ENTRANCE TEST-2025

SCHOOL OF PHYSICAL AND MATHEMATICAL SCIENCES

CHEMISTRY

Total Questions	:	60
Time Allowed	:	70 Minutes

Question Booklet Series $\boxed{\text{A}}$

Entrance Test Roll No. : $\boxed{}\boxed{}\boxed{}\boxed{}\boxed{}\boxed{}$
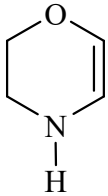
Important Instructions for Candidates :

1. Candidates shall compulsorily use only **blue/ black ball point pen.** In no case gel/ink pen or pencil should be used.

2. Compulsorily write your **entrance test roll number** in the space provided at the top of this page of the question booklet.

3. Fill up the necessary information in the spaces provided on OMR Answer Sheet including **Question Booklet Number** and **Question Booklet Series**.

4. 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.

5. All entries in the OMR Answer Sheet, including answers to questions, are to be recorded in the Original Copy only.

6. **Choose only one correct/most appropriate response** for each question among the options A, B, C and D and darken the circle of the appropriate response completely. Incompletely darkened circle is not correctly read by the OMR scanner and no complaint to this effect shall be entertained.

7. **Do not darken more than one circle of option for any question. A question with more than one darkened response shall be considered wrong.**

8. **There will be negative marking for wrong answers. Each wrong answer will lead to deduction of 0.25 marks per wrong answer from the score.**

9. Only those candidates who obtain positive score in Entrance Test shall be eligible for admission.

10. Do not make any stray mark on the OMR sheet as this may lead to errors while scanning.

11. OMR answer sheet must be handled carefully and it should not be folded or mutilated, as in such case it will not be properly evaluated by the scanning machine.

12. Use of Electronic gadgets like calculator, mobile, smart watch, blue tooth etc. is strictly prohibited.

13. Rough work, if any, should be done on the blank sheets provided with the question booklet.

14. Ensure that the OMR Sheet is signed by the Examinee as well as by the invigilator.

15. At the end of the examination, fold the OMR Sheet along the crease on the top and tear off the top strip to separate the Original OMR Sheet from the Duplicate Copy.

16. Compulsorily hand over the **Original OMR Answer Sheet** to the invigilator.

17. Candidate's can retain duplicate copy of the OMR, Question Booklet and Admit Card.

18. If any of the information in the Response Sheet/Question Paper has been found missing or not mentioned as stated above, the candidate is solely responsible for that lapse.

19. Any deficiency on the OMR shall be the responsibility of the candidate himself/herself.
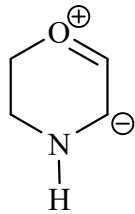
1. For a reaction of pyramidal AB_3E molecules, suppose the intermediate is a trigonal planar AB_3E unit, which of the following shall undergo fastest reaction as per VSEPR theory?

    (A) NH_3

    (B) PH_3

    (C) PF_3

    (D) NF_3

2. Predict energy of 4s electron in element with atomic number 19, given the shielding constant calculated using Slater rules to be 16.8.

    (A) 4.1 KJ

    (B) –4.1 KJ

    (C) –4.1 eV

    (D) 4.1K cal

3. Which of the following ^{19}F NMR describes the VSEPR predicted structure for ClF_3 molecule?

    (A) A singlet for three Fluorine

    (B) Two signals of unequal intensity

    (C) A down field doublet and up field triplet

    (D) Two equivalent environments in 2:1 intensity ratio

4. For X_2 molecules X = B, C, N, O and F, which experimental evidence predicts σ-π energy crossover of molecular orbital's?

    (A) F_2 is diamagnetic

    (B) N_2 is diamagnetic

    (C) O_2 is paramagnetic

    (D) B_2 is paramagnetic

5. What is incorrect for molecular symmetry of NH_3 and BF_3?

    (A) Both have a C_3 axis

    (B) Both have σ_v planes

    (C) BF_3 has a C_2 axis

    (D) NH_3 has a σ_h plane

6. The topology of the Borane's A and B produced in the sequence will be:

    $$\left[B_6H_6\right]^{2-} \xrightarrow[-2e,-BH]{+4H_2} A \xrightarrow[+2H]{-BH} B$$

    (A) closo, nido

    (B) closo, arachno

    (C) arachno, nido

    (D) nido, arachano

7. What is incorrect for the cyclic silicate anion $[Si_3O_9]^{n-}$?

    (A) It has a six membered ring with three Si—O—Si linkages

    (B) It has an overall charge of –9

    (C) Each Si center has a tetrahedral environment

    (D) It has all oxygen in formal -2 oxidation state with overall charge of –6

8. The interhalogen IF_3 (1.84 g) reacts with the 0.93 g of tetramethylammonium fluoride forming the product X, what is incorrect about this reaction ?

    (A) It forms the quaternary ammonium salt

    (B) It forms the cationic interhalogen compound

    (C) The changes involve from T shape to square planar

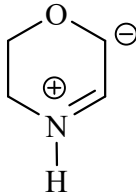   (D) The changes involves from planar shape to tetrahedral

9. Identify the complex with larger CFSE among the following pairs :

(I) (i) $\left[Cr(OH_2)_6 \right]^{2+}$ or

(ii) $\left[Mn(OH_2)_6 \right]^{2+}$

(II) (iii) $\left[Mn(OH_2)_6 \right]^{2+}$ or

(iv) $\left[Fe(OH_2)_6 \right]^{3+}$

(III) (v) $\left[Fe(OH_2)_6 \right]^{3+}$ or

(vi) $\left[Fe(CN)_6 \right]^{3-}$

(IV) (vii) tetrahedral $\left[FeCl_4 \right]^{2-}$ or

(viii) $\left[Co(Cl)_4 \right]^{2-}$

(A) i, iii, v, vii

(B) ii, iii, v, vii

(C) i, iv, vi, viii

(D) ii, iii, vi, vii

10. An uncharged tetradentate macrocyclic ligand develops a square planar red complex with a d^8 metal ion which is of diamagnetic nature when treated with perchlorate ions no change is observed in magnetism however on adding coordinating SCN^- ions its color changes to violet and it becomes two electron paramagnetic this can be due to:

(A) Substitution of macrocyclic ligand by added SCN^- ions

(B) Change from square planar to tetrahedral geometry

(C) Change from low spin to high spin complex

(D) Change from coordination number 4 to coordination number 6 with octahedral geometry

11. The linkage isomers possible for the complex Trans-bis(ethylenediamine)dithiocyanatocopper (II) will be:

(A) None

(B) one

(C) two

(D) three

12. Which of these transition metal compounds can be studied with ESR spectroscopy?

(A) $VOSO_4$

(B) $K_2Cr_2O_7$

(C) $KMnO_4$

(D) Ferrocene

13. The number of radial nodes possessed by a 4f atomic orbital is :

(A) 4

(B) 3

(C) 2

(D) 0

14. What is incorrect for the inner transition metal complex $[Ce(NO_3)_6]^{2-}$?

(A) It involves stabilization of unusual Ce^{4+} oxidation state

(B) NO_3^- ion acts as a bidentate ligand in it

(C) It has icosahedron geometry with coordination number 12

(D) All of the above

15. [Xe] $4f^6$ configuration of Eu^{3+} corresponds to:

(A) $^3F_0$
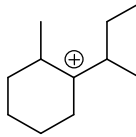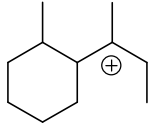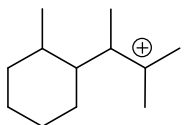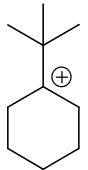
(B) $^7F_0$

(C) $^3F_6$

(D) $^4F_0$

16. Which statement correctly describes the function of cytochromes P-450?

   (A) Cytochromes P-450 act as dioxygenases

   (B) Cytochromes P-450 act as monooxygenases and catalyse the insertion of O into a C–H bond

   (C) Cytochromes P-450 couple to cytochrome c in the mitochondrial electron-transfer chain

   (D) Cytochromes P-450 contain high-spin Fe(III); this directly binds O_2 and acts as an O_2 carrier

17. Match these items for their biological role:

   A. As ferritin   I. Iron Storage

   B. As haemoglobin   II. Dioxygen transport

   C. As a siderophore   III. Iron transport

   D. As transferrin   IV. Mobilization and sequester

   (A) A-III, B-II, C-I, D-IV

   (B) A-I, B-II, C-III, D-IV

   (C) A-I, B-II, C-IV D-III

   (D) A-III, B-II, C-I, D-IV

18. The presence of solvent in a crystalline sample of a compound could be detected and quantified using:

   (A) UV-VIS

   (B) TGA

   (C) ESI-MS

   (D) AAS

19. In a transition metal alkyl compound, which σ-bonded R group could undergo β-hydrogen elimination reaction?

   (A) Ethyl

   (B) Methyl

   (C) Benzyl

   (D) Neopentyl

20. Conversion of Nitrogen to ammonia by nitrogenase enzyme is ……. reduction.

   (A) 2 electron

   (B) 4 electron

   (C) 6 electron

   (D) 8 electron

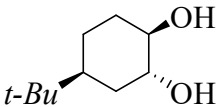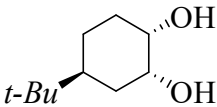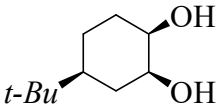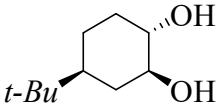21. The least stable canonical structure among the following is:

   (I)   (II)   (III)

   (A) I

   (B) II

   (C) III
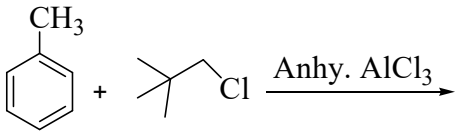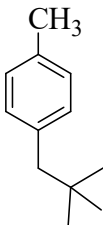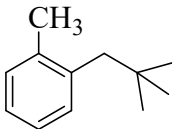
   (D) All are equally stable

22. Which among the following is the most stable carbocation?

   (A)

   (B)

   (C)

   (D)

23. Which among the following statements is incorrect?

(A) CF_2 is more stable than CCl_2

(B) CCl_2 is more stable than CBr_2

(C) Singlet CH_2 is more stable than triplet CH_2

(D) Singlet CH_2 has planar geometry
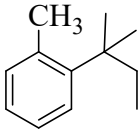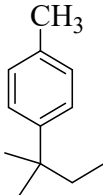
24. Among the below given vicinal diols only three are cleaved by HIO_4. The diol which is NOT cleaved by HIO_4 is :

(A)

(B)

(C)

(D)

25. Which of the following alkenes gives only acetic acid on oxidation with hot concentrated $KMnO_4$?

(A) Ethylene

(B) 1-Butene

(C) Propene

(D) 2-Butene

26. Identify the major product formed in the below given reaction :

(A)

(B)

(C)

(D)

27. Which one of the following is not a metal catalyst for the hydrogenation of an alkene?

(A) Pd

(B) Pt

(C) Na

(D) Ni

28. How many signals will the below given compound show in ^{1}H NMR Spectroscopy?
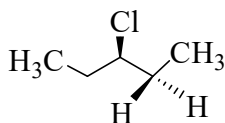

   (A) 3
   (B) 4
   (C) 5
   (D) 6

29. Predict the order of the C=O stretch in IR spectroscopy for the following compounds :
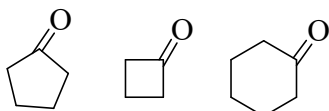
   (i)   (ii)   (iii)

   (A) i > ii > iii
   (B) ii > iii > i
   (C) ii > i > iii
   (D) i = ii = iii

30. Which among the following is an atom un-economic process?
   (A) Substitution reactions
   (B) Addition reactions
   (C) Rearrangement reactions
   (D) Diels-Alder reaction

31. Which among the following molecules will not produce heat upon microwave irradiation?
   (A) Ethanol
   (B) Hexane
   (C) Benzaldehyde
   (D) Water

32. Predict the major product formed in the below given reaction :
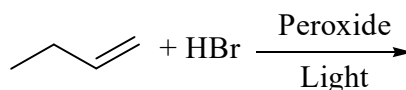
   (A)

   (B)

   (C)

   (D) None of these

33. Which of the following reactions can be used to prepare alkanes?
   (A) Wurtz reaction
   (B) Wolf-Kishner reduction
   (C) Kolbe's electrolysis
   (D) All of these

34. The hydroboration-oxidation reaction can be characterized as the _____ to an alkene.
   (A) anti-Markovnikov syn addition of water
   (B) anti-Markovnikov anti addition of water
   (C) Markovnikov syn addition of water
   (D) Markovnikov anti addition of water

35. Predict the number of stereoisomers possible for the below given cholesterol molecule :

Cholesterol
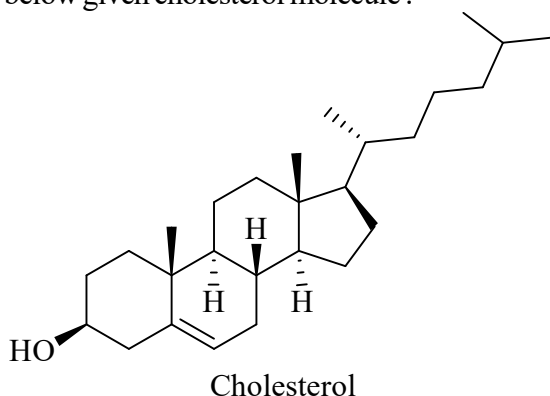
(A) 158

(B) 8

(C) 256

(D) 81

36. Which of the following factors has no effect on the rate of S_N1 reactions?

(A) The nature of the alkyl halide

(B) The nature of the leaving group

(C) The concentration of the alkyl halide

(D) The concentration of the nucleophile

37. Identify the major product formed in the below given reaction :
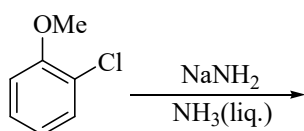
(A)

(B)

(C)

(D)

38. Identify the product formed in the below given reaction :

$$C_3H_7 \!\!-\!\!\!\equiv\!\!\!-\!\! (CH_2)_7OH \xrightarrow[\text{(ii) NH}_4\text{Cl}]{\text{(i) Na, NH}_3}$$
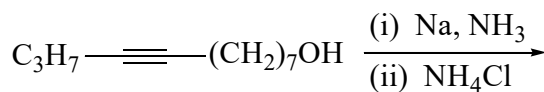
(A)

(B)

(C)

(D)

39. Identify the major product formed in the below given reaction :
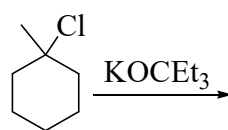
(A)

(B)

(C)

(D)

40. According to the Kinetic theory of gases :

(A) The most probable kinetic energy of the constituents of an ideal gas is more than their average kinetic energy

(B) The most probable kinetic energy of the constituents of an ideal gas is less than their average kinetic energy

(C) The most probable kinetic energy of the constituents of an ideal gas is equal to their average kinetic energy

(D) Depending upon the temperature, the most probable kinetic energy of the constituents of an ideal gas can be higher or lower than their average kinetic energy

41. According to van der Waals equation of state, the actual volume (V_{actual}) and the excluded volume ($V_{excluded}$) per molecule of gas with radius "r" is given as :

(A) $V_{actual} = \dfrac{4}{3}\pi r^3$, $V_{excluded} = \dfrac{4}{3}\pi r^3$

(B) $V_{actual} = \dfrac{4}{3}\pi r^3$, $V_{excluded} = \dfrac{8}{3}\pi r^3$

(C) $V_{actual} = \dfrac{4}{3}\pi r^3$, $V_{excluded} = \dfrac{16}{3}\pi r^3$

(D) $V_{actual} = \dfrac{4}{3}\pi r^3$, $V_{excluded} = \dfrac{32}{3}\pi r^3$

42. For a crystal with a six-fold axes of symmetry, a rotation by how much angle along this axes will lead to similar appearance ?

(A) $60°$

(B) $120°$

(C) $180°$

(D) All the three

43. The possible number of Bravais Lattices is highest for :

(A) Hexagonal Crystal Systems

(B) Tetragonal Crystal Systems

(C) Orthorhombic Crystal Systems

(D) Cubic Crystal Systems

44. In the kinetic investigations over a chemical reaction with balanced stoichiometry of $2A + B \xrightarrow{\text{yields}} 2C$, the rate of reaction doubles when the concentration of A is doubled but increases by a factor of 8 if both the concentrations are doubled. This implies that the reaction follows a rate law of :

(A) $\text{Rate} = k[A][B]$, with an overall order of 2

(B) $\text{Rate} = k[A]^2[B]$, with an overall order of 3

(C) $\text{Rate} = k[A][B]^2$, with an overall order of 3

(D) $\text{Rate} = k[A]^2[B]^2$, with an overall order of 4

45. The half-life of a reaction was observed to reduce to one half when the initial concentration of the reactant was doubled, then the order of the reaction is :

(A) Zero

(B) One

(C) Two

(D) Cannot be predicted

46. In the catalysis of a reversible reaction, the use of catalyst results in :

(A) Increase in the rate constant of forward reaction only

(B) Increase in the rate constant of forward as well as backward reaction

(C) Increase in the rate constant of forward reaction with a shift in equilibrium to favor products

(D) Increase in the rate constant of forward reaction and a decrease in the rate constant of backward reaction

47. Photochemical internal conversion involves the transition of electrons from :
   (A) Lower singlet states to higher singlet states
   (B) Higher singlet state to lower singlet state
   (C) Singlet states to triplet states
   (D) Triplet states to singlet states

48. In phosphorescence there is a change in electronic spin state from :
   (A) S_1 to S_0
   (B) T_1 to T_0
   (C) T_1 to S_0
   (D) S_0 to T_1

49. Which of the following is not correct for heat capacity of ideal gases ?
   (A) For monoatomic gases $C_p - C_v = R$
   (B) Heat capacity of diatomic gases is higher than that of monoatomic gases
   (C) Heat capacity does not depend upon the molecular structure of gas
   (D) For a diatomic gas $C_p - C_v = 2R$

50. In the isothermal expansion of an ideal gas :
   (A) $\Delta H = \Delta U = 0$
   (B) $\Delta U = 0, \Delta H = P\Delta V$
   (C) $\Delta U = \Delta H = P\Delta V$
   (D) $\Delta U = \Delta H = nRT$

51. Which among the following statements best describes the behaviour of an ideal vs. non-ideal gas during adiabatic expansion ?
   (A) Both ideal and non-ideal gases cool at the same rate during adiabatic expansion
   (B) An ideal gas cools more than a non-ideal gas during adiabatic expansion
   (C) A non-ideal gas may cool less than an ideal gas during adiabatic expansion
   (D) While ideal gas cools, the non-ideal gas always heats up during adiabatic expansion

52. The slope of the Clausius-Clapeyron plot ($\ln P$ vs. $1/T$) gives :
   (A) The enthalpy of vaporization
   (B) The enthalpy of vaporization divided by R
   (C) The negative of enthalpy of vaporization
   (D) The negative of enthalpy of vaporization divided by R

53. Which of the following hydrates is stable at room temperature in $FeCl_3$– H_2O system?
   (A) $FeCl_3.2H_2O$
   (B) $FeCl_3.3H_2O$
   (C) $FeCl_3.5H_2O$
   (D) $FeCl_3.6H_2O$

54. A solute with its dimer form as the only stable form in benzene in contrast to its monomeric form in water distributes between water and benzene. The concentration of solute in water was observed to be 0.20 mol/L, while in benzene it was 0.10 mol/L. The distribution coefficient K_D(Benzene/water) of solute will be :
   (A) 0.20
   (B) 0.50
   (C) 1.00
   (D) 1.58

55. Which among the following statements correctly explains the reason for the increase in molar conductance of a string electrolyte with dilution ?
   (A) Increase in the number of ions with increase of dilution
   (B) Increase in the degree of dissociation of the electrolyte with increase of dilution
   (C) Increase in the mobility of ions with increase of dilution
   (D) Decrease in the viscosity of solution with increase of dilution

56. Which among the following statements is correct for the conductance of electrolyte solutions ?

(A) At infinite dilution the transport number as well as the ionic mobility of an ion is independent of its counter ions

(B) At infinite dilution the transport number as well as the ionic mobility of an ion is dependent on the nature of its counter ions

(C) At infinite dilution the transport number of an ion is independent of the nature of its counter ions but it's ionic mobility is dependent on the nature of its counter ions

(D) At infinite dilution the ionic mobility of an ion is independent of the nature of its counter ions but it's transport number is dependent on the nature of its counter ions

57. For a sparingly soluble salt like $BaSO_4$, the solubility (S) is related to its specific conductance (k) and molar conductance at infinite dilution $\left(\lambda_m^0\right)$ as :

(A) $S = \left(\dfrac{k}{\lambda_m^0}\right)^2$

(B) $S = \left(\dfrac{k}{\lambda_m^0}\right)^1$

(C) $S = \left(\dfrac{k}{\lambda_m^0}\right)^{1/2}$

(D) $S = \dfrac{(k)^2}{\lambda_m^0}$

58. The Total energy (E) produced by a galvanic cell of voltage "V Volts" when it delivers a current of I amperes for a total of "t" seconds will be :

(A) $E = I \times t \times V$

(B) $E = \dfrac{I \times t}{V}$

(C) $E = \dfrac{i \times V}{t}$

(D) $E = \dfrac{V \times t}{i}$

59. The correct statement about saturated calomel electrode is :

(A) It is the most commonly used primary reference electrode

(B) Its potential does not depend upon the temperature

(C) It is regarded as an electrode of first kind

(D) None of the above

60. Theoretically, for a Galvanic cell with a positive temperature coefficient :

(A) The electrical energy will be always equal to the enthalpy of the cell reaction

(B) The electrical energy will be less than the enthalpy of the cell reaction

(C) The electrical energy will be more than the enthalpy of the cell reaction

(D) The emf of the cell decreases with an increase of temperature

ROUGH WORK

ENTRANCE TEST-2024

SCHOOL OF PHYSICAL AND MATHEMATICAL SCIENCES

CHEMISTRY

Question Booklet Series **A**

Total Questions : 60
Time Allowed : 70 Minutes

Roll No. :

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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.

1. Which among the following conformers of cyclohexane has highest energy ?

   (A) Chair form

   (B) Boat form

   (C) Twist boat form

   (D) Half chair form

2. α-D-glucose and β-D-glucose differ from each other due to differences in one of the carbon atoms with respect to its :

   (A) Size of hemiacetal ring

   (B) Number of OH groups

   (C) Configuration

   (D) Conformation
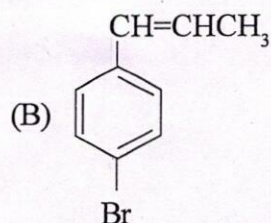
3. Allenes show chirality because of the presence of :

   (A) Chiral carbon atom

   (B) Chiral axis

   (C) Chiral plane

   (D) Chiral helix

4. Which of the following will facilitate the electrophile attack on the benzene ring ?

   (A) – NO$_2$

   (B) – CHO

   (C) – Cl

   (D) – SO$_3$H

5. The reaction of C$_6$H$_5$CH=CHCH$_3$ with HBr produces :

   (A) C$_6$H$_5$CH$_2$CH(Br)CH$_3$

   (B)

   (C) C$_6$H$_5$CH$_2$CH$_2$CH$_2$Br

   (D) C$_6$H$_5$CH(Br)CH$_2$CH$_3$

6. The product formed in the following reaction

   (A)

   (B)

   (C)

   (D)
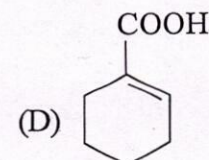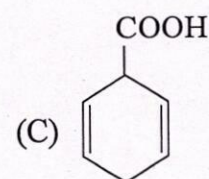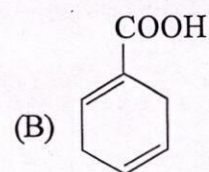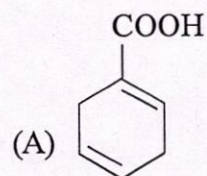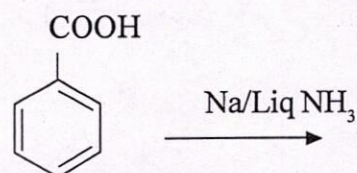
7. In an S_N2 substitution reaction of the type :

$$R-Br + Cl^- \xrightarrow{DMF} R-Cl + Br^-$$

Which one of the following has the highest relative rate ?

(A) CH_2CH_2Br

(B) $CH_3-CH_2-CH_2Br$

(C) $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-Br$

(D) $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_2Br$
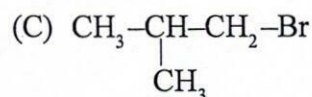
8. Which alkene would you expect to be the major product of the following dehydration ?

(A)

(B)

(C)

(D)
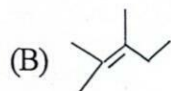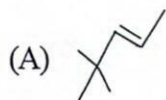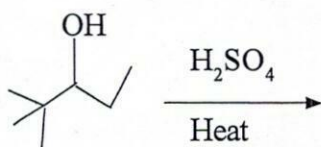
9. Pick out the correct match :

(A) Birch Reduction H_2/N_2

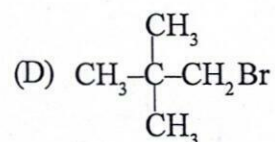(B) Wolf-Kishner reduction Zn/HCl

(C) Clemenson Reduction   Anhyd. $AlCl_3$

(D) Meerwin-Ponndorf-
Verly reduction $Al[OCH(CH_3)_2]_3$

10. Which of the following reagents is/are used in the given reaction ?
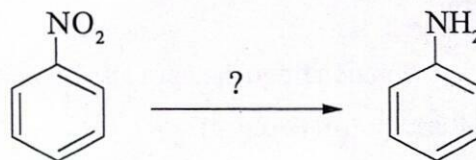
(A) H_2/Pd, Ethanol

(B) $Sn + HCl$

(C) $Fe + HCl$

(D) All of the above

11. When Aryl diazonium salt is treated with hypophosphorous acid, it is reduced to which of the following compound ?

(A) Arene

(B) Methane

(C) Ethyl alcohol

(D) Amines

12. Which of the following reactions involves a carbene as an intermediate ?

(A) Reformatsky reaction

(B) Reimer-Tiemann reaction

(C) Witting reaction

(D) Perkin reaction

13. The λ(max) of the given compound lies at :
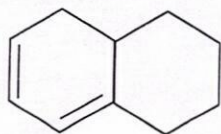
(A) 230 nm

(B) 273 nm

(C) 270 nm

(D) 246 nm

14. The stretching vibration frequencies of alkyl cyanide –C≡N is in the region of (in cm^{-1}) :

(A) 1400 to 1250

(B) 2260 to 2240

(C) 2950 to 2650

(D) 3590 to 4420

15. Among the following the NMR inactive nucleus is :

(A) $^{14}N_7$

(B) $^{31}P_{15}$

(C) $^{24}Mg_{12}$

(D) $^{29}Si_{14}$

16. How many ^{1}H–NMR signals are observed for propanol in low-resolution NMR ?

(A) One

(B) Two

(C) Three

(D) Four

17. The pH at which a protein ionizes as acid and also as a base to the same extent is called :

(A) Eutectic point

(B) Isomeric point

(C) Isotonic point

(D) Iso-electric point

18. Among the following the amino acid which is basic in nature is :

(A) Tyrosine

(B) Asparagine

(C) Leucine

(D) Arginine

19. Cholesterol belongs to which class of natural products ?

(A) Alkaloid

(B) Terpenoid

(C) Steroid

(D) Flavonoids

20. Which purine and pyrimidine bases are paired together by hydrogen bonds in DNA ?

(A) GC and AT

(B) TC and AG

(C) GC and AT; TC and AG

(D) UC and AT

21. Which of the following is not tetrahedral ?

(A) P4

(B) SiF4

(C) Ni(CO)$_4$

(D) XeF$_4$

22. Which statement is incorrect ?

(A) A molecule of white phosphorus, P4, contains six homonuclear bonds

(B) A molecule of NH_3 contains heteronuclear bonds

(C) S6 is a cyclic molecule and it contains six S–S covalent bonds

(D) A molecule of H_2O_2 contains two homonuclear bonds

23. Which of the following observations in ^{19}F NMR describe the VSEPR structure of ClF_3 molecule ?

(A) Three chemical shifts for three fluorine

(B) Single chemical shift for three fluorine

(C) Two chemical shifts for three fluorine

(D) Two chemical shifts for two fluorine

24. Which statement about organoaluminium compounds is incorrect ?

(A) $Al_2\{CH(SiMe_3)_2\}_4$ contains an Al–Al bond

(B) In $Al_2Ph_4(\mu\text{-}C\equiv CPh)_2$, the bridge bonds can be described in a similar way to those in $Al_2Me_4(\mu\text{-}Ph)_2$

(C) The bonding in $Al_2Me_4Cl_2$ molecule with bridging Cl can be described in terms of a localized scheme

(D) Dimer of $AlMe_3$ possesses three centre Al–C–Al bonding interactions

25. Which oxidation states correctly represent the usual range exhibited by the stated f block metal ?

(A) U: + 2, + 3 and + 4

(B) Th: + 1 and + 4

(C) Ce: + 3 and + 4

(D) Pu: + 3, + 4, + 5 and + 6

26. What is the main difference between NMR-spectroscopy and X-ray diffraction in structural analysis ?

(A) Simple NMR analysis of molecules in solutions does not yield details on bond angles, lengths and inter-particle contacts

(B) X-ray diffraction does not yield details on bond angles and lengths

(C) NMR gives the identity of constituents in molecules while X-ray diffraction does not

(D) Both yield the same results; choosing one or the other is a matter of preference or availability

27. Transmetallation a common reaction of s-block metals essentially involves :

(A) Breaking metal-carbon bonds and forming new metal-carbon bonds but with a different metal

(B) Breaking metal-carbon bonds and forming metal-metal and carbon-carbon bonds

(C) Breaking metal-carbon bonds and forming carbon-carbon bonds and elemental metal

(D) Any of these

28. What is correct for B_5H_9 ?

(A) 24 skeletal electrons giving nido structure

(B) 14 skeletal electrons giving arachno structure

(C) 7 skeletal electrons giving nido structure

(D) None of these

29. "Lithium therapy" for bipolar disorders generally uses :

(A) LiCl or Li_2CO_3 salt

(B) A pill with Li silicate as an active ingredient

(C) An injection of Li-containing phosphate buffer

(D) Any of these depending on choice

30. What is incorrect for Jahn Teller distortion in octahedral complexes ?

   (A) It describes the general instability of octahedral complexes

   (B) It can be explained using crystal field theory

   (C) It is always present in d^9 systems irrespective of ligand field strength

   (D) It has lowest magnitude in case of d^4 high spin complexes

31. In case of the Allred-Rochow electronegativity scale, electronegativity values are :

   (A) Inversely proportional to square of effective nuclear charge

   (B) Directly proportional to square of effective nuclear charge

   (C) Inversely proportional to the covalent radius r

   (D) None of these

32. Pick the odd one out among the following for the type of Pi bonding :

   (A) BO_3^-

   (B) CO_3^{2-}

   (C) NO_3^-

   (D) SO_3^{2-}

33. Identify correct statement for P_4O_{10} :

   (A) It has a peroxide linkage connecting phosphorus atoms

   (B) It has direct P–P bonds

   (C) Two phosphorous atoms are in different chemical bonding to other two

   (D) Each phosphorus makes a total 5 bonds acquiring its + 5 oxidation state

34. Permanganate ion MnO_4^- is pink coloured while perrhenate ion ReO_4^- is colour less because :

   (A) d-d transition in the Re^{+7} compounds is of higher energy than in Mn^{+7} compound

   (B) d-d transition in the Re compound is forbidden but allowed in Mn compound

   (C) charge drift from O^- to Re^{+7} is of lower energy

   (D) charge drift from O^- to Mn^{+7} is of lower energy

35. What is the correct statement ?

   (A) Ag_2S has lower solubility product than MnS

   (B) Ag_2S has higher aqueous solubility than MnS

   (C) Soft soft interaction gives Ag_2S lower solubility product than MnS

   (D) Borderline soft interaction gives MnS a lower solubility product than Ag_2S

36. Volume is a unique concentration term used in case of H_2O_2, (considering density = 1) if 5 gm of hydrogen peroxide are present in 56 mL of solution, the solution will approximately correspond to :

   (A) 10 volumes

   (B) 20 volumes

   (C) 30 volumes

   (D) 2 volumes

37. Which of the following f-block trivalent metal ions has highest number of unpaired electrons ?

   (A) Pr^{3+}

   (B) Pm^{3+}

   (C) Eu^{3+}

   (D) Er^{3+}

38. Using EAN concept, identify compound having sigma as well as pi bonded ligands to metal centre: (Cp: cyclopentadienyl ring system) :

(A) Fe (CP)$_2$

(B) Fe(Cp)$_2$ (CO)$_2$

(C) Mn(CP)$_2$

(D) Be(CP)$_2$

39. Identify the correct match for Titrations as analytical methods :

I		II
I. Acid Base Titration	a.	Xylenol Organge
II. Redox Titration	b.	Methyl Orange
III. Complexometric Titrations	c.	Diphenylamine
IV. Mohr Titration	d.	Sodium chromate

(A) I-b; II-d; III-c; IV-a

(B) I-b; II-c; III-d; IV-a

(C) I-d; II-c; III-a; IV-b

(D) I-b; II-c; III-a; IV-d

40. The deep blue colour of [CoCl$_4$]$^{4-}$ and light pink colour of [Co(OH$_2$)$_6$]$^{2+}$ are due to :

(A) MLCT transition in the first and d-d transition in second

(B) LMCT transition in both

(C) d-d transition in both

(D) d-d transition in the first and MLCT transition in the second

41. According to Kinetic theory of gases, which among the following statements is not correct ?

(A) Gases are made up of non-interacting constituents

(B) In their random motion, the constituents of a gas perfectly follow the laws of conservation of energy and Newton's second law of motion

(C) The total energy of a gas sample is partly kinetic and partly potential

(D) Pressure of a gas sample is independent of the volume of its constituents

42. According to kinetic theory of gases, the average translational kinetic energy per mole of C$_2$H$_2$ ideal gas is :

(A) 9 RT

(B) $\dfrac{19}{2}$ RT

(C) 6 RT

(D) $\dfrac{9}{2}$ RT

43. For the crystal plane that cuts the crystal axes at (2a, −3b, −3c), the Miller indices are :

(A) (2 −3 −3)

(B) (−2 3 3)

(C) (3 −2 −2)

(D) (−3 2 2)

44. The number of Bravais Lattices possible for Cubic, Orthorhombic and Tetragonal Crystal systems respectively are :

(A) 3, 3, 3

(B) 3, 4, 2

(C) 3, 2, 2

(D) 3, 2, 4

45. For a first-order reaction with just one reactant and a product, select the most appropriate statement :
   (A) The concentration of reactant decreases linearly with time
   (B) If estimated, the rate of the reaction would be highest at the beginning of the reaction
   (C) The concentration of product increases linearly with time
   (D) Both (A) and (C)

46. According to collision theory of reaction rates :
   (A) Increase of the size of reactants increases rate constant of the reaction
   (B) Increase of molecular mass of the reactants decreases its apparent rate constant
   (C) Chemical reactions have activation barrier
   (D) All of the above

47. For Photochemical $H_2 - Cl_2$ reaction :
   (A) Rate of reaction is first order with respect to the concentration of Cl_2
   (B) Rate of reaction varies as the square root of the intensity of absorbed radiations
   (C) The reaction starts with photochemical dissociation of H_2
   (D) All of the above

48. The activation energy of reaction R_1 is Twice as that of reaction R_2. Both the reactions were investigated for variation of their rate constants with temperature. Which among the following shall correctly represent the apparent variation of rate constants for similar changes of the temperature ?
   (A) The apparent variation of the rate constant of reaction R_1 is greater than that of reaction R_2
   (B) The apparent variation of rate constant of reaction R_2 is greater than that of reaction R_1
   (C) The apparent variation of rate constant of reaction R_1 is similar to that of reaction R_2
   (D) The apparent variation of rate constant of reaction R_1 can be greater or smaller than that of reaction R_2

49. For isothermal expansion of an ideal gas from volume V_1 to V_2 :
   (A) $\Delta H = \Delta U \neq 0$
   (B) $q = w$
   (C) $w = nRT \ln \dfrac{V_2}{V_1}$
   (D) $q = \Delta U$

50. In the adiabatic expansion of one mole of an ideal gas from volume of V_1 to volume V_2, where T_1 and T_2 are the temperatures in initial and final state, and ratio
   $$\frac{Cp}{Cv} = \gamma$$
   (A) $\Delta U = -w$
   (B) $\Delta U = -C_v (T_2 - T_1)$
   (C) $\dfrac{T_2}{T_1} = \left(\dfrac{V_1}{V_2}\right)^{1-\gamma}$
   (D) $\Delta H = \Delta U + R(T_2 - T_1)$

51. The maximum work that can be done by a Carnot engine from 600 kJ of heat it absorbs if operated with source and sink temperatures of 100°C and 0°C respectively will be :
   (A) 600 kJ
   (B) 160.8 kJ
   (C) 219.8 kJ
   (D) Will depend upon the nature of the gas used in the engine

52. The chemical potential of a component :
   (A) Is an extensive property that increases with increase of pressure
   (B) Is an intensive property that decreases with increase of pressure
   (C) Is an extensive property that decreases with increase of temperature
   (D) Is an intensive property that decreases with increase of temperature

53. In the phase diagram of water :

(A) The curves imply two phase univariant states

(B) The areas imply one phase bivariant states

(C) The intersection of curves imply two phase nonvariant state

(D) Both (A) and (B)

54. The molar conductance of a weak electrolyte at infinite dilution is 0.04 Sm^2mol^{-1} at 298 K. What will be its degree of dissociation at 0.02 M if the specific conductance of its said solution is 0.016 Sm^{-1} ?

(A) 0.02

(B) 0.2

(C) 0.04

(D) 0.4

55. The extent of solvation is known to depend upon the ionic size and increasing ionic size decreases the extent of solvation. Assuming that higher solvated size implies smaller ionic mobility (μ_i), which among the following correctly depicts the correct order of ionic mobilities in water ?

(A) $\mu_{H^+} > \mu_{Li^+} > \mu_{Na^+} > \mu_{K^+}$

(B) $\mu_{H^+} < \mu_{Li^+} < \mu_{Na^+} < \mu_{K^+}$

(C) $\mu_{H^+} > \mu_{K^+} > \mu_{Na^+} > \mu_{Li^+}$

(D) $\mu_{K^+} > \mu_{Na^+} > \mu_{Li^+} > \mu_{H^+}$

56. In the conductometric titration of a strong acid with weak base :

(A) Conductance initially decreases and then remains constant after equivalence point

(B) Conductance initially decreases and then increases after equivalence point

(C) Conductance initially increases slowly and then increases sharply after equivalence point

(D) Conductance initially remains constant and then increases sharply after equivalence point

57. In a galvanic cell :

(A) Electrical energy is converted into chemical energy

(B) The electrical energy will be equal to enthalpy of cell reaction if temperature coefficient of cell EMF is zero

(C) The electrical energy will be more than enthalpy of cell reaction if temperature coefficient of cell EMF is positive

(D) Both (B) and (C)

58. If rotational spectrum is recorded for a homo-diatomic molecule :

(A) The spectrum will consist of series of successive spectral lines with spacing equal to 2B

(B) The spectrum will consist of series of successive spectral lines with spacing equal to B

(C) The spectrum will consist of series of successive spectral lines with spacing equal to B/2

(D) No rotational spectrum can be recorded

59. Which among the following will be microwave active ?

(A) CH_4

(B) CO_2

(C) H_2O_2

(D) BF_3

60. The number of Vibrational degrees of freedom for CO_2, NO_2 and SO_2 are :

(A) 4, 4, 4

(B) 4, 4, 3

(C) 4, 3, 3

(D) 3, 3, 3