

Sr. No. ....380.....

# ENTRANCE TEST-2023

SCHOOL OF PHYSICAL & MATHEMATICAL SCIENCE

CHEMISTRY

Total Questions : 60  
Time Allowed : 70 Minutes

Question Booklet Series

D

Roll No. :

--	--	--	--	--	--

## Instructions for Candidates :

1. Write your Entrance Test Roll Number in the space provided at the top of this page of Question Booklet and fill up the necessary information in the spaces provided on the OMR Answer Sheet.
2. OMR Answer Sheet has an Original Copy and a Candidate's Copy glued beneath it at the top. While making entries in the Original Copy, candidate should ensure that the two copies are aligned properly so that the entries made in the Original Copy against each item are exactly copied in the Candidate's Copy.
3. All entries in the OMR Answer Sheet, including answers to questions, are to be recorded in the Original Copy only.
4. Choose the correct / most appropriate response for each question among the options A, B, C and D and darken the circle of the appropriate response completely. The incomplete darkened circle is not correctly read by the OMR Scanner and no complaint to this effect shall be entertained.
5. Use only blue/black ball point pen to darken the circle of correct/most appropriate response. In no case gel/ink pen or pencil should be used.
6. Do not darken more than one circle of options for any question. A question with more than one darkened response shall be considered wrong.
7. There will be '**Negative Marking**' for wrong answers. Each wrong answer will lead to the deduction of 0.25 marks from the total score of the candidate.
8. Only those candidates who would obtain positive score in Entrance Test Examination shall be eligible for admission.
9. Do not make any stray mark on the OMR sheet.
10. Calculators and mobiles shall not be permitted inside the examination hall.
11. Rough work, if any, should be done on the blank sheets provided with the question booklet.
12. OMR Answer Sheet must be handled carefully and it should not be folded or mutilated in which case it will not be evaluated.
13. Ensure that your OMR Answer Sheet has been signed by the Invigilator and the candidate himself/herself.
14. At the end of the examination, hand over the OMR Answer Sheet to the invigilator who will first tear off the original OMR sheet in presence of the Candidate and hand over the Candidate's Copy to the candidate.

SM-29577-D

1

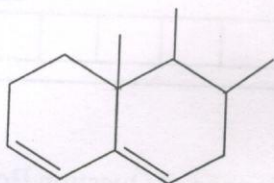
⊗⊗⊗⊗

[Turn over

SEAL



1. Choose the correct IR frequency of C=O of amide :
- (A) 1800  $\text{cm}^{-1}$   
 (B) 1730  $\text{cm}^{-1}$   
 (C) 1630  $\text{cm}^{-1}$   
 (D) 1680  $\text{cm}^{-1}$
2. Choose the  $\lambda_{\text{max}}$  of the molecule given below :

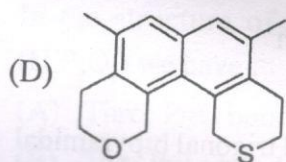
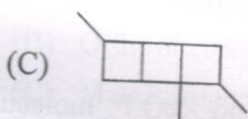
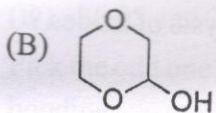
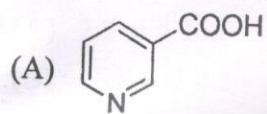


- (A) 215 nm  
 (B) 235 nm  
 (C) 234 nm  
 (D) 265 nm

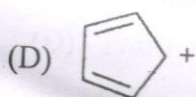
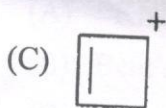
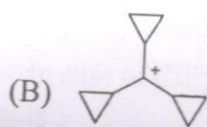
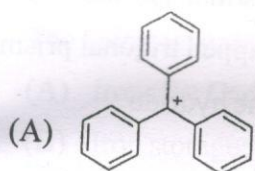
3. The approximate value of methyl proton in NMR is :
- (A) 1.3  
 (B) 1.5  
 (C) 0.9  
 (D) 2.5
4. Signal splitting in NMR arises from :
- (A) Shielding effect  
 (B) Spin-spin decoupling  
 (C) Spin-spin coupling  
 (D) Deshielding effect
5. Which of the following is used to prepare Benzoyl chloride from benzoic acid ?
- (A)  $\text{Cl}_2, \text{H}_2\text{O}$   
 (B)  $\text{SOCl}_2$   
 (C)  $\text{SO}_2, \text{Cl}_2$   
 (D)  $\text{Cl}_2, \text{hv}$
6. Which of the following organic compound is formed when aniline reacts with acetaldehyde ?
- (A) Diazonium salt  
 (B) Schiff's base  
 (C) Imine  
 (D) Carbylamine
7. In which of the following reactions lead tetraacetate is used to cleave a carbon-carbon bond in a glycol ?
- (A) Swern oxidation  
 (B) Criegee oxidation  
 (C) Jones oxidation  
 (D) Baeyer-Villiger oxidation
8. Which of the following is a phospholipid ?
- (A) Sterol  
 (B) Cholesterol  
 (C) Lecithin  
 (D) Steroid
9. Which of the following is an example of Epimers ?
- (A) Glucose and Ribose  
 (B) Glucose and Galactose  
 (C) Galactose, Mannose and Glucose  
 (D) Glucose, Ribose and Mannose
10. Which of the following factors is not responsible for the denaturation of proteins ?
- (A) Heat  
 (B) Charge  
 (C) pH change  
 (D) Organic solvents



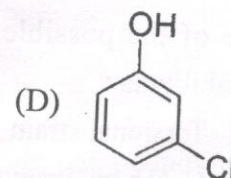
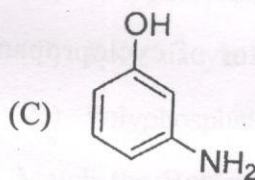
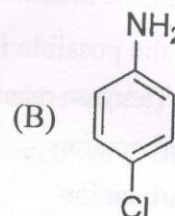
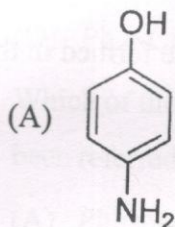
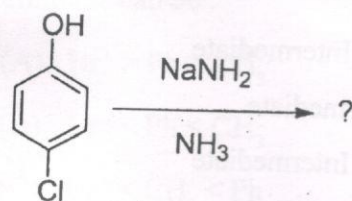
11. Which of the following is an example of alkaloid ?



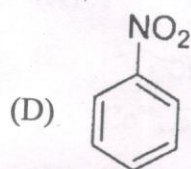
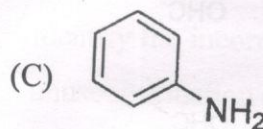
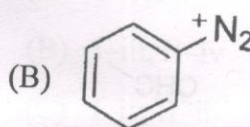
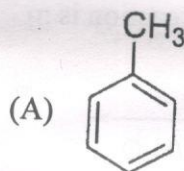
12. Which one among the following carbocations has the longest half-life ?



13. The major product of the below given reaction is :

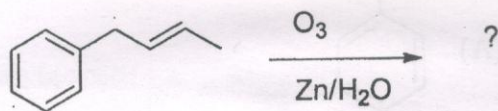


14. Which among the following undergo ArSN<sub>2</sub> mechanism with ease ?





15. Aromatic electrophilic substitution reaction proceed via :
- Carbocation Intermediate
  - Radical Intermediate
  - Arinium Ion Intermediate
  - Benzyne Intermediate
16. What is the possible intermediate formed in the Reimer-Tiemann reaction ?
- Carbocation
  - Carboanion
  - Carbene
  - Free radicals
17. One of the possible factor of cyclopropane instability is :
- Torsional strain
  - C-H bond length
  - 60 bond angles
  - Due to  $sp$  character of Carbons
18. The product of the below given reaction is :



- (A) +
- (B) +
- (C) +
- (D) +

19. The suitable electrophilic substitution on Pyridine occurs at :
- C-2
  - C-3
  - C-4
  - None of the above
20. What is obtained by thermolysis of azides ?
- Free radicals
  - Carbocation
  - Arene
  - Nitrene
21. What Geometries  $SNF_3$  and  $XeO_2F_2$  molecules have as per covalent bonding pattern ?
- Square planar both
  - Tetrahedral both
  - Square planar and trigonal bipyramidal
  - Tetrahedral and trigonal bipyramidal
22. Match the hydride with its general property :
- |                   |                               |
|-------------------|-------------------------------|
| a. NaH            | I. Polymeric Chain            |
| b. $BeH_2$        | II. Interstitial hydride      |
| c. $HfH_{2.10}$   | III. Tricapped trigonal prism |
| d. $[TcH_9]^{2-}$ | IV. Saline hydride            |
- a-IV, b-II, c-III, d-I
  - a-I, b-IV, c-II, d-III
  - a-IV, b-I, c-II, d-III
  - a-IV, b-I, c-III, d-II
23. The observed enthalpies of hydration of divalent cations follows the order :
- $Mn^{2+} < Ca^{2+} > Zn^{2+}$
  - $Zn^{2+} > Ca^{2+} > Mn^{2+}$
  - $Mn^{2+} > Zn^{2+} > Ca^{2+}$
  - $Zn^{2+} > Mn^{2+} > Ca^{2+}$



24. The screening constant and effective nuclear charge for 4s electron of copper respectively are :
- (A) 2.2 and 26.8  
 (B) 26.8 and 2.2  
 (C) 2.95 and 26.05  
 (D) 26.05 and 2.95
25. Pick the odd one out for intermolecular hydrogen bonding :
- (A) Acetic acid  
 (B) Ortho nitrophenol  
 (C) Meta nitrophenol  
 (D) Ortho boric acid
26. In the structure of Pyrophosphate molecule ( $H_4P_2O_7$ ) we have :
- (A) Three P=O bonds  
 (B) Two P=O bonds and one POP bridge type bond  
 (C) One P=O bond and two POP bridge type bond  
 (D) Only POH, POP and none P=O
27. The incorrect pair among the following is :
- (A) Iron (II); Carbonic anhydrase  
 (B) Iron storage; Ferritin  
 (C) Cadmium toxicity; Metallothionein  
 (D) Cytochrome 450; Monooxygenase
28. In case of  $ClF_3$  molecule, the incorrect statement is :
- (A)  $^{19}F$  NMR shows non-equivalent Fluorine's  
 (B) Bent's rule is followed in T shape  
 (C) Di axial lone pair position gives highest energy  
 (D) Two Fluorine distances are short and one long
29. The choice of bridging group in case of Aluminium dimers can be :
- (A)  $Br^- > Ph > CH_3$   
 (B)  $Br^- < Ph < CH_3$   
 (C)  $Br^- < CH_3 < Ph$   
 (D)  $Ph > CH_3 > Br^-$
30. Which of the following non-metal systems have been referred to as one dimensional conductors ?
- (A) Phosphonitrilic halides  
 (B) Polyphosphazenes  
 (C) Polythiazyls  
 (D) Polyphosphates
31. Match the Boron hydride compounds to their correct styx and topology :
- |                 |                   |
|-----------------|-------------------|
| I. $B_5H_9$     | i. 4120, nido     |
| II. $B_4H_{10}$ | ii. 4012, arachno |
|                 | iii. 4012, nido   |
|                 | iv. 4120, arachno |
- (A) I-i, II-ii  
 (B) I-iii, II-iv  
 (C) I-iv, II-iii  
 (D) I-ii, II-i
32. Identify the incorrect match for stabilization of unusual oxidation of metal :
- (A)  $Fe^{2+}$ ,  $OH^-$   
 (B)  $Cu^+$ , soft sulphur donor thiourea  
 (C)  $Co^{3+}$ , EDTA  
 (D)  $Cu^{3+}$ , hard  $F^-$  ions



33. Which of the following lanthanide (III) ion has considerably different calculated and observed magnetic moment for its aqua complex ?
- (A)  $\text{Ce}^{3+}$   
 (B)  $\text{Pr}^{3+}$   
 (C)  $\text{Eu}^{3+}$   
 (D)  $\text{Yb}^{3+}$
34. The peculiar properties of lanthanide (III) ion compounds are :
- (A) Coordination numbers  $> 6$  and sharp f-f transitions  
 (B) Coordination numbers  $> 6$  and sharp d-d transitions  
 (C) Coordination numbers  $< 6$  and sharp f-f transitions  
 (D) Octahedral geometry, broad electronic transitions and mostly spin only magnetic moment
35. Identify the correct match for Titration indicator :
- | Titration                                    | Indicator             |
|--|-----------------------|
| I. $\text{Ni}^{2+}$ with EDTA                | a. Murexide           |
| II. $\text{Cl}^-$ with $\text{Ag}^+$         | b. Potassium chromate |
| III. $\text{Fe}^{2+}$ with $\text{Ce}^{4+}$  | c. Ferroin            |
| IV. $\text{NH}_4\text{OH}$ with $\text{HCl}$ | d. Methyl orange      |
|  | e. Methyl red         |
- (A) I-a; II-b; III-c; IV-d  
 (B) I-a; II-b; III-c; IV-e  
 (C) I-c; II-b; III-a; IV-d  
 (D) I-b; II-c; III-a; IV-e
36. From the given solubility product  $\{K_{sp}\}$  values, pick the most appropriate precipitating agent for  $\text{Ca}^{2+}$  ions in solution :
- $\text{CaSO}_4 = 2.4 \times 10^{-5}$ ;  $\text{CaCO}_3 = 4.5 \times 10^{-9}$ ;  
 $\text{Ca(OH)}_2 = 6.5 \times 10^{-6}$ ;  $\text{CaCl}_2 = 1.57 \times 10^{-3}$
- (A)  $\text{Na}_2\text{SO}_4$   
 (B)  $\text{Na}_2\text{CO}_3$   
 (C)  $\text{NaOH}$   
 (D)  $\text{NaCl}$
37. For estimating total chloride content of 30 mL of 0.01 M solution of  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$  complex as silver chloride, the volume of 0.1 M  $\text{AgNO}_3$  required for complete precipitation will be :
- (A) 3 mL  
 (B) 6 mL  
 (C) 5 mL  
 (D) 9 mL
38. The complexes of which of the following inner transition metal ion are commonly used as MRI (Magnetic Resonance Imaging) contrast agents ?
- (A)  $\text{Gd}$   
 (B)  $\text{Eu}^{2+}$   
 (C)  $\text{Lu}^{3+}$   
 (D)  $\text{Gd}^{3+}$
39. In the chelation therapy method of treating harmful effects of metal ions in humans, the ligands used to treat excess of iron and copper ions are :
- (A) Penicillamine  
 (B) Penicillamine & deferoxamine respectively  
 (C) Deferoxamine & Penicillamine respectively  
 (D) BAL (2,3-Dimercaprol)



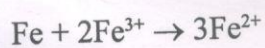
40. Which of the following complexes obey 18-electron rule with overall charge zero ?  
(Considering  $(\eta^5-C_5H_5)$  as 6 electron donor ligand)
- (A)  $(\eta^5-C_5H_5)Fe(CO)_2$   
 (B)  $(\eta^5-C_5H_5)Mo(CO)_3$   
 (C)  $(\eta^5-C_5H_5)_2Co$   
 (D)  $(\eta^5-C_5H_5)Re((\eta^6-C_6H_6))$
41. In van der Waal's equation,  $(P-a/V^2)(V-b)=RT$ , the units of 'a' would be :
- (A)  $Nm^2$   
 (B)  $Nm^4$   
 (C)  $Nm^{-4}$   
 (D)  $Nm^{-2}$
42. Which of the following is true about the mean velocity ( $V_m$ ), root mean square velocity ( $V_{rms}$ ) and the most probable velocity ( $V_{mp}$ ) of a gas at a temperature T ?
- (A)  $V_{mp} > V_m > V_{rms}$   
 (B)  $V_{mp} < V_{rms} < V_m$   
 (C)  $V_{mp} > V_{rms} > V_m$   
 (D)  $V_{mp} < V_m < V_{rms}$
43. The Miller indices of a diagonal plane of a cube would be :
- (A) 110  
 (B) 100  
 (C) 200  
 (D) 111
44. A gas cannot be liquefied whatever the pressure is only above its :
- (A) Boyle temperature  
 (B) Inversion temperature  
 (C) Critical temperature  
 (D) Room temperature
45. A compound decomposes according to the first order rate law with a half life period of 30 min. What will be the percentage of the remaining compound after 120 min ?
- (A) 62.5%  
 (B) 12.5%  
 (C) 6.25%  
 (D) 25.0%
46. Which of the following represent the law(s) of photochemistry ?
- (A) Grothus-Draper and Stark-Einstein law  
 (B) Raoult's and Dalton's law  
 (C) Law of mass action  
 (D) Lambert's and Beer's law
47. For a reaction  $A \rightarrow B$ , the temperature dependence of rate constant, k, is given by  $\log k = 8 - 10^3/T$ . If universal gas constant,  $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ , then the activation energy of this reaction would be close to :
- (A) 8314 J/mol  
 (B) 19147 J/mol  
 (C) 1000 J/mol  
 (D) 120 J/mol
48. When the two or more molecules get decomposed by the absorption of one photon, the quantum yield of the reaction is said to have value :
- (A)  $>1$   
 (B)  $<1$   
 (C)  $=1$   
 (D) Cannot be predicted



49. Which of the following statement is/are INCORRECT?
1. Second law of thermodynamics allows us to calculate absolute entropy of a substance.
  2. Heat (Q) and work done (W) in thermodynamics are path functions.
  3. Density of a liquid is an extensive thermodynamic property.
- (A) 1 and 2  
(B) 1 and 3  
(C) 2 and 3  
(D) 1,2 and 3
50. Which of the following is correct for the reversible isothermal expansion of one mole of an ideal gas at a given temperature from volume  $V_1$  to  $V_2$ ?
- (A)  $Q = W = \Delta U = \Delta H = 0$   
(B)  $Q = W$  and  $\Delta U = \Delta H = 0$   
(C)  $Q = W = 0$  and  $\Delta U = -\Delta H$   
(D)  $Q = -W$  and  $\Delta U = \Delta H = 0$
51. A Carnot engine operates between  $200^\circ\text{C}$  and  $20^\circ\text{C}$ . Its maximum possible efficiency is :
- (A) 90%  
(B) 100%  
(C) 38%  
(D) 72%
52. For a reaction  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$ ;  $\Delta H = 92.22 \text{ kJ/mol}$  and  $\Delta S = -198.75 \text{ J/K-mol}$ . At  $127^\circ\text{C}$ , which of the following is true for this reaction?
- (A) It is spontaneous  
(B) It is not spontaneous  
(C) It may or may not be spontaneous  
(D) Data is insufficient to predict its spontaneity
53. The number of phases in a two component system with 2 degrees of freedom would be :
- (A) 1  
(B) 2  
(C) 3  
(D) 4
54. If the specific conductance of a sparingly soluble (1 : 1) salt in its saturated aqueous solution at  $25^\circ\text{C}$  is  $1.5 \times 10^{-5} \Omega^{-1} \text{ cm}^{-1}$ ; and the ionic conductance for its cation and anion at infinite dilution are  $0.495$  and  $1.0 \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$  respectively; the solubility (in  $\text{mol L}^{-1}$ ) of the salt in water at  $25^\circ\text{C}$  is :
- (A)  $1 \times 10^{-6}$   
(B)  $1 \times 10^{-2}$   
(C)  $2 \times 10^{-1}$   
(D)  $2 \times 10^{-4}$
55. During the conductometric titration of an acid (placed in beaker) by an alkali (taken in burette), the plot between the conductance and volume of alkali added was found to initially decrease steeply followed by a sharp increase. Which of the following combinations would give such a plot?
- (A) Strong acid and strong base  
(B) Weak acid and strong base  
(C) Strong acid and weak base  
(D) Weak acid and weak base
56.  $\Lambda_m^\circ(\text{H}_2\text{O})$  is equivalent to :
- (a)  $\Lambda_m^\circ(\text{HCl}) + \Lambda_m^\circ(\text{NaOH}) - \Lambda_m^\circ(\text{NaCl})$   
(b)  $\Lambda_m^\circ(\text{HNO}_3) + \Lambda_m^\circ(\text{NaNO}_3) - \Lambda_m^\circ(\text{NaOH})$   
(c)  $\Lambda_m^\circ(\text{HNO}_3) + \Lambda_m^\circ(\text{NaOH}) - \Lambda_m^\circ(\text{NaNO}_3)$   
(d)  $\Lambda_m^\circ(\text{NH}_4\text{OH}) + \Lambda_m^\circ(\text{HCl}) - \Lambda_m^\circ(\text{NH}_4\text{Cl})$
- (A) (a) only  
(B) (a) and (d)  
(C) (a), (c) and (d)  
(D) (a), (b), (c) and (d)



57. If  $E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.441\text{V}$  and  $E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = 0.771\text{V}$ , the standard EMF of the reaction,



will be :

- (A) 1.212 V  
(B) 0.111 V  
(C) 0.330 V  
(D) 1.653 V
58. Which of the following molecules will not display an infrared spectrum ?  
(A)  $\text{CO}_2$   
(B)  $\text{N}_2$   
(C) Benzene  
(D) Both (A) and (B)
59. A molecule  $\beta$ -carotene ( $\text{MW} = 536 \text{ gmol}^{-1}$ ) has  $\lambda_{\text{max}} = 450 \text{ nm}$  and  $\epsilon = 15,000 \text{ m}^2 \text{ mol}^{-1}$ . Calculate the absorbance expected for a solution in which 0.1 mg has been dissolved in 10 ml of water in a cuvette of path length 1 cm.  
(A) 2.8  
(B)  $2.8 \times 10^{-4}$   
(C) 0.28  
(D) .028
60. When all the three principal moments of inertia of a molecule are equal, it is called :  
(A) Symmetric top  
(B) Prolate symmetric top  
(C) Asymmetric top  
(D) Spherical top