

Question Paper for the Screening Test  
for the Junior Technical (JT) Post in Chemistry

Post: JT

Department: Chemistry

Name:

Application Number:

Date: November 17, 2023

Duration: 90 minutes

Total Marks: 50

Information to the Candidate:

1. Please answer all 50 questions.
2. Each question carries 1 mark.
3. There is no negative marking for any wrong answer
4. Please return both the question paper and the ORS sheet after the examination
5. Additional blank sheets may be requested for the rough works
6. Nonprogrammable calculator is allowed to use

QUESTIONS

1. The relation between the tetrahedral crystal field splitting ( $\Delta_t$ ) and octahedral crystal field splitting ( $\Delta_o$ ) for a transition-metal complex is  
(A)  $\Delta_t = \Delta_o$   
(B)  $\Delta_t > \Delta_o$   
(C)  $\Delta_t < \Delta_o$   
(D) cannot be defined
2. Purple pink color of  $\text{KMnO}_4$  is due to  
(A) d-d transition  
(B) metal-to-ligand charge-transfer  
(C) ligand-to-metal charge-transfer  
(D) ligand-to-ligand charge-transfer
3. The geometry of  $[\text{Ni}^{\text{II}}(\text{dmg})_2]$  (dmg = dimethylglyoximate) is  
(A) tetrahedral  
(B) octahedral  
(C) square planar  
(D) trigonal bipyramid

4. The total kinetic energy for a 1 mole of ideal gas at T K temperature in units of RT is
- (A) 0.5  
(B) 1.0  
(C) 1.5  
(D) 2.0
5. The relation between pH and pOH is  $\text{pH} + \text{pOH} = 14$  at 298 K temperature. The value of  $\text{pH} + \text{pOH}$  at an elevated temperature will be
- (A) greater than 14  
(B) less than 14  
(C) equal to 14  
(D) 7
6. The more probable number of hydrogen bonds that a water molecule can show
- (A) 1  
(B) 2  
(C) 3  
(D) 4
7. Hybridization of N atom in  $\text{NH}_4^+$  is
- (A)  $\text{sp}^3$   
(B)  $\text{sp}^2$   
(C) sp  
(D)  $\text{sp}^3\text{d}$
8. Complete neutralization of 5 mL of 0.5M  $\text{H}_2\text{SO}_4$  requires 1N NaOH of
- (A) 5 mL  
(B) 0.5 mL  
(C) 0.25 mL  
(D) 2.5 mL
9. With increasing solvent polarity, the Stokes shift due to a charge-transfer emissive state in an organic molecular chromophore
- (A) increases  
(B) decreases  
(C) remains constant  
(D) first increases and then decreases

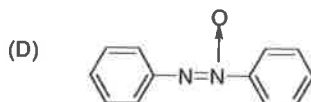
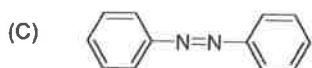
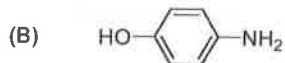
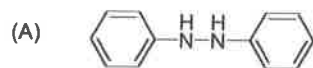
10. Stiffness of a chemical bond can be determined using
- (A) vibrational spectroscopy
  - (B) electronic spectroscopy
  - (C) microwave spectroscopy
  - (D) X-ray spectroscopy
11. The entropy change for a spontaneous chemical process is
- (A) positive
  - (B) negative
  - (C) zero
  - (D) none of the above
12. Molecular pair that doesn't display the s-p mixing in the molecular orbital diagram between the following diatomic molecules  $B_2$ ,  $C_2$ ,  $N_2$ ,  $O_2$ ,  $F_2$  and CO
- (A)  $B_2$  and  $C_2$
  - (B)  $C_2$  and  $N_2$
  - (C)  $N_2$  and CO
  - (D)  $O_2$  and  $F_2$
13. The net orbital angular momentum for an electron in 4s atomic orbital in a one-electron atom is
- (A)  $0 \mu_B$
  - (B)  $1.41 \mu_B$
  - (C)  $2.45 \mu_B$
  - (D)  $1 \mu_B$
14. The number of angular nodes for a 3d electron is
- (A) 1
  - (B) 2
  - (C) 3
  - (D) 4
15. The He-He bond order in  $He_2^+$  molecular ion is
- (A) 0
  - (B) 0.5
  - (C) 1
  - (D) 1.5

16. Presence of chloride ion in a water sample can be analytically detected using
- (A)  $\text{HNO}_3$
  - (B)  $\text{HCl}$
  - (C)  $\text{AgNO}_3$
  - (D)  $\text{NH}_3$
17. The unit of the pre-exponential factor for Arrhenius equation in the case of 1<sup>st</sup> order chemical reaction is
- (A) dimensionless
  - (B)  $\text{second}^{-1}$
  - (C) Kelvin
  - (D) moles/litre
18. Consider  $\text{CH}_4$  and  $\text{CH}_3\text{Cl}$ , in the context of infrared spectroscopy which statement is true?
- (A) For some vibrational modes, both the molecules are IR active.
  - (B) Only  $\text{CH}_3\text{Cl}$  is IR active.
  - (C) Only  $\text{CH}_4$  is IR active.
  - (D) Both the molecules are IR inactive.
19. In the case of Beer-Lambert law, the unit of molar absorptivity co-efficient is
- (A) It is unitless.
  - (B)  $\text{moles liter}^{-1}$
  - (C)  $\text{cm}^{-1} \text{ moles}^{-1} \text{ liter}$
  - (D)  $\text{moles liter}^{-1} \text{ cm}^2$
20. Ring test for nitrate ion detection cannot be performed successfully with
- (A)  $\text{NaNO}_3$
  - (B)  $\text{AgNO}_3$
  - (C)  $\text{Pb}(\text{NO}_3)_2$
  - (D)  $\text{NH}_4\text{NO}_3$
21. Rate constant of an exothermic reaction ----- with increasing temperature
- (A) increases
  - (B) decreases
  - (C) remain constant
  - (D) depends on the reactants

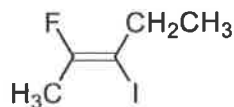
22. Which pair of the following substances are the primary standard
- (A) Oxalic acid, HCl
  - (B) HCl,  $\text{Na}_2\text{CO}_3$
  - (C) Oxalic acid,  $\text{Na}_2\text{CO}_3$
  - (D)  $\text{KMnO}_4$ , Oxalic acid
23. Given that 1 mol of  $\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$  with excess  $\text{AgNO}_3$  precipitates 2 mols of  $\text{AgCl}$ ; what is the secondary valence of Ni?
- (A) 1
  - (B) 2
  - (C) 4
  - (D) 6
24. The  $[\text{Ni}(\text{CN})_4]^{2-}$  and  $[\text{NiCl}_4]^{2-}$  complexes are square planar and tetrahedral in geometries, respectively; magnetic properties of the these complexes will be, respectively:
- (A) paramagnetic & diamagnetic
  - (B) diamagnetic & paramagnetic
  - (C) diamagnetic & diamagnetic
  - (D) paramagnetic & paramagnetic
25. What will happen to the molar extinction coefficient ( $\epsilon$ ) value of a molecule if we vary the concentration?
- (A) increase
  - (B) decrease
  - (C) unaltered
  - (D) altered
26. The oxygen transport protein is
- (A) ferredoxin
  - (B) hemoglobin
  - (C) myoglobin
  - (D) transferrin
27. CO bond-order is lowest in
- (A) Free CO
  - (B) CO bonded to one metal
  - (C) CO bridging two metals
  - (D) CO bridging three metals

28. Which one of the following compounds can easily be reduced?  
(A)  $V(CO)_6$   
(B)  $Cr(CO)_6$   
(C)  $Ni(CO)_4$   
(D)  $Fe(CO)_5$
29. Which of the following is paramagnetic?  
(A)  $[Cr(CO)_6]$   
(B)  $[Fe(CO)_6]^{2+}$   
(C)  $[Fe(CN)_6]^{4-}$   
(D)  $[Cr(NH_3)_6]^{3+}$
30. Which one has regular tetrahedron geometry  
(A)  $SF_6$   
(B)  $SF_4$   
(C)  $[BF_4]^-$   
(D)  $XeF_4$
31. The possible number of geometrical isomers shown by  $[Co(en)Br_2Cl_2]^-$  is:  
(A) 2  
(B) 3  
(C) 4  
(D) 6
32. The transition metal complex with zero magnetic moment, zero dipole moment and CFSE of  $-2.4 \Delta_0$  is  
(A)  $[Mn(CO)_5(CH_3)]$   
(B)  $[trans-Ni(ethylene\ diamine)_2Cl_2]$   
(C)  $[trans-Co(CN)_4(H_2O)_2]^-$   
(D)  $[Fe(CN)_4NH_3Cl]^{4-}$
33. The metal ion cluster that is involved in the photosystem II for the oxidation of water is,  
(A)  $Mn_4Cd$   
(B)  $Mn_4Cu$   
(C)  $Mn_4Ca$   
(D)  $Mn_4Co$

34. Orbital contribution to the magnetic moment is possible in which of the following?  
 (A)  $d^4$  ( $T_d$ , HS) &  $d^4$  ( $O_h$ , HS)  
 (B)  $d^3$  ( $T_d$ , HS) &  $d^5$  ( $O_h$ , LS)  
 (C)  $d^8$  ( $T_d$ , HS) &  $d^7$  ( $O_h$ , LS)  
 (D)  $d^{10}$  ( $T_d$ , HS) &  $d^6$  ( $O_h$ , HS)
35. The hardest cation among the following is  
 (A)  $Na^+$   
 (B)  $H^+$   
 (C)  $Fe^{+2}$   
 (D)  $K^+$
36. The nitrosyl ligand binds to  $d$ -metal atoms in linear and bent fashion to behave as  
 (A)  $NO^+$  and  $NO^+$   
 (B)  $NO^+$  and  $NO^-$   
 (C)  $NO^-$  and  $NO^-$   
 (D)  $NO^-$  and  $NO^+$
37. Major product (X) of the reaction is

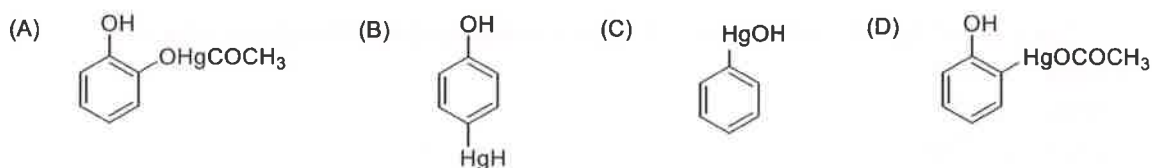


38. The IUPAC name of the following compound is.

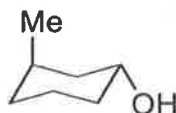


- (A) trans-2-Fluoro-3-iodo-2-pentene  
 (B) cis-3-Iodo-4-fluoro-3-pentene  
 (C) trans-3-Iodo-4-fluoro-3-pentene  
 (D) cis-2-Fluoro-3-iodo-2-pentene

39. Refluxing phenol with  $(\text{CH}_3\text{COO})_2\text{Hg}$  produces



40. The IUPAC name of the following compound is



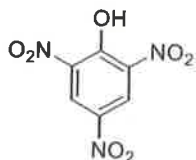
- (A) cis-3-Methyl cyclohexanol  
 (B) cis-5-Methyl cyclohexanol  
 (C) trans-3-Methyl cyclohexanol  
 (D) trans-5-Methyl cyclohexanol

41. Vanillin is obtained by using

- (A) Reimer-Tieman reaction  
 (B) Hoffman-bromide reaction  
 (C) Houben-Hosches reaction  
 (D) Gattermann reaction



42. The given structure is for



- (A) Aspirin  
(B) RDX  
(C) Picric acid  
(D) Trinitrotoluene

43. Major product (X) of the reaction is



- (A)  $\text{RNH}_2$       (B)  $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{H}$       (C)  $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\overset{\text{Br}}{\text{N}}-\text{H}$       (D)  $\text{R}-\text{O}-\text{NH}_2$

44. Identify the nonaromatic species/molecule.

- (A)       (B)       (C)       (D) 

45. Identify the most reactive compound for Friedel-Crafts acylation reaction

- (A) Anisole  
(B) Nitrobenzene  
(C) Fluorobenzene  
(D) Acetophenone

46. Which of the following molecule has *sp*-hybridized atom.

- (A) Ethylacetoacetate  
(B) Allene  
(C) Benzoic acid  
(D) Phenol

47. Which of the following is the most stable radical?

- (A)  $\bullet\text{C}_6\text{H}_5$
- (B)  $\bullet\text{C}_2\text{H}_5$
- (C)  $\bullet\text{CH}(\text{CH}_3)_2$
- (D)  $\bullet\text{C}(\text{CH}_3)_3$

48. Which of the following has highest boiling point?

- (A)  $\text{CH}_3\text{--O--CH}_3$
- (B)  $\text{CH}_3\text{--CH}_2\text{--OH}$
- (C)  $\text{CH}_3\text{--CH}_2\text{--CH}_3$
- (D)  $\text{CH}_2\text{=CH--CH}_3$

49. Acetamide to ethylamine chemical conversion is possible using

- (A)  $\text{LiAlH}_4$
- (B)  $\text{Br}_2/\text{NaOH}$
- (C)  $\text{NaOH}$
- (D)  $\text{NaBH}_4$

50. Which of the following reactions is suitable for the preparation of  $\alpha$ -amino acids?

- (A) Schmidt reaction
- (B) Hofmann reaction
- (C) Strecker synthesis
- (D) Gabriel synthesis



