FEDERAL PUBLIC SERVICE COMMISSION

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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. By contrast the lower molecular mass compound NH_3 boils at 33^0 C and is well know as Lewis base. (4)
      (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)

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CHEMISTRY, PAPER-I:

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

20 (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) $\mu_{calc} = (n^2+1)^{1/2}$

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(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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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) $CH_3 - \underset{Br}{\underset{|}{CH}} - \underset{Br}{\underset{|}{CH}} - CH_3$ (ii) $CH_3 - \underset{OH}{\underset{|}{CH}} - \underset{OH}{\underset{|}{CH}} - CH_3$

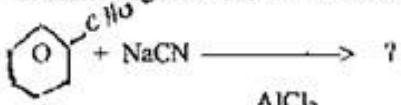
4. (a) What happens when CH_3MgI is treated with following reagents and the Product hydrolysed? (10)

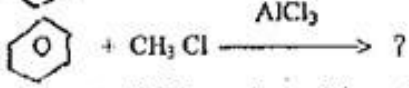
   (i) formaldehyde (ii) ethylene oxide (iii) Acetaldehyde

   (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) 

   (ii) 

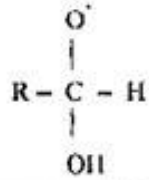
   (b) What is Iodoform test? Discuss its usefulness for the detection of Acetyl group (CH_3CO^-). (5)

   (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) (ii) 

   (d) Define the terms Enantiomer, Diastereomers with example. (3)

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CHEMISTRY, PAPER-II:

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 Grignard reagent? Give reason. (3)
   (i) Ether (ii) T H F

   (c) Describe the mechanism and synthetic application of Reformkasty 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

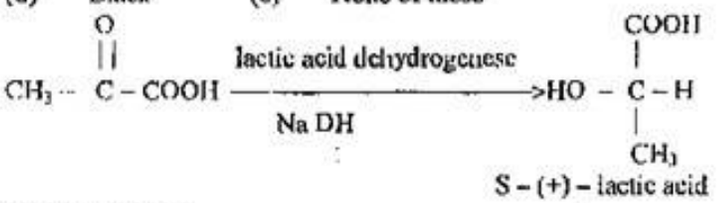
(4) Aniline shows two absorption maxima in U.V. region:
   (a) 200,250mu (b) 190,280mu
   (c) 210,270mu (d) 230,280mu

(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) $2NO + O_2(g)$ -------$2NO_2(g)$ 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) $K_2 Co_3$ (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)


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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