

Ph. D. Entrance Test – 2015**Subject: Chemistry****Paper – I**

Important: Please consult your Admit Card/Roll No. slip before filling your Roll Number on the Test Booklet and Answer Sheet.

Roll No.*In Figure**In Words*

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O.M.R. Answer Sheet Serial No.

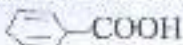
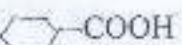
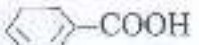
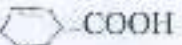
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Signature of Candidate: _____

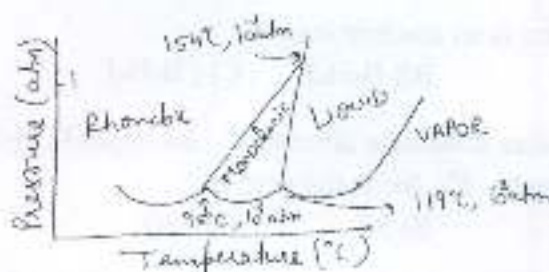
Signature of Invigilator: _____

Time: 60 Minutes**Number of Questions: 50****Maximum Marks: 50****DO NOT OPEN THE SEAL ON THE BOOKLET UNTIL ASKED TO DO SO.****INSTRUCTIONS:**

1. Write your Roll No. on the Questions Booklet and also on the OMR Answer Sheet in the space provided and nowhere else.
2. Enter the Question Booklet Serial No. on the OMR Answer Sheet. Darken the corresponding bubbles with **Black Ball Point/Black Gel Pen**.
3. Do not make any identification mark on the Answer Sheet or Question Booklet.
4. Please check that this Question Booklet contains **50** Questions. In case of any discrepancy, inform the Assistant Superintendent within 10 minutes of the start of Test.
5. Each question has four alternative answer (A,B,C,D) of which only one is correct. For each question, darken only one bubble (A or B or C or D), whichever you think is the correct answer, on the Answer Sheet with **Black Ball Point/Black Gel Pen**. **There shall be no negative marking for wrong answers.**
6. If you do not want to answer a question, leave all the bubbles corresponding to that question blank in the Answer Booklet. No marks will be deducted in such cases.
7. Darken the bubbles in the OMR Answer Sheet according to the Serial No. of the question given in the Question Booklet.
8. If you want to change an already marked answer, erase the shade in the darkened bubble completely.
9. For rough work only the blank sheet at the end of the Question Booklet be used.
10. The Answer Sheet is designed for computer evaluation. Therefore, if you do not follow the instructions given on the Answer Sheet, it may make evaluation by the computer difficult. **Any resultant loss to the candidate on the above account, i.e. not following the instructions completely, shall be of the candidate only.**
11. After the test, hand over the Question Booklet and the Answer Sheet to the Assistant Superintendent on duty.
12. In no case the Answer Sheet, the Question Booklet, or its part or any material copied/noted from this Booklet is to be taken out of the examination hall. Any candidate found doing so would be expelled from the examination.
13. A candidate who creates disturbance of any kind or changes his/her seat or is found in possession of any paper possibly of any assistant or found giving or receiving assistant or found using any other unfair means during the examination will be expelled from the examination by the Centre Superintendent/Observer whose decision shall be final.
14. **Communication equipment such as mobile phones, pager, wireless set, scanner, camera or any electronic/digital gadget etc., is not permitted inside the examination hall. Use of calculators is not allowed.**
15. The candidates will not be allowed to leave the Examination Hall/Room before the expiry of the allotted time.

1. A reaction mixture is prepared containing 0.60 mol of aluminium and 1.20 mol of manganese dioxide. The mixture is heated until one of the reactants has been completely consumed according to the equation $2\text{Al} + 3\text{MnO}_2 \rightarrow 3\text{Mn} + \text{Al}_2\text{O}_3$. What quantity of reactant remains uncombined?
- A) 0.20 mol Al B) 0.40 mol Al
C) 0.30 mol MnO_2 D) 0.60 mol MnO_2
2. Bakelite is
- A) Phenol formaldehyde resin B) Urea-formaldehyde resin
C) Polyurea resin D) Poly urethane resin
3. Which of the following can exhibit geometric isomerism?
- A) 1-pentene B) 2-pentene C) 2-methyl-2-butene D) 2-butene
4. Which mixture of water and H_2SO_4 represent a solution with a concentration that is closest to 30% by mass H_2SO_4 ?
- A) 30 g H_2SO_4 + 100 g H_2O B) 1 mol H_2SO_4 + 200g H_2O
C) 30 mol H_2SO_4 + 0.70 Kg H_2O D) 0.30 mol H_2SO_4 + 0.70 mol H_2O
5. Which of the following is an arachno borane?
- A) $[\text{B}_5\text{H}_5]^{12-}$ B) $[\text{B}_5\text{H}_9]$ C) $[\text{B}_2\text{H}_6]$ D) $[\text{B}_6\text{H}_{12}]$
6. The molar conductivities at infinite dilution λ_m° for Na_2SO_4 , H_2SO_4 , CH_3COONa are 260, 160 and 150 respectively. λ_m° for acetic acid is
- A) 200 B) 50 C) 300 D) 100
7. The bond dissociation energies of four bonds C-A, C-B, C-D and C-E are respectively 240, 382, 276 and 486 KJ mol^{-1} . The atom with smallest size is
- A) A B) B C) D D) E
8. The conversion of acetophenone to acetanilide is best accomplished by using
- A) Beckmann rearrangement B) Curtius rearrangement
C) Lossen rearrangement D) Hoffman rearrangement
9. The birch reduction of benzoic and guies-
- A) -COOH B) -COOH
C) -COOH D) -COOH
10. Which of the complexes is expected to have lowest Δ_n value?
- A) $[\text{Co}(\text{NH}_3)_6]^{3+}$ B) $[\text{Rh}(\text{NH}_3)_6]^{3+}$
C) $[\text{Ir}(\text{NH}_3)_6]^{3+}$ D) $[\text{CoF}_6]^{3-}$
11. $\text{Fe}(\text{Co})_4$ is isolobal with
- A) CH_2^+ B) CH_2^- C) CH_2 D) CH_4
12. The total number of α particles, β particles emitted for the transformation of ${}^{232}_{92}\text{U} \rightarrow {}^{220}_{86}\text{Ac}$ and how many steps will take place for above transformation:
- A) 3α , 3β , 6 steps B) 3α , 3β , 3 steps
C) 4α , 2β , 6 steps D) 4α , 2β , 3 steps

13. Which of the following most favors a high lattice energy in ionic compounds?
- A) Small ion, high charge B) Small ion, low charge
C) Large ion, high charge D) Large ion, low charge
14. Which of the following are isoelectronic and isostructural?
- NO_3^- , CO_3^{2-} , ClO_3^- , SO_3
- A) NO_3^- , CO_3^{2-} B) SO_3 , NO_3^-
C) ClO_3^- , CO_3^{2-} D) CO_3^{2-} , SO_3
15. Under what conditions does the behavior of real gases deviate most from that predicted by the ideal gas law?
- A) Low P, low T B) High P, low T
C) Low P, high T D) High P, high T
16. When 0.25 L of liquid nitrogen ($d = 0.807 \text{ g/ml}$) is vaporized, what volume does the resulting gas occupy at 25°C and 5.00 atm ?
- A) 71 L B) 54 L C) 35 L D) 32 L
- 17.

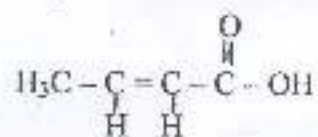


- Phase diagram of Sulphur is shown above. Which statement about this diagram is correct?
- A) The critical point is above 154°C and 10^{-3} atm .
B) There are only two tripple points in this diagram.
C) Monoclinic sulfur is more dense than rhomic sulfur at any temperature.
D) Monoclinic sulfur forms rhombic sulfur at higher pressure or lower temperature.
18. The correct order of hybridization of central atom in following species NH_3 , $[\text{PCl}_4]^{2-}$, PCl_5 and BCl_3 is
- A) dsp^2 , dsp^3 , sp^3 , sp^3 B) sp^3 , dsp^2 , dsp^3 , sp^3
C) dsp^2 , sp^2 , sp^3 , dsp^3 D) dsp^2 , sp^3 , sp^2 , dsp^3
19. Molarity of $0.2\text{N H}_2\text{SO}_4$ is
- A) 0.2 B) 0.4 C) 0.6 D) 0.1
20. Use the following data to calculate the molar enthalpy of combustion of ethane C_2H_6
- $2 \text{C}_2\text{H}_2 (\text{g}) + 5 \text{O}_2 (\text{g}) \rightarrow 4 \text{CO}_2 (\text{g}) + 2 \text{H}_2\text{O} (\text{l}) \quad \Delta\text{H} = -2511 \text{ KJ/mol}$
 $\text{C}_2\text{H}_2 (\text{g}) + 2 \text{H}_2 (\text{g}) \rightarrow \text{C}_2\text{H}_6 (\text{g}) \quad \Delta\text{H} = -311 \text{ KJ/mol}$
 $2 \text{H}_2 (\text{g}) + \text{O}_2 (\text{g}) \rightarrow 2 \text{H}_2\text{O} (\text{g}) \quad \Delta\text{H} = -484 \text{ KJ/mol}$
- A) -1428 KJ/mol B) -2684 KJ/mol
C) -2856 KJ/mol D) -3306 KJ/mol

21. A compound decomposes with a first order rate constant of 0.00854 s^{-1} . Calculate the concentration after 5.0 minutes for an initial concentration of 1.2 M.
 A) 0.010 M B) 0.093 M C) 0.92 M D) 1.1 M
22. What is the formula of ethyl propanoate?
 A) $\text{CH}_3 \text{CH}_2 \text{CO}_2 \text{CH}_2 \text{CH}_3$ B) $\text{CH}_3 \text{CH}_2 \text{CH}_2 \text{CO}_2 \text{CH}_2 \text{CH}_3$
 C) $\text{CH}_3 \text{CH}_2 \text{CO}_2 \text{CH}_2 \text{CH}_2 \text{CH}_3$ D) $\text{CH}_3 \text{CH}_2 \text{CO} \text{CH}_2 \text{CH}_2 \text{O} \text{CH}_3$
23. The number of nodes in R (r) plots of 3s, 2p, 4d and 5f orbitals respectively are
 A) 1, 2, 3 and 4 B) 0, 2, 1 and 3
 C) 3, 2, 4 and 5 D) 2, 0, 1, 1
24. Natural Rubber is polymer of
 A) Neoprene B) Isoprene C) Chloroprene D) Butadiene
25. $\text{Sn}^{4+} (\text{aq}) + 2\text{e}^- \rightarrow \text{Sn}^{2+} (\text{aq}) \quad E^\circ = 0.15 \text{ V}$
 $\text{Cr}^{3+} (\text{aq}) + \text{e}^- \rightarrow \text{Cr}^{2+} (\text{aq}) \quad E^\circ = -0.41 \text{ V}$
 According to standard reduction potentials above, what is the value of E° for the reaction below?
 $2\text{Cr}^{3+} (\text{aq}) + \text{Sn}^{2+} (\text{aq}) \rightarrow 2\text{Cr}^{2+} (\text{aq}) + \text{Sn}^{4+} (\text{aq})$
 A) -0.97 V B) -0.56 V C) +0.56 V D) +0.97 V
26. The rate of decomposition of certain compound in solution is first order. If the concentration of the compound is doubled, what happens to the reaction's half-life?
 A) It doubles.
 B) It decreases to $\frac{1}{2}$ of the original volume.
 C) It decreases to $\frac{1}{4}$ of the original volume.
 D) It remains the same.
27. Hoffmann's bromamide reaction is the formation of R-NH_2 from
 A) RCHO B) RCOOH C) RCONH_2 D) None
28. A 10.00 g sample of a compound containing C, H and O is burned completely to produce 14.67 g of CO_2 and 6 g of H_2O . What is the empirical formula of this compound?
 A) CHO B) CH_2O C) CH_2O_2 D) $\text{C}_2\text{H}_4\text{O}$
29. Which set of quantum numbers (n, l, m_l, m_s) is possible for outermost electron in strontium atom in ground state
 A) 5, 0, 0, $-\frac{1}{2}$ B) 5, 0, 1, $\frac{1}{2}$ C) 5, 1, 0, $\frac{1}{2}$ D) 5, 1, 1, $-\frac{1}{2}$
30. For the synthesis of ammonia K_c is 1.2 at 37°C $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$
 What is K_p at this temperature?
 A) 4.1×10^{-8} B) 4.2×10^{-4} C) 1.3×10^{-3} D) 3.4×10^3
31. Which of the following molecules has a dipole moment of zero?
 A) HCN B) CH_2Cl_2 C) SO_2 D) CO_2
32. A reaction has a rate constant $k = 8.54 \times 10^{-4} \text{ M}^{-1}\text{s}^{-1}$ at 45°C and activation energy $E_A = 90.8 \text{ KJ}$. What is value of k at 25°C ?
 A) $4.46 \times 10^{-5} \text{ M}^{-1}\text{s}^{-1}$ B) $8.54 \times 10^{-5} \text{ M}^{-1}\text{s}^{-1}$
 C) $8.52 \times 10^{-4} \text{ M}^{-1}\text{s}^{-1}$ D) $8.54 \times 10^{-3} \text{ M}^{-1}\text{s}^{-1}$

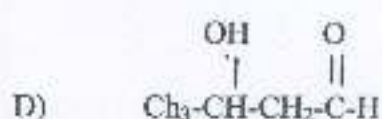
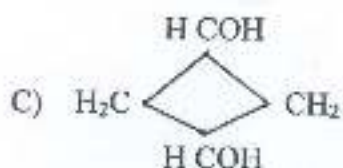
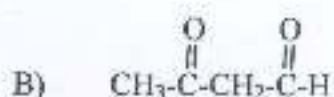
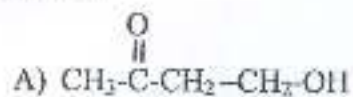
33. The electronic configuration of an element is $1s^2, 2s^2, 2p^5$. The ground state atomic term will be
 A) $2P_{1/2}$ B) $2P_{3/2}$ C) $2S_{3/2}$ D) $3P_2$
34. What is coordination geometry on nickel in $Ni(CO_4)$?
 A) Tetrahedral B) Square planar
 C) See-Saw D) T-shaped
35. The vapour pressure of pure liquid solvent A is 0.80 atm. When a non volatile substance B is added to the solvent, its vapour pressure drops to 0.60 atm. What is the mole fraction of component B in solvent?
 A) 0.75 B) 0.50 C) 0.25 D) 1.0
36. Which indicates the correct order of variation in atomic size?
 A) $F > N < O > C$ B) $F > N > O > C$
 C) $F < N < O < C$ D) $F > N > O > C$
37. The microwave spectrum of a diatomic molecule shows lines with equal spacing 10cm^{-1} . The position of the first Stokes line in rotational Raman Spectra of that molecule is
 A) 10cm^{-1} B) 20cm^{-1} C) 30cm^{-1} D) 40cm^{-1}
38. Two hypothetical acids HA and HB have the dissociation constant 1×10^{-3} and 1×10^{-5} respectively in water. How many times HA is stronger than HB?
 A) 10 times B) 100 times C) 1000 times D) Note definite
39. Solubility of a sparingly soluble salt S, specific conductance K and the equivalent conductance λ_{∞} are related as
 A) $S = 1000 \lambda_{\infty} / K$ B) $S = K \lambda_{\infty}$
 C) $S = K / 1000 \lambda_{\infty}$ D) $S = 1000 K / \lambda_{\infty}$
40. Iron has an oxidation number of +3 in which of the following compounds
 A) $Fe(NO_3)_2$ B) FeC_2O_4
 C) $[Fe(H_2O)_6]Cl_3$ D) $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$
41. The correct name (IUPAC) for the compound $[Co(en)_2Cl(ONO)]$ is
 A) Nitrochlorobis(ethylenediamine)cobalt(III) chloride
 B) Chloronitro di(ethylenediamine)cobalt(III) chloride
 C) Chloronitro bis(ethylenediamine)cobalt(III) chloride
 D) Chloronitro bis(ethylenediamine)cobalt(II) chloride
42. The reaction $[IrCl_6]^{2-} + [Cr(H_2O)_6]^{2+} \rightarrow [IrCl_6]^{3-} + [Cr(H_2O)_6]^{3+}$ is
 A) Outer sphere reaction
 B) Inner sphere reaction
 C) SN_1CB
 D) Inner sphere Mechanism without transfer of Legend
43. Based on molecular orbital theory, which species has the highest bond order?
 A) O_2^+ B) O_2 C) O_2^- D) O_2^{2-}

44. How many carbon atoms can be described as sp^2 hybridized in this molecule?



- A) 0 B) 1 C) 2 D) 3

45. What is the product when two molecules of ethanol CH_3CHO undergo aldol condensation?



46. All of the following are monosaccharides except

- A) Fructose B) Glucose C) Ribose D) Sucrose

47. How many isomers of octahedral $\text{Co}(\text{NH}_3)_3\text{Cl}_3$ are there?

- A) 2 B) 3 C) 4 D) 5

48. How many pi bonds and how many lone pairs are there in Lewis structure of hydrazine N_2H_4 ?

- A) 2 pi bonds, 0 lone pairs B) 1 pi bond, 0 lone pairs
C) 1 pi bond, 1 lone pair D) 0 pi bond, 2 lone pair

49. Barium metal crystallizes in a body centered cubic lattice with barium atoms only at the lattice points. If the density of barium metal is 3.50g/cm^3 , what is length of unit cell?

- A) $3.19 \times 10^{-8}\text{ cm}$ B) $4.02 \times 10^{-8}\text{ cm}$ C) $5.07 \times 10^{-8}\text{ cm}$ D) $6.39 \times 10^{-8}\text{ cm}$

50. The order of stability of rotamers of ethane is

- A) Eclipsed > skew > staggered B) Eclipsed > staggered > skew
C) Staggered > skew > Eclipsed D) Staggered > Eclipsed > skew

x-x-x