    What shape of ions would you propose on the bases of VSEPR model? (4)

4. (a) What do you understand by the term thermodynamics? Discuss its scope and limitations. (4)
    (b) Explain the following terms: (4)
        (i) Reversible and irreversible processes
        (ii) Isothermal and adiabatic process.
    (c) What is the second law of thermodynamics? Discuss the conditions under which heat can be converted to work. (4)
    (d) State and explain the thermodynamic terms? "Work function" and "Free energy". (4)
    (e) State Clausius and Claperon equation? Comment on its applications. (4)

5. (a) Describe the main features of Crystal Field Theory. (4)
    (b) Define and explain the terms: Crystal Field splitting, high spin Complexes, low spin complexes spectrochemical series (5)
    (c) How crystal field theory can explain the spectral and magnetic properties of coordination compounds? (5)
    (d) Compounds containing the Sc^{+3} ions are colourless, where as those containing the Ti^{+3} ions are coloured. Explain. (2)
    (e) Determine the molecular orbital bond orders of S_2, Cl_2, NO^+ from the Molecular orbital configuration and compare the values with the bond orders determines from Lewis structure. (4)

6. (a) Name the chief ores of iron. (2)
    (b) How pig iron is extracted from hematite ore? Is this process oxidation or reduction? Explain. (5)
    (c) Give the reactions that take place in the blast furnaces at various temperature zones during the production of pig iron. (5)
    (d) What are the main impurities present in the cast iron? State their adverse effect on the properties of iron. (4)
    (e) What are carbon steels and alloys steels? State their applications. (4)

7. Write notes on four of the following: (5 x 4)
    (i) Debye Huckel theory of activity coefficients.
    (ii) Cement industry and the process of setting of cement.
    (iii) Glass industry and ceramics
    (iv) Fullerenes and their applications
    (v) Silicates and their uses.

COMPULSORY QUESTION

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

    (1) Interstitial alloy tungsten carbide (WC) has the rock salt structure. The description in terms of holes in closed packed structure is given by:
      (a) Closed packed C with W in octahedral holes
      (b) Closed packed W with C in octahedral holes
      (c) Closed packed W with C in tetrahedral holes
      (d) None of these

    (2) A semiconductor is a substance showing the property where electrical conductivity:
      (a) Increases with increase in temperature
      (b) Decrease with increase in temperature
      (c) First increase and then decrease with increase in temperature
      (d) None of these

    (3) Thomson observed that when light of certain frequency strikes the surface of metal:
      (a) Electrons move to higher energy   (b) Electrons are ejected from the metal
      (c) The light is totally reflected   (d) The temperature of metal is increased
      (e) None of these

    (4) Select which one is n-type of semiconductor:
      (a) Arsenic doped Germanium   (b) Gallium doped Germanium
      (c) Silicon doped germanium   (d) None of these

    (5) Which one of the following schemes for repeating pattern of closed packed planes are not ways of generating closed packed lattices:
      (a) ABCABC......   (b) ABBA.......
      (c) ABCCB.....   (d) None of these

    (6) The complex ion $[Pd(NH_3)_4]^{-2}$ exists in:
      (a) Square planer   (b) Tetrahedral   (c) Octahedral
      (d) Trigonal pyramidal   (e) None of these

    (7) Magnetic moments (μ_{calc}) is related to the number of unpaired electrons (n) by the relationship:
      (a) $\mu_{calc} = [n(n+2)]^{1/2}$ (b) $\mu_{calc} = (n+2)^{1/2}$
      (c) $\mu_{calc} = [n(n+1)]^{1/2}$ (d) $\mu_{calc} = (n^2+1)^{1/2}$

(8)   Magnetic moments as measured in units of:
    (a)   Ampere meter^{-1} (b)   Bohr magneton
    (c)   Volt meter^{-1} (d)   Coulomb meter^{-2}

(9)   The transition elements show less reactivity because of:
    (a)   High heats of vapourization   (b)   Low ionization energy
    (c)   High heats of solvations   (d)   None of these

(10)   Mn^{+7} in the form of $KMnO_4$ is violet in colour due to transition of electrons from:
    (a)   s to s orbital   (b)   d to d orbital
    (c)   p to d orbital   (d)   None of these

(11)   The oxidation number of iron in $[Fe(CN)_6]^{4-}$ is:
    (a)   2   (b)   3   (c)   4   (d)   6   (e)   None of these

(12) $TiCl_3$ is used as catalyst for the:
    (a)   Oxidation of ethanol to acetaldehyde
    (b)   Polymerization of ethane to polythene
    (c)   Manufacture of ammonia
    (d)   Oxidation of ammonia to nitric oxide
    (e)   None of these

(13)   Interstitial compounds are crystalline solids in which interstices in the crystals lattice of metal is occupied by:
    (a)   Atoms of transition elements
    (b)   Metals atoms having large atomic size
    (c)   Non metals having small atomics sizes
    (d)   Atoms of non metals that are highly reactive

(14)   If the wave length of electron wave is infinite the electron must be :
    (a)   Moving with very high velocity
    (b)   Moving with low velocity
    (c)   Stationary
    (d)   None of these

(15)   The reaction of NO_2^- as an oxidizing agent on lowering the pH of the medium generally:
    (a)   Increases   (b)   Decreases
    (c)   Have no effect   (d)   None of these

(16)   Predict the stability of the compounds CsI_3 and NaI_3 with respect to its elements:
    (a) NaI_3 is more stable   (b) CsI_3 is more stable
    (c) CsI_3 is less stable   (d) CsI_3 and NaI_3 are equally stable

(17)   Helium is present in low concentration in the atmosphere even though it is the second most abundant element in the universe because:
    (a)   It has decomposed with time
    (b)   It has reacted with other element
    (c)   It is light and its velocity is high
    (d)   None of these

(18)   Carbon mono oxide is one of the most abundant pollutants and widely distributed in air. But its global level does not seem to be changing because:
    (a)   CO is oxidized by oxygen to CO_2
    (b)   CO is reduced by other chemicals to carbon particles
    (c)   Polar CO is dissolved readily in water
    (d)   None of these

(19)   Some batteries are constructed in such a way that the oxidation reduction product remains separated during the discharge reaction. These batteries:
    (a)   Can not be recharged   (b)   Can be recharged
    (c)   Have long life   (d)   None of these

(20)   Aluminosilicates are largely responsible for the rich variety of the mineral world they are compounds:
    (a)   When aluminum atom is embedded between silicates groups
    (b)   When aluminum atoms replaces some of the silicon atoms in silicates
    (c)   Of aluminum having no silicon atoms but structurally is similar to silicates
    (d)   None of these

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FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BPS-17 UNDER THE FEDERAL GOVERNMENT, 2004.

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.

1. (a) How MOT is applied to explain ionic character of bond in heteronuclear Diatomic molecule? Give suitable examples. (10)

    (b) Which of the following species is possible to exist? Give reason. (5)
       (i) NF_5 (ii) PF_5

    (c) What are alkaloids? Write name and formulae of any five important alkaloids.(5)

2. (a) Define order of a reaction? Describe one method of determining the order of a Reaction. (10)

    (b) Show that in first order reaction, time required to complete half of a Reaction is: (2 x 4 = 8)
       (i)   Independent of initial concentration.
       (ii) Inversely proportional to rate constant.

    (c) What are units of rate constant of 1st order reaction? (2)

3. (a) What are hybrid orbitals? Discuss conditions of their formation. (8)

    (b) Suggest reasons for the following statements: (3 x 2 = 6)
       (i)   Cyclooctatetraene does not show resonance while benzene shows.
       (ii) O-benzoic acid is more acidic than its para isomer.
       (iii) Why Benzene diazonium chloride shows coupling reaction with N,N-dimethylaniline but not with N,N,2,6-teramethylaniline.

    (c) Draw staggered, gauche, semi eclipsed and fully eclipsed conformers of the following compounds. And arrange them in order of stabilities with Reasoning. (6)

       (i) $CH_2 - CH - CH - CH_3$ with Br, Br substituents

       (ii) $CH_3 - CH - CH - CH_3$ with OH, OH substituents

4. (a) What happens when CH_3MgI is treated with following reagents and the Product hydrolysed? (10)
       (i)   formaldehyde (ii) ethylene oxide (iii) Acetaledehyde
       (iv) Acetone (v) Carbon dioxide

    (b) Discuss the phenomenon of chain lengthening and shortening of aldoses. (10)

5. (a) Complete the following reactions with mechanisms (10)

       (i)   2 (benzaldehyde) + NaCN ⟶ ?

       (ii) (benzene with O) + CH_3Cl —$AlCl_3$⟶ ?

    (b) What is Iodoform test? Discuss its usefulness for the detection of Acetyl group ($CH_3CO^{\cdot}$). (5)

    (c) Define the term antibiotics? Describe their chelation property. (5)

6. (a) What are Azo dyes? Discuss their chemistry with special reference to Methyl Orange and Congo red. (12)

    (b) Describe the synthesis of 1,3,5 tribromo benzene from aniline? Explain why it can not be synthesized by direct bromination of benzene. (3)

    (c) Which of the following species is better hydride donor in Cannizaro Reaction. (2)

       (i)   R - C - H (with O, O)   (ii) R - C (with O, OH)

    (d) Define the terms Enantiomer, Diasteromers with example. (3)
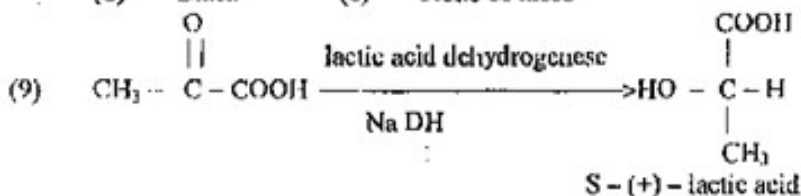
7. (a)   Differentiate between the following terms   (3 x 3 = 9)
           (i)   Fats and oils
           (ii)   Hydrolytic and oxidative rancidification
           (iii) Saponification and Iodine number.
    (b)   Which of the following solvent is more useful for the synthesis of   (3)
           Grignard reagent? Give reason.
           (i)   Ether   (ii)   T H F
    (c)   Describe the mechanism and synthetic application of Reformksty reaction . (8)

COMPULSORY QUESTION

8. Write only the correct answer in the Answer Book. Do not reproduce the
    question.   (20)
    (A) Choose the suitable answer from given option.
         (1) Glycogen is also called as:
              (a)   Plant starch   (b)   Animal starch
              (c)   a & b   (d)   None of these
         (2) Cupric ion complexed with citrate ion is known as:
              (a)   Fehling reagent   (b)   Benedict reagent
              (c)   Tollen' reagent   (d)   None of these
         (3) Naturally occurring fructose is also called as:
              (a)   Levulose   (b)   Dextrose
              (c)   Ribose   (d)   b & c
              (e)   None of these
         (4) Aniline shows two absorption maxima in U.V. region:
              (a)   200,250mu   (b)   190,280mu
              (c)   210,270mu   (d)   230,280mu
         (5) The hybridization in case of the Co_3^{-2} molecule will be:
              (a)   SP   (b) SP^2 (c) dSP^3 (d)   None of these
         (6) $2NO + O_2(g) \text{------} 2NO_2(g)$ is an example of:
              (a) 1st order reaction   (b)   Second order reaction
              (c)   Zero order   (d)   None of these
         (7) Which of the following carbonate is water insoluble:
              (a) Na_2Co_3 (b) K_2Co_3 (c) $(NH_4)_2 Co_3$
              (d) $ZnCo_3$ (e)   None of these
         (8) What will be the colour of CdS:
              (a)   Brownish   (b)   Yellow   (c)   Brownish black
              (d)   Black   (e)   None of these

         (9) $CH_3 - \overset{\overset{O}{||}}{C} - COOH \xrightarrow[\text{Na DH}]{\text{lactic acid dehydrogenese}} HO - \overset{\overset{COOH}{|}}{\underset{\underset{CH_3}{|}}{C}} - H$

              S – (+) – lactic acid

              is an example of:
              (a)   Stereospecific reaction   (b)   Cannizaro reaction
              (c)   Stereoselective reaction   (d)   Strecker reaction
         (10) Heat of Adsorption in case of Physical adsorption is:
              (a)   10 k cal   (b)   14 k cal   (c)   20 k cal
              (d)   5 k cal   (e)   None of these
    (B) Write only True or False in the Answer Book. Do not reproduce the statements.
         (11) $H NO_2$ is stronger acid than $H NO_3$.
         (12) Organometallic compounds are nucleophile.
         (13) The substance that concentrates at the surface is called Adsorbent.
         (14) Sr. SO_4 is water soluble.
         (15) Ethyl alcohol has higher b.p than ethanethiol.
         (16) Alkaloids are optically active.
    (C) Suggest the most suitable word for each of the following statements.
         (17) Water has total number of electron pairs.
         (18) 1,2 - dimethyl cyclo ane has stable Isomer.
         (19) The stereochemistry A $B_2 E_2$ will be.
         (20) Green vitriol is often named.
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FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS
IN BPS-17, UNDER THE FEDERAL GOVERNMENT, 2005

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.

1. (a) Discuss the results of a particle in a box. (5)
    (b) Describe the main conditions of wave equation to understand the behaviour of hydrogen atom. (6)
    (c) What is meant by eigen function? How it can be used to represent an orbital hydrogen atom? (9)

2. (a) Derive an equation to determine the pH of dibasic acid. (6)
    (b) Discuss the chemical composition of glass membrane used in glass electrode. (3)
    (c) Write the chemical composition and reaction of dry cell used as power flash light. (5)
    (d) What are fuel cells? Discuss the chemistry of hydrogen oxygen fuel cell. (6)

3. (a) Give various methods for the determination of entropy and free energy of system.
        Discuss their importance in thermodynamics. (7 + 5)
    (b) For the general reaction, the standard free energy at $300^\circ C$ is 11004 J. (8)
        Calculate the value for equilibrium constant.

    $$(R = 8.31 \text{ J K}^{-1}\text{mol}^{-1}).$$

4. (a) What are Roasting and Smelting processes? Discuss the importance of carbon as a reducing agent
        for the production of metals. (7)
    (b) Differentiate between homocatenation and heterocatenation. Give suitable examples. (4)
    (c) Explain briefly invitro and invivo nitrogen fixation. Discuss the importance of molybdenum
        compounds in the process. (5)
    (d) Starting from silica, how will you prepare any two of the following: (4)
        (i) $SiCl_4$ (ii) Water glass (iii) Hydrofluoro silicic acid

5. (a) Describe the importance of Calcium Super phosphate as fertilizer. How it is prepared on
        commercial scale. (8)
    (b) What is the function of NO in the manufacture of H_2SO_4 by Chamber Process. (6)
    (c) Thermodynamic Stability is different from Kinetic stability. Comment on the above statement. (6)

6. (a) What is meant by Crystal Field Stabilization Energy? How it can be calculated? Give its applications. (5)
    (b) Explain briefly the spectrochemical series. (5)
    (c) Discuss various experimental evidences in favour of Werner's Theory. (5)
    (d) What is Chelate Effect? Explain. (5)

7. Write notes on any four of the following: (5 each)
    (1) Molecular Orbital Theory   (2) Metallurgy of Aluminium
    (3) Semiconductors   (4) Forms of Oxygen
    (5) Uses of Chlorine gas   (6) Air Pollution

COMPULSORY QUESTION

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

    (1) An important characteristic of the Transition Elements is that:
        (a) They generally exhibit more than one valence. (b) They have identical chemical properties.
        (c) They are all amphoteric elements.   (d) Their f subshells are partially filled.
        (e) They are magnetic

    (2) The elements of Group Ia are known as:
        (a) The halogens   (b) The alkali metals
        (c) The alkaline earths   (d) Transition elements

    (3) The elements which possess the property of ferromagnetism are (Identify the set of elements):
        (a) Fe, Co and Al   (b) Os, Ir and Pt
        (c) Fe, Co and Ni   (d) Fe, Al and Ni

    (4) All the transition elements:
        (a) Are metals   (b) have high melting points
        (c) have large atomic radii (d) form covalent bonds with non metals

(5) The reaction of an acid with a base to form water and salt is called:
   (a) Dissociation   (b) Ionization
   (c) Neutralization   (d) Hydrolysis

(6) As a solution of weak acid becomes more dilute:
   (a) The strength of the acid increases.   (b) The concentration of the ions in solution increases.
   (c) The percentage of the molecules that ionize increases.

(7) Which one is the principal quantum number?
   (a) l (b) s
   (c) n (d) m

(8) The energy change in a chemical reaction at constant pressure is known as:
   (a) ΔS (b) ΔH
   (c) ΔG (d) ΔE

(9) Chlorine heptoxide (Cl_2O_7) reacts with water to form:
   (a) A mixture of hypochlorous acid and chloric acid.   (b) Hypochlorous acid
   (c) Chloric acid   (d) Perchloric acid

(10) The formula of cryolite is:
   (a) Al_2O_3 (b) $Na_3 Al F_6$
   (c) $K_2 Cr_2 O_7$ (d) $Al F_3$

(11) An anhydride of nitric acid is:
   (a) NO_2 (b) N_2O_3
   (c) N_2O_4 (d) N_2O_5

(12) The thermodynamic systems that have high stability tend to demonstrate:
   (a) minimum ΔH, minimum ΔS (b) minimum ΔH, maximum ΔS
   (c) maximum ΔH, minimum ΔS (d) maximum ΔH, maximum ΔS

(13) In electrolysis, E^0 tends to be:
   (a) negative   (b) positive
   (c) neutral   (d) zero

(14) When an excited electron tends to return to the ground state, it releases:
   (a) Alpha particles   (b) Beta particles
   (c) Protons   (d) Protons

(15) A non-metallic oxide which reacts with water to form an acid is often called:
   (a) Basic oxide   (b) Hydroxide
   (c) Acid Hydrate   (d) Acid Anhydride

(16) When Phosphorus is burned in oxygen, the product is:
   (a) Red Phosphorus   (b) P_4O_6
   (c) P_4O_{10} (d) H_3PO_4

(17) If ΔH and ΔS are both positive:
   (a) ΔF is always positive   (b) ΔF is always negative
   (c) The reaction becomes spontaneous at low temperatures
   (d) The reaction becomes spontaneous at high temperatures

(18) Chalcocite is an ore of:
   (a) Aluminium   (b) Copper
   (c) Zinc   (d) Iron

(19) Transition metal, Zinc exhibits oxidation states of:
   (a) +2 only   (b) +1 only
   (c) +2 & +4   (d) +2 & +3

(20) A gas which when present in air causes acid rain:
   (a) Nitrogen   (b) Ammonia
   (c) Sulphur dioxide   (d) Carbon monoxide

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FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS
IN BPS-17, UNDER THE FEDERAL GOVERNMENT, 2005
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.

1.   (a)   Discuss the principles involved in the Valence Bond Theory. How this theory (11) is applied to explain the formation of Chemical bonds in, NH_3, HCl & N_2 molecules.

     (b)   Predict the shape of the following molecules:

           ClF_3, SF_6, ClO_2^- and NO_3^- (6)

     (c)   Write the structural formula of:
         (i)   Blood Sugar   (ii)   Table Sugar   (iii)   Milk Sugar   (3)

2.   (a)   Distinguish between the Molecularity and the Order of reaction. Explain with examples   (8)

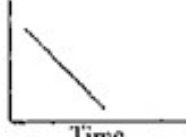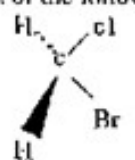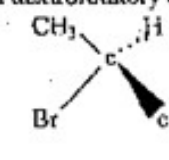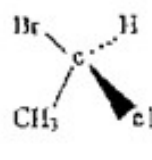   (b)   In Thermal Decomposition of benzene diazonium Chloride

$$C_6H_5N=NCl \xrightarrow[50^\circ c]{H_2O} C_6H_5Cl + N_2$$

Time (min.)	5	10	15	20	∞
Volume of N_2 (ml)	17.5	29.7	38.2	44.3	58.3

       From the give data show that this is first order reaction.   (6)

     (c)   Describe the synthesis of "DDT" from Trichloro-acetaldehyde.   (6)

3.   (a)   How Aromatic amino compounds are converted to diazonium salts.   (5)

     (b)   What happens when Benzene diazonium salt is treated with   (12)

       (1) H_3PO_2 (2) $H_2 \%_\Delta$ (3)   ROH

       (4)   RCOOH   (5)   NaCN + CuCN   (6) $\dfrac{NaOAc + H_2O}{C_6H_6}$

     (c)   Give structures of three alkaloids obtained from opium   (3)

4.   (a)   Explain Cahn-Ingold-Prelog rules. Where are they applied in Chemistry. Give examples.   (8)

     (b)   Predict the Product of the following reaction and explain its formation: (6)

       [reaction diagram: cyclobutane with OH, OH and C(Me)(Me) group, H_2SO_4]

     (c)   Give the Industrial use of Whale oil and Cod-Liver oil.   (6)

5.   (a)   How Primary, Sec., Tertiary alcohols; Carboxylic acids; Aldehydes; Ketones and Hydroperoxide are synthesized from Grignard's reagent.   (12)

     (b)   Explain, why Halogens' are Ortho, para directors and are deactivating.   (5)

     (c)   Give the decreasing order of reactivity of alkyl halides in reactions with metals (3) to give Organometallics.

6.   (a)   One mole of benzene is mixed with 1 mole of nitrobenzene and ½ mole (6) of bromine. Some $FeBr_3$ is added and the mixture is heated to reflux. What is the major reaction product? Explain your answer giving full reaction.

     (b)   Explain:
       (i)   Why Dimethyl amine has higher boiling point than trimethylamine?   (2)
       (ii)   Carbonyl compounds are more soluble in water than the corresponding (2) alkanes but less than the corresponding alcohols.

     (c)   What makes azo compounds so suitable as dyes?   (3)

     (d)   Describe the preparation of Streptomycin by Fermentation.   (7)

7.   (a)   Prove the nucleophilicity and basicity are fundamentally different properties. Prove with special reference to Aromatic amines.   (4)

     (b)   Discuss importance of Alkylation, Hydroalkylation and cracking in the manufacture of petrochemicals.   (8)

     (c)   Write note on Homogeneous and Heterogeneous Catalysis.   (8)

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COMPULSORY QUESTION

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

(A) Choose the suitable answer from the given options. (10)

(1) Perspex belongs to which class:
    (a) Alkaloid   (b) Anti-biotic   (c) Polymer
    (d) Organic Solvent (e) Alkylhalide   (f) None of these

(2) The formula of "Laughing Gas" is:
    (a) CH_3COCl (b) Ph—N=N—Ph   (c) N_2O
    (d) HNO_2 (e) CH_2O (f) None of these

(3) "PbS" is also called:
    (a) Gallic acid   (b) Galena   (c) Alum
    (d) Pyrogallol   (e) Sulphonamide   (f) None of these

(4) Which of the following is not an Alkaloid:
    (a) Atropine   (b) Nicotine   (c) Piperine
    (d) Hygrine   (e) Piperitone   (f) None of these

(5) Aqua Regia is also known as:
    (a) Aq. $AgNo_3$ (b) Royal Water   (c) Carborundum
    (d) Argentite   (e) Aragonite   (f) None of these

(6) In the given reaction $2N_2O_5 \longrightarrow 4NO_2 + O_2$

    What is the order of this reaction from the following straight line plot?
    (a) Third   (b) Fourth   (c) Zero
    (d) Second   (e) First   (f) None of these

(7) Which of the following is a dextrorotatory compound?

    (d) Can't be decided by structure alone.   (e) None of these

(8) A person unable to see in the dark or dim light due to deficiency of:
    (a) Ascorbic acid (b) Vitamin D   (c) Vitamin A
    (d) Vitamin E   (d) Thiamine   (f) None of these

(9) What is the bond order of F_2, according to Molecular Orbital Theory:
    (a) 1   (b) 2   (c) 4
    (d) 3   (e) 2 ½   (f) None of these

(10) Which of the following compounds has most likely been formed by Covalent bonding of atoms?
    (a) CaF_2 (b) SiH_4 (c) NaCl
    (d) MgO   (e) RbCl   (f) None of these

(B) Write only True or False in the Answer Book. Do not reproduce the statements. (6)

(11) Octane number for heptane is zero.

(12) Grignard's reagent can be prepared from alkyl halide containing acidic hydrogen.

(13) Lower the Pka higher will be acid strength.

(14) Drying oil contains saturated fatty acids which polymerize on oxidation.

(15) Glucose on acetylation forms penta acetate derivative.

(16) NO_2^+ has a linear structure.

(C) Suggests the most suitable word for each of the following statement. (4)

(17) Hardening of rubber by heating it with sulphur is called ———.

(18) Used as an explosive and formed by the nitration of Tolvene.

(19) A reaction between a compound and its solvent is named ———.

(20) Isomers obtained by rotation about a single bond are called ———.

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