FEDERAL PUBLIC SERVICE COMMISSION

Roll Number

COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT, 2013

CHEMISTRY, PAPER-I

TIME ALLOWED:	**(PART-I MCQs)**	**30 MINUTES**	**MAXIMUM MARKS: 20**
THREE HOURS	**(PART-II)**	**2 HOURS & 30 MINUTES**	**MAXIMUM MARKS: 80**

NOTE:**(i) First** attempt **PART-I (MCQs)** on separate **OMR Answer Sheet** which shall be taken back after **30**Minutes.
(ii) Overwriting/cutting of the options/answers will not be given credit.
(iii) Use of calculator is allowed.

PART-I ((MCQs) (COMPULSORY)

Q.1. (i) Select the best option/answer and fill in the appropriate Circle◯ on the **OMR Answer Sheet. (20x1=20)**
(ii) Answers given anywhere, other than OMR Answer Sheet, shall not be considered.

1. What happens when Al dissolves in aqueous NaOH?
(a) Forms soluble $NaAl(OH)_4$ **(b)** Forms Al_2O_3 **(c)** Precipitates of $Al(OH)_3$
(d) Precipitates $[Al(OH_2)_6]^{3+}$ forms which then loses H^+ **(e)** None of these

2. The magnetic moment of the fluoride complex is expected to be:
(a) The same as the magnetic moment of the cyanide complex.
(b) Larger than the magnetic moment of the cyanide complex because there are more unpaired electrons in the fluoride complex.
(c) Smaller than the magnetic moment of the cyanide complex because there are more unpaired electrons in the fluoride complex.
(d) Larger than the magnetic moment of the cyanide complex because there are fewer unpaired electrons in the fluoride complex. **(e)** None of these

3. When solid $CoCl_2$ is dissolved in water, a pink solution results and the following equilibrium is established:

$$Co(H_2O)_6^{2+}{}_{(aq)} + 4\ Cl^-{}_{(aq)} <=> CoCl_4^{2-}{}_{(aq)} + 6\ H_2O_{(l)}$$

Which one of the following best describes what will happen when a concentrated HCl is added to the $CoCl_2$ solution without changing the volume significantly?
(a) Because a solution of HCl is colorless, the color of the $CoCl_2$ solution will not change.
(b) Because HCl is a strong acid, the number of unpaired electrons in $[Co(H_2O)_6]^{2+}$, but not $[CoCl_4]^{2+}$, will change.
(c) The concentration of $[Co(H_2O)_6]^{2+}$ will decrease and the concentration of $[CoCl_4]^{2-}$ will increase; the color of the solution will become more blue.
(d) The concentration of $[Co(H_2O)_6]^{2+}$ will increase and the concentration of $[CoCl_4]^{2-}$ will decrease; the color of the solution will become more pink. **(e)** None of these

4. Passage of electric current through the metals is due to:
(a) Oxidation reaction **(b)** Reduction reaction **(c)** Electrolysis
(d) Free movement of electrons **(e)** None of these

5. VBT is unable to explain the nature of some of the complexes of:
(a) Cobalt **(b)** Copper **(c)** Nickel **(d)** Manganese **(e)** None of these

6. Energy available to do work at constant_____ and _____ is known as Gibbs free energy.
(a) Pressure, temperature **(b)** Pressure, volume **(c)** Temperature, volume
(d) All of these **(e)** None of these

7. A spontaneous reaction is not possible if:
(a) ΔH and $T\Delta S$ are both negative **(b)** ΔH and $T\Delta S$ are Positive
(c) ΔH is positive and $T\Delta S$ is negative **(d)** ΔH is negative and $T\Delta S$ is Positive **(e)** None of these

8. Which is not true about thermodynamics?
(a) It ignores the internal structure of atoms and molecule. **(b)** It involves the matter in bulk.
(c) It is concerned only with the initial and final states of the system.
(d) It is not applicable to macroscopic system. **(e)** None of these

9. The zero point energy of a particle is 1-D box of dimension $6A^0$ is:
(a) $10^{-22}J$ **(b)** $10^{-2}J$ **(c)** $16.22 \times 10^{-20}J$ **(d)** $10^{22}J$ **(e)** None of these

10. The salt bridge in the electrochemical cell serves to:
(a) Increase the rate at which equilibrium is attained. **(b)** Increase the voltage of the cell.
(c) Maintain electrical neutrality **(d)** Increase the oxidation/reduction rate.
(e) None of these

11. The equation $\frac{dP}{dT} = \frac{\Delta H}{T(V_2 - V_1)}$ is called:

(a) Gibbs Helmohtz equation **(b)** Kirchoff's equation **(c)** Clapeyron equation
(d) Clausius Clapeyron equation **(e)** None of these

12. The hydrogen molecule may be represented by two wave functions, Ψcovalent and Ψionic and C_1 and C_2 are coefficient indicating the weight of each function. The real wave function may be written as (N is the normalization constant)

(a) Ψ= N [Ψcovalent + Ψionic] **(b)** Ψ= N [C_1 Ψcovalent + C_2 Ψionic]
(c) Ψ= N [C_1 Ψcovalent x C_2 Ψionic] **(d)** Ψ= ($C_1 + C_2$) N [Ψcovalent x C_2 Ψionic]
(e) None of these

13. Copper metal will replace silver ions in solution, resulting in the production of silver metal and copper ions. This indicates that:

(a) Silver has a higher oxidation potential than copper. **(b)** A combustion reaction is occurring.
(c) Copper has a higher oxidation potential than silver. **(d)** Silver is much less soluble than copper.
(e) None of these

14. According to Debye-Huckel theory of strong electrolytes, and ion moving in an atmosphere of oppositely charged ions experiences a drag. This effect is known as the:

(a) Asymmetric effect **(b)** Electrophoretic effect **(c)** Inter-ionic effect
(d) Concentration effect **(e)** None of these

15. The electrical conductivity of an electrolyte depends upon:

(a) The number of molecules in the electrolyte. **(b)** The number of ions present in the electrolyte.
(c) The number of ions present in the solution . **(d)** The number of molecules of the solvent.
(e) None of these

16. Brass is an alloy of:

(a) Cu and Zn **(b)** Cu, Ni, Zn **(c)** Cu and Ni **(d)** Cu, Al, Zn **(e)** None of these

17. Urea is a high quality nitrogenous fertilizer with:

(a) 76% nitrogen **(b)** 46% nitrogen **(c)** 66% nitrogen **(d)** 26% nitrogen **(e)** None of these

18. When Zn metal is kept in $CuSO_4$ solution, copper is precipitated and $ZnSO_4$ is formed because:

(a) Atomic number of Zinc is smaller than copper. **(b)** Atomic number of Zinc is larger than copper.
(c) Standard reduction potential of Zinc is more than that of copper.
(d) Standard reduction potential of Zinc is less than that of copper. **(e)** None of these

19. The most important ore of aluminium is:

(a) Bauxite **(b)** Magnetite **(c)** Haematite **(d)** Monazite **(e)** None of these

20. The inexpensive and commonly used variety of glass is called soda glass. It is called so because:

(a) Was used initially for making bottles of soda (carbonated drink). **(b)** Is made using soda (sodium carbonate)
(c) Was initially used for storing sodium carbonate. **(d)** Is made using soda lime. **(e)** None of these

PART-II

NOTE: **(i) Part-II** is to be attempted on the separate **Answer Book.**
(ii) Candidate must write **Q. No.** in the **Answer Book** in accordance with **Q. No.** in the **Q. Paper.**
(iii) Attempt **ONLY FOUR** questions from **PART-II. ALL questions carry EQUAL marks.**
(iv) Extra attempt of any question or any part of the attempted question will not be considered.
(v) Periodic Table of Elements is available on page-4.
(vi) Use of calculator is allowed.

Q.2. **(a).** What is engineering ceramics? Describe the raw materials used in making classic ceramic products. **(08)**

(b). How urea is manufactured on commercial scale, support with a schematic diagram. **(08)**

(c). In what respect does inner orbital complexes differ from an outer orbital complexes? **(04)**

Q.3. **(a).** Describe the oxyacids of chlorine. **(06)**

(b). Describe what is meant by *silane* and *silanol.* What is their role in preparation of *Silicons.* **(08)**

(c). Define the following types of Processes: **(06)**
(i) Isothermal **(ii)** Adiabatic **(iii)** Isochoric **(iv)** Isobaric

Q.4.	**(a).**	How CFT and MOT account for the fact that $[CoF_6]^{3-}$ is paramagnetic but $[Co(NH_3)_6]^{3+}$ is diamagnetic?	**(06)**
	(b).	Discuss crystal field splitting in complexes having different geometries?	**(08)**
	(c).	What are the raw materials for the production of calcium superphosphate and cement?	**(06)**
Q.5.	**(a).**	Derive Schrodinger wave equation and calculate the energy of the particle in one dimensional box having length α.	**(14)**
	(b).	What are the hazardous effects of acid rain and global warming on plants?	**(06)**
Q.6.	**(a).**	How Debye-Huckel theory is applied to determine activity and activity coefficients for strong electrolytes? Derive its mathematical form.	**(12)**
	(b).	How standard electrode potential is measured?	**(06)**
	(c).	What is de Broglie hypothesis?	**(02)**
Q.7.	**(a).**	How chorine is produced on industrial scale?	**(08)**
	(b).	How Werner□s Theory explains the structure of coordination compounds?	**(08)**
	(c).	Why the Ozone Layer exists at a certain altitude in Stratosphere?	**(04)**
Q.8.	**(a).**	Give the applications of chelates in biological and analytical systems.	**(04)**
	(b).	What are the advantages of semiconductive devices?	**(04)**
	(c).	Derive mathematical form of Clausius-Clapeyron equation.	**(12)**

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CHEMISTRY, PAPER-II

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PART-I ((MCQs) (COMPULSORY)

(i) Select the best option/answer and fill in the appropriate Circle ● on the **OMR Answer Sheet. (20x1=20)**
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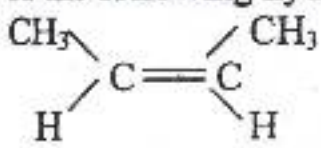
The hybridization and geometry of $C_6H_5NH_2$ is:
(a) sp^3, tetrahedral (b) sp, linear (c) sp^2, pyramidal (d) dsp^2, square planar

Which of the following hydrocarbons have the lowest dipole moment?

(a).  (b) $CH_3-C{=}C-CH_3$ (c) $CH_3-CH_2-C\equiv CH$ (d) $CH_2{=}CH-C\equiv CH$

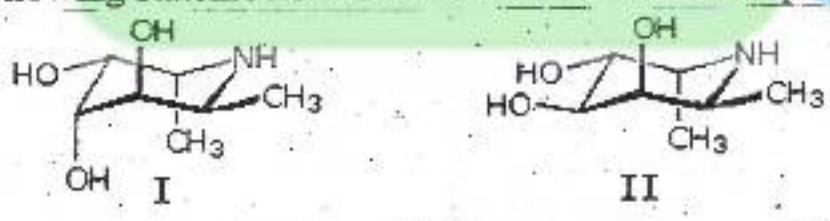
If a reaction consists of several steps, the _____ is the rate determining step.
(a) Specific rate constant (b) Steepest (c) Slowest step (d) Smaller

Half-life is independent of the _____ of reactant for first order reaction.
(a) Order of reaction (b) Initial concentration
(c) Amount of radiation absorbed (d) Specific rate constant

Which one of the following is not a condensation polymer?
(a) Dacron (b) Neoprene (c) Melamine (d) Glyptal

Bakelite is obtained from phenol by reacting with:
(a) HCHO b) $(CH_2OH)_2$ (c) CH_3CHO (d) CH_3COCH_3

Which of the following statements best describes the relationship of Structures I and II?



(a) They are diastereomers. (b) They are different conformations of enantiomers.
(c) They are different conformations of the same compound.
(d) They are identical conformations of the same compound.

Why does the exothermic reaction C(diamond)——> C (graphite) does not occur spontaneously (ΔH=3 KJ mol^{-1})
(a) The density of graphite is less than that of diamond.
(b) Tetrahedral configuration is always more stable than a planar one.
(c) The change from diamond to graphite has high activation energy.
(d) Graphite has delocalized electron.

If the substituents of higher priority are on the opposite sides of the double bond, the alkene has_____ configuration.
(a) *E* configuration (b) *Z* configuration (c) Planar (d) None of these

0. Enantiomers are _____ molecules that are mirror images of one another.
(a) Identical (b) Non-identical (c) Symmetric (d) None of these

1. The three-dimensional arrangement of atoms or groups attached to a chiral centre is called:
(a) Configuration (b) Chiral Centre (c) Symmetry (d) None of these

2. Hammond postulate suggests that "activation energy" of the rate-determining step is _____to the stability of the carbocation intermediate.
(a) Directly proportional (b) Inversely proportional
(c) Activation energy is discrete of stability of carbocation (d) None of these

3. Heterolytic cleavage of the carbon-halogen bond of alkyl halides may be facilitated by:
(a) Isotopes (b) Deionized water (c) Metal cations (d) None of these

14. Decomposition of Ozone takes place according to the following equation:

$$2O_3\,(g) \longrightarrow 3O_2\,(g)$$

Rate equation for the reaction is rate $K=[O_3]^2\,[O_2]^{-1}$; what is the order of reaction?

(a) Zero **(b)** 1 **(c)** 2 **(d)** 3

15. Carbohydrates have several roles in living organisms e.g.

(a) Photosynthesis in plants **(b)** Used as fertilizers
(c) Act as Hormones in development **(d)** Energy transportaion

16. Which of the statement is **TRUE**?

(a) Alkaloids are found in non-vascular plants **(b)** Alkaloids are usually acidic in nature
(c) Alkaloids are usually basic in nature **(d)** None of these

17. One of the following vitamin helps metabolize carbohydrate and maintain appetite.

(a) Vitamin A **(b)** Vitamin B_2 **(c)** Vitamin B_1 **(d)** Folic acid

18. The sources of vitamin B_{12} are:

(a) Citrus fruits, strawberries, tomatoes, spinach, cabbage and turnips
(b) Vegetable oils, wheat germ, liver, and leafy green vegetables
(c) Liver, kidney, meat, fish, eggs and milk
(d) Carotene from carrots, vegetables and dairy products

19. A chemical compound or mixture of compounds consisting of repeating structural units is called:

(a) Carbohydrate **(b)** Vitamin **(c)** Polymer **(d)** All of these

20. Processes such as catalytic cracking, steam cracking and catalytic reforming are involved in:

(a) Preparation of ethanol **(b)** Petrochemicals **(c)** Food processing **(d)** Preparation of glu

PART-II

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Q.2. **(a).** Why do we use the three p-orbitals ($2p_x$, $2p_y$, $2p_z$) alone to form the three equivalent hybrid orbitals on carbons? **(05)**

(b). Give an example of an element that undergoes sp hybridization in forming covalent bonds with other elements. What is the value of the angle between the bonds that result from *s – sp* overlap of atomic orbitals. **(05)**

(c). What do you mean by luminiscence? What are its types? **(10)**

Q.3. **(a).** The rate constant of a reaction is 1.2×10^{-3} sec^{-1} at 30^0 C and 2.1×10^{-3} sec^{-1} at 40^0 C. Calculate the energy of activation of the reaction. **(10)**

(b). What is *E/Z* system of configuration. Why it is preferred over *cis-/trans*-system of nomenclature in alkenes? **(10)**

Q.4. **(a).** Arrange the following functional groups in increasing order of stability of carbocation? **(05)**

$(CH_3)_3C^+$, CH_3^+, $CH_3CH_2^-$, $(CH_3)_2CH^+$, $CH_2{=}CH{-}CH_2^+$, $C_6H_5CH_2^+$

(b). How can we prepare an aldehyde by following reactions. Give atleast ONE representative example for each of these reactions. **(10)**

(i) Oxidation of 1^0 and 2^0 alcohols (b) Friedel-Crafts acylation
(c) Hydration of alkynes (d) Glycol clevage

(c). Draw the structures of the following compounds: **(05)**

(i) benzyl alcohol (ii) 3-pentanol (iii) 2,3-dihydroxyhexane
(iv) 2-sulfhydrylbutane (v) 3-pentanethiol

Q.5. **(a).** What are drying oils. For what purpose they are used? **(10)**

(b). How can you differentiate between trans-unsaturated and cis-unsaturated fatty acids. Which are more hazardous to health? Explain with the help of example. **(10)**

Q.6. **(a).** Give at least one representative example of the following reactions. **(10)**

(i) Termination reaction (ii) Disproportionation reaction
(iii) Addition polymerization (iv) Friedel Crafts alkylation
(v) Claisen condensationn

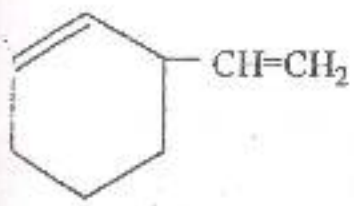
(b). What do you mean by gels? How are they classifed? **(10)**

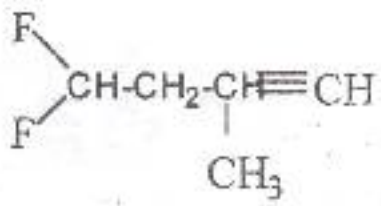
CHEMISTRY, PAPER-II

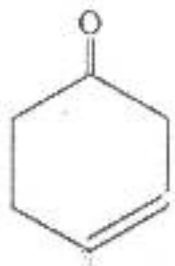
Q.7. **(a).** What are the applications of colloids? **(10)**

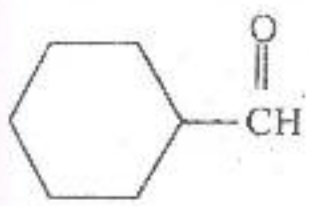
(b). What are the applications of emulsions? Also give the harmful effects of emulsions. **(10)**

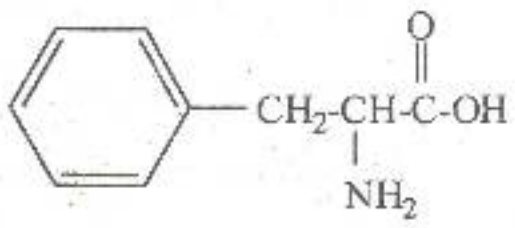
Q.8. Name the following structures: **(20)**

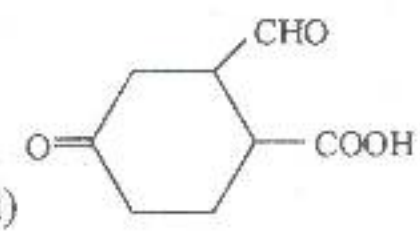
(i) 

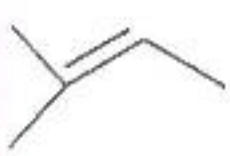
(ii) 

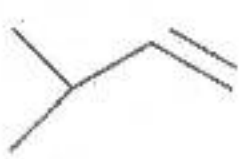
(iii) 

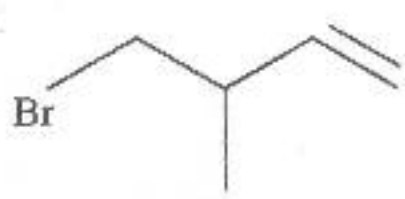
(iv) 

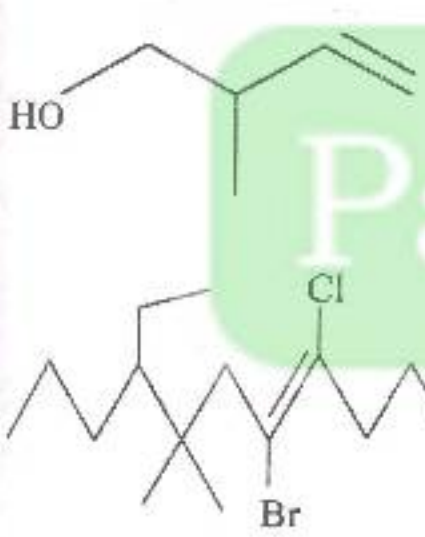
(v) 

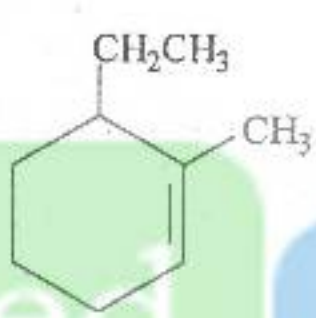
(vi) 

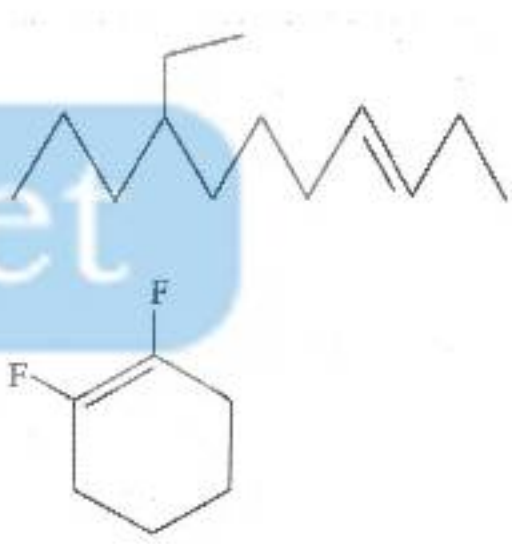
(vii) 

(viii) 

(ix) 

(x) 

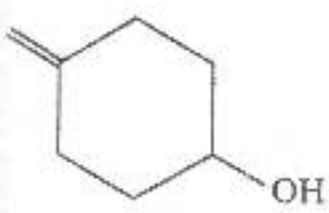
(xi) 

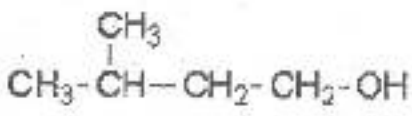
(xii) 

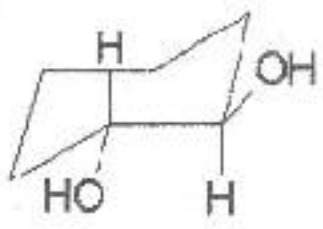
(xiii)

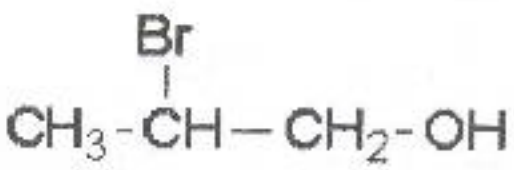
(xiv) $CH_3(CH_2)_{14}CH_3$

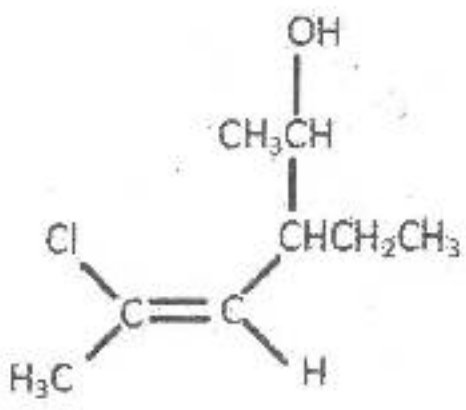
(xv)

(xvi) 

xvii) 

(xviii) 

(xix) 

(xx) 

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