Sr. No. 541

ENTRANCE TEST-2024

SCHOOL OF PHYSICAL AND MATHEMATICAL SCIENCES

CHEMISTRY

Question Booklet Series **A**

Total Questions : 60
Time Allowed : 70 Minutes

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.
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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.
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SEAL

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) $-NO_2$

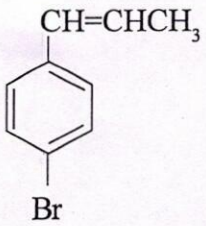
(B) $-CHO$

(C) $-Cl$

(D) $-SO_3H$

5. The reaction of $C_6H_5CH=CHCH_3$ with HBr produces :

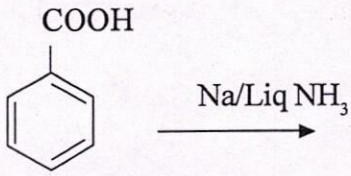
(A) $C_6H_5CH_2CH(Br)CH_3$

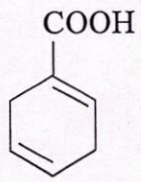
(B) 

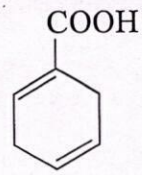
(C) $C_6H_5CH_2CH_2CH_2Br$

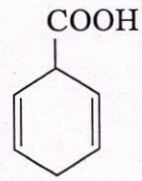
(D) $C_6H_5CH(Br)CH_2CH_3$

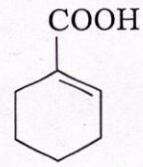
6. The product formed in the following reaction



(A) 

(B) 

(C) 

(D) 

7. In an S_N2 substitution reaction of the type :

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

Which one of the following has the highest relative rate ?

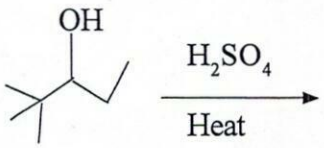
(A) CH_2CH_2Br

(B) $CH_3\text{–}CH_2\text{–}CH_2Br$

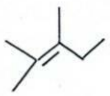
(C) $CH_3\text{–}\underset{\displaystyle CH_3}{\underset{|}{CH}}\text{–}CH_2\text{–}Br$

(D) $CH_3\text{–}\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}\text{–}CH_2Br$

8. Which alkene would you expect to be the major product of the following dehydration ?



(A) 

(B) 

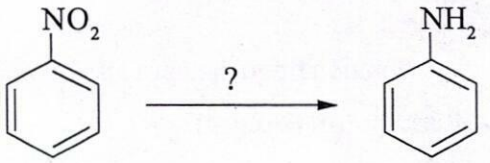
(C) 

(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 ?

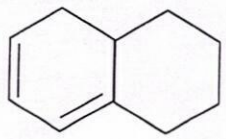
(A) Reformatsky reaction

(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 ^1H–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_2H_2 ideal gas is :

(A) 9 RT

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

(C) 6 RT

(D) $\frac{9}{2}$ 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 $\mathbf{R}_1$ is Twice as that of reaction $\mathbf{R}_2$. 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 $\mathbf{R}_1$ is greater than that of reaction $\mathbf{R}_2$
(B) The apparent variation of rate constant of reaction $\mathbf{R}_2$ is greater than that of reaction $\mathbf{R}_1$
(C) The apparent variation of rate constant of reaction $\mathbf{R}_1$ is similar to that of reaction $\mathbf{R}_2$
(D) The apparent variation of rate constant of reaction $\mathbf{R}_1$ can be greater or smaller than that of reaction $\mathbf{R}_2$

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) $w = nRT \ln \frac{V_2}{V_1}$
(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) $\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{1-\gamma}$
(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

Sr. No. .....

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1. What Geometries SNF_3 and XeO_2F_2 molecules have as per covalent bonding pattern ?
   (A) Square planar both
   (B) Tetrahedral both
   (C) Square planar and trigonal bipyramidal
   (D) Tetrahedral and trigonal bipyramidal

2. Match the hydride with its general property :

a.	NaH	I.	Polymeric Chain
b.	BeH_2	II.	Interstitial hydride
c.	$Hf\ H_{2.10}$	III.	Tricapped trigonal prism
d.	$[TcH_9]^{2-}$	IV.	Saline hydride

   (A) a–IV, b–II, c–III, d–I
   (B) a–I, b–IV, c–II, d–III
   (C) a–IV, b–I, c–II, d–III
   (D) a–IV, b–I, c–III, d–II

3. The observed enthalpies of hydration of divalent cations follows the order :
   (A) $Mn^{2+} < Ca^{2+} > Zn^{2+}$
   (B) $Zn^{2+} > Ca^{2+} > Mn^{2+}$
   (C) $Mn^{2+} > Zn^{2+} > Ca^{2+}$
   (D) $Zn^{2+} > Mn^{2+} > Ca^{2+}$

4. 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

5. Pick the odd one out for intermolecular hydrogen bonding :
   (A) Acetic acid
   (B) Ortho nitrophenol
   (C) Meta nitrophenol
   (D) Ortho boric acid

6. 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 bride type bond
   (C) One P=O bond and two POP bridge type bond
   (D) Only POH, POP and none P=O

7. The incorrect pair among the following is :
   (A) Iron (II); Carbonic anhydrase
   (B) Iron storage; Ferritin
   (C) Cadmium toxicity; Metallothoniens
   (D) Cytochrome 450; Monooxygenase

8. 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

9. The choice of bridging group in case of Aluminium dimmers can be :
   (A) $Br^- > Ph > CH_3$
   (B) $Br^- < Ph < CH_3$
   (C) $Br^- < CH_3 < Ph$
   (D) $Ph > CH_3 > Br^-$

10. Which of the following non-metal systems have been referred to as one dimensional conductors ?
   (A) Phosphonitrilic halides
   (B) Polyphosphazenes
   (C) Polythiazyls
   (D) Polyphosphates

11. 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

12. 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

13. Which of the following lanthanide (III) ion has considerably different calculated and observed magnetic moment for its aqua complex ?
(A) Ce^{3+}
(B) Pr^{3+}
(C) Eu^{3+}
(D) Yb^{3+}

14. 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

15. Identify the correct match for Titration indicator :

Titration		Indicator	
I.	Ni^{2+} with EDTA	a.	Murexide
II.	Cl^- with Ag^+	b.	Potassium chromate
III.	Fe^{2+} with Ce^{4+}	c.	Ferroin
IV.	NH_4OH with 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

16. From the given solubility product {Ksp} values, pick the most appropriate precipitating agent for Ca^{2+} ions in solution :
$CaSO_4 = 2.4 \times 10^{-5}$; $CaCO_3 = 4.5 \times 10^{-9}$; $Ca(OH)_2 = 6.5 \times 10^{-6}$; $CaCl_2 = 1.57 \times 10^{-3}$
(A) Na_2SO_4
(B) Na_2CO_3
(C) NaOH
(D) NaCl

17. For estimating total chloride content of 30 mL of 0.01 M solution of $[Co(NH_3)_5Cl]Cl_2$ complex as silver chloride, the volume of 0.1 M $AgNO_3$ required for complete precipitation will be :
(A) 3 mL
(B) 6 mL
(C) 5 mL
(D) 9 mL

18. The complexes of which of the following inner transition metal ion are commonly used as MRI (Magnetic Resonance Imaging) contrast agents ?
(A) Gd
(B) Eu^{2+}
(C) Lu^{3+}
(D) Gd^{3+}

19. 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)

20. Which of the following complexes obey 18-electron rule with overall charge zero ? (Considering (η^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) $(\eta^5–C_5H_5)Re((\eta^6–C_6H_6)$

21. 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}

22. 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) $V_{mp} < V_m < V_{rms}$

23. The Miller indices of a diagonal plane of a cube would be :
(A) 110
(B) 100
(C) 200
(D) 111

24. A gas cannot be liquefied whatever the pressure is only above its :
(A) Boyle temperature
(B) Inversion temperature
(C) Critical temperature
(D) Room temperature

25. 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%

26. 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

27. 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, $R = 8.314\ J\ mol^{-1}\ K^{-1}$, 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

28. 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

29. Which of the following statement is/are INCORRCT ?
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

30. 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 $\Delta U = \Delta H = 0$

31. A Carnot engine operates between 200°C and 20°C. Its maximum possible efficiency is :
(A) 90%
(B) 100%
(C) 38%
(D) 72%

32. For a reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$; $\Delta H = 92.22$ kJ/mol and $\Delta S = -198.75$ J/K-mol. At 127°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

33. The number of phases in a two component system with 2 degrees of freedom would be :
(A) 1
(B) 2
(C) 3
(D) 4

34. If the specific conductance of a springily soluble (1 : 1) salt in its saturated aqueous solution at 25°C is $1.5 \times 10^{-5} \Omega^{-1}$ cm^{-1}; and the ionic conductance for its cation and anion at infinite dilution are 0.495 and 1.0 Ω^{-1} cm^2 mol^{-1} respectively; the solubility (in mol L^{-1}) of the salt in water at 25°C is :
(A) 1×10^{-6}
(B) 1×10^{-2}
(C) 2×10^{-1}
(D) 2×10^{-4}

35. During the conductometric titration of an acid (placed in beaker) by an alkali (taken in burrette), 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

36. $\Lambda^{o}_{m}(H_2O)$ is equivalent to :

(a) $\Lambda^{o}_{m}(HCl) + \Lambda^{o}_{m}(NaOH) - \Lambda^{o}_{m}(NaCl)$

(b) $\Lambda^{o}_{m}(HNO_3) + \Lambda^{o}_{m}(NaNO_3) - \Lambda^{o}_{m}(NaOH)$

(c) $\Lambda^{o}_{m}(HNO_3) + \Lambda^{o}_{m}(NaOH) - \Lambda^{o}_{m}(NaNO_3)$

(d) $\Lambda^{o}_{m}(NH_4OH) + \Lambda^{o}_{m}(HCl) - \Lambda^{o}_{m}(NH_4Cl)$

(A) (a) only

(B) (a) and (d)

(C) (a), (c) and (d)

(D) (a), (b), (c) and (d)

37. If $E^{o}_{Fe^{2+}/Fe} = -0.441V$ and $E^{o}_{Fe^{3+}/Fe^{2+}} = 0.771V$, the standard EMF of the reaction,

$$Fe + 2Fe^{3+} \rightarrow 3Fe^{2+}$$

will be :

(A) 1.212 V

(B) 0.111 V

(C) 0.330 V

(D) 1.653 V

38. Which of the following molecules will not display an infrared spectrum ?

(A) CO_2

(B) N_2

(C) Benzene

(D) Both (A) and (B)

39. A molecule β-carotene (MW = 536 $gmol^{-1}$) has l_{max} 450 nm and e = 15,000 $m^2\ mol^{-1}$. 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) 2.8×10^{-4}

(C) 0.28

(D) .028

40. When all the three principal moments of intertia of a molecule are equal, it is called :

(A) Symmetric top

(B) Prolate symmetric top

(C) Asymmetric top

(D) Spherical top

41. Choose the correct IR frequency of C=O of amide :

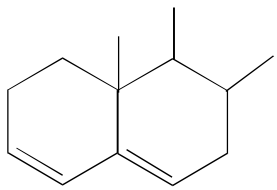
(A) 1800 cm^{-1}

(B) 1730 cm^{-1}

(C) 1630 cm^{-1}

(D) 1680 cm^{-1}

42. Choose the λ_{max} of the molecule given below :



(A) 215 nm

(B) 235 nm

(C) 234 nm

(D) 265 nm

43. The approximate value of methyl proton in NMR is :

(A) 1.3

(B) 1.5

(C) 0.9

(D) 2.5

44. Signal splitting in NMR arises from :

(A) Shielding effect

(B) Spin-spin decoupling

(C) Spin-spin coupling

(D) Deshielding effect

45. Which of the following is used to prepare Benzoyl chloride from benzoic acid ?

(A) Cl_2, H_2O

(B) $SOCl_2$

(C) SO_2, Cl_2

(D) Cl_2, hv

46. Which of the following organic compound is formed when aniline reacts with acetaldehyde ?

(A) Diazoniumsalt

(B) Schiff 's base

(C) Immine

(D) Carbylamine

47. 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

48. Which of the following is a phospholipid ?

(A) Sterol

(B) Cholesterol

(C) Lecithin

(D) Steroid

49. 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

50. Which of the following factors is not responsible for the denaturation of proteins ?

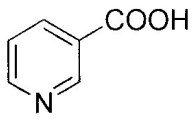
(A) Heat

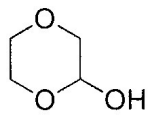
(B) Charge

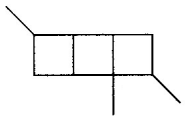
(C) pH change

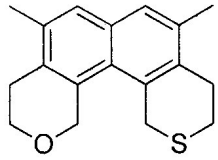
(D) Organic solvents

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

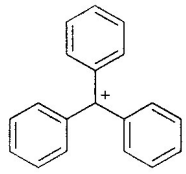
(A) 

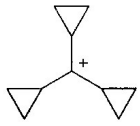
(B) 

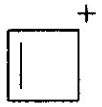
(C) 

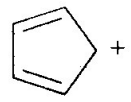
(D) 

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

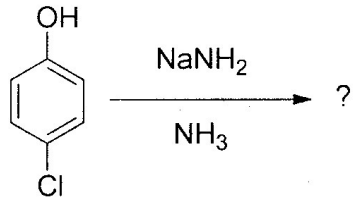
(A) 

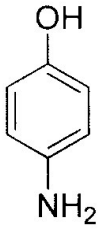
(B) 

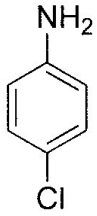
(C) 

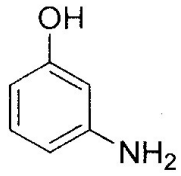
(D) 

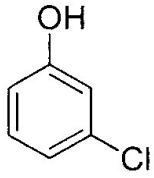
53. The major product of the below given reaction is :



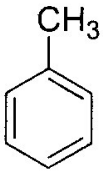
(A) 

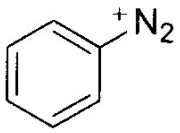
(B) 

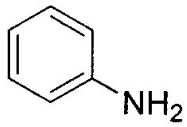
(C) 

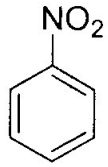
(D) 

54. Which among the following undergo $ArSN_2$ mechanism with ease ?

(A) 

(B) 

(C) 

(D) 

55. Aromatic electrophilic substitution reaction proceed via :

(A) Carbocation Intermediate

(B) Radical Intermediate

(C) Arinium Ion Intermediate

(D) Benzyne Intermediate

56. What is the possible intermediate formed in the Reimer-Tiemann reaction ?

(A) Carbocation

(B) Carboanion

(C) Carbene

(D) Free radicals

57. One of the possible factor of cyclopropane instability is :

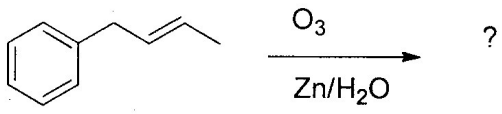
(A) Torsional strain

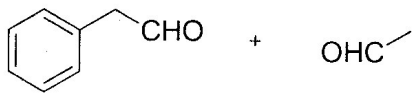
(B) C–H bond length

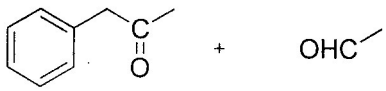
(C) 60 bond angles

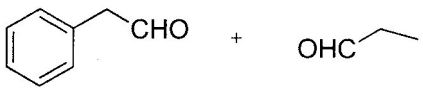
(D) Due to Sp character of Carbons

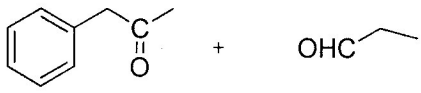
58. The product of the below given reaction is :



(A) 

(B) 

(C) 

(D) 

59. The suitable electrophilic substitution on Pyridine occurs at :
(A) C–2
(B) C–3
(C) C–4
(D) None of the above

60. What is obtained by thermolysis of azides ?
(A) Free radicals
(B) Carbocation
(C) Arene
(D) Nitrene

ROUGH WORK

ROUGH WORK

Sr. No. .....520.....

ENTRANCE TEST-2022

SCHOOL OF PHYSICAL & MATHEMATICAL SCIENCES

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.

1. Which of the following statement is/are false about the correction terms in van der Waals equations ?

(A) The coefficient "a" accounts for the mutual attraction between the molecules.

(B) The term a/v^2 increases the pressure of real gas relative to ideal gas.

(C) The coefficient "b" represents the volume that is compressible.

(D) Both (B) and (C)

2. The fraction of total gas molecules which has acquired most probable velocity will _____ with the decrease in temperature.

(A) increase

(B) decrease

(C) remains constant

(D) can't say without knowing pressure

3. For a cubic crystal, the Miller indices of the plane for which interplanar spacing is $a/\sqrt{3}$ would be :

(A) 111

(B) 100

(C) 200

(D) 110

4. Which of the following liquid crystalline phases has only orientational order and no positional order ?

(A) Smectic liquid crystal

(B) Cholesteric liquid crystal

(C) Nematic liquid crystal

(D) None of these

5. After two half lives, the concentration of reactan is reduced to _____ in case of zero orde reaction.

(A) 0%

(B) 25%

(C) 50%

(D) 75%

6. The rate of formation of NO in the reactio $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + H_2O(g)$ i 5.90×10^{-3} $molL^{-1}s^{-1}$. The rate of disappearanc of oxygen would be :

(A) 4.72×10^{-3} $molL^{-1}s^{-1}$

(B) 7.38×10^{-3} $molL^{-1}s^{-1}$

(C) 3.39×10^{-3} $molL^{-1}s^{-1}$

(D) 5.90×10^{-3} $molL^{-1}s^{-1}$

7. For the $T \rightarrow \infty$, what will be the value of A the rate constant, $k = 3.2 \times 10^3$ mol^{-1} L s^{-1} an $E_a = 1.0 \times 10^2$ kJ mol^{-1} ?

(A) $A = 1.0 \times 10^2$ kJ mol^{-1}

(B) $A = 3.2 \times 10^3$ mol^{-1} L s^{-1}

(C) $A = 1.2 \times 10^3$ mol^{-1} L s^{-1}

(D) $A = 3.2 \times 10^3$ kJ mol^{-1} s^{-1}

8. If the intensity of incident beam of monochromat radiation having intensity I_o is reduced to ha when passed through a solution of concentratic c and thickness l, then what would be intensi of transmitted radiation if thickness of the solutic is kept the same and concentration tripled ?

(A) I_o

(B) 1/2 I_o

(C) 1/4 I_o

(D) 1/8 I_o

9. Which of the following statement is/are CORRECT ?

1. Third law of thermodynamics allows us to calculate absolute entropy of a substance.
2. Temperature dependence of enthalpy of a reaction is given by Arhenius equation.
3. Residual entropy of carbon monoxide is not zero

(A) 1 and 2

(B) 1 and 3

(C) 2 and 3

(D) 1, 2 and 3

10. The Clasius-Clapeyron equation is not applicable to which of the following processes ?

(A) Sublimation of ice in freezer

(B) Condensation of steam into water

(C) Evaporation of mercury liquid from a broken thermometer

(D) Conversion of O_2 (g) into O_3 (g)

11. The following processes are used for cooling :

1. Adiabetic expansion
2. Adiabetic demagnetization
3. Joule-Thomson effect
4. Evaporation

The correct sequence of these processes to produce lower and lower temperature is :

(A) 1, 4, 2, 3

(B) 1, 4, 3, 2

(C) 4, 1, 2, 3

(D) 4, 1, 3, 2

12. If one mole of ethane is burnt in excess of O_2 at constant pressure and 500K, 1560 kJ of heat is liberated. What is the change in internal energy for the reaction

$C_2H_6(g) + 3.5\ O_2(g) \rightarrow 2\ CO_2(g) + 3\ H_2O(g)$

(A) –1562.08 kJ

(B) +1562.08 kJ

(C) –518.5 kJ

(D) –1557.9 kJ

13. If the dissociation constant of weak acid, HA, is K_a of 1.00×10^{-6}, then the percentage acid dissociated at equilibrium will be closed to _____ if 0.100 mol of this acid is dissolved in 100 mL of water.

(A) 99.0%

(B) 1.00%

(C) 99.9%

(D) 0.10%

14. During the conductometric titration of an acid (placed in beaker) by an alkali (taken in burrette), the plot between the conductance and volume of alkali added was found to initially decrease slightly and then slowly increase 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

15. Molar conductance at infinite dilution for a compound AB is 145.0 Scm^2mol^{-1} and for CB is 110.1 Scm^2mol^{-1}. Limiting molar conductance for A^+ is 73.5 Scm^2mol^{-1}. What is limiting molar conductance for C^+ ion ?

(A) 326.6 Scm^2mol^{-1}

(B) 38.6 Scm^2mol^{-1}

(C) 181.6 Scm^2mol^{-1}

(D) 90.8 Scm^2mol^{-1}

16. For a cell reaction involving two electrons change, the standard e.m.f. of the cell is found to be 0.295 V at 25°C. The equilibrium constant of the reaction would be (Given F = 96500 C mol^{-1}; R = 8.314 $JK^{-1}mol^{-1}$)

(A) 10×10^2

(B) 1.0×10^{10}

(C) 2.0×10^{11}

(D) 4.0×10^{12}

17. Which of the following quantum numbers specifies the z-component of angular momentum of an electron in an atom ?

(A) Principal quantum number (n)

(B) Azimuthal quantum number (l)

(C) Magnetic quantum number (m)

(D) Both (B) and (C)

18. For a particle in a one-dimensional box w potential V_o inside the box and infinite out the ratio of the energy difference betv n = 1 and n = 2 states to that of between 1 and n = 3 states is :

(A) 4:9

(B) 3:5

(C) 1:1

(D) 1:4

19. The number of vibrational degrees of fre for SO_2 molecule would be :

(A) 2

(B) 3

(C) 4

(D) 5

20. The rotational spectrum of a rigid diatomic consists of equally spaced lines with s equal to :

(A) B

(B) B/2

(C) 2B

(D) 6B

21. The number of lone pairs are identica pair :

(A) XeF_4, ClF_3

(B) XeO_4, ClF_3

(C) XeO_2F_2, ICl_4^-

(D) XeO_4, ClF_3

22. An orbital with same number of angular and radial nodes is :

(A) 4p

(B) 5d

(C) 4f

(D) 3d

23. Switching the internuclear axis from Z to X, the molecular orbital formed from combination of px orbital's of two atoms in a homo diatomic molecule will have a change from :

(A) Having one node to no node along the x axis

(B) Having no node to one node along the x axis

(C) Will keep its node

(D) A low energy M.O. to high energy M.O.

24. Identify the molecule whose bond length decreases on adding an extra electron.

(A) O_2

(B) N_2

(C) B_2

(D) Li_2

25. The correct order of lewis acidity in case of xenon compounds can be :

(A) $XeF_6 > XeOF_4 > XeF_4$

(B) $XeOF_4 > XeF_4 > XeF_6$

(C) $XeF_4 > XeOF_4 > XeF_6$

(D) $XeF_4 > XeF_6 > XeOF_4$

26. The BBB multicentre bond is seen in higher boranes. Identify number of such BBB bonds in B_5H_9 borane molecule. (styx of B_5H_9 = 4120)

(A) 1

(B) 2

(C) 3

(D) 4

27. What is correct for the carborane $C_2B_{10}H_{12}$?

(A) It has a nido type structure

(B) It has 12 electron pairs for skeletal structure

(C) It has an arachno type structure

(D) It has (n+1) skeletal pairs with three isomeric closo structures

28. The ^{19}F NMR spectra of ClF_3 molecule depicts :

(A) T shape evidenced from Doublet and Triplet

(B) T shape evidenced from Singlet

(C) T shape evidenced from Doublet and Singlet

(D) Sp^3d hybridization from Singlet

29. The inner transition elements differ to transition elements in :

(A) Coordination chemistry especially higher coordination numbers

(B) Electronic transitions and factors affecting these excitations

(C) Magnetic properties especially couplings

(D) All of these

30. Which of the following lanthanide (III) ions has highest observed magnetic moment ?

(A) Nd{$4f^3$}

(B) Gd{$4f^7$}

(C) Dy{$4f^9$}

(D) La({$4f^0$}

31. Metallothioneins are natural polypeptides to reverse the toxicity of softer heavy metals like mercury and cadmium; these have mostly the aminoacid residue with softer donor site :

(A) Glycine

(B) Leucine

(C) Lysine

(D) Cysteine

32. Which of the following is the correct order of arrangement of the first five lanthanides according to atomic number ?

(A) La, Ce, Pr, Nd, Pm

(B) La, Pr, Ce, Pm, Nd

(C) La, Pr, Ce, Nd, Pm

(D) La, Ce, Pr, Pm, Nd

33. Which of the following can be facile reducing agent ?

(A) $(\eta^5\text{-}C_5H_5)_2Fe$

(B) $(\eta^5\text{-}C_5H_5)_2Co$

(C) $(\eta^5\text{-}C_5H_4)_2Ru$

(D) $(\eta^5\text{-}C_5H_5)_2Mn$

34. The correct order of Δt for the tetrahedral cobalt(complexes is :

(A) $[CoCl_4]^{2-} > [CoBr_4]^{2-} > [Co(NCS)_4]^{2-}$

(B) $[Co(NCS)_4]^{2-} > [CoCl_4]^{2-} > [CoBr_4]^{2-}$

(C) $[CoBr_4]^{2-} > [CoCl_4]^{2-} > [Co(NCS)_4]^{2-}$

(D) $[Co(NCS)_4]^{2-} > [CoBr_4]^{2-} > [CoCl_4]^{2-}$

35. The final product of the reaction between Me and $[Mn(CO)_6]^+$ is :

(A) $[Mn(CO)_6]^+ Me^-$

(B) $[Mn(CO)_5Me]$

(C) $[Mn(CO)_6]$

(D) $[(MeCO)Mn(CO)_5]$

36. Cysteine is an amino acid with an S-donor s The calculated formation constants of complexes with some metals (log K values) 6.2, 14.4, < 4 and 9.8. Which set of assignme can be the correct one ?

(A) Fe^{2+}, 6.2; Hg^{2+}, 14.4; Mg^{2+}, < 4; Zn^{2+},

(B) Fe^{2+}, 14.4; Hg^{2+}, < 4; Mg^{2+}, 6.2; Zn^{2+},

(C) Fe^{2+}, 6.2; Hg^{2+}, 9.8; Mg^{2+}, < 4; Zn^{2+}, 1

(D) Fe^{2+}, < 4; Hg^{2+}, 6.2; Mg^{2+}, 14.4; Zn^{2+},

37. For the precipitation based method using A ions, Mark the odd one out.

(A) Volhard

(B) Haber

(C) Fajan's

(D) Mohr method

38. For clear quantitative estimation of Ag^+ and Ni^{2+} binary mixture, the correct sequence can be :

(A) EDTA titration followed by dimethylglyoxime to estimate Ni^{2+} gravimetrically.

(B) EDTA titration followed by chloride addition to estimate Ag^+ gravimetrically.

(C) Gravimetric estimation of Ni^{2+} with dmg followed by Ag^+ gravimetrically with chloride.

(D) Ag^+ gravimetrically with chloride followed by Ni^{2+} with EDTA.

39. In the qualitative analysis scheme of cations (metal ions) of group II, when H_2S gas is passed through HCl containing analyte solution, which of the following precipitates are not obtained ?

(A) CuS

(B) HgS

(C) Bi_2S_3

(D) CoS

40. NO ligand has two binding modes linear and bent, identify its binding mode in $[Co(CO)_3(NO)]$ and $[Ni(\eta^5C_5H_5(NO)]$ complexes respectively.

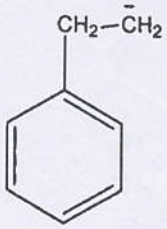
(A) Linear and Bent

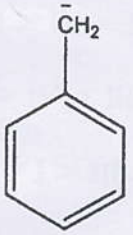
(B) Bent and Linear

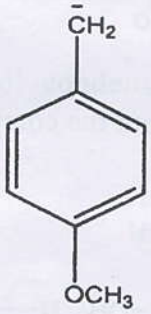
(C) Both Linear

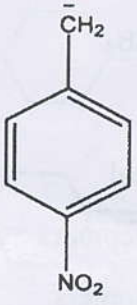
(D) Both Bent

41. The most stable carbanion among the following is :

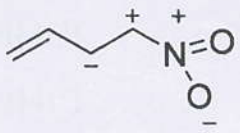
(A) 

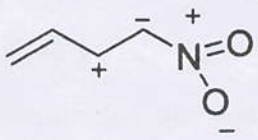
(B) 

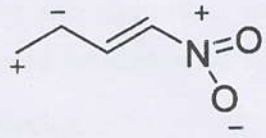
(C) 

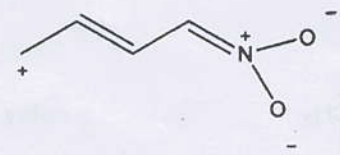
(D) 

42. Among the following the least stable resonance structure is :

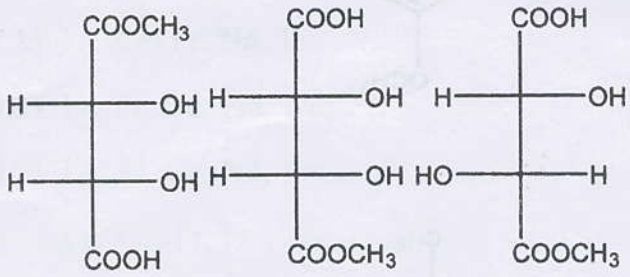
(A) 

(B) 

(C) 

(D) 

43. The correct statement about the compounds I, II & III :



(I) (II) (III)

(A) (I) & (II) are identical

(B) (I) & (II) are diastereomers

(C) (I) & (III) are enantiomers

(D) (I) & (II) are enantiomers

44. Which among the following is true for cyclohex chair conformer ?

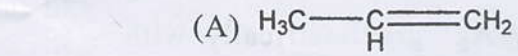
(A) It has 12 axial H's

(B) It has 6 axial H's & 6 equatorial H's

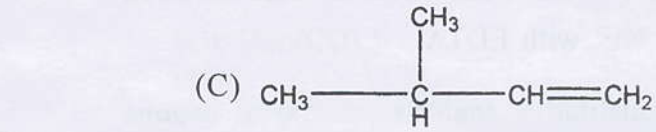
(C) It has 12 equatorials H's

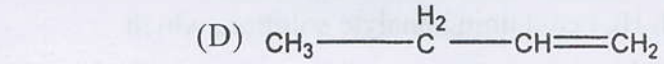
(D) None of these

45. Which among the following doesn't o Markownikoff's rule ?

(A) 

(B) 

(C) 

(D) 

46. Acidic character of terminal alkynes is bec of :

(A) Increased electron density

(B) Increased p-character of sp hybridized ca atom

(C) Increased s-character of sp hybridized ca atom

(D) None of these

47. Isopropylchloride undergoes hydrolysis by

(A) S_N^1 Mechanism

(B) S_N^2 Mechanism

(C) S_N^1 & S_N^2 Mechanism

(D) Neither S_N^1 nor S_N^2 Mechanism

48. In case of elimination reaction of alkyl halide which among the following is the best leaving group ?

(A) –I

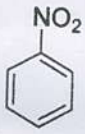
(B) –Br

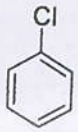
(C) –Cl

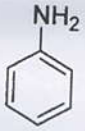
(D) –F

49. Which among the following exhibits higher rate of electrophilic substitution ?

(A) 

(B) 

(C) 

(D) 

50. With periodic acid (HIO_4) glycerol undergoes oxidation to form :

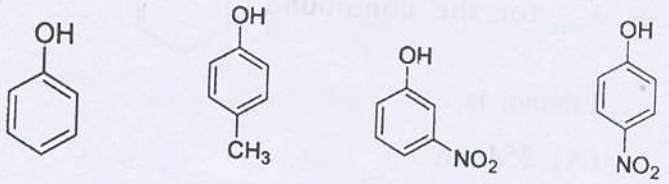
(A) Glyceric acid & Meso-oxalic acid

(B) Oxalic acid & dihydroxyacetone

(C) Formaldehyde and formic acid

(D) Gtyceraldehyde & glyceric acid

51. Among the following compounds, the order of acidity is :



(I) (II) (III) (IV)

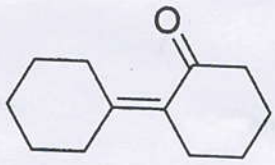
(A) III > IV > I > II

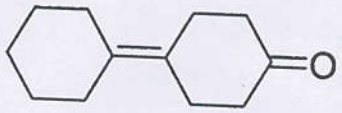
(B) I > IV > III > II

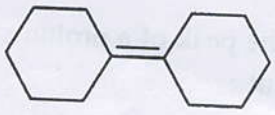
(C) II > I > III > IV

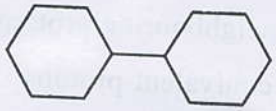
(D) IV > III > I > II

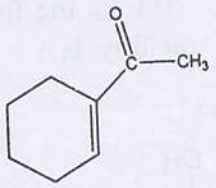
52. Alcohol condensation of  with NaOH yields :

(A) 

(B) 

(C) 

(D) 

53. λ_{max} for the compound  in Ethanol is :

(A) 254 nm

(B) 237 nm

(C) 286 nm

(D) 313 nm

54. The stretching vibration frequency of C≡N is in the region of :

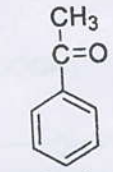
(A) 1400-1250 cm^{-1}

(B) 2260-2240 cm^{-1}

(C) 2950-2650 cm^{-1}

(D) 3590-4420 cm^{-1}

55. The no. of ^{1}HNMR peaks observed for the below given compound is/are :



Acetophenone

(A) Two

(B) Three

(C) Four

(D) None of the above

56. The area under the peak of a proton signal gives information about :

(A) The nature of protons

(B) The no. of neighbouring protons

(C) The no. of equivalent protons

(D) None of the above

57. Which of the following is not a sex hormone ?

(A) Testosterone

(B) Estrone

(C) Estradiol

(D) Cortisone

58. Which among the following is correct statement ?

(A) Starch is a polymer of α glucose

(B) Amylose is a component of cellulose

(C) Proteins of compounds of only one type of amino acid

(D) In cyclic structure of fructose there are four carbon atoms

59. α-D(+) glucose & β-D(+)-glucose are :

(A) Enantiomers

(B) Geometrical isomers

(C) Epimers

(D) Anomers

60. At isoelectric point amino acids are present as :

(A) $NH_2-CH(R)-COOH$

(B) $NH_2-CH(R)-COO^-$

(C) $\overset{+}{N}H_3-CH(R)-COOH$

(D) $\overset{+}{N}H_3-CH(R)-COO^-$

Sr. No. .....

ENTRANCE TEST-2021

SCHOOL OF PHYSICAL & MATHEMATICAL SCIENCES

CHEMISTRY

Question Booklet Series **A**

Total Questions : 60

Time Allowed : 70 Minutes

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.

1. What is correct for ClF_3 molecule ?

(A) It has 2 axial lone pairs

(B) It has two equatorial lone pairs

(C) It has all fluorine's of equal bond length

(D) It has one axial and one equatorial lone pair

2. Match these compounds with their right geometries ?

(a)	$Ni(CO)_4$	(I)	Tetrahedral
(b)	ICl_2^-	(II)	Linear
(c)	ICl_4^-	(III)	Square Planar
(d)	FClO	(IV)	Bent
(e)	$FClO_3$		

	(a)	(b)	(c)	(d)	(e)
(A)	(III)	(II)	(I)	(II)	(III)
(B)	(III)	(II)	(I)	(III)	(II)
(C)	(I)	(II)	(III)	(IV)	(I)
(D)	(I)	(II)	(III)	(IV)	(III)

3. Assuming the energy difference between 4s and 3d orbitals to be small, the exchange energy for Cr as $4s^2\,3d^4$ and $4s^1\,3d^5$ will correspond to :

(A) 6 and 15 exchanges respectively

(B) 15 and 10 exchanges respectively

(C) 6 and 10 exchanges respectively

(D) 10 and 15 exchanges respectively

4. Which of the following sandwich compounds can be a good one electron oxidizing agent ?

(A) Ferrocene

(B) Cobaltocene

(C) Manganocene

(D) Nickelocene

5. Match up the following acids to the basicities. Which pairing is correct ?

(A) Phosphoric acid; dibasic

(B) Phosphinic acid; monobasic

(C) Phosphonic acid; monobasic

(D) Phosphorous acid is monobasic

6. All of the following, except one, are radicals. Which is diamagnetic ?

(A) NO_2

(B) NO

(C) FNO

(D) NF_2

7. Find the incorrect match among the following :

(A) Zinc(II); Carbonic anhydrase

(B) Iron transport; Ferritin

(C) Cadmium toxicity; Metallothoniens

(D) Cytochrome 450; monooxygenase

8. On structural analogy to hydrogen peroxide, peroxosulphuric acids: Caro's and Marshall's can be considered as :

(A) Completely analogous to H_2O_2

(B) Caro's as monosulphonic derivative of H_2O_2

(C) Marshall's as monosulphonic derivative of H_2O_2

(D) Caro's as disulphonic derivative of H_2O_2

9. Which of the following non metal systems shows electrical anisotropy with a possible superconductivity application around 0.26K ?

(A) Phosphonitrilic halides

(B) Polyphosphazenes

(C) Polythiazyls

(D) Polyphosphates

10. Match the Boron compounds to their structure :

(I)	$B_7H_7^{2-}$	(i)	closo
(II)	B_9H_{15}	(ii)	nido
(III)	B_6H_{10}	(iii)	arachno
(IV)	B_6H_{12}		

	(I)	(II)	(III)	(IV)
(A)	(i)	(ii)	(iii)	(i)
(B)	(i)	(iii)	(ii)	(iii)
(C)	(iii)	(ii)	(i)	(iii)
(D)	(ii)	(i)	(i)	(iii)

11. The soft sulphur donor ligands can stabilize which of the following uncommon transition metal oxidation states ?

(A) Fe^{2+}

(B) Cu^{+}

(C) Co^{3+}

(D) Cu^{3+}

12. Which isotope is produced by an (n, ?) reaction starting from ^{230}Th ?

(A) ^{229}Th

(B) ^{229}Ac

(C) ^{231}Th

(D) ^{231}Pa

13. In the coordination chemistry of Ln(III) centres, bulky amido ligands are used to stabilize :

(A) high coordination numbers (>10)

(B) coordination numbers of 6 to 8

(C) coordination numbers of 8 to 10

(D) low coordination numbers (<6)

14. As a comparative property of 3d,4d and 5d transition metals which of these is incorrect ?

(A) $[MnO_4]^-$ is very strong oxidizing agent compared to $[TcO_4]^-$ and $[ReO_4]^-$

(B) The metal bonding strength of group 8 dimers is $[Mn_2Cl_8]^{2-} > [Tc_2Cl_8]^{2-} > [Re_2Cl_8]^{2-}$

(C) RuO_4 is thermodynamically more stable than FeO_4

(D) The kinetic inertness of coordination compounds follows the order $Cr^{3+} > Mo^{3+} > W^{3+}$

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

	(I)		(II)
(i)	Xylenol orange	(a)	Acid Base Titration
(ii)	Methyl Orange	(b)	Redox Titration
(iii)	Diphenylamine	(c)	Complexometric titrations
(iv)	Sodium chromate	(d)	Mohr Titration

	(i)	(ii)	(iii)	(iv)
(A)	(c)	(d)	(a)	(d)
(B)	(c)	(b)	(d)	(a)
(C)	(d)	(c)	(a)	(b)
(D)	(c)	(a)	(b)	(d)

16. The volume of 0.1 M $AgNO_3$ required for precipitation of chloride ions present in 30 mL of 0.01 M solution of $[Cr(H_2O)_5Cl]Cl_2$, as silver chloride will be :

(A) 3 mL

(B) 4 mL

(C) 5 mL

(D) 6 mL

17. Wilson's disease is related to :

(A) Hyper-accumulation of copper

(B) Deficiency of copper

(C) Hyper-accumulation of copper and is treated effectively with EDTA

(D) Hyper-accumulation of copper and is treated effectively with d- Penicillamine

18. For the ligands F^-, NH_3, CN^- and CO, the correct order of their position in spectrochemical series will be :

(A) $F < CN^- < NH_3 < CO$

(B) $CO < NH_3 < F^- < CN^-$

(C) $F^- < NH_3 < CN^- < CO$

(D) $CN^- < NH_3 < CO < F^-$

19. Identify the correct statement about $[Ni(H_2O)_6]^{2+}$ and $[Cu(H_2O)_6]^{2+}$:

(A) All Ni-O and Cu-O bond lengths of individual species are equal

(B) Ni-O(equatorial) and Cu-O(equatorial) are only equal

(C) All Ni—O bond lengths are equal whereas Cu—O (equatorial) bonds are shorter than Cu—O(axial) bonds

(D) All Cu—O bond lengths are equal whereas Ni—O (equatorial) bonds are shorter than Ni—O(axial) bonds

20. Which of the following possesses highest degree of aromatic character ?

(A) Cyclopentadienyl anion

(B) Pyrrole

(C) Furan

(D) Thiophene

21. Identify the most stable carbocation among the following :

(A) Ph+

(B) $CH_2=CH^+$

(C) $CH_3-C^+=O$

(D) $CH_3-CH_2^+$

22. Which of the following reaction intermediates is stereo-chemically unstable and rapidly inverts like ammonia ?

(A) Carbocations

(B) Carbanion

(C) Free-radicals

(D) Carbenes

23. The least stable conformer of cyclohexane is :

(A) Chair form

(B) Half chair form

(C) Twist boat form

(D) Boat form

24. What type of stereoisomers would you expect for the compound $CH_3CH(OH)CH(OH)CH_3$?

(A) A pair of enantiomers

(B) Two pair of enantiomers

(C) A pair of enantiomers and a meso-dia-stereoisomer

(D) A pair of enantiomers and a pair of dia-stereoisomers

25. Addition of HCl to 3-methyl-1-butene at 0^0C gives :

(A) 2-Choloro-3-methyl butane

(B) 2-Choloro-2-methyl butane

(C) Both (A) and (B)

(D) 40:60 mixture of (A) and (B)

26. The rate of Diels-Alder reaction of maleic anhydride is fastest with :

(A) 1.3 butadiene

(B) 2-methyl-1.3 butadiene

(C) 2,3 Dimethyl-1.3 butadiene

(D) Cyclopentadiene

27. Which of the following will undergo fastest SN_2 reaction ?

(A) Allyl halide

(B) Benzyl halide

(C) a halo acetone

(D) Ethyl halide

28. Friedal Craft's acylation of benzene in presence of $CH_3COCl/AlCl_3$ is an example of :

(A) Free radical substitution

(B) Nucleophilic substitution

(C) Electrophilic substitution

(D) Electrophilic addition

29. Aldol condensation does not take place between :

(A) Two moles of formaldehyde

(B) Two moles of acetaldehyde

(C) Two moles of acetone

(D) One mole of acetaldehyde and one mole of acetone

30. Which of the following is not correctly matched ?

(A) >C=O on Clemmenson' reduction yields $>CH_2$

(B) >C=O on Wolf Kishner reduction yields >CHOH

(C) -COCl on Rosenmunds reduction yields -CHO

(D) -C≡N on Stephen's reduction yields -CHO

31. Which of the following acids have lowest pK_a value ?

(A) HCOOH

(B) C_6H_5COOH

(C) CH_3COOH

(D) CH_3CH_2COOH

32. The least basic amines among the following is :

(A) $C_6H_5NH_2$

(B) $(C_6H_5)_2NH$

(C) CH_3NH_2

(D) $(CH_3)_2NH$

33. λ_{max} for the compound cyclopent-2-en-one :

(A) 245nm

(B) 202nm

(C) 320nm

(D) 340nm

34. The absorption band in the IR spectrum for -O-H is observed at the frequency of :

(A) 3000-2850 cm^{-1}

(B) 3550-3200 cm^{-1}

(C) 2260-2200 cm^{-1}

(D) 1660-1640 cm^{-1}

35. The chemical shift (d) for aromatic proton in ^{1}HNMR spectra is in the range :

(A) 5.5-6.5

(B) 4.2

(C) 7-8

(D) 10

36. The total no peaks in the ^{1}H NMR spectra of the organic compound $CH_3CH_2CH_2$-OH will be :

(A) 3

(B) 5

(C) 4

(D) 6

37. The carbohydrate which serves as reserve glucose in body is :

(A) Sucrose

(B) Starch

(C) Glycogen

(D) Fructose

38. The sequence in which amino acids are arranged in protein is called its :

(A) Primary structure

(B) Secondary structure

(C) Tertiary structure

(D) Quaternary structure

39. Which among the following are not the essential molecules of life ?

(A) Proteins

(B) Carbohydrates

(C) Lipids

(D) Vitamins

40. The root mean square velocity of SO_2 molecule will become double its value at STP when the temperature is :

(A) 1192K

(B) 819 ^{o}C

(C) 298K

(D) 40 ^{o}C

41. As per the Maxwell distribution of molecular velocities, the fraction of total gas molecules which has acquired the most probable velocity will ———— with the decrease in temperature.

(A) Increase

(B) Decrease

(C) Remains constant

(D) Can't say without knowing the pressure

42. The number of atoms in each different cubic unit cells of monoatomic substances is :

(A) SC-1, BCC-2, FCC-4

(B) SC-8, BCC-9, FCC-14

(C) SC-1, BCC-9, FCC-3

(D) SC-2, BCC-3, FCC-4

43. Which liquid crystal phase has the least order and is most liquid-like ?

(A) Smectic liquid crystal

(B) Cholesteric liquid crystal

(C) Nematic liquid crystal

(D) Discotic liquid crystals

44. For the first-order reaction, after two average lives (t_{av}) , the concentration of reactant is reduced to _____. (Given $t_{av} = 1/k$, k being its rate constant)

(A) 25%

(B) 75%

(C) 100/e %

(D) $100/e^2$ %

45. For a reaction, $A(g) + 2B(g) \rightarrow C(g) + D(g)$, $dx/dt = k[A][B]$. The initial concentration of A and B are respectively 0.1 M and 0.2 M. Now if the concentration of A is reduced to 0.05 M and that of Y to 0.05 M, then the rate of reaction relative to the initial value would be :

(A) 1/6

(B) 1/8

(C) 1/12

(D) 1/200

46. The rate constant of a first order reaction at 27 °C is 10^{-3} min^{-1}. The temperature coefficient of this reaction is 2. What is the rate constant (in min^{-1})at 17 °C for this reaction ?

(A) 10^{-3}

(B) 5×10^{-4}

(C) 2×10^{-3} s^{-1}

(D) 10^{-2} s^{-1}

47. Consider the following statements :

(1) Half life period of first order reaction is independent of the initial concentration of reactants

(2) The plot of rate of reaction vs concentration of reactant is a straight line with slope 2k for a unimolecular second order reaction

(3) A zero order reaction takes finite time for completion while the first order reaction would get completed in infinite time

Which of the above statement(s) is/are correct ?

(A) (1) and (2)

(B) (2) and (3)

(C) (1) and (3)

(D) (1), (2) and (3)

48. Which of the following photochemical reactions shows highest quantum yield ?

(A) Decomposition of HI

(B) Decomposition of HBr

(C) Formation of HBr from H_2 and Br_2

(D) Formation of HCl from H_2 and Cl_2

49. Which among the following plots are linear ? (a-x) is the concentration of reactant remaining after time, t :

(A) (a-x) vs t, for a first order reaction

(B) (a-x) vs t, for a half order reaction

(C) (a-x) vs t, for a second order reaction

(D) $(a-x)^{-1}$ vs t, for a second order reaction

50. Strike out the INCORRECT statement(s) from the following?

(1) H, U, w and q are all zero for expansion of an ideal gas under isothermal conditions

(2) The entropy change during an irreversible adiabetic process is zero

(3) Entropy is a state function

(A) (1) only

(B) (2) only

(C) (2) and (3)

(D) (1), (2) and (3)

51. Consider the following statements :

(1) For the H_2O system, no. of degrees of freedom at its triple point is three

(2) Water expands on melting and has fusion curve with a positive slope

(3) No. of phases existing on a line in its phase diagram is two

Which of these statements is/are correct ?

(A) (1) and (3)

(B) (1) and (2)

(C) (2) only

(D) (3) only

52. When one mole of an ideal gas is heated to three times its initial temperature at constant volume, then the change in entropy would be :

(A) Zero

(B) $(R-C_v)\ln 3$

(C) $C_v \ln 3$

(D) $C_p \ln 3$

53. 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 and followed by a constant value. 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

54. The standard Gibbs free energy of the electrochemical reaction

$$Cr_2O_7^{2-} + 2Fe + 14H^+ \rightarrow 2Cr^{3+} + 2Fe^{3+} + 7H_2O$$

is –793 kJ/mol. What would be the standard cell emf? (Given F=96500 C mol^{-1}; R = 8.314 $JK^{-1}mol^{-1}$)

(A) +1.37 V

(B) +4.11 V

(C) + 2.74 V

(D) +2.05 V

55. What is the molar solubility(s) of $Al_2(SO_4)_3$ in terms of K_{sp} ?

(A) $s = (K_{sp}/27)^{1/5}$

(B) $s = (K_{sp}/72)^{1/5}$

(C) $s = (K_{sp}/6)^{1/2}$

(D) $s = (K_{sp}/108)^{1/5}$

56. For Cu^{2+}/Cu, $E^o = 0.34V$ and for Cu^{2+}/Cu^+, $E^o = 0.15V$. The E^o for the disproportionation of Cu^+ would be :

(A) –0.19V

(B) 0.19V

(C) 0.49 V

(D) 0.38V

57. Which of the following is the expression for Hamiltonian operator ?

(A) $\frac{-h^2}{8p^2m}\nabla^2 + V$

(B) $\frac{-h^2}{8p^2m}\nabla + V$

(C) $\frac{-h^2}{4p^2}\frac{\partial^2}{\partial x^2}$

(D) $\frac{-h^2}{4p^2}\frac{\partial^2}{\partial f^2} + V$

58. Which of the following is an eigenfunction of the operator d^2/dx^2 ?

(A) Cos(ax)

(B) e^{ax}

(C) Sin(ax)

(D) All of these

59. The selection rule for a vibrational transition in the simple harmonic oscillator is :

(A) $\Delta v = 0$

(B) $\Delta v = \pm 1$

(C) $\Delta v = \pm 2$

(D) $\Delta v = \pm 1, \pm 2, \pm 3$ etc

60. The frequency of the absorption of a rigid diatomic rotating molecule when it undergoes the rotational transition from $j = 2 \rightarrow j = 3$ energy level will be :

(A) 3B

(B) 4B

(C) 6B

(D) 12B

ROUGH WORK

ROUGH WORK

Sr. No. 0138

ENTRANCE TEST-2020

SCHOOL OF PHYSICAL & MATHEMATICAL SCIENCES

CHEMISTRY

Total Questions : 60
Time Allowed : 70 Minutes

Question Booklet Series B

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.

1. Consider the following statements :

   1. The half-life of second order reaction is represented by the expression $t_{0.5} = 1/(ak)$, where "a" is initial concentration of reactant.
   2. A catalyst increases the rate of a reaction by decreasing the heat of reaction.
   3. A zero order reaction takes finite time to get 100% complete while the first order reaction gets 100% complete in infinite time.

   Which of the above statement(s) is/are correct ?

   (A) 1 and 2

   (B) 2 and 3

   (C) 1 and 3

   (D) 1, 2 and 3

2. If for a reaction, rate = $k(H^+]^n$ and rate becomes 100 times when pH changes from 2 to 1. Hence, order (n) is :

   (A) 1

   (B) 2

   (C) 3

   (D) 0

3. Consider the following :

   1. Internal conversion
   2. Intersystem crossing
   3. Phosphorescence
   4. Fluorescence

   Which of the above processes involve non-radiative mode of energy dissipation ?

   (A) 1, 2 and 3

   (B) 1 and 2

   (C) 3 and 4

   (D) 1, 2 and 4

4. For a cyclic process performed by an ideal gas, changes in some thermodynamic functions are zero. Indicate the set in which all the functions are zero.

   (A) w, ΔH, ΔE, ΔG

   (B) q, ΔS, ΔE, ΔA

   (C) q, ΔE, ΔS, ΔG

   (D) ΔE, ΔS, ΔG, ΔA

5. Which of the following statement is/are CORRECT ?

   1. For an ideal gas expanding under isothermal condition, ΔH and ΔE would be both zero.
   2. The entropy of an isolated system increases during an irreversible process.
   3. Temperature dependence of ΔH is given by Kirchoff's equation.

   (A) 1 and 2

   (B) 2 and 3

   (C) 1 and 3

   (D) 1, 2 and 3

6. Phenolphthalein as a strong acid strong base titration indicator becomes colored in :

   (A) Acidic medium

   (B) Alkaline medium

   (C) Neutral medium

   (D) Any of these

7. 18 electron system among the following is :

1. [Cp Cu(CO)]
2. [Cp $Mn(CO)_2$]
3. [Cp $Cr(CO)_3$]
4. [Cp $V(CO)_4$]

(A) 1 and 2

(B) 2 and 3

(C) 3 and 4

(D) 1 and 4

8. The complex that shows orbital contribution to the magnetic moment can be :

(A) $[Cu(OH_2)_6]^{2+}$

(B) $[Ni(OH_2)_6]^{2+}$

(C) $[Co(OH_2)_6]^{2+}$

(D) $[Cr(OH_2)_6]^{2+}$

9. The type of reaction involved in conversion of H_3PO_4 to $H_4P_2O_7$:

(A) Reduction

(B) Hydrolysis

(C) Condensation

(D) Oxidation

10. A 100 mL solution of 2.5×10^{-3} M in Bi(III) and Cu(II) each is titrated complexometrically with 0.1 M EDTA solution. Identify incorrect statement for this titration :

(A) Total Volume of EDTA consumed is 5.0 mL

(B) 2.5 mL of EDTA is required to complex each Bi(III) and Cu(II) ions

(C) First end point in titration happens for Cu(II) {logKf $[Cu(EDTA)]^{2-} = 19$}

(D) First end point in titration happens for Bi(III) {logKf $[Bi(EDTA)]^{-} = 28$}

11. The reagent which converts aldoses to gluconic acid is :

(A) Conc.HNO_3

(B) Br_2/H_2O

(C) Fehling's solution

(D) Tollen's reagent

12. In alkaline medium, fructose behaves as :

(A) A furanose

(B) An aldose

(C) A non-reducing sugar

(D) A reducing sugar

13. Which amino acid is chiral ?

(A) Alanine

(B) Valine

(C) Proline

(D) Histidine

14. Which of the following is a basic amino acid ?

(A) Leucine

(B) Valine

(C) Histidine

(D) Aspartic acid

15. Which of the following is the monomer of natural rubber ?

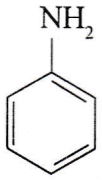
(A) 2-Methylbuta-1,2-diene

(B) 2-Methylbuta-1,3-diene

(C) Chloroprene

(D) Buta-1,3-diene

16. Consider the following compounds :

1. 

2. 

3. 

4. 

Arrange these compounds in decreasing order of their basicity :

(A) 1>2>3>4

(B) 2>3>1>4

(C) 4>1>3>2

(D) 4>1>2>3

17. Which one of the nitrogen containing compounds is an electrophile ?

(A) NH_2-NH_2

(B) NH_2-OH

(C) NF_3

(D) NH_2

18. Reimer-Tiemann reaction involves a :

(A) Carbocation intermediate

(B) Carbanion intermediate

(C) Carbene intermediate

(D) Mono free radical intermediate

19. In which compound aromatic electrophilic substitution takes place at ortho/para position ?

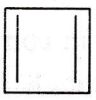
(A) $C_6H_5B(OH)_2$

(B) $C_6H_5(NH_3)_3^+$

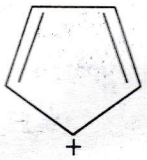
(C) C_6H_5Br

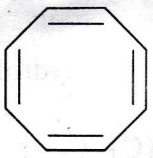
(D) $C_6H_5NO_2$

20. Which one of the following species has unpaired electrons in its bonding pi MO orbitals ?

(A) 

(B) 

(C) 

(D) 

21. Consider the following statements :

1. For a one component system, the maximum number of phases that can exist in equilibrium is three.
2. A system can have negative degrees of freedom.
3. Water contracts on melting and has fusion curve with a negative slope.

Which of these statements is/are correct ?

(A) 1 and 3

(B) 1 and 2

(C) 2 and 3

(D) 1 only

22. The entropy change associated with the freezing of 18 g of water at 0° C and 1 atm (heat of fusion under these conditions is 6.0 kJ/mol) is :

(A) –6 J/K

(B) –22 J/K

(C) +22 J/K

(D) +6 J/K

23. A plot between the conductance and volume of alkali added to an acid in the beaker during conductometric titration was found to be V-shaped. 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

24. The molar conductances at infinite dilution for CH_3COONa and HCl are 91.0 and 426.2 $Scm^2 mol^{-1}$ respectively. To calculate molar conductances at infinite dilution for CH_3COOH, the additional value required is molar conductance at infinite dilution of :

(A) H_2O

(B) KCl

(C) NaOH

(D) NaCl

25. A weak acid, HA, has a K_a of 1.00×10^{-5}. If 0.100 mol of this acid is dissolved in 1 L of water, the percentage of acid dissociated at equilibrium is closest to :

(A) 99.0%

(B) 1.00%

(C) 99.9%

(D) 0.100%

26. Given $E°(Cr^{3+}/Cr) = -0.72$ V, $E°(Fe^{2+}/Fe) = -0.42$ V. What is EMF of the cell $Cr/Cr^{3+}(0.1M)$ Fe^{2+} (0.01M)/Fe at 25°C ? (Given that the numerical value of RT/F at 25°C = 0.06)

(A) –0.26 V

(B) +0.26 V

(C) 0.339 V

(D) –0.339V

27. Which of the following is an eigenfunction of the operator d/dx ?

(A) cos(ax)

(B) e^{ax}

(C) sin(ax)

(D) Both (A) and (C)

28. Which of the following statements about infrared spectroscopy is correct ?

(A) Vibrational modes are IR active only if dipole moment change occurs during vibration.

(B) Bending vibrations of a bond occurs at higher frequencies compared to stretching vibrations at the same bond.

(C) As the bond strength increases, the vibrational frequency decreases.

(D) The number of normal vibrational modes are more in non-linear triatomic molecule than in a linear triatomic molecule.

29. For a particle in a one-dimensional box with a potential V_o inside the box and infinite outside, the energy state corresponding to n = 0 is not allowed because :

(A) The total energy becomes zero

(B) The average momentum becomes zero

(C) The wave function becomes zero everywhere

(D) All of these

30. The rotational spectrum of a rigid diatomic rotor consists of equally spaced lines with spacing equal to :

(A) B

(B) B/2

(C) 3B/2

(D) 2B

31. Permanganometry is an analytical technique based on pink colored permanganate ions MnO_4^-. Perrhenate ion ReO_4^- although similar to MnO_4^- is colorless because :

(A) d-d transition in the Re compound is of higher energy than in Mn Compound.

(B) d-d transition in the Re compound is of lower intensity than in Mn Compound.

(C) Charge transfer from O^- to Re^{+7} is of lower energy.

(D) Charge transfer from O^- to Mn^{+7} is of lower energy.

32. The reason for chemical inertness of gaseous nitrogen at room temperature can be :

(A) Homo-Lumo energy separation

(B) Electronic configuration

(C) High bond energy

(D) Both (A) and (C)

33. The light pink colour of $[Co(OH_2)_6]^{2+}$ and deep blue colour of $[CoCl_4]^{2-}$ are due to :

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

(B) LMCT transition in both

(C) d-d transition in both

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

34. Identify correct statements for mercury as toxic metal.

(a) Carbanionicbiomethylation converts it to $MeHg^+$

(b) Thiol group of cysteine has strong affinity for mercury

(c) Mercury containing industrial catalyst release caused Minamata disaster

(A) (a) and (b)

(B) (a) and (c)

(C) (b) and (c)

(D) (a), (b) and (c)

35. Identify the incorrect statement :

(A) Spectra of Ln^{3+} ions contain larger number of absorptions than M^{3+} Transition metal ions.

(B) f—f transitions are sharp and their positions are little affected by complex formation.

(C) Absorption due to 4f—5d transitions are broad and are affected by complex formation.

(D) Absorption due to f—f transitions are broad but bands due to 4f—5d transitions are sharp.

36. The correct Lewis acidity order of following boron halides towards pyridine is :

(A) $BMe_3 > BPh_3 > BCl_3$

(B) $BMe_3 < BPh_3 < BCl_3$

(C) $BPh_3 > BMe_3 > BCl_3$

(D) $BPh_3 > BCl_3 > BMe_3$

37. Among the following sulfur nitrogen compounds, the one with highest electrical conductivity is :

(A) S_4N_4

(B) S_7N_4

(C) S_2N_2

(D) $(SN)_x$

38. A sodalite cage in Zeolites is :

(A) A truncated Tetrahedron

(B) An Icosahedron

(C) A truncated Octahedron

(D) A dodecahedron

39. The thiocyanate and isothiocyanate complexes of Co(III) can be distinguished by :

(A) Nuclear magnetic resonance

(B) Fourier transform infrared spectroscopy

(C) Electron paramagnetic resonance

(D) Mass spectroscopy

40. The correct statement among the following is :

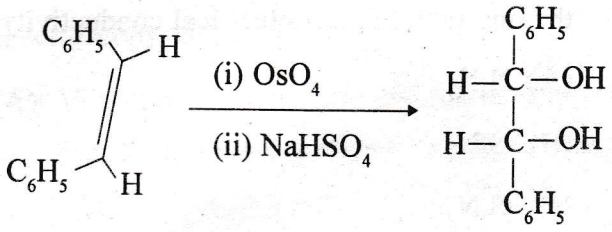
(A) N_2 has higher bond other than N_2^+ and hence has larger bond length compared to N_2^+

(B) N_2^+ has higher bond other than N_2 and hence has larger bond length compared to N_2

(C) N_2 has higher bond other than N_2^+ and hence has higher dissociation energy compared to N_2^+

(D) N_2 has lower bond other than N_2^+ and hence has lower dissociation energy compared to N_2^+ energy

41. The given reaction



is an example of :

(A) Stereospecific reaction

(B) Stereoselective reaction

(C) Both (A) and (B)

(D) Neither Stereospecific nor Stereoselective reaction

42. When benzyl chloride is treated with ethanolic KCN, large amount of benzyl ethyl ether is produced along with benzyl cyanide. Therefore, the most likely mechanism for the reaction will be :

(A) SN2

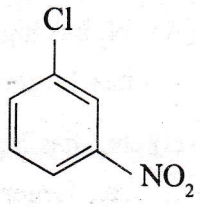
(B) SN1

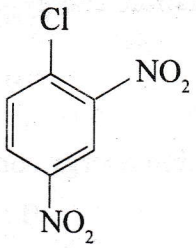
(C) Both SN1 and SN2

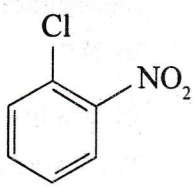
(D) None of the above

43. Which of the following compounds is most reactive for ArSN reaction ?

(A) 

(B) 

(C) 

(D) 

44. The Groups $-NH_2$, -OH, $-CH_3$, -Cl when attached to benzene ring activate, activate it for electrophilic substitution, their decreasing order of activation is :

(A) $-NH_2$>-OH>-Cl>$-CH_3$

(B) $-NH_2$>-Cl>-OH>$-CH_3$

(C) $-NH_2$>-OH>$-CH_3$>-Cl

(D) -OH>$-NH_2$>CH_3>Cl

45. Toluene when refluxed with bromine in the presence of light gives mainly :

(A) O-bromotoluene

(B) m-bromotoluene

(C) o-and p-bromotoluene

(D) Benzyl bromide

46. The root mean square velocity of SO_2 gas becomes the same as that of O_2 at 300K when the temperature is :

(A) 327K

(B) 127K

(C) 600K

(D) 150K

47. The correct statement(s) about the correction terms in Van der Waals equations is/are ?

(A) Mutual attraction between the molecules is accounted by the coefficient "a".

(B) The term a/v^2 increases the pressure of real gas relative to ideal gas.

(C) The compressible volume is represented by the coefficient "b".

(D) Both (A) and (B)

48. The angle between the two planes represented by the Miller indices (100) and (010) in a cubic crystal is :

(A) 30°

(B) 90°

(C) 45°

(D) 0°

49. Which of the following liquid crystalline phase type finds utility in thermography ?

(A) Smectic

(B) Cholestric

(C) Nematic

(D) Both nematic and smectic

50. The activation energy of a reaction is zero. The rate constant (k) of the reaction at 280 K is 1.6×10^{-6} s^{-1}. The value of k for this reaction at 300 K would be :

(A) Zero

(B) 3.2×10^{-6} s^{-1}

(C) 1.6×10^{-5} s^{-1}

(D) 1.6×10^{-6} s^{-1}

51. The shape of $[TeF_5]^-$ molecular ion on the basis of VSEPR theory can be :

(A) Trigonal Bipyramidal

(B) Pentagonal planar

(C) See Saw Type

(D) Square Pyramidal

52. Match the metal to its medical application :

I		II	
I.	Gadolinium	a.	Cancer
II.	Gold	b.	Manic Depression
III.	Platinum	c.	MRI Contrast agent
IV.	Lithium	d.	Arthritis

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

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

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

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

53. The correct matching of the effective nuclear charge using Slater rules is :

I.	2p electron in Nitrogen atom	(i) 3.9
II.	4s electron in Zinc atom	(ii) 4.35
III.	3d electron in Zinc atom	(iii) 8.85
IV.	2s electron in Boron atom	(iv) 2.58

(A) I-(i), II-(ii), III-(iii), IV-(iv)

(B) I-(ii), II-(i), III-(iv), IV-(iii)

(C) I-(iv), II-(iii), III-(i), IV-(ii)

(D) I-(i), II-(iii), III-(ii), IV-(iv)

54. What is incorrect for Borazine ?

(A) Borazine is isoelectronic with benzene.

(B) Borazine has similar physical and chemical properties as benzene.

(C) Borazine and Benzene both have $p\pi$-$p\pi$ bonding.

(D) Borazine has electron rich Nitrogen and electrophillic Boron atoms in ring structure.

55. Which of the following coordination compounds cannot produce white precipitate on reaction with silver nitrate ?

(A) $[Co(NH_3)_3Cl_3]$

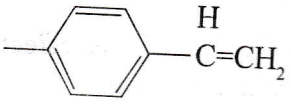
(B) $[Co(NH_3)_4Cl_2]Cl$

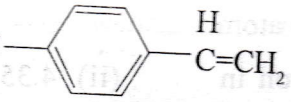
(C) $[Co(NH_3)_5Cl]Cl_2$

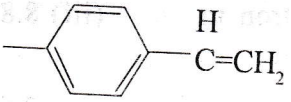
(D) $[Co(NH_3)_6]Cl_3$

56. Which of the following alkenes is most reactive towards addition of HBr :

(A) $C_6H_5–CH=CH_2$

(B) 

(C) 

(D) 

57. Which of the following is most reactive for bromination reaction ?

(A) Benzene

(B) Anisol

(C) Phenol

(D) N, N-dimethylaniline

58. The given pairs of isomeric compounds can be distinguished by which spectroscopy ?

CH_3-CH_2-NH_2 and CH_3-NH-CH_3

(A) Both UV and IR

(B) Both IR and NMR

(C) UV and NMR

(D) UV, IR and NMR

59. Arrange the following bonds in decreasing order of the stretching frequencies :

C=C	C≡C	C=O	C-C
I	II	III	IV

(A) III>II>I>IV

(B) II>III>I>IV

(C) I>II>III>IV

(D) IV>I>III>II

60. Presence of chloro group in organic compound can best be known by its :

(A) UV spectrum

(B) IR spectrum

(C) Mass spectrum

(D) PMR spectrum

Which of the following statement is true about the correction terms in Van der Waals equations ?

(A) The coefficient "a" accounts for the mutual attraction between the molecules.

(B) The term a/v^2 increases the pressure of real gas relative to ideal gas.

(C) The coefficient "b" represents the volume that is compressible.

(D) Both (A) and (C)

2. The parameters of an orthorhombic unit cell are $a = 50$ pm, $b = 100$ pm and $c = 150$ pm. The spacing between the (123) planes will be :

(A) 50 pm

(B) 19 pm

(C) 29 pm

(D) 75 pm

3. On increasing temperature, the fraction of total gas molecules which has acquired most probable velocity will :

(A) increase

(B) decrease

(C) remains constant

(D) can't say without knowing pressure

4. Which liquid crystal phase has the least order and is most liquid-like ?

(A) Smectic liquid crystal

(B) Chloesteric liquid crystal

(C) Nematic liquid crystal

(D) Discotic liquid crystal

5. Consider the following statements :

1. Half life period of first order reaction is directly proportional to the initial concentration of reactants.
2. A catalyst increases the rate of a reaction by lowering its activation energy.
3. A zero order reaction takes finite time for completion while the first order reaction would get completed in infinite time.

Which of the above statement(s) is/are correct ?

(A) 1 & 2

(B) 2 & 3

(C) 1 & 3

(D) None of these

6. Which among the following plots are linear ? (a-x) is the concentration of reactant remaining after time, t ?

(A) (a-x) *vs t*, for a first order reaction

(B) (a-x) *vs t*, for a half order reaction

(C) (a-x) *vs t*, for a second order reaction

(D) $(a\text{-}x)^{-1}$ *vs t*, for a second order reaction

7. For a reaction, $A(g) + 2B(g) \rightarrow C(g) + D(g)$, $dx/dt = k[A][B]^2$. Initial concentration of A and B are respectively 0.6 M and 0.8 M. At a time when concentration of C is 0.2 M, rate of reaction relative to the initial value would be :

(A) 1/6

(B) 1/48

(C) 1/4

(D) 1/24

8. Consider the following :

i. Internal conversion

ii. Vibrational relaxation

iii. Phosphorescence

iv. Fluorescence

Which of the above involves radiative processes ?

(A) i, ii and iii

(B) ii and iii

(C) ii, iii and iv

(D) iii and iv

9. The following processes are used for cooling :

1. Adiabetic expansion
2. Adiabetic demagnetization
3. Joule-Thomson effect
4. Evaporation

The correct sequence of these processes in order to produce lower and lower temperature is :

(A) 4,1,2,3

(B) 4,1,3,2

(C) 1,4,2,3

(D) 1,4,3,2

10. Strike out the INCORRECT statement(s) from the following:
    1. ΔH, ΔU, w and q are all zero for expansion of an ideal gas under isothermal conditions.
    2. Temperature dependence of enthalpy of a reaction is given by Kirchoff's equation.
    3. Residual entropy of carbon monoxide is zero.
    (A) 1 and 2
    (B) 2 and 3
    (C) 1 and 3
    (D) 1, 2 and 3

11. The Classius-Clapeyron equation is applicable to which of the following processes:
    1. Melting of ice into water
    2. Condensation of steam into water
    3. Burning of H_2 gas in presence of O_2
    (A) 1 and 2
    (B) 1 and 3
    (C) 2 and 3
    (D) 1,2 and 3

12. When at a point, liquid phase transforms into two different solids on cooling then it is known as:
    (A) Eutectoid point
    (B) Eutectic point
    (C) Peritectic point
    (D) Peritectoid point

13. Which of the following electrodes can be used to find out pH of a solution?
    (A) Quinhydrone electrode
    (B) Calomel electrode
    (C) Glass electrode
    (D) Both (A) and (C)

14. In case of conductometric titration between NaOH (taken in cell) and acetic acid (taken in burrette), the conductance will
    (A) First decrease and then increase
    (B) First decrease and then remain almost constant
    (C) First increase and then remain almost constant
    (D) First decrease slightly, then increase slowly and finally increase at faster rate

15. Molar conductance for a compound AB is 145.0 Scm^2mol^{-1} and for CB is 110.1 Scm^2mol^{-1}. Limiting molar conductance for A^+ is 73.5 Scm^2mol^{-1}. What is limiting molar conductance for C^+ ion?
    (A) 326.6 Scm^2mol^{-1}
    (B) 38.6 Scm^2mol^{-1}
    (C) 181.6 Scm^2mol^{-1}
    (D) 90.8 Scm^2mol^{-1}

16. What is the molar solubility (s) of $Ba_3(PO_4)_2$ in terms of K_{sp}?
    (A) $s = (K_{sp}/27)^{1/5}$
    (B) $s = (K_{sp})^{1/5}$
    (C) $s = (K_{sp})^{1/2}$
    (D) $s = (K_{sp}/108)^{1/5}$

17. Select the INCORRECT statement:
    (A) The acceptable wave function needs to be continuous, finite and single valued.
    (B) Quantum mechanical operators must be Hermetian.
    (C) Eigen function of a given state must be normalized in itself.
    (D) Multiplication of any eigen-function of a linear operator by a constant changes its eigenvalue.

18. By what factor the spacing between first two energy levels of an electron trapped in one dimensional box will change if its length is doubled?
    (A) will become doubled
    (B) decreases to half the initial value
    (C) become quadrupled
    (D) reduce to $1/4^{th}$ of initial value

19. The value of Rydberg constant is 1.09737 31568 $\times 10^7$ m^{-1}. The wavelength of light that is emitted when the electron in hydrogen atom makes a transition from n = 6 to n = 4 is:
    (A) 1500nm
    (B) 2050nm
    (C) 2624nm
    (D) 3500nm

20. Pure rotational spectrum is not shown by :
(A) H_2O
(B) NO_2
(C) H_2
(D) HCl

21. Which of the following statements is INCORRECT ?
(A) The ground state of an atom will be the one having the greatest spin multiplicity.
(B) The product of the uncertainty in the energy and the life time of an electronic excited state is greater than or equal to $h/4\pi$.
(C) The number of radial nodes of an orbital is equal to the value of **n**, the principal quantum number.
(D) A radial distribution function (P) gives the probability that an electron will be found at a given distance from the nucleus, regardless of the direction, and is equal to $4\pi r^2\psi^2$.

22. The number of nodal surfaces and nodal planes in 2p orbital, respectively, are :
(A) 0 and 1
(B) 2 and 0
(C) 1 and 2
(D) 2 and 1

23. Given:
$C\ (Graphite) + O_2(g) \rightarrow CO_2(g);\ \Delta H° = -393.5\ kJ$
$WC(s) + 5/2\ O_2(g) \rightarrow WO_3(s) + CO_2(g);$
$\Delta H° = -1196.4\ kJ$
$W(s) + 3/2\ O_2(g) \rightarrow WO_3(s);\ \Delta H° = -837.9\ kJ$
The standard enthalpy of formation of WC(s) is
(A) 358.5kJ
(B) –35.0 kJ
(C) 35.0 kJ
(D) –358.5 kJ

24. The molecular structure of XeF_6 is :
(A) Square pyramidal
(B) Octahedral
(C) Pentagonal bipyramid
(D) Distorted octahedral

25. The following synthetic reaction is an example of :
$BF_3 + 3CH_3MgBr$ (in dibutyl ether) $\rightarrow B(CH_3)_3 + 3MgBrF$
(A) Transmetallation
(B) Metathesis
(C) Direct metal-hydrocarbon reaction
(D) Both transmetallation and metathesis

26. According to Wade's rule, boron hydrides of formula B_nH_{n+2} and n+2 pairs of bonding electrons have ;
(A) Hypho structure
(B) Closo structure
(C) Nido structure
(D) Arachno structure

27. The reaction of XeF4 with the lewis base F- in cyanomethane solution produces the XeF_5^- ion which has :
(A) Planar pentagonal geometry
(B) Square pyramidal geometry
(C) Trigonal bipyramidal geometry
(D) Distorted octahedral geometry

28. With respect to halogens, four statements are given below :
I. The bond dissociation energies for halogens are in order of $I_2 < F_2 < Br_2 < Cl_2$.
II. The only oxidation state exhibited by all the halogens is -1.
III. The amount of energy required for the excitation of electrons to first excited state decreases progressively as we move from F to I.
IV. They form HX^{2-} species in their aqueous solutions (X = halogen)
The CORRECT statements are :
(A) I, II, IV
(B) I, III, IV
(C) II, III,IV
(D) I, III

29. The common salt is important for physiological activity of human body, because :
(A) Contains ions, each having eight electrons in its outermost shell and therefore acts as an inert nutrient.
(B) Is involved in the carbohydrate metabolism
(C) Has a high lattice energy and is one of the sources of energy in the body
(D) Helps in maintaining the osmotic balance among the body fluids

30. 10 Dq for the complexes $[CrCl_6]^{3-}$, $[Cr(NH_3)_6]^{3+}$, $[Cr(CN)_6]^{3-}$ are 13,500cm^{-1}, 21,600cm^{-1}, and 28,200 cm^{-1} respectively. The number of unpaired electrons in the above complexes, in their electronic ground states :
(A) is the same in all the complexes
(B) goes on increasing with increasing 10Dq
(C) goes on decreasing with decreasing 10Dq
(D) can not be predicted.

31. The theoretical value of the magnetic moment of a high spin octahedral Mn^{2+} complex at 273K is :
(A) 2.83 B.M
(B) 3.87 B.M
(C) 4.90 B.M
(D) 5.92 B.M

32. Which one of the following ions is the most stable in aqueous solutions ?
(A) Cr^{3+}
(B) V^{3+}
(C) Ti^{3+}
(D) Mn^{3+}

33. Which of the following lanthanoid ions is paramagnetic ? (At. Number: La = 57, Eu = 63, Yb = 70, Lutetium = 71)
(A) La^{3+}
(B) Eu^{3+}
(C) Yb^{2+}
(D) Lu^{3+}

34. The application of Jahn-Teller theorem to the stereochemistry of complexes suggests that the distortion in ML_6 complexes prevails in the ground state when :
(A) M is Cr^{3+} and L is a weak ligand
(B) M is Ti^{3+}
(C) M is Co^{3+} and L is strong field ligand
(D) M is Cr^{3+} and L is a strong ligand

35. The phenomenon of spin-crossover will be observed for ML_6 complexes with M ion having electronic configuration :
(A) d^1
(B) d^3
(C) d^4
(D) d^8

36. The energy expression for low-spin ground state of d^6 ion in octahedral field is :
(A) $-(2/5)\Delta_o + P$
(B) $-(6/5)\Delta_o + P$
(C) $-(12/5)\Delta_o + P$
(D) 0

37. The standard reduction potential of Cu^{2+}, Zn^{2+}, Sn^{2+} and Ag^+ are 0.34, –0.76, –0.14 and 0.80 V respectively. The storage that is possible without any reaction is for :
(A) $CuSO_4$ solution in a zinc vessel
(B) $AgNO_3$ solution in a zinc vessel
(C) $AgNO_3$ solution in a tin vessel
(D) $CuSO_4$ solution in a silver vessel

38. Which of the following is not used as an oxidizing agent in redox titrations ?
(A) $KMnO_4$
(B) $K_2Cr_2O_7$
(C) I_2
(D) $Na_2S_2O_3$

[Turn over

39. Which of the following statements is INCORRECT in context of gravimetry ?

(A) A highly supersaturated solution leads to the formation of large well developed particles upon precipitation.

(B) The particle size of a precipitate decreases with increasing concentration of the reactants.

(C) Precipitation is usually carried out in hot solution in order to minimize the supersaturation of the reaction solution.

(D) Increasing the solubility of the precipitate by a suitable reagent leads to the formation large primary particles.

40. Potassium chromate is used as indicator in :

(A) Redox titration

(B) Complexation titration

(C) Neutralisation titration

(D) Mohr titration

41. The following compounds rank in which of the order of increasing reactivity in electrophilic substitution reaction ?

I. C_6H_5Cl II. C_6H_6

III. $C_6H_5NO_2$ IV. $C_6H_5NH_2$

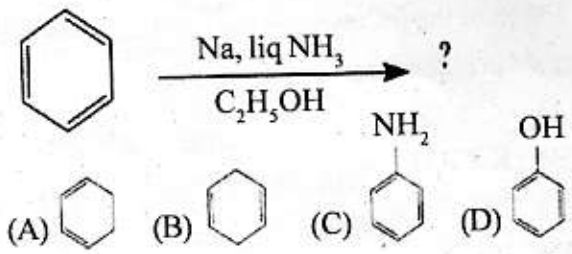
(A) IV < III < II < I

(B) III < I < II < IV

(C) I < II < III < IV

(D) IV < I < II < III

42. Identify the product :



43. 2, 3 dimethyl-2-pentene on ozonolysis yields:

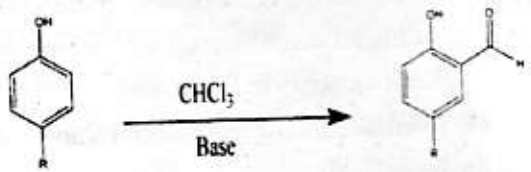
(A) Acetone

(B) Ethylmethylketone

(C) Propionaldehyde & Ketone

(D) Ethylmethylketone & Acetone

44. Identify the name of the following reaction :



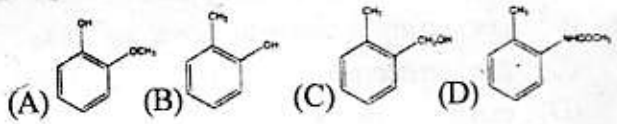
(A) Reimer-Tiemann Reaction

(B) Mannich Reaction

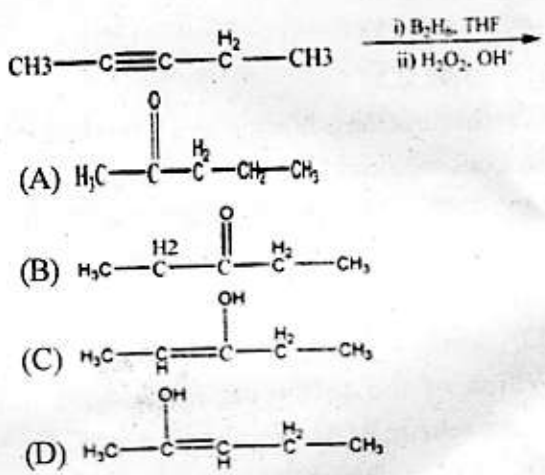
(C) Birch Reduction

(D) Gatterman Reaction

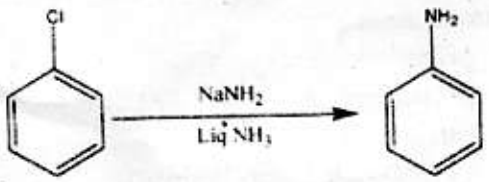
45. Which one of the following is most reactive towards electrophilic substitution reagent ?



46. Identify the major product of the following reactions :

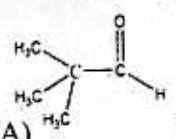
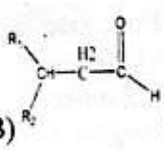
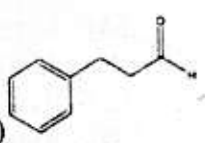
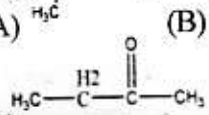


47. Identify the reaction intermediate in the following reaction :

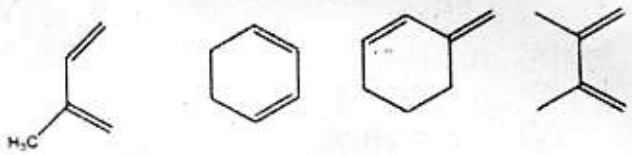


(A) Carbocation
(B) Free radical
(C) Carbanion
(D) Benzyme

48. Which amongst the following does not undergo Aldol Condensation reaction ?

(A) 
(B) 
(C) 
(D) 

49. Which of the following cannot undergo Diels-Alder Reaction ?



(A) (B) (C) (D)

50. Arrange the relative order of migratory aptitude of groups in Pinacol-Pinacolone rearrangement?

(A) $H > Ph > Me_3C > MeCH_2 > Me$
(B) $Ph > Me_3C > MeCH_2 > Me > H$
(C) $Me_3C > Ph > MeCH_2 > Me > H$
(D) $Me_3C > MeCH_2 > Ph > Me > H$

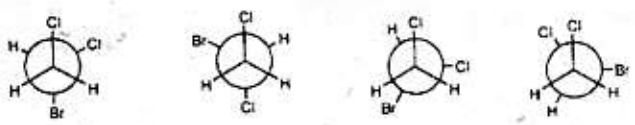
51. Perkin Condensation reaction takes place in :

(A) Acidic medium
(B) Alkaline medium
(C) Neutral medium
(D) Basic medium

52. A protein attached to a carbohydrate moiety is called as :

(A) Lipoprotein
(B) Glycoprotein
(C) Apoprotein
(D) Nucleoprotein

53. Which one of the following is the most stable conformation of the given molecule ?



(A) (B) (C) (D)

54. Which of the following is the correct assignment of the absorption maxima (λ_{max}) to the respective molecules ?

Molecules : (I) Ethylene
(II) 1,2-Butadiene
(III) 1,3, 5-Hexatriene
(IV) β-Carotene

λ_{max} : (a) 258nm (b) 175nm
(c) 465nm (d) 217nm

(A) (I)-(a), (II)-(b), (III)-(c), (IV)-(d)
(B) (I) -(b), (II)-(d), (III)-(a), (IV)-(c)
(C) (I) -(b), (II)-(a), (III)-(c), (IV)-(d)
(D) (I) -(a), (II)-(c), (III)-(b), (IV)-(d)

55. The IR spectrum of an organic molecule shows, in addition to other peaks, a strong absorption band in the region 1730–1700 cm^{-1} and a broad absorption band in the region 3400–2400 cm^{-1}. Which of the following organic classes does the molecule belong to ?

(A) Hydrocarbons
(B) Alcohols
(C) Phenols
(D) Carboxylic acids

56. Using Woodward rules, identify the correct value of λ_{max} for α-Terpinene molecule given bellow :

(A) 214nm
(B) 253nm
(C) 273nm
(D) 210nm

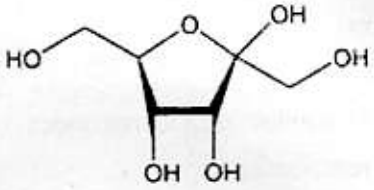
57. Using a 60MHz spectrometer, the proton signal in dichloromethane appears at 5.30 ppm. When the same sample is placed in a 100 MHz instrument, where does the signal appear ?

(A) 3.18 ppm
(B) 5.30 ppm
(C) 8.83 ppm
(D) 9.50 ppm

58. The isoelectric point of glycine and cysteine is at pH 6.1 and pH 5.0, respectively. The separation of these two amino-acids in a binary mixture by electrophoresis is :

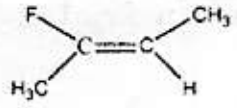
(A) pH independent
(B) pH dependent
(C) carried out at pH 7
(D) carried out at highly basic pH

59. Which among the following is correct for the following sugar ?

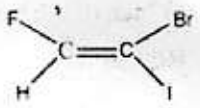


(A) Ketose, Furanose, α
(B) Aldose, Pyranose, α
(C) Ketose, Furanose, β
(D) Aldose, Pyranose, β

60. Determine the double bond stereochemistry (E or Z) for the following molecules ?



A



B

(A) A: E and B: E
(B) A: Z and B: E
(C) A: E and B: Z
(D) A : Z and B: Z

1. Match the effective nuclear charge of the electrons using Slater rules :

I.	2p electron in Nitrogen atom :	(i)	3.9
II.	4s electron in Zinc atom :	(ii)	4.35
III.	3d electron in Zinc atom :	(iii)	8.85

(A) I–(i), II–(ii), III–(iii)
(B) I–(ii), II–(i), III–(iii)
(C) I–(ii), II–(iii), III–(i)
(D) I–(i), II–(iii), III–(ii)

2. Assuming you discovered a new element of atomic number 162, what can be correct statement for this new element ?
(A) It has a valence electron configuration of $8S^2 7d^{10}$
(B) It has 18 electrons in g subshell
(C) It can be placed two periods below mercury in periodic table
(D) All of these

3. In terms of *styx* convention of bonding in boranes B_2H_6 is represented by :
(A) 2002
(B) 2012
(C) 4012
(D) 3203

4. Which of the following Nitrogen oxides is paramagnetic in nature ?
(A) N_2O
(B) N_2O_3
(C) N_2O_4
(D) NO_2

5. Which of the following oxoacids of sulfur has two sulfur centres linked through one oxygen centre ?
(A) $H_2S_2O_4$
(B) $H_2S_2O_7$
(C) $H_2S_2O_8$
(D) $H_2S_2O_3$

6. What is incorrect for Borazine ?
(A) Borazine is isoelectronic with benzene
(B) Borazine has similar physical and chemical properties as benzene
(C) Borazine and Benzene both have $p\pi$-$p\pi$ bonding
(D) Borazine has electron rich Nitrogen and electrophillic Boron atoms in ring structure

7. Identify incorrect statement for refractory materials like MgO :
(A) These are suitable for use in furnace lining
(B) These have high melting point and high thermal conductivity
(C) These have high melting point and chemically inert nature
(D) These have low melting point and high electrical conductivity

8. Which of the following nickel complexes has highest magnetic moment ?
(A) $[Ni(CO)_4]$
(B) $K_2[Ni(CN)_4]$
(C) $[Ni(OH_2)_6]Cl_2$
(D) All have same magnetic moment

9. Which of the following 3d series metal ions give a colorless aqueous solution ?
(A) Cr(III)
(B) Mn(II)
(C) Co(II)
(D) Ni(II)

10. The metal compound used in treatment of Rheumatoid arthritis is :
    (A) Auranofin
    (B) *d-penicill amine*
    (C) Oxaliplatin
    (D) Deferoxamine

11. The geometry of a metal compound in the nine coordination number can be :
    (A) Tricapped trigonal prism
    (B) Bicapped trigonal prism
    (C) Square antiprism
    (D) Any of these

12. Identify the incorrect statement :
    (A) Linkage isomers can be studied by IR spectroscopy
    (B) Hydrate isomers of $CrCl_3 \cdot 6H_2O$ can be distinguished with Mohr Titration
    (C) Cis and trans isomers of $[PtCl_2(NH_3)_2]$ can be distinguished by IR spectroscopy
    (D) The propeller type $[M(AA)_3)]$ octahedral complexes are optically inactive

13. Which of the following complexes has the d^8 metal centre ?
    (A) $[CoCl_3(Py)_3]$
    (B) $K[ReO_4]$
    (C) $[Ni(en)_3]Cl_2$
    (D) $[Cr(acac)_3]$

14. Which of the following lanthanide ions give a zero magnetic moment ?
    (A) Dy^{3+}
    (B) Yb^{3+}
    (C) Ce^{3+}
    (D) Lu^{3+}

15. The complex of which of the following lanthanide ions is used as intravenous magnetic resonance contrast agent ?
    (A) Dy^{3+}
    (B) Gd^{3+}
    (C) Yb^{3+}
    (D) Lu^{3+}

16. The precipitating agent in the gravimetric analysis of silver ions is :
    (A) Dimethyl glyoxime
    (B) Cupferroin
    (C) Dilute Hydrochloric acid
    (D) Sodium tetraphenyl borate

17. Which of the following in not a group reagent in Qualitative analysis of metals ?
    (A) Concentrated HCl
    (B) H_2S in acidic medium
    (C) Hydrazine hydrochloride
    (D) Dilute HCl

18. Paper Chromatography is a type of :
    (A) Solid liquid Chromatography
    (B) Liquid—liquid Chromatography
    (C) Solid liquid adsorption Chromatography
    (D) Liquid—liquid Partition Chromatography

19. Which of the following has octahedral shape ?
    (A) XeF_6
    (B) SF_6
    (C) Both (A) & (B)
    (D) None of these

20. Which of these compounds has one of the bond angles less than 90° ?
    (A) SeF_6
    (B) $(CH_3)_2PF_3$
    (C) $POCl_3$
    (D) IF_7

21. The carbon-carbon sigma bond in ethyne is formed by :
(A) sp^3–sp^3 orbital overlap
(B) sp^2-sp^2 orbital overlap
(C) sp^2-sp orbital overlap
(D) sp-sp orbital overlap

22. The addition of HBr to Ph-CH=CH–CH_3 leads to the formation of :
(A) Ph–CHBr–CH_2–CH_3 (100%)
(B) Ph–CH_2–CHBr–CH_3 (100%)
(C) 50% both of (A) and (B)
(D) Major product is (B) and minor product is (A)

23. Which of the following alkenes would react more rapidly with HBr ?
(A) $H_2C=C(CH_3)_2$
(B) $H_2C=CCH_3–CH_2OCH_3$
(C) $H_2C=CCH_3–O–CH_3$
(D) $H_2C=CH–CH_3$

24. Which of the carbanions is most stable ?
(A) $\bar{C}H_2$–CO–R
(B) $\bar{C}H_2$–CN
(C) $\bar{C}H_2$–CO–OR
(D) $\bar{C}H_2$–CO–NR_2

25. Which of the following alkyl halides are the best substrates for E2 elimination giving alkenes as major product ?
(A) Primary alkyl halide
(B) Secondary alkyl halide
(C) Tertiary alkyl halide
(D) Aryl alkyl halide

26. Which of the following halo-acids adds to alkanes in the presence of peroxide to give anti-Markonikov product ?
(A) H-F
(B) H-Cl
(C) H-Br
(D) H-I

27. Addition of 2 moles of HBr to 1-butyne would give :
(A) 1,1-dibromobutane
(B) 1,2-dibromobutane
(C) 2,2-dibromobutane
(D) 2-bromo-1-butene

28. Diels–Alder reaction is facilitated by :
(A) Electron rich diene and electron-deficient dienophile
(B) Electron deficient diene and electron-deficient dienophile
(C) Electron rich diene and electron-rich dienophile
(D) Electron deficient diene and electron-rich dienophile

29. Which of the following carbonyl compounds exhibits highest reactivity towards nucleophiles ?
(A) R–CHO (aldehydes)
(B) RR' C=O (ketones)
(C) RCOOR' (esters)
(D) $RCONH_2$ (amides)

30. Which of the following species is not part of mechanistic steps involved in HVZ reaction of CH_3CH_2COOH ?
(A) CH_3CH_2COBr
(B) $CH_3CH=COHBr$
(C) $CH_3CHBrCOBr$
(D) CH_3CH_2COOBr

31. Which of the following nitrogen bearing compounds is least basic ?
(A) CH_3CN
(B) $CH_3CH=NH$
(C) CH_3NH_2
(D) $(CH_3)_3N$

32. Which is the weakest acid among the following ?
(A) O_2N-CH_2-COOH
(B) Cl-CH_2-COOH
(C) NC-CH_2-COOH
(D) HO-CH_2-COOH

33. The correct increasing order of frequency of carbonyl absorption bands of the following compounds is :
(A) $PhCHO < CH_3COCH_3 < CH_3CHO < HCHO$
(B) $PhCHO < HCHO < CH_3CHO < CH_3COCH_3$
(C) $HCHO < CH_3CHO < CH_3COCH_3 < PhCHO$
(D) $CH_3COCH_3 < CH_3CHO < HCHO < PhCHO$

34. Which of the following electronic transitions occur in the UV-Visible region ?
(A) π to σ^*
(B) n to σ^*
(C) n to π^*
(D) σ to σ^*

35. In which of the following compounds the chemical shift of CH_3-protons would be observed at highest δ value ?
(A) CH_3–Cl
(B) CH_3–Br
(C) CH_3–I
(D) CH_3–OH

36. Which of the following coupling constant values represents the trans protons of an alkene ?
(A) 2 Hz
(B) 7 Hz
(C) 10 Hz
(D) 15 Hz

37. How many stereoisomers are possible for a ketohexose and an aldohexose ?
(A) 16 & 16
(B) 8 & 16
(C) 16 & 8
(D) 8 & 8

38. The only naturally occurring achiral amino acid is :
(A) Lysine
(B) Alanine
(C) Glycine
(D) Cysteine

39. The only amino acid containing a secondary amino group is :
(A) Histidine
(B) Tryptophan
(C) Arginine
(D) Proline

40. The steroid bearing an aromatic ring is :
(A) Cholesterol
(B) Oesterone
(C) Testosterone
(D) Cortisone

41. The interface between a liquid and its vapour disappears at :
(A) Inversion temperature
(B) Boyle temperature
(C) Critical temperature
(D) None of these

42. He-I is a conventional fluid but He-II is a superfluid. The latter has :
(A) Zero resistivity
(B) Zero viscosity
(C) It does not exert any vapour pressure
(D) All of the above are correct

43. A (101) plane in a cubic lattice is :
(A) Parallel to Y-axis
(B) Perpendicular to the Y-axis
(C) Parallel to the YZ plane
(D) Parallel to the XZ plane

44. In a cubic unit cell the spacing between (111) planes is 350 nm. The length of the unit cell is :
(A) 202.1 nm
(B) 280 nm
(C) 175 nm
(D) 350 nm

45. Determine from the data given below, the order of the reaction with respect to H_2 and NO :

$NO(g) + H_2(g) \rightarrow$ products

p(H2)/torr	p(NO)/torr	rate/torr s^{-1}
400	159	34
400	300	125
289	400	160
205	400	110
147	400	79

(A) 1 & 2

(B) 1 & 1

(C) 2 & 1

(D) 2 & 2

46. The hydrolysis of cane sugar to form glucose and fructose can be studied by which of the following techniques ?

(A) Conductometry

(B) Potentiometry

(C) Spectrophotometry

(D) Polarimetry

47. A solution transmits 50% of a beam of light incident on it. The absorbance of the solution is :

(A) 0.50

(B) 0.301

(C) 0.255

(D) 0.421

48. The phenomenon of phosphorescence is a delayed process compared to fluorescence. The process involves :

(A) Intersystem crossing

(B) Internal conversion

(C) Vibrational relaxation

(D) None of the above

49. One mole of an ideal gas is compressed to one-tenth of its original volume. The corresponding change in entropy is :

(A) 2.303 R

(B) –2.303 R

(C) 2 RT

(D) –RT

50. Which of the following is not a state function ?

(A) A

(B) H

(C) q

(D) q/T

51. Which of the following equations is not correct ?

(A) $dA = -SdT - VdP$

(B) $S = -\left(\frac{\partial G}{\partial T}\right)_P$

(C) $V = \left(\frac{\partial G}{\partial P}\right)_T$

(D) $dE = dH - PdV$

52. The phase diagram of the sulphur system exhibits more than one triple point. How many phases are in equilibrium at the triple point ?

(A) 1

(B) 2

(C) 3

(D) 4

53. The Kohlrausch's law can be used in the calculation of which of the following ?

(A) Degree of dissociation of a weak acid

(B) Equivalent conductance of a weak electrolyte at infinite dilution

(C) Solubility of a sparingly soluble salt

(D) All of the above

54. The ionic conductances of H^+ and CH_3COO^- ions are 34.96 and 4.09 mS m^2 mol^{-1} respectively. Given the conductivity of CH_3COOH solution as 20.18 mS m^2 mol^{-1}, the degree of its dissociation is :

(A) .23

(B) .46

(C) .39

(D) .52

55. An electrochemical cell is set up between a Ag/Ag^+ and a Fe/Fe^{2+} half cell. Which of the following is the correct statement about the cell ?

(A) Ag/Ag^+ acts as anode

(B) Fe/Fe^{2+} acts as cathode

(C) Ag is precipitated at the Ag/Ag^+ electrode

(D) Fe will deposit at the Fe/Fe^{2+} electrode

56. Given that the standard redox potential of Cu^{2+}/Cu and Cu^+/Cu couples are +0.340 V & + 0.522 V respectively. What is $E^\circ(Cu^{2+}/Cu^+)$?

(A) +0.158V

(B) –0.158V

(C) +0.316V

(D) –0.316V

57. According to classical theory the radiant energy density from a black body depends :

(A) Directly on temperature

(B) Inversely on temperature

(C) Exponentially on temperature

(D) Is independent of temperature

58. Which of the following commutation relations is correct ?

(A) $\lfloor \hat{L}_x, \hat{L}_y \rfloor = \hbar \hat{L}_z$

(B) $\lfloor \hat{L}_y, \hat{L}_z \rfloor = -i\hbar \hat{L}_x$

(C) $\lfloor \hat{L}_z, \hat{L}^2 \rfloor = \hat{L}_y$

(D) $\lfloor \hat{X}, \hat{P}_x \rfloor = 0$

59. On the basis of moment of inertia the NH_3 molecule can be classified as :

(A) Asymmetric top

(B) Symmetric top

(C) Spherical top

(D) None of these

60. The gross and specific selection rules for a molecule to exhibit rotational spectra are :

(A) $\mu = 0, \Delta J = 0$

(B) $\mu = 0, \Delta J = \pm 1$

(C) $\Delta\mu \neq 0, \Delta J = 0$

(D) $\mu \neq 0, \Delta J = \pm 1$

Sr. No. .....0079.....

ENTRANCE TEST-2017

SCHOOL OF PHYSICAL AND MATHEMATICAL SCIENCES

CHEMISTRY

Total Questions : 60
Time Allowed : 70 Minutes

Question Booklet Series A

Roll No. : | | | | | | |

Instructions for Candidates :

1. Write your 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.

SEAL

1. Radius of Bohr's orbit in hydrogen and hydrogen like species can be calculated as radius of orbit $= r = \frac{n^2h^2}{4\pi^2me^2} \times \frac{1}{Z} = 0.529 \times \frac{n^2}{Z}$ Å where, n = principal quantum number of orbit and Z = atomic number. If the radius of the first Bohr orbit of hydrogen atom is 'r', the radius of the 3rd orbit will be :
   (A) 3 r
   (B) 4.5 r
   (C) 9 r
   (D) 27 r

2. Correct set of all four quantum numbers for an unpaired electron for $3d^9$ is;
   (A) 3, 2, – 2, – 1/2
   (B) 3, 2, – 2, +1/2
   (C) 3, 3, + 2, +1/2
   (D) 3, 3,+ 2, –1/2

3. The total wave functions must change their signs on exchange of any pair of electrons in the system. It means that if two electrons have the same spin they must have different spatial wave functions and if they occupy the same orbital they must have paired spins. This rule is called
   (A) Hund's Rule
   (B) Pauli Exclusion Principle
   (C) Aufbau Principle
   (D) Selection Rule

4. The structures of $AlCl_3$ and PCl_3 can be described as:
   (A) both planar
   (B) both pyramidal
   (C) planar and pyramidal, respectively
   (D) pyramidal and planar, respectively

5. Bond orders for NO and NO^+ are, respectively
   (A) 2.5 and 3
   (B) 2 and 4
   (C) 3.5 and 2.5
   (D) 3 and 2

6. Consider the reaction :
   $CCl_4(g) + 2H_2O(g) \rightarrow CO_2(g) + 4HCl(g)$
   The standard enthalpies of formation at 298 K for $CC1_4(g)$, $H_2O(g)$, $CO_2(g)$ and HCl(g) are –106.7, –241.8, –393.7, and –92.5 kJmol $^{-1}$ respectively. The value of $AH°_{298}$ for the above reaction is
   (A) –137.7 kJ
   (B) 173.4 kJ
   (C) –173.4 kJ
   (D) 137.7 kJ

7. The diagonal relationship of elements in the periodic table arises because of similarity in :
   (A) Ionic radii
   (B) Electronic configuration
   (C) Crystal structure
   (D) Charge/radius ratio of the corresponding ions

8. Metallic hydrides are:
   (A) Non-stoichiometric, electrically conducting solids.
   (B) Non-volatile, electrically non-conducting crystalline solids
   (C) Binary compounds of an element and hydrogen in the form of individual, discrete molecules
   (D) All of the above

9. Which oxyacid of chlorine shows oxidation state of +5 ?
   (A) Hypochlorous acid
   (B) Chloric acid
   (C) Chlorous acid
   (D) Perchloric acid

10. The carbide that gives methane on hydrolysis is:
   (A) SiC
   (B) CaC_2
   (C) Al_4C_3
   (D) TiC

11. Which of the following complexes do you expect to be kinetically inert?
   (A) $V(H_2O)_6^{3+}$
   (B) $Cr(H_2O)_6^{3+}$
   (C) $Mn(H_2O)_6^{3+}$
   (D) $Ti(H_2O)_6^{3+}$

SEAL

12. IUPAC name for $K_3[Al(C_2O_4)_3]$ is

(A) potassium trioxalato aluminate(III)

(B) potassium aluminium oxalate

(C) potassium trioxalate aluminium(II)

(D) potassium trisoxalato aluminate(III)

13. Calculate the crystal field stabilization energy (in cm^{-1}) for $[Co(NH_3)_6]^{2+}$, for which $\Delta_{oct} = 10,200\ cm^{-1}$.

(A) 5,100 cm^{-1}

(B) 10,200 cm^{-1}

(C) 18,360 cm^{-1}

(D) 26,000 cm^{-1}

14. The theoretical value of the magnetic moment of $[Fe(H_2O)_6]Cl_3$ at 273K is

(A) 2.83 BM

(B) 3.87 BM

(C) 4.90 BM

(D) 5.92 BM

15. Which of the following complexes is not expected to be paramagnetic?

(A) $Ni(H_2O)_6^{2+}$ (octahedral)

(B) $Ni(CN)_4^{2-}$ (square planar)

(C) $Ni(Cl)_4^{2-}$: (tetrahedral)

(D) $[Ni(SPh)_4]^{2-}$ (tetrahedral)

16. Hemoglobin is a protein involved in the transport of oxygen from lungs to different tissues. In this protein, oxygen binds to

(A) iron-phthalocyanin

(B) iron-porphyrin

(C) cyanocobalamine

(D) copper-porphyrin

17. The colour change of an acid-base indicator is due to the formation of

(A) benzoic structure

(B) quinoid structure

(C) ionic structure

(D) covalent bond

18. Lead chloride has a solubility product of 1.7×10^{-5} at 300 K. Its solubility will be

(A) 1.62×10^{-2} mol dm^{-3}

(B) 4.123×10^{-3} mol dm^{-3}

(C) 4.123×10^{-6} mol dm^{-3}

(D) 5.1×10^{-3} mol dm^{-3}

19. The standard reduction potentials at 298 K for the half reactions are:

$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$, – 0.762 V

$Cr^{3+}(aq) + 3e^- \rightarrow Cr(s)$, – 0.740 V

$2H^+(aq) + 2e^- \rightarrow H_2(g)$, 0.000 V

$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$, 0.770 V

Which is the strongest reducing agent?

(A) Zn(s) (B) Cr(s)

(C) H_2 (g) (D) $Fe^{2+}(aq)$

20. EDTA is mostly used in which of the following class of titrations?

(A) Redox titration

(B) Complexation titration

(C) Neutralisation titration

(D) Mohr Titration

21. The hybridizations of central carbon atom in $CH_2 = \overset{\oplus}{C}H$ and $CH_2 = \overset{\ominus}{C}H$ are:

(A) sp & sp^2 respectively

(B) sp^2 & sp respectively

(C) Both are sp^2 hybridized

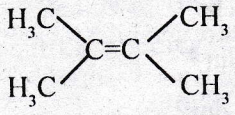
(D) both are sp hybridized

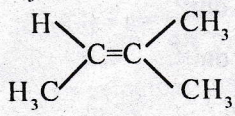
22. Which among the following carbanion is most stable ?

(A) $\overset{\ominus}{\ddot{C}}F_3$ (B) $\overset{\ominus}{\ddot{C}}Cl_3$

(C) $\overset{\ominus}{C}H_3$ (D) $(CH_3)_3\overset{\ominus}{\ddot{C}}$

23. Which of the alkenes is thermodynamically more stable ?

(A) 

(B) 

(C) $CH_3–CH=CH–CH_3$

(D) $CH_3–CH=CH_2$

24. The correct order of basic strength in an aqueous solution is:

(A) $R_2NH > RNH_2 > R_3N > NH_3$

(B) $NH_3 > R_3N > RNH_2 > R_2NH$

(C) $R_3N > R_2NH > RNH_2 > NH_3$

(D) $NH_3 > R_2NH > R_2NH > R_3N$

25. Which of the following aromatic compounds would not undergo diazo-coupling reaction with $Ar\overset{\oplus}{N} \equiv N$?

(A) $Ph–CH_3$

(B) $Ph\ddot{N}Me_2$

(C) $Ph-\ddot{O}H$

(D) $Ph\ddot{N}H_2$

26. Which of the following aldehydes is most reactive in Cannizaro's reaction ?

(A) $Ph–\overset{O}{\overset{\|}{C}}–H$

(B) $(CH_3)_3C–\overset{O}{\overset{\|}{C}}–H$

(C) $Ph–\overset{O}{\overset{\|}{C}}–\overset{O}{\overset{\|}{C}}–H$

(D) $H–\overset{O}{\overset{\|}{C}}–H$

27. Which of the following reagents does not reduce a carbonyl carbon ($–\overset{O}{\overset{\|}{C}}–$) to methylene ($CH_2$) carbon?

(A) $NH_2–NH_2/\overset{\ominus}{O}H$

(B) Zn(Hg)/HCl

(C) $HS.CH_2–CH_2.SH/HCl$

(D) $NaBH_4$

28. In which of the following compounds nitrogen uses sp^3 hybridized orbitals ?

(A) CH_3NH_2

(B) $CH_3–\overset{\oplus}{N}H_3$

(C) R–CH=NH

(D) Both (A) and (B)

29. Mutarotation is observed only in :

(A) Aldoses

(B) Ketoses

(C) Glycosides

(D) All aldoses and ketoses that exist as hemiacetals

30. Primary structure of a protein is:

(A) amino-acid sequence of peptide chain

(B) the different conformations a peptide chain can take

(C) the folding of chain on itself

(D) the one in which two or more chains are linked together by weak forces of attraction

31. Proteins comprise of:

(A) β-amino acids of L-series

(B) α-amino acids of D-series

(C) α-amino acids of L-series

(D) β-amino acids of D-series

32. The steroid having an aromatic ring is:

(A) cholesterol

(B) oesterone

(C) andosterone

(D) cortisone

33. The reaction of aqueous HBr with n-butyl alcohol follows the mechanism :

(A) S_N^2

(B) S_N^1

(C) S_E^1

(D) S_E^2

34. In case of aromatic rings Birch reduction gives non-conjugated hexadiene due to:

(A) 1, 2-addition

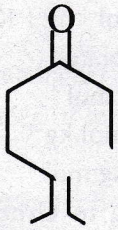
(B) 1, 4-addition

(C) 2, 4-addition

(D) 1, 3-addition

35. Usually Diels-Alder reaction is :
(A) 2+4 cycloaddition
(B) 2+2 cycloaddition
(C) 4+2 cycloaddition
(D) none of the these

36. The tertiary alkyl halide undergoes Friedal-Crafts reaction via the formation of:
(A) carbocation
(B) carbanion
(C) carbene
(D) free radical

37. The λ_{max} for the compound  is :
(A) 239 nm
(B) 235 nm
(C) 219 nm
(D) 208 nm

38. In mass spectrum the base peak is :
(A) the lowest peak
(B) the largest peak
(C) the medium peak
(D) both lowest and highest peak

39. The ^1H spectrum of $CH_2(Cl)CH(Cl)OCH_3$ would show :
(A) a 3 proton singlet, 1 proton triplet and 2 proton doublet
(B) a 3 proton doublet, 1 proton triplet and 2 proton singlet
(C) a 3 proton triplet, 1 proton doublet and 2 proton doublet
(D) a 3 proton singlet, 1 proton singlet and 2 proton doublet

40. The stretching frequency (cm^{-1}) of C≡N in alky cyanides is in the region of:
(A) 1400–1250
(B) 2260–2240
(C) 2950–2650
(D) 3590–4420

41. The real gas behavior approximates the behavior predicted for ideal gas under
(A) High temperature and high pressure conditions
(B) Low temperature and low pressure conditions
(C) High temperature and low pressure conditions
(D) Low temperature and high pressure conditions

42. The constituents of a liquid are usually
(A) Closer together and lower in energy than those in solids
(B) Farther apart and higher in energy than those in a gas
(C) Farther apart and lower in energy than those in solids
(D) Closer together and lower in energy than those in a gas

43. Select the incorrect statement
(A) The flow of smectic liquid crystals is non-newtonian
(B) Smectic phases are anisotropic while Nematic phases are isotropic
(C) Both cholesteric and smectic possess layer structure
(D) Both smectic and nematic phases are uniaxial but only the latter are affected by magnetic field

44. The correct representation of Miller indices for a crystallographic plane that cuts through the crystal axes at (6a, 3b, 3c) will be
(A) (6 3 3)
(B) (1/6 1/3 1/3)
(C) (1 2 2)
(D) (2 1 1)

45. In the kinetic investigations of a single reactant chemical reactions it was observed that the half life of the reactant doubles if its concentration is doubled; this implies
(A) The reaction follows a zero order kinetics
(B) The reaction follows a first order kinetics
(C) The reaction follows a second order kinetics
(D) The rate of reaction decreases with increase in the concentration of the reactant

46. Which among the following statements is not true regarding the Collision theory of reaction rates ?
(A) The rate constant for a bimolecular reaction is sensitive to size and the mass of the reactants
(B) Only the translational energy of reactants contributes for the kinetics of reaction
(C) The effective energy for the reaction of two colliding partners is equal to the sum of their individual kinetic energies
(D) The temperature dependence of rate constant follows an Arrhenius behavior

47. Regarding the photochemical combination of hydrogen-chlorine and hydrogen-bromine reactions, select the incorrect statement
(A) Both the reactions are examples of chain reactions
(B) The quantum yield of hydrogen-bromine is less than one
(C) The rate of both the reactions is proportional to the intensity of absorbed radiations
(D) The quantum yield of hydrogen-bromine decreases with progress of reaction

48. The aqueous solution of a substance with known concentration was observed to absorb 10 percent of the incident light in a Lambert-Beer law cell. What fraction of the incident light shall be absorbed in the same setup if the cell thickness is increased by five times ?
(A) 50 percent
(B) 41 percent
(C) 20 percent
(D) 10 percent

49. Regarding the isothermal expansion for similar amounts of an ideal and a van der Waals gas, which of the following statements is correct ?
(A) The magnitude of work for ideal gas is more than that of van der Waals gas
(B) The entropy change for ideal gas shall be negative
(C) The change in internal energy and enthalpy of ideal gas shall be non zero
(D) Work done by the van der Waals gas is equal to the heat it absorbs from the surroundings

50. Out of three Carnot engines, operating between reservoir temperatures of (i) 400 and 500 K (ii) 600 and 800 K (iii) 400 and 600 K, which has the greatest thermal efficiency ?
(A) (i)
(B) (ii)
(C) (iii)
(D) All three shall have the same efficiency

51. The concentration of a non volatile and non-ionizing solute required to depress the freezing temperature of a solvent with a cryoscopic constant of 0.5K $kg.mol^{-1}$ by 1 K will be
(A) 2 $mol.kg^{-1}$
(B) 2 $kg.mol^{-1}$
(C) 0.5 $mol.kg^{-1}$
(D) 0.5 $kg.mol^{-1}$

52. According to Gibbs phase rule, the maximum number of degrees of freedom (F) for a system of C-components shall be
(A) C–1
(B) C+1
(C) C–2
(D) C+2

53. Which of the following is not correct for dilute solutions of a strong electrolyte ?
(A) Molar conductance increases with increase of dilution
(B) Molar conductance vs. square root of concentration is linear with positive slope
(C) Specific conductance decreases with increase of dilution
(D) Dilution does not affect the total number of ions responsible for conductance of solution

54. During conductometric titration of a strong acid by a weak base
(A) The conductivity increases upto end point and then decreases
(B) The conductivity increases upto end point and then remains almost unchanged
(C) The conductivity decreases upto end point and then remains almost unchanged
(D) The conductivity remains almost unchanged upto end point and then increases

55. The standard reduction potentials of Zn^{2+}/Zn, Cu^{2+}/Cu and Ag^{+}/Ag are respectively –0.76, 0.34 and 0.8 V. The following cells were constructed

1. $Zn/Zn^{2+}||\ Cu^{2+}/Cu$
2. $Zn/Zn^{2+}||\ Ag^{+}/Ag$
3. $Cu/Cu^{2+}||\ Ag^{+}/Ag$,

The correct order for the emf of these cells will be

(A) 2 > 3 > 1
(B) 2 > 1 > 3
(C) 1 > 2 >3
(D) 3 > 1 > 2

56. Which of the following statements is not correct for the thermodynamic variables of an electrochemical cell ?

(A) If the emf is negative it implies ΔG for the cell reaction is positive
(B) ΔG will be equal to ΔH of cell reaction if emf of the cell does not depend on temperature
(C) In case the emf of the cell does not depend on temperature, ΔS for the cell reaction shall be greater than zero
(D) In case the emf of the cell does not depend on temperature, ΔG for the cell reaction shall be independent of temperature

57. For an electron and proton having same de-Broglie wavelength, which one is correct ?

(A) Both have same kinetic energy
(B) Both have same velocity energy
(C) Both have same momentum
(D) All the above

58. By what extent shall the energy gap between successive energy levels accessible to a particle in one dimensional box change if the length of the box is doubled ?

(A) The gap will not change
(B) The gap will be reduced to one half of its initial value
(C) The gap will be increased to twice its initial value
(D) The gap will be reduced to one fourth of its initial value

59. Which of the following diatomic molecules will not give a rotational spectrum ?

(A) CO
(B) N_2
(C) HF
(D) NO

60. If the vibrations of a hetero-diatomic molecule are approximated vibrations of harmonic oscillator, then

(A) The zero-point energy of the molecule will be independent of strength of bond
(B) The frequency absorbed for transition between two successive vibrational energy levels shall be independent of the vibrational quantum no. of the two states
(C) The allowed change in vibrational quantum number for the vibrational transitions shall be $\pm 1, \pm 2$
(D) The gap between successive vibrational energy states shall decrease with increase in vibrational quantum number

Sr. No. 0157

ENTRANCE TEST-2016

FACULTY OF PHYSICAL AND MATERIAL SCIENCE

M.Sc. CHEMISTRY

Total Questions : 60
Time Allowed : 70 Minutes

Question Booklet Series A

Roll No. : | | | | | | |

Instructions for Candidates :

1. Write your 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.

SEAL

1. For the complex of type (Cp) M $(CO)_x$, identify M for X = 2, 3, 4 :

   (A) Rh, Tc, Nb (B) Ag, Tc, Rh

   (C) Nb, Ag, Rh (D) Rh, Nb, Tc

2. Which one of the following complexes can exhibit geometrical isomerism ?

   (A) $[Co(NH_3)_4Cl_2]^+$ (B) $[Zn(NH_3)_2Cl_2]$

   (C) $[Co(NH_3)_5Cl]^{2+}$ (D) $[Cu(CN)_2]^-$

3. In terms of *styx* convention of bonding in boranes, diborane is represented by :

   (A) 2012 (B) 2002

   (C) 4012 (D) 3203

4. The 2-centre 2-electron BB bond is absent in which of these boranes ?

   (A) B_4H_{10} (B) B_5H_9

   (C) B_6H_{10} (D) B_5H_{11}

5. Which of the following complexes represents stabilization of metal in unusual oxidation state ?

   (A) $[Cu(acac)_2]$ (B) $[Cu(bipy)_2]^{2+}$

   (C) $[Cu(NH_3)_4]^{2+}$ (D) $K_3[CuF_6]$

6. Curie and Neel Temperatures are characteristic of which materials ?

   (A) Para and Ferromagnetic (B) Dia and Antiferromagnetic

   (C) Ferro and Antiferromagnetic (D) Para and Diamagnetic

7. Which of these nitrogen compounds is a strong and structurally diverse ligand ?

   (A) Dinitrogen (B) Nitrous Oxide

   (C) Nitric Oxide (D) Nitrogen Dioxide

8. Which of the following Ln^{III} ions has highest spin magnetic moment ?

   (A) Gd (B) Pm

   (C) Ce (D) Lu

9. For a low spin octahedral complex if 0.6 (a.u) is the stabilization per electron in T_2g set of orbitals then destabilization per electron in Eg set will be :

(A) 0.4
(B) 0.9
(C) 0.6
(D) 0.3

10. Which of the following is a sulfane ?

(A) H_2S
(B) SF_2
(C) S_2F_4
(D) H_2SO_3

11. The Penta-atomic Inter-halogen anions have :

(A) Square Planar Structure
(B) Octahedral Structure with two trans lone pairs
(C) Octahedral Structure with two cis lone pairs
(D) Trigonal Bipyramidal Structure

12. The Bond angles in IF_7 molecule are :

(A) 60°, 90°
(B) 120°, 60°
(C) 109.5°, 72°
(D) 72°, 90°

13. The correct order of stability for the following super oxides is :

(A) $KO_2 > RbO_2 > CsO_2$
(B) $RbO_2 > CsO_2 > KO_2$
(C) $CsO_2 > RbO_2 > KO_2$
(D) $KO_2 > CsO_2 > RbO_2$

14. The antidote for Arsenic toxicity in humans via chelation therapy is :

(A) Dimercaprol
(B) d-Pencillamine
(C) EDTA
(D) Deferoxamine

15. Which of the following bio-molecules does not contain iron ?

(A) Hemerythrin
(B) Cytochrome c
(C) Carbonic anhydrase
(D) Cytochrome P450

16. Which of the following methods involve redox titration ?

(A) Mohr
(B) Volhard
(C) Fajans
(D) None of these

17. For a redox titration the transition potential of its redox indicator should be :

(A) Equal to the potential at the start of titration

(B) Equal to the potential at equivalence point

(C) More than the potential at any point of titration

(D) Equal to the potential at end point

18. The group reagent for separation of Selenium and Tellurium metal ions in qualitative analysis is :

(A) Dilute HCl

(B) H_2S in acidic medium

(C) Hydrazine hydrochloride

(D) H_2S in alkaline medium

19. Molecular orbital treatment comparison of CN and CN^- indicates :

(A) CN^- has a higher bond order and is paramagnetic

(B) CN^- has a lower bond order and is diamagnetic

(C) CN^- has a higher bond order and is diamagnetic

(D) CN^- has a lower bond order and is paramagnetic

20. As per Slater rules, Screening constant and effective nuclear charge experienced by the **4s** electron of Zinc atom are :

(A) 25.65 and 4.35

(B) 4.35 and 25.65

(C) 21.15 and 8.85

(D) 8.85 and 21.15

21. Which of the following orbital overlaps would result in the strongest carbon-carbon bonds ?

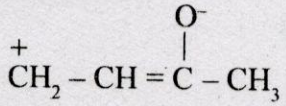
(A) sp^3-sp^3

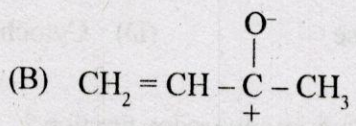
(B) sp^2-sp^2

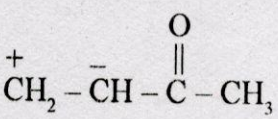
(C) sp-sp

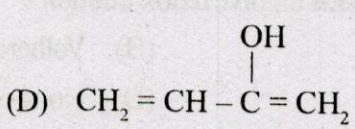
(D) sp-sp^2

22. Which among the following cannot be a valid contributing resonance structure for methyl vinyl ketone ?

(A) 

(B) 

(C) 

(D) 

23. Which of the following statements is not true for a compound to be designated as aromatic ?

(A) The π-cloud must be cyclic

(B) The π-cloud must be uninterrupted

(C) The π-cloud must contain an even number of pairs of π-electrons

(D) The π-cloud must contain an odd number of pairs of π-electrons

24. The least stable conformer of cyclohexane is :

(A) Chain form

(B) Half chair form

(C) Boat form

(D) Twisted-boat form

25. Which of the following has the highest rate of S_N2 reaction ?

(A) $R - CH_2 - I$

(B) $R - CH_2 - Br$

(C) $R - CH_2 - Cl$

(D) $R - CH_2 - F$

26. Which of the following haloalkanes would give 1-hexene as the major product in an E2 reaction with NaOMe ?

(A) 2-Iodohexane

(B) 2-fluorohexane

(C) 2-Bromohexane

(D) 2-Chlorohexane

27. Which of the following would be least reactive towards electrophilic substitution ?

(A) Benzene

(B) Bromobenzene

(C) Benzaldehyde

(D) Nitrobenzene

28. How many products are expected to be formed upon reaction between one mole each of HBr and 1,3-pentadiene ?

(A) 01

(B) 02

(C) 03

(D) 04

29. The compound bearing highest reactivity towards nucleophilic aromatic substitution is :

(A) Chlorobenzene

(B) 3-chloronitrobenzene

(C) 4-chloronitrobenzene

(D) 1-chloro-2,4-dinitrobenzene

30. Which of the following can't be reduced by $LiAlH_4/NaBH_4$?

(A) R–CH=CH–R
(B) R–CO–NHR
(C) R–CO–R
(D) R–CO–OR

31. The reductive process employed to convert a carbonyl carbon to methylene group can be :

(A) $NaBH_4$ reduction
(B) Wolf-Kishner reduction
(C) Meerwein-Pondorff-Verly reduction
(D) Catalytic hydrogenation

32. The addition of enolate of one ester molecule to the carbonyl carbon of another in an acyl substitution reaction to yield β-keto ester and an alcohol molecule is known as :

(A) Benzoin condensation
(B) Knoevenegal reaction
(C) Claisen condensation
(D) Aldol condensation

33. Which of the following dienes would have lowest absorption maxima (λ_{max}) ?

(A) 
(B) 
(C) 
(D) 

34. The carbonyl absorption peak in the IR spectrum at the lowest frequency is observed in case of :

(A) $R - CO - NH_2$
(B) $R - CO - R$
(C) $R - CO - OR$
(D) $R - CO - OH$

35. Which of the following protons is most deshielded ?

(A) $-\overset{|}{C}=\overset{|}{C}-H$
(B) $-C \equiv C - H$
(C) $Ar - H$
(D) $- CO - H$

36. Identify the compound having molecular formula $C_3H_6Cl_2$ and exhibiting a multiplet at δ 1.8 and a triplet at δ 3.8 in the NMR spectrum :

(A) $CH_3 - CCl_2 - CH_3$
(B) $Cl - CH_2 - CH_2 - CH_2 - Cl$
(C) $CH_3 - CH_2 - CHCl_2$
(D) $CH_3 - CHCl - CH_2Cl$

37. Oligosacharrides comprise of :

(A) A single sugar subunit
(B) Two sugar subunits
(C) Three to ten sugar subunits
(D) More than ten sugar subunits

38. Which of the following is a sulphur containing amino acid ?

(A) Alanine
(B) Cysteine
(C) Serine
(D) Histidine

39. Which of the following group of compounds cannot be classified as lipids ?

(A) Triglycerides of higher fatty acids
(B) Steroidal hormones
(C) Alkaloids
(D) Terpenes

40. Which of the following statements is not true for most of the naturally occurring fatty acids ?

(A) Contain even number of carbon atoms
(B) Are unbranched
(C) In polyunsaturated fatty acids the double bonds are always conjugate
(D) In polyunsaturated fatty acids the double bonds are always separated by a methylene group

41. Match the entries in Column I with those in Column II to find the correct matches :

I	II
(a) Boyle Temperature	(i) RT/p
(b) Ideal molar volume of a gas	(ii) RT/PV_m
(c) Compressibility factor	(iii) a/bR

	(a)	(b)	(c)
(A)	(i)	(ii)	(iii)
(B)	(iii)	(i)	(ii)
(C)	(iii)	(ii)	(i)
(D)	(ii)	(i)	(iii)

42. The gases O_2, N_2, NH_3 and CH_4 have the van der Waals constant 'a' equal to 1.360, 1.350, 4.170 and 2.252 L^2 atm. mol^{-1} respectively. Which of them can be liquefied most easily ?

(A) CH_4 (B) NH_3

(C) O_2 (D) N_2

43. The number of 3-fold axes of symmetry in a cubic crystal are :

(A) 1 (B) 2

(C) 3 (D) 4

44. An LCD is composed of several seven segment sections. While displaying the digits 3 and 6 the number of active segments are :

(A) 3 and 7 (B) 5 and 4

(C) 5 and 6 (D) 4 and 6

45. A certain system absorbs 3×10^{21} quanta of light per second. On irradiation for 10 minutes 1.5 m mole of the reactant was found to have reacted. Quantum efficiency of the process is :

(A) 1.0 (B) 0.1

(C) 3.1 (D) 0.3

46. Identify the reaction orders from each of the following rate constants :

(i) $k = 5.6 \times 10^{-4}$ mol dm^{-3} s^{-1} (ii) $k = 4.0 \times 10^{-6}$ atm^{-1} s^{-1}

(A) 0 and 1 (B) 1 and 2

(C) 0 and 2 (D) 2 and 1

47. Find the correct rate law from the reaction scheme given below :

$$O_3 \overset{k}{\Leftrightarrow} O_2 + O$$

$$O + O_3 \overset{k_1}{\rightarrow} 2O_2$$

(A) $k_1 [O_3][O_2]$ (B) $k_1 K[O_3]^2[O_2]$

(C) $k_1/K[O_3]^2/[O_2]$ (D) $k_1 K[O_3]/[O_2]^2$

48. The rate law for the photochemical combination of Hydrogen and Bromine to form HBr is :

$$r = \frac{k_1 I^{1/2}[H_2][Br_2]}{[Br_2] + k_2[HBr]}$$

The reaction is

(A) Ist order each in H_2 and Br_2 (B) Zero order

(C) Complex with inhibition by HBr (D) Has quantum efficiency 2

49. **Assertion :** All of the energy lost in an exothermic reaction in solution can be transformed into useful work.

Reason : For all reactions in solution ΔH and ΔG are numerically the same.

(A) Assertion correct; Reason correct

(B) Assertion correct; Reason incorrect

(C) Assertion incorrect; Reason correct

(D) Assertion incorrect; Reason incorrect

50. State of a one component open system having three coexisting phases at equilibrium is completely specified by which of the following ?

(A) Temperature

(B) Pressure

(C) Temperature and pressure together

(D) Nature of the component

51. Latent heat of fusion of ice is 80 cal. g^{-1}. The molar entropy change accompanying the melting of ice is equal to :

(A) 80 cal. K^{-1} g^{-1} (B) 22 JK^{-1} mol^{-1}

(C) 11 kJ K^{-1} (D) 0

52. Joule Thomson expansion is :

(A) Isobaric (B) Isothermal

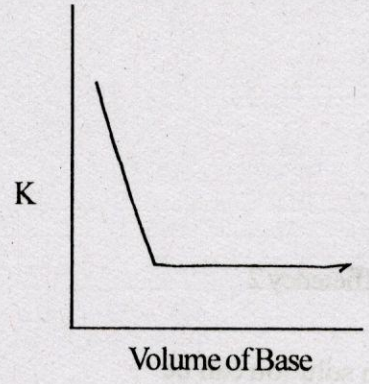
(C) Isochoric (D) Isenthalpic

53. The half cell reaction : Hg_2Cl_2 (s) + $2e^- \Leftrightarrow 2Hg$ (l) + 2 Cl^- (aq, 0.1N) corresponds to which electrode ?

(A) Mercury electrode (B) Quinhydrone electrode

(C) Saturated calomel electrode (D) Decinormal calomel electrode

54. The graph below represents which conductometric titration ?



(A) Strong base vs strong acid
(B) Strong base vs weak acid
(C) Strong acid vs weak base
(D) Weak acid vs weak base

55. The conductivity of a certain solution is 0.3586 S cm^{-1}. When placed in a cell, the conductance recorded is 0.0268 S. The cell constant of the cell is :

(A) 13.31 cm^{-1}
(B) 0.175 cm
(C) 0.330 cm^{-2}
(D) 0.119 cm

56. Consider the arrangement

Pt, H_2 (1atm) | 0.1 M HCl | H_2 (3 atm), Pt

The combination :

(A) Constitutes an electrolyte concentration cell with transference
(B) Constitutes an electrolyte concentration cell without transference
(C) Constitutes an electrode concentration cell
(D) Will not function as an electrochemical cell

57. The wave function $\psi(z) = \sqrt{\frac{2}{\lambda}} \sin\frac{2\pi z}{\lambda}$ with $0 < z < \lambda$, is an eigenfunction of ∇^2 operator. The eigenvalue is :

(A) $-\frac{2\pi^2}{\lambda^2}$
(B) $\frac{2\pi^2}{\lambda^2}$
(C) $-\frac{\pi^2}{\lambda^2}$
(D) $-\frac{4\pi^2}{\lambda^2}$

58. Which of the following are Hermitian Operators ?

(A) $\widehat{Px}$

(B) $\widehat{H}$

(C) Both (A) and (B)

(D) Neither of the two

59. An ammonia molecule is equivalent to :

(A) A symmetric rotator

(B) An asymmetric rotator

(C) A spherical rotator

(D) Is rotationally inactive

60. HCl may be treated as a harmonic oscillator with fundamental frequency v_0. Its vibrational spectrum in the gas phase will consist of :

(A) A single line at frequency v_0

(B) A number of lines separated by equal spacings of hv_0

(C) A number of lines with unequal spacings

(D) HCl will not give a vibrational spectrum

ROUGH WORK

SEAL

1. Directional quantization (Orientation) of orbital angular momentum associated with an electron in a definite energy level is correlative with which of the four quantum numbers ?

   (A) Principle quantum number (*n*)
   (B) Azimuthal quantum number (*l*)
   (C) Magnetic quantum number (m)
   (D) Spin quantum number (*s*)

2. Lanthanum (La) is positioned in which of the given transition/inner transition series in the periodic table ?

   (A) 1st Transition series
   (B) 2nd Transition series
   (C) 1st Inner transition series
   (D) 3rd Transition series

3. Which of the following molecules/ions does not contain unpaired electron ?

   (A) O_2
   (B) O_2^{2-}
   (C) N_2^+
   (D) B_2

4. Which of the following is isoelectronic as well as has same structure as that of N_2O ?

   (A) N_3H
   (B) H_2O
   (C) NO_2
   (D) CO_2

5. Chemical composition of Plaster of Paris is :

   (A) $CaSO_4 \cdot \frac{1}{2} H_2O$
   (B) $MgSO_4 \cdot \frac{1}{2} H_2O$
   (C) $CaSO_4 \cdot 1\frac{1}{2} H_2O$
   (D) $MgSO_4 \cdot 1\frac{1}{2} H_2O$

6. Which of the following oxides is most basic ?

   (A) Al_2O_3
   (B) Na_2O
   (C) As_2O_3
   (D) BaO

7. Which of the following shows maximum catenation property ?

(A) S (B) Se

(C) Te (D) O

8. Which of the following acids is not stored in a glass bottle because of its ability to itch glass ?

(A) H_2SO_4 (B) HF

(C) $HClO_4$ (D) $HBrO_4$

9. Name of which of the below given inner transition elements is not derived from the name of a scientist ?

(A) Es (B) No

(C) Md (D) Np

10. **[Xe]$5d^6 6s^2$** represents the electronic configuration for which one the following elements ?

(A) Re (B) Rh

(C) Ru (D) Os

11. Which one of the following is diamagnetic ?

(A) Zn^{2+} (B) Cu^{2+}

(C) Ni^{2+} (D) Co^{2+}

12. Silver gets **tarnished** in ordinary air due to the reaction of silver with :

(A) CO_2 (B) H_2S

(C) O_2 (D) H_2O

13. Ca^{2+} in human body is not associated with one of the following biological processes :

(A) Glycolysis (B) Gluconeogenesis

(C) Muscle contraction (D) Lymphosarcoma

14. Which of the following d-orbitals on metal ion, will experience maximum repulsion interactions with the ligand orbitals in a square planar metal complex ?

(A) d_{xy} (B) d_{xz}

(C) $d_{x^2-y^2}$ (D) d_{z^2}

15. Carbonyl (CO) as a ligand has a higher binding affinity with transition metal ions in lower oxidation state due to :

(A) Pi back acceptance character

(B) High electronegativity of oxygen

(C) Linear shape

(D) Strong and polar Carbon Oxygen triple bond

16. Which of the following is used as a food additive to prevent excess metal deposition in our body ?

(A) Sodium Bicarbonate (B) Sodium Carbonate

(C) Ascorbic Acid (D) EDTA

17. Which of the following indicators is a redox indicator ?

(A) Eurochrome Black T (B) Ferroin

(C) Muroxide (D) Methyl Orange

18. Which of the following is not a quantitative method of analysis ?

(A) Potentiometric titration (B) Ion detection by a group reagent

(C) Visual titration (D) Gravimetry

19. In **paper chromatography** method of separation, paper acts as :

(A) Stationary phase (B) Developer

(C) Mobile phase (D) All of the above

20. A metal salt Solution (X), when added to water containing SO_4^{2-} ions, resulted in the formation of a white precipitate, the metal salt solution (X) contained :

(A) $MgCl_2$ (B) $CaCl_2$

(C) $BaCl_2$ (D) LiCl

21. The correct order of reactivity of organic halides towards SN^1 reaction is :

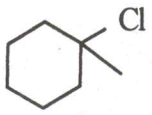
(A) 3° Alkyl halide > Allyl halide > Benzyl halide

(B) Allyl halide > 3°Alkyl halide > Benzyl halide

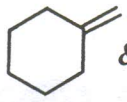
(C) 3° Alkyl halide > Allyl halide ~ Benzyl halide

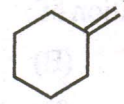
(D) Allyl halide ~ Benzyl halide > 3°Alkyl halide

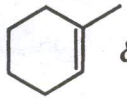
22. The major product and the mechanism of elimination involved in the following reaction is :

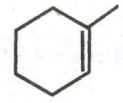


+ t-BuOK ⟶ ?

(A)  & E1

(B)  & E2

(C)  & E1

(D)  & E2

23. Which of the following statements is most appropriate about addition of HBr to 1, 3- Butadiene ?

(A) 1, 2 addition is always favoured

(B) 1, 4 addition is always favoured

(C) 1, 2 addition is favoured at higher temperature and 1, 4 addition at lower temperature

(D) 1, 2 addition is favoured at lower temperature and 1, 4 addition at higher temperature

24. The correct order of reactivity of Benzene, Aniline and Toluene towards Fridel Craft's reaction in presence of Lewis acid is :

(A) Aniline > Benzene > Toluene

(B) Toluene > Benzene > Aniline

(C) Aniline > Toluene > Benzene

(D) Toluene > Aniline > Benzene

25. Amongst Methylcyclohexane (1), Methoxycyclohexane (2) and t-Butylcyclohexane (3), the decreasing order of the amount of the axial conformer present at room temperature is :

(A) 2 > 1 > 3 (B) 2 > 3 > 1

(C) 1 > 2 > 3 (D) 3 > 2 > 1

26. Number of d & l isomers (a) and number of Meso forms (m) in CH_3.CHBr.CHBr.COOH is :

(A) a = 2, m = 2 (B) a = 4, m = 0

(C) a = 3, m = 1 (D) a = 4, m = 2

27. Carbenes can be obtained by decomposition of :

(A) Epoxides (B) Tetrazoles

(C) Both (D) None

28. Which of the following is not chiral ?

(A) Cis-1, 2-dichlorocyclohexane

(B) Trans-1, 2-dichlorocyclohexane

(C) Cis-1-Bromo-2-chlorocyclohexane

(D) Trans-2, 3-dichlorosuccinic acid

29. Coupling between arenediazonium cations and amines takes place most readily in :

(A) Neutral solutions (B) Slightly acidic solutions

(C) Strongly acidic solutions (D) Slightly alkaline solutions

30. Rearrangement of 2-Allylphenylether to *o*-Allylphenol is an example of :

(A) Fries rearrangement (B) Curtius rearrangement

(C) Claisen rearangement (D) Hofmann rearrangement

31. A carbonyl group can be reduced to a $-CH_2-$ group by using :

(A) Zn (Hg)/HCl (B) Al (O-ipr)$_3$

(C) Zn/CH_3COOH (D) $LiAlH_4$

32. Correct order of acidity of hydroxy substituted Benzoic acids (BA) is :

(A) *o*-Hydroxy BA > *m*-Hydroxy BA > BA > *p*-Hydroxy BA

(B) BA > *o*-Hydroxy BA > *p*-Hydroxy BA > *m*-Hydroxy BA

(C) BA > *m*-Hydroxy BA > *o*-Hydroxy BA > *p*-Hydroxy BA

(D) *o*-Hydroxy BA > BA > *m*-Hydroxy BA > *p*-Hydroxy BA

33. Which of the following will not reduce Fehling's or Tollen's solutions ?

(A) Maltose (B) Sucrose

(C) Methylglucoside (D) Both (B) and (C)

34. Which of the following pairs of sugars yield the same Phenylosazone ?

(A) D-Glucose & D-Galactose

(B) D-Glucose & D-Mannose

(C) D-Galactose & D-Fructose

(D) D-Galactose & D-Mannose

35. Which of the following amino acids has the amine group present as part of a ring ?

(A) Arginine (B) Threonine

(C) Proline (D) Lysine

36. Carotene belongs to a class of compounds called :

(A) Terpenes (B) Alkaloids

(C) Steroids (D) Lipids

37. Which of the following will show both π-π^* and n-π^* electronic transitions ?

(A) Alkane (B) Alkene

(C) Ether (D) Ketone

38. The calculated λ_{max} value for 2,4-Hexadiene is :

(A) 217 nm (B) 227 nm

(C) 253 nm (D) 263 nm

39. In H^1NMR, if alkenic hydrogens resonate at $\delta 5.68$, the same in an α, β-unsaturated carbonyl will resonate at δ value of :

(A) Less than 5.68
(B) More than 5.68
(C) Equal to 5.68
(D) Cannot be predicted from the given data

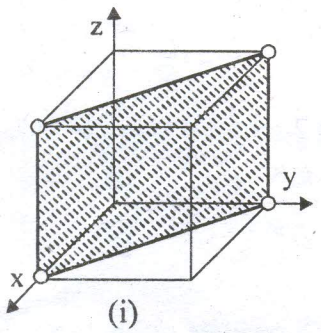
40. Which of the following will show a singlet, a triplet and a quarter in H^1NMR spectrum ?

(A) Propanaldehyde
(B) Ethylmethyl ketone
(C) Ethyl acetate
(D) All

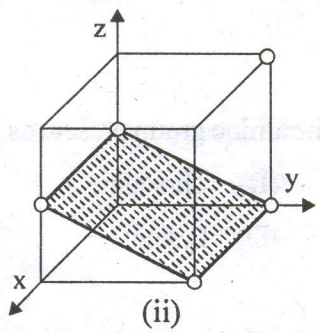
41. For a cubic crystal, the order of diffraction from (220) planes for which angle of diffraction will be same as that of 2nd order diffraction (110) plane ?

(A) 1st order
(B) 2nd order
(C) 3rd order
(D) 4th order

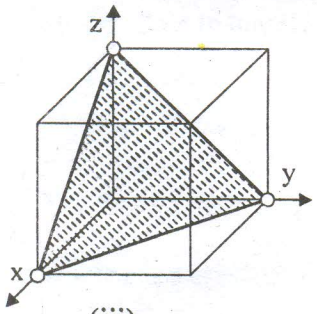
42. Identify the planes using Miller indices and select the correct match :



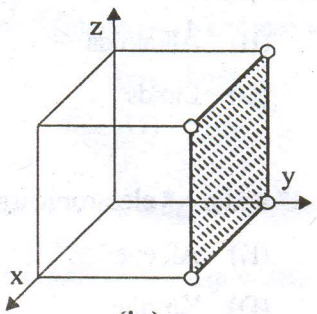
(i)



(ii)



(iii)



(iv)

	(i)	(ii)	(iii)	(iv)
(A)	102	210	222	100
(B)	110	012	111	010
(C)	001	210	200	001
(D)	101	021	010	001

43. The compressibility factor for a real gas at high pressure is :

(A) $1 + RT/Pb$ (B) 1

(C) $1 + Pb/RT$ (D) $1 - Pb/RT$

44. Match Column I with Column II and select correct answer using the code given below :

	Column–I		Column–II
A	Temperature of inversion in Joule Thomson effect is related to	1	$\left(\frac{\partial U}{\partial V}\right)_T = 0$
B	For perfect gas	2	$\left(\frac{\partial T}{\partial P}\right)_H = \frac{1}{C_p}\left[\frac{2a}{RT} - b\right]$
C	For perfect gas Joule-Thomson effect vanishes because	3	$\frac{\partial}{\partial P}(PV)_T \neq 0$
D	Deviation from Boyle's law implies	4	$\left(T\frac{\partial V}{\partial T} - V\right) = 0$

Codes :

	A	B	C	D
(A)	2	4	1	3
(B)	3	1	4	2
(C)	2	1	4	3
(D)	3	4	1	2

45. What will be the value of rate constant for a given first order reaction if reactant reduces to 1/4th its initial value in 10 min ?

(A) $0.1386\ min^{-1}$ (B) $0.0693\ min^{-1}$

(C) $0.1386\ mol\ L^{-1}\ min^{-1}$ (D) $0.0693\ mol\ L^{-1}\ min^{-1}$

46. For the pre equilibrium mechanism rate of product formation is given by :

$2A \rightleftharpoons I \quad (k)$

$I + B \longrightarrow P \quad (k_b)$

(A) $k/k_b\,[A]^2[B]^1$

(B) $kk_b\,[A]^1\,[B]^1[P]^1$

(C) $kk_b\,[A]^1\,[B]^2$

(D) None of the above

47. A quantum mechanically forbidden non-radiative relaxation process is :

(A) $S_1 \longrightarrow S_o$ (B) $S_1 \longrightarrow T_1$

(C) $T_1 \longrightarrow S_o$ (D) both (B) and (C)

48. For a first order decomposition A ⟶ B, the specific rate of decomposition is represented as

$$\ln k = -\frac{(6000)}{T} + 6.0$$

The activation energy of decomposition for compound A at 300 K is :

(A) 12 kcal/mol (B) 12 cal/mol

(C) 20 kcal/mol (D) 115 kcal/mol

49. Assuming statistical disorder, how would you expect a crystal of octahedral cis-MX2Y4 to have residual entropy related to its trans isomer ?

(A) same (B) higher

(C) lower (D) zero

50. The free energy of a photon gas enclosed in a volume V varies as $A = -\frac{1}{3}aVT^4$, where a is a constant and T is the temperature of the gas. The chemical potential of the gas is :

(A) 0 (B) $-\frac{4}{3}aVT^3$

(C) $-\frac{1}{3}aT^4$ (D) aVT^3

51. Identify the correct option :

(A) If X = intensive variable and y = extensive variable, yX and y/X are intensive variables while $\partial y/\partial X$ is extensive variable

(B) If x and y = extensive variable, (x + y) and x/y are extensive variables while $\partial x/\partial y$ is intensive variable

(C) If X and Y = intensive variable, XY and X/Y are extensive while $\partial X/\partial Y$ and X + Y are intensive variables.

(D) If x and y = extensive variable, (x + y) is an extensive while x/y and $\partial x/\partial y$ are intensive variables.

52. Consider the following processes :

(1) $2A + 5B \longrightarrow 4C + 2D$

(2) $2E + 7B \longrightarrow 4C + 6D$

(3) $2F + B \longrightarrow 2D$

Which of the following calculations will give ΔH for the process ?

$A + 2F \longrightarrow E$?

(A) $\Delta H_1 - \Delta H_2 + \Delta H_3$

(B) $1/2\ \Delta H_1 + 1/2\ \Delta H_2 - \Delta H_3$

(C) $1/2\ \Delta H_1 - 1/2\ \Delta H_2 + \Delta H_3$

(D) $\Delta H_1 + \Delta H_2 + \Delta H_3$

53. EMF of the concentration cell with transference

Pt/H_2 (1 atm), HCl ($a_{\pm} = -0.0090$) : HCl ($a_{\pm} = 0.018$). H_2 (1 atm)/Pt is 0.028 V at 25° C. The EMF of the corresponding cell without transference is 0.017 V. The transference number of H^+ ions is :

(A) 0.2 (B) 0.4

(C) 0.6 (D) 0.8

54. If H^+ concentration is decreased from 1 $moldm^{-3}$ to 10^{-4} $moldm^{-3}$ at 25° C for the couple MnO_4^-/Mn_2^+, then oxidizing power of MnO_4^-/Mn_2^+ couple changes by :

(A) 0.18 V (B) – 0.18 V

(C) 0.38 V (D) – 0.38 V

55. The ionic strength of 0.01 mol kg^{-1} potassium ferricyanide solution will be :

(A) 0.1 (B) 0.05

(C) 0.06 (D) 0.085

56. For the reduction of the permanganate ion $MnO_4^- Mn_2^+$ in an acidic solution, E is + 1.51 V. The standard reduction potentials for Zn_2^+, Ag^+ and Au^+ are – 0.7618, 0·7996 and 1.692 V respectively. Which of these metals will be oxidized by the MnO_4^- ion ?

(A) Zn and Ag (B) Au and Ag

(C) Zn and Au (D) Zn only

57. Which of the following wave functions is eigenfunction of the operator d^2/dx^2 ?

(A) $a\,e^{-3x} + b\,e^{-3ix}$

(B) $\sin^2 x$

(C) e^{-ix^2}

(D) $\cos ax$

58. For a wavefunction $\Psi(x) = \sqrt{\frac{2}{L}} \sin \frac{\pi x}{L}, 0 < x < L$, expectation value of P2 is given by :

(A) $\frac{\pi^2 \hbar^2}{L^2}$ (B) $\frac{\pi^2 \hbar}{L^2}$

(C) $\frac{\pi \hbar^2}{L^2}$ (D) $\frac{\pi^2 \hbar^2}{L}$

59. Among the given functions, the acceptable state function over the indicated integrals is :

(A) $e^{-|x|}$ $(-\infty, \infty)$ (B) $sin^{-1} x$ $(-1, 1)$

(C) e^{-x} $(-\infty, \infty)$ (D) e^{-x} $(0, \infty)$

60. Consider the result for the energy eigen values for the one-dimensional box and indicate correct choice :

(i) By what factor do you need to change the box length to decrease the zero point energy by a factor of 400 for a fixed value of m ?

(ii) By what factor would you have to change n for fixed values of L and m to increase the energy by a factor of 400 ?

(iii) By what factor would you have to increase L at constant n to have the zero point energies of an electron be equal to the zero point energy of a proton in the box ?

	(i)	(ii)	(iii)
(A)	20,	20,	43
(B)	23,	20,	40
(C)	40,	40,	20
(D)	20,	20,	40

M.Sc. Chemistry/A

1. Which of the following statements on the square of atomic wave function is not correct ?
   (A) ψ^2 may be positive, negative or imaginary
   (B) ψ^2 is proportional to electron density
   (C) ψ^2 is directly proportional to the probability of finding the electron
   (D) ψ^2 is equal to the probability of finding the electron, if ψ is a normalized wave function

2. If $E_{C-C} = 348$ KJ mol^{-1}, $E_{C-H} = 412$ KJ mol^{-1} and $E_{H-H} = 436$ KJ mol^{-1}, the Pauling electronegativity of C is about :
   (A) 1.64 (B) 1.82
   (C) 2.58 (D) 2.91
   (Given : Electronegativity of H = 2.1 and E represents bond enthalpy)

3. Which of the following halides is least stable and has a doubtful existence ?
   (A) CI_4 (B) PbI_4
   (C) GeI_4 (D) SnI_4

4. The nodal plane in the π-bond of ethene is located in :
   (A) a plane perpendicular to the molecular plane, which contains the carbon-carbon σ-bond
   (B) a plane parallel to the molecular plane
   (C) a plane perpendicular to the molecular plane, which bisects the carbon-carbon σ-bond at right angle
   (D) the molecular plane

5. The correct order regarding the acidity of aromatic carboxylic acids is :
   (A) benzoic acid < p-toluic acid < p-hydroxybenzoic acid
   (B) benzoic acid > p-toluic acid > p-hydroxybenzoic acid
   (C) benzoic acid > p-toluic acid < p-hydroxybenzoic acid
   (D) benzoic acid < p-toluic acid > p-hydroxybenzoic acid

6. In non-benzenoid homocyclic aromatic cations, the number of canonical forms is generally equal to:

(A) number of π-electrons

(B) number of π-electrons + 1

(C) number of π-electrons + 2

(D) number of π-electrons – 1

7. Which of the following compounds has no enantiotopic hydrogens ?

(A) Propane (B) Butane

(C) 2-Chlorobutane (D) 2,2-Dichlorobutane

8. Which of the following is correct for boat conformation of cyclohexane ?

(A) Eclipsed interactions are less severe than flag pole interactions

(B) Eclipsed interactions are more severe than flagpole interactions

(C) The interactions are of same extent

(D) No flagpole interactions are in cyclohexane

9. The critical molar volume of a Van der Waals gas is related to the Vander Waals volume correction for nonideal behavior in the ratio :

(A) 1 : 2 (B) 2 : 1

(C) 1 : 3 (D) 3 : 1

10. The principle of corresponding states applies to :

(A) Ideal gases only

(B) Gases with spherical molecules

(C) Gases with non-spherical molecules

(D) Universally to all gases

11. Van der Waals equation is a cubic equation in volume. Depending upon the conditions, it may have :

(A) Only one root

(B) Two real roots and one imaginary root

(C) Two complex conjugate roots and one real root

(D) Three complex roots

12. Equivalent lattice points within the unit cell of a Bravais lattice have identical surroundings. What points within an fcc unit cell are equivalent to the lattice point (1/2, 1/2, 0) ?

(A) Lattice points in the centers of six faces

(B) Points at the eight corners

(C) Points at the twelve edge centers

(D) Points at the centers of diagonal planes

13. Which of the following compounds on thermal decomposition yields a basic as well as acidic oxide ?

(A) $KClO_3$ (B) $CaCO_3$

(C) NH_4NO_3 (D) $NaNO_3$

14. White enamel of our teeth is :

(A) CaF_2 (B) $Ca_3(PO_4)_2$

(C) $CaCl_2$ (D) $CaBr_2$

15. The compound commonly known as inorganic benzene is :

(A) B_6H_6 (B) $C_3N_3H_3$

(C) $B_3N_3H_6$ (D) C_5H_5B

16. Which of the following properties does not correspond to the order HI < HBr < HCl < HF ?

(A) Thermal stability (B) Reducing power

(C) Ionic character (D) Dipole moment

17. Which of the following reactions gives $CH_2=C=C=CH_2$?

(A) $CH_2Br - CHBr = CH_2 \xrightarrow{Zn/CH_3OH}$

(B) $CH \equiv C - CH_2 - COOH \xrightarrow{Na_2CO_3/Ag}$

(C) $BrCH_2 - C \equiv C - CH_2 - Br \xrightarrow{Zn/\Delta}$

(D) $2CH_2 = CH - CH_2 - I \xrightarrow{Zn/\Delta}$

18. The one which is most reactive towards the ring nitration is :

(A) o-Xylene (B) Toluene

(C) p-Xylene (D) m-Xylene

19. Butanenitrile is formed by the reaction of KCN with :

(A) propyl alcohol (B) butyl alcohol

(C) butyl chloride (D) propyl chloride

20. A cubic unit cell has dimensions a = b = c = 0.8 nm. The inter-planar spacing between planes with miller index (hkl) is given by $d_{hkl} = a/(h^2 + k^2 + l^2)^{1/2}$. What is d_{121} ?

(A) 0.65 nm (B) 0.46 nm

(C) 0.33 nm (D) 0.23 nm

21. A student attempted to follow the kinetics of hydrolysis of an ester catalyzed by a mineral acid conductometrically. The conductivity of the reaction mixture :

(A) remains constant with time

(B) increase with time

(C) decreases linearly with time

(D) first increases and then decreases

22. A substance A reacts to form products and the rate constant of the reaction was found to follow the rate law $k = \frac{1}{t} \frac{x}{A0(A0 - x)}$, where A_0 is the initial concentration of A and x is the amount of A that has reacted in time t. The order of the reaction is :

(A) 2 (B) 1

(C) 3 (D) 0

23. The rate constant of the reaction :

$2\ N_2O_5 \rightarrow 4\ NO_2 + O_2$

doubles when heated from 22.5°C to 27.5°C. The activation energy of the reaction is :

(A) 340.0 kJ mol^{-1} (B) 680.1 kJ mol^{-1}

(C) 430.1 kJ mol^{-1} (D) 860.0 kJ mol^{-1}

24. As oxidising agents, the strength of the following species in acidic solution decreases in the order :

(A) $S_2O_8^{2-} > Cr_2O_7^{2-} > MnO_4^-$

(B) $MnO_4^- > Cr_2O_7^{2-} > S_2O_8^{2-}$

(C) $S_2O_8^{2-} > MnO_4^- > Cr_2O_7^{2-}$

(D) $Cr_2O_7^{2-} > S_2O_8^{2-} > MnO_4^-$

25. The basic character of the transition metal monoxides follows the order :

(A) CrO > VO > FeO > TiO

(B) TiO > FcO > VO > CrO

(C) VO > CrO > TiO > FeO

(D) TiO > VO > CrO > FeO

26. The separation of Lanthanoids by ion exchange method is based on :

(A) size of the ions

(B) oxidation state of the ions

(C) the solubility of their nitrates

(D) basicity of their hydroxides

27. Knowing that the chemistry of Lanthanoids (Ln) is dominated by +3 oxidation state, which of the following statements is incorrect ?

(A) The ionic sizes of Ln (III) decrease in general with increasing atomic number

(B) Ln (III) compounds are generally colourless

(C) Ln (III) hydroxides are mainly basic in character

(D) Because of the large size of Ln (III) ions, the bonding in its compounds is predominantly ionic in character

(Where Ln is the general abbreviation of Lanthanoids)

28. The end product 'Z' in the reaction,

Ethylamine $\xrightarrow{HNO_2}$ x $\xrightarrow{POCl_3}$ y $\xrightarrow{NH_3}$ z, is :

(A) Methylamine

(B) Acetamide

(C) Ethylamine

(D) Propylamine

29. The oxidation of 1,2-Cyclohexanediol to hexanedial is carried out with :

(A) chromic acid

(B) periodic acid

(C) sulphuric acid

(D) pyridinium Chlorochromate

30. The ketone which we do not generally reduce by Meerwein-Pondroff Verley reduction is :

(A) ethylmethyl ketone (B) diethyl ketone

(C) methylphenyl ketone (D) dimethyl ketone

31. Reaction of aldehydes or ketones with α-bromoesters in presence of Zn-dust, followed by hydrolysis to yield β-hydroxyesters is :

(A) Perkin reaction (B) Knoevenagel reaction

(C) Reformatsky reaction (D) Schmidt reaction

32. The integral $\int_0^T Cp.\, dlnT$ gives :

(A) Enthalpy change of a system when heated from 0 to T K

(B) Change of heat capacity between 0 and T K

(C) Absolute entropy of the system at T K

(D) Is not a correct integral

33. Which one of the following relations is true for mixing of two ideal gases at constant temperature and pressure ?

(A) $\Delta S < 0$ & $\Delta G = 0$ (B) $\Delta S = 0$ & $\Delta H = 0$

(C) $\Delta S > 0$ & $\Delta G = 0$ (D) $\Delta S > 0$ & $\Delta G < 0$

34. For the heat capacity of an ideal gas which of the following relations is correct ?

(A) $C_p - C_v = 4.18\ JK^{-1}\ mol^{-1}$

(B) $C_p/C_v = 1.67$

(C) Both (A) and (B)

(D) None of the above is correct

35. A gas expands adiabatically against a constant external pressure. Which of the following conditions is true ?

(A) $\Delta H = 0$ & $\Delta T = 0$

(B) $\Delta H = 0$ & $\Delta T < 0$

(C) $\Delta q = 0$ & $\Delta T = 0$

(D) $\Delta q = 0$ & $\Delta T < 0$

36. Which of the following will form an octahedral complex ?

(A) d^6 (high spin) (B) d^8 (high spin)

(C) d^4 (low spin) (D) None of these

37. The value of the 'spin only' magnetic moment for one of the following configurations is 2.84 BM :

(A) d^1 (in weak ligand field)

(B) d^4 (in strong ligand field)

(C) d^5 (in strong ligand field)

(D) d^3 (in weak as well as in strong ligand fields)

38. In which of the following pair, both the complexes show optical isomerism ?

(A) cis - $[Cr(C_2O_4)_2Cl_2]^{3-}$, cis - $[Co(NH_3)_4Cl_2]$

(B) $[Co(en)_3]Cl_3$, cis - $[Co(en)2\ Cl_2]Cl$

(C) [Pt Cl(dien)] Cl , $[NiCl_2Br_2]^{2-}$

(D) $[Co(NO_3)_3(NH_3)_3]$, cis - $[Pt(en)_2Cl_2]$

39. Which of the following elements plays a vital role in muscle contraction, blood clotting and activation of various enzymes ?

(A) Iron (B) Magnesium

(C) Lithium (D) Calcium

40. As per letter designation, the bands pertaining to $\Pi \rightarrow \Pi^*$ transitions in molecules containing conjugated Π–systems are referred to as :

(A) R-bands (B) K-bands

(C) B-bands (D) E-bands

41. In a molecule with a centre of symmetry, the vibrations symmetrical about the centre of symmetry are :

(A) active in IR but inactive in Raman

(B) inactive in IR but active in Raman

(C) active in IR as well as in Raman

(D) inactive in IR as well as in Raman

42. Slight variations in molecular structure and absorption patterns are most obvious in finger-print region, which lies between :

(A) 3500 to 15 cm^{-1} (B) 3300 to 2700 cm^{-1}

(C) 1500 to 400 cm^{-1} (D) 3100 to 400 cm^{-1}

43. In NMR, allylic hydrogens have signals at δ :

(A) 0.8 – 1.7 (B) 1.6 – 2.6

(C) 2.0 – 3.0 (D) 4.6 – 5.7

44. For which of the following solutions the conductivity method cannot be used to determine the degree of dissociation ?

(A) HCl (B) CH_3COOH

(C) NH_4OH (D) C_6H_5OH

45. The phenol-water phase diagram is a semicircular curve concave towards the composition axis. The number of phases in the inside and outside regions separated by the curve are :

(A) 2, 1 (B) 1, 2

(C) 1, 1 (D) 2, 2

46. Li^+ is the smallest alkali metal cation. Its transport number is :

(A) Largest of all alkali metal ions

(B) Larger than that of Na+ ion only

(C) Smaller than that of Na+ ion

(D) Smallest of all alkali metal ions

47. Saturated calomel electrode is a convenient reference electrode that belongs to the type :

(A) Metal/metal ion type

(B) Metal/metal ion/anion type

(C) Redox type

(D) Gas/metal/ion type

48. Which of the following cations will give red precipitate with dimethylglyoxime in ammoniacal solution ?

(A) Co^{2+} (B) Ni^{2+}

(C) Zn^{2+} (D) Cr^{3+}

49. The phenomenon in which white transparent crystal changes into white powder is called :

(A) deliquescence (B) allotropy

(C) sublimation (D) efflorescence

50. 25 mL of H_2SO_4 solution required 48.75 mL of 0.02 M NaOH for complete titration. Calculate the molarity of H_2SO_4 :

(A) 0.195 M (B) 0.185 M

(C) 0.0185 M (D) 0.0195 M

51. Which amongst the following is not a redox indicator of high normal potential (0.76 V and above) ?

(A) Methyl blue (B) Diphenylamine

(C) Triphenylmethane (D) o-Phenanthroline

52. The four chiral centres in D(+) Glucose are :

(A) 2S, 3R, 4R, 5R (B) 2R, 3S, 4R, 5R

(C) 2R, 3S, 4S, 5S (D) 2R, 3S, 4R, 5S

53. The amino acid, the presencc of which causes a kink or bend and interrupts with the α-helical structure of proteins is :

(A) Arginine (B) Histidine

(C) Proline (D) Tyrosine

54. The reactions of sugars are generally carried out in neutral or acidic medium because in alkaline medium they undergo :

(A) Racemization (B) Decomposition

(C) Inversion (D) Rearrangement

55. Drying oil invariably contains :

(A) Linoleic acid (B) Lauric acid

(C) Stearic acid (D) Butyric acid

56. A silver rod is dipped in $AgNO_3$ solution and a Cu rod dipped in $CuSO_4$ solution. The two solutions are interconnected with a KCl salt bridge :

(A) The arrangement will form a galvanic cell with Ag rod as anode

(B) The arrangement will form a galvanic cell with Cu rod as anode

(C) The two electrolytes should have a common anion to form a galvanic cell

(D) KCl salt bridge is not suitable for the arrangement to act as a galvanic cell

57. A pi electron of mass m in a conjugated diene of length l absorbs energy equal to 5 times the energy of the lowest pi level. Assuming the electron equivalent to a particle in a one-dimensional box, from which level to which level the electron gets excited :

(A) $1 \rightarrow 2$ (B) $2 \rightarrow 3$

(C) $3 \rightarrow 4$ (D) $2 \rightarrow 4$

58. A quantum mechanical operator must be Hermitian because :

(A) Hermitian operators have real eigenvalues

(B) Hermitian operators have finite and non-degenerate eigenvalues

(C) Hermitian operators have orthogonal eigenfunctions

(D) Their eigenfunctions can be normalized

59. MO theory can be used to predict bonding in C_2 molecule. The nature of bonds and their number in C_2 are :

(A) two sigma bonds

(B) one sigma bond and two pi bonds

(C) one sigma and one pi bond

(D) two sigma bonds and one pi bond

60. Using the equipartition principle what is the average energy of CH_4 at a temperature T ?

(A) 5kT (B) 6kT

(C) 9kT (D) 12kT

Chemistry

(Inorganic Chemistry)

1. The number of nodes in radial probability function curves for 3s and 2p orbitals. respectively are :
   (a) 2 & 0 (b) 1 & 2
   (c) 0 & 2 (d) 2 & 1

2. Identify incorrect statement for Hydrogen bonding :
   (a) Hydrogen bond stabilizes many protein & Nucleic acid structures in biological systems
   (b) Explains less steam volatility of para nitro phenol over ortho nitro phenol
   (c) Low boiling point of enolic form of acetoacetic ester than ketonic form
   (d) Hydrogen bond can be detected by IR and H^1 NMR spectroscopy

3. The effective nuclear charge felt by 1s & 2p electron of Nitrogen atom as per Slater rules :
   (a) 7 & 5 respectively (b) 6.7 & 3.9 respectively
   (c) 6.7 each (d) 6.0 & 4.7 respectively

4. In an unsymmetrical trigonal bipyramidal molecule PCl_2F_3, the lowest energy form is :
   (a) When both chlorines are equatorial
   (b) When both chlorines are axial
   (c) When one chlorine is axial and other equatorial
   (d) Any of these

5. Which of the following oxoacids of Sulphur have peroxo and dithio linkages respectively?
   (a) $H_2S_2O_8$ & $H_2S_2O_6$ (b) H_2SO_3 & $H_2S_2O_3$
   (c) H_2SO_5 & $H_2S_2O_7$ (d) $H_2S_2O_6$ & $H_2S_2O_8$

6. Identify wrong statement :
   On Replacing B with Br in BF_3 molecule :
   (a) A change of shape from planar to T shape occurs
   (b) Loss of $p\pi$-$p\pi$ back bonding
   (c) Introduction of $d\pi$-$p\pi$ back bonding
   (d) Converts a colourless pungent gas into straw coloured conducting solvent

58. By what factor does the spacing between successive energy levels for a particle trapped in one dimensional box change when the length of box is doubled ?

(a) Becomes double initial value

(b) Is reduced to one half of its initial value

(c) Is reduced to one fourth of its initial value

(d) Increases by a factor of 4 of its initial value

59. Assuming the rotational motion of A-A molecule as that of a rigid rotor, which statement is most appropriate for its rotational spectrum ?

(a) The spacing between its successive spectral lines will be uniform

(b) Its spectrum will show a maxima corresponding to a characteristic value of rotational quantum number

(c) Spacing between two successive spectral line can be used for estimation of its moment of inertia

(d) Molecule will not absorb radiations responsible for the rotational excitations and hence rotational spectrum

60. If the vibrations of a hetero diatomic molecule are approximated as vibrations of harmonic oscillator, then ;

(a) Zero point energy of the molecule will be independent of strength of bond

(b) The frequency of radiation absorbed to change the vibrational quantum number by one is independent of level from which excitation takes place

(c) The vibrational spectrum will consist of a series of equally spaced spectral lines

(d) The vibrational spectrum will consist of a series of lines with no fixed gap between any two of them

7. Silicates containing extended chains of linked SiO_4 tetrahedra are :

(a) meta silicates (b) amphiboles

(c) pyroxenes (d) asbestos

8. Which of the following Nitrogen oxides is linear in shape ?

(a) Dinitrogen trioxide (b) Dinitrogen oxide

(c) Dinitrogen tetraoxide (d) Dinitrogen pentaoxide

9. Which of the following Copper complexes depict the stabilization of unusual oxidation state ?

(a) $[Cu(NH_3)_4]^{2+}$ (b) $[Cu(acac)_2]$

(c) $K_3[Cu\ F_6]$ (d) $K_3[Cu(CN)_4]$

10. Which of the following does not represent the correct sequence of property indicated ?

(a) $Sc^{3+} > Cr^{3+} > Fe^{3+} > Mn^{3+}$: stability of +3 oxidation states

(b) $Sc < Ti < Cr < Mn$: number of oxidation states

(c) $Mn^{2+} < Ni^{2+} < Co^{2+} < Fe^{2+}$: spin only magnetic moment

(d) $FeO > CoO > Nio > CuO$: basic character of oxides

11. Which of the following metal carbonyl will follow EAN rule as an anionic complex ?

(a) $Fe(CO)_5$ (b) $Cr(CO)_6$

(c) $Ni(CO)_4$ (d) $Mn(CO)_5$

12. As per crystal field theory, the energy of d orbital's in square planar geometry will be :

(a) $dxy = dyz = dxz > dx^2 - y^2 = dz^2$ (b) $dx^2 - y^2 = dz^2 > dxy = dyz = dxz$

(c) $dxz = dyz < dxy < dz^2 < dx^2 - y^2$ (d) $dxz = dyz < dz^2 < dxy < dx^2 - y^2$

13. The appropriate IUPAC name for the complex $[Ru\{(C_2H_5)_3P\}_3\ H_3]$ is :

(a) Tri (tris ethyl phosphorus) tris hydrido ruthenium (III)

(b) Tris (tri ethyl phosphorus) tri hydride ruthenium (III)

(c) Tris (tri ethyl phosphine) trihydrido ruthenium (0)

(d) Mer-tris (tri ethyl phosphine) trihydrido ruthenium (III)

14. If in arbitrary units 6u is the stabilization per electron in t_{2g} set of orbital's than destabilization per electron eg set will be :

(a) 3u (b) 6u

(c) 9u (d) 4u

15. If the spin only magnetic moment of complex $K_4[CoI_6]$ is 3.87 BM then what will be spin only magnetic moment of $[Co(en)_3]Cl_2$?

(a) 0.00 BM (b) 1.732 BM

(c) 1.414 BM (d) 3.87

16. The metal pharmacologically used to treat manic-depressive patients is :

(a) Sodium (b) Potassium

(c) Magnesium (d) Lithium

17. Identify a redox indicator :

(a) Dichlorofluorescein (b) Diphenylamine

(c) Phenolphthalein (d) Ferrozine

18. Identify incorrect statement for Gravimetry :

(a) Calcium is precipitated as calcium oxalate but estimated as CaO after ignition

(b) The best washing solution is always acidified water

(c) Crucibles with silver chloride precipitate can be cleaned by treatment with dilute ammonia

(d) Precipitation from homogenous solution eliminates undesirable concentration effects inevitable with conventional precipitation process

19. Number of moles of $KMnO_4$ that are needed to react completely with one mole of Ferrous oxalate in acidic medium is :

(a) 2/5 (b) 3/5

(c) 4/5 (d) 1

20. In the analysis of Inorganic mixtures group 1st reagent is :

(a) Concentrated HCl (b) H_2S

(c) H_2S in slightly acidic medium (d) Dilute HCl

(Organic Chemistry)

21. The most stable carbanion amongst the following is :

(a) $(CH_3)_3\,C^{\ominus}$ (b) $CH_3^{\ominus}$

(c) $(CH_3)_2CH^{\ominus}$ (d) $CH_3CH_2^{\ominus}$

22. The state of Hybridization of Carbon in Carbenes is :

(a) Sp^3 (b) Sp^2

(c) Sp (d) Sp & Sp^2

23. Trans-2-butenedioic acid on reaction with $KMnO_4$ yields :

(a) d – tartaric acid (b) l – tartaric acid

(c) dl —tartaric acid (d) meso tartaric acid

24. 2, 3- dimethyl-2-pentene on ozonolysis yields :

(a) Ethyl methyl Ketone (b) Acetone

(c) Propionaldehyde & Acetone (d) Ethyl methyl Ketone & Acetone

25. The compound which represents example of a Cumulative dienes is :

(a) 1, 4, Pentadiene (b) 1, 2, Propadiene

(c) 1, 3, Butadiene (d) 1, 5, Hexadiene

26. The name reaction used for synthesis of aryl halides is :

(a) Gatermann & Koch Reaction (b) Sandmayer's Reaction

(c) Grignard Reaction (d) Riemer–Tiemann Reaction

27. Isopropyl alcohol on treatment with $K_2Cr_2O_7$ yields a compound 'A' which on reaction with methyl magnesium bromide yields compound 'B'. This on acidic hydrolysis yields compound 'C' which on further reaction with hot reduced copper yields compound 'D'. The compound D is :

(a) Propanone (b) 2 – Methyl – 1 – Propene

(c) 2 – Methyl – 2 – Propanol (d) tertiarybutoxymagnesium bromide

28. The conversion of alkyl phenyl ether into o-allylphenol involves :

(a) Claisen rearrangement (b) Fries rearrangement

(c) Huben Hosch reaction (d) Claisen Schmidt reaction

29. Generally aldehydes are more reactive than ketones towards nucleophilic reagents. This holds true for acetaldehyde and acetone as well, which is due to :

(a) Steric effect
(b) Inductive effect
(c) Mesomeric effect
(d) Both Steric & Inductive effects

30. An amide 'A' having molecular formula C_3H_7ON, on hydrolysis gives an acid $C_3H_6O_3$(B) which on chlorination in presence of red phosphorus (HVZ) reaction yields chloroacid. This on boiling with NaOH and subsequent acidifications forms Lactic acid. The compound 'A' is :

(a) Propanamide
(b) Acetamide
(c) N – Methyl acetamide
(d) Formamide

31. The compound which readily undergoes esterification under normal condition is :

(a) 2, 6 dimethyl benzoic acid
(b) 2, 4, 6 trimethyl phenyl acetic acid
(c) 2, 4, 6 trimethyl benzoic acid
(d) 2, 4, 6 trinitrophenol

32. Nitrobenzene on reduction with Sn/HCl yields compound 'A' C_6H_7N. This on treatment with $NaNO_2$/ HCl yields compound 'B' $C_6H_5N_2Cl$ which further reacts with phenol to give :

(a) Azobenzene
(b) Azoxy benzene
(c) p – hydroxyazo benzene
(d) Hydrazobenzene

33. Methyl magnesium bromide on reaction with Carbon dioxide, followed by acidic hydrolysis yields :

(a) Acetic acid
(b) Acetaldehyde
(c) Acetone
(d) Ethyl alcohol

34. The compound which displays absorption at 245 nm in the UV- Spectra is :

(a) 2 – butenal
(b) Methyl phenyl Ketone
(c) Cis 1 : 3 Pentadeiene
(d) Trans 1 : 3 Pentadiene

35. The compound which displays strong carbonyl absorption band in the IR spectra at, 1800 cm^{-1} is :

(a) Acetone
(b) Acetamide
(c) Acetic anhydride
(d) Acetophenone

36. The compound which displays broad band in the IR spectra between 3350 –3450 cm^{-1} is :

(a) Dimethyl Ether (b) 1 : 3 – butadiene

(c) Styrene (d) Ethyl Alcohol

37. The compound which will not exhibit triplet – quartet type of splitting pattern in its signals in the HNMR spectra is :

(a) Acetophenone (b) Ethyl acetate

(c) Ethyl bromide (d) Methyl Ethyl Ketone

38. The compound which will display highly deshield protons is :

(a) Ethanol (b) Acetaldehyde

(c) Acetophenone (d) Ethyl bromide

39. The compound which does not display hormonal activity is :

(a) Androsterone (b) Progestrone

(c) Cholesterol (d) Estrone

40. The amino acid which presents disulphide linkage in its structure is :

(a) Cysteine (b) Methionene

(c) Asparagine (d) Cystine

(Physical Chemistry)

41. For one mole of an ideal gas, select the incorrect statement about its state variables, P, V and T :

(a) Fixing the value of any two automatically fixes the value of other variable

(b) $\left(\frac{\partial P}{\partial V}\right)_T = -\frac{RT}{V}$

(c) $\left(\frac{\partial P}{\partial T}\right)_V = \frac{R}{V}$

(d) $\left(\frac{\partial V}{\partial P}\right)_T = -\frac{RT}{P^2}$

42. Select the correct statement for the average translational kinetic energy of a molecule in ideal gas :

(a) It is directly proportional to the mass of the molecule

(b) It is directly proportional to the square of the mass of molecule

(c) It is independent of the mass of the molecule

(d) It depends upon the nature of the molecule

43. Temperature at which the average speed of constituents of Helium gas will be equal to that of the constituents of Hydrogen gas maintained at 20 K is :

(a) 20 K (b) 40 K

(c) 10 K (d) 5 K

44. Choose the incorrect statement :

(a) The interfacial angles in a crystal vary with the shape and size of crystal

(b) Four Bravais lattices are possible for an Orthorhombic crystal system

(c) Plane that cuts crystal axes at (2a, – 3b, –3c) has Miller indices as $(3\,\bar{2}\,\bar{2})$

(d) For crystals there are 32 possible point groups and 14 space lattices that can be divided into seven crystal systems.

45. For a reaction with stoichiometry

$$2A + B \xrightarrow{\text{yields } I} D + 2E$$

The rate doubles when concentration of A is doubled and is halved when concentration of B is doubled, select the correct statement :

(a) Its order with respect to A is 2 and B is one

(b) Its order with respect to A is 1 and B is 2

(c) Its order with respect to A is 1 and B is –1

(d) Its order with respect to A is – 1 and B is 1

46. During kinetic investigations of a reaction involving single reactant, it was observed that $t_{1/2}$ was double if reactant concentration is doubled, then order of the reaction will be :

(a) 1 (b) 2

(c) 0 (d) Can't be predicted

47. Which among the following is not true regarding Collision theory of reaction rates ?

(a) The rate constant depends upon the size of the reactions

(b) Only the translational energy of reactants contribute for the kinetics of reaction

(c) Rate constant of a bimolecular reaction is equal to the frequency of effective collisions

(d) The effective energy for collision of two reactants is equal to their total kinetic energy

48. Accounting to Beer-Lambert law, the intensity of monochromatic radiation on passing through an absorbing medium :

(a) decreases exponentially with increase in concentration of absorbing medium

(b) decreases linearly with increase in concentration of absorbing medium

(c) increases exponentially with increase in concentration of absorbing medium

(d) increases linearly with increase in concentration of absorbing medium

49. Regarding photochemical combination hydrogen-chlorine and hydrogen-bromine reactions select the incorrect statement :

(a) Both reactions are examples of chain reactions

(b) The quantum yield of H_2-Br_2 is less than one

(c) The rate of both the reactions is proportional to intensity of absorbed radiation

(d) The quantum yield of H_2-Br_2 decreases with progress of reaction

50. In thermodynamic experiments involving reversible isothermal expansion of equivalent amounts of ideal and van der Waals gases to similar extent, which is the correct observation ?

(a) Work done by ideal gas is numerically less than that by van der Waals gas

(b) Internal energy change for van der Waals gas is positive

(c) Enthalpy change for ideal gas is non zero

(d) Enthalpy change for real gas is equal to that of ideal gas

51. One mole of an ideal gas expanded reversibly to 10 times its initial volume, change in its entropy will be :

(a) $8.314\ JK^{-1}$ (b) $-8.314\ JK^{-1}$

(c) $19.14\ JK^{-1}$ (d) $-19.14\ JK^{-1}$

52. Which among the following represents Clausius inequality?

(a) $(dS)_{system} \geq \frac{dq}{T}$ (b) $(dS)_{system} \leq \frac{dq}{T}$

(c) $(dS)_{system} < \frac{dq}{T}$ (d) $(dS)_{system} = \frac{dq}{T}$

53. The maximum number of degrees of freedom (F) for a system of C-components is by:

(a) C –1 (b) C + 1

(c) C – 2 (d) C + 2

54. Concentration of solute required to increase the boiling point of solvent with molal boiling constant of 0.5° C/m by 1°C will be:

(a) 2 m (b) 1 m

(c) 0.5 m (d) 10 m

55. With increase in dilution of an electrolyte solution, which one is more appropriate?

(a) Both molar conductance and specific conductance increase

(b) Both molar conductance and specific conductance decrease

(c) Since dilution increases solvent not solute, both remain unchanged

(d) Molar conductance increases while specific conductance decreases

56. For a hypothetical electrochemical cell A, $A^{n+}_{(1M)} \mid B^{n+}_{(1M)}$, B at 25°C, the standard potentials of the two half cells are –0.81 and 0.19 V respectively, choose the correct one:

(a) Cell reaction is feasible and emf of cell +1.0 V

(b) Cell reaction is feasible and emf of cell –1.0 V

(c) Cell reaction is not feasible and emf of cell +0.62 V

(d) Cell reaction is not feasible and emf of cell – 0.62 V

57. Select the incorrect statement:

(a) With increase in temperature of black body, the wavelength of maximum intensity shifts to lower values while the intensity remains unchanged

(b) The kinetic energy of electrons emitted through photoelectric effect does not depend on intensity of the illuminating radiations

(c) For a particle in one dimensional box, the position operator does not commute with its momentum operator

(d) The acceptable wave function for a quantum mechanical system needs to fullfil all the three criteria of being continuous, finite and single valued

CHEMISTRY - 2010

M.Sc. Chemistry

1. Identify the correct statement :
   (a) The second ionization energy (I_2) is the ionization energy of the least, tightly bound electron of the neutral atom
   (b) The second ionization energy (I_2) is the ionization energy of the least tightly bound electron of the monovalent cation of the element
   (c) The first ionization energy (I_2) is the ionization energy of the least tightly bound electron of the neutral atom
   (d) The first ionization energy (I_2) is the ionization energy of the least tightly bound electron of the monovalent cation of the element

2. Which of the following statements is incorrect :
   (a) Ionic radii increases down a group
   (b) Ionic radii decreases across a period
   (c) Ionic radii decrease with increase in coordination number
   (d) Ionic radii increase with decreasing charge number

3. Which of the following statements is correct :
   (a) The higher radius ratio gives an indication of a higher coordination number of a compound
   (b) The higher radius ratio gives an indication of a lower coordination number of a compound
   (c) The lower radius ratio gives an indication of a higher oxidation state of a metal ion in a compound
   (d) None of the above

4. According to Fajan's rule, the covalent bond is favoured by :
   (a) Large cation and small anion
   (b) Large cation and large anion
   (c) Small cation and small anion
   (d) Small cation and large anion

5. The structures of $AlCl_3$ and PCl_3 can be described by :
   (a) Planar geometry
   (b) Pyramidal geometry
   (c) Planar and Pyramidal geometry, respectively
   (d) Pyramidal and planar geometry, respectively

6. Identify the incorrect statement :
   (a) The existence of electron deficient species is explained by the delocalization of the bonding influence of electrons over several atoms
   (b) Molecular orbitals are formed from linear combination of atomic orbitals of different symmetry
   (c) The bond order in N_2 is 3
   (d) As per M.O. theory, the oxygen molecule is paramagnetic

7. Which of the following statements is incorrect ?
   (a) In heteronuclear diatomic molecules, the more electronegative element makes the larger contributions to bonding orbitals and less electronegative element makes the greater contribution to the antibonding orbitals
   (b) In HF, the bonding orbital is more concentrated on the H atom and the antibonding orbital is more concentrated on F atom
   (c) A bonding orbital arises from the constructive interference of neighbouring atomic orbitals; an antibonding orbital arises from their destructive interferences
   (d) The bond order assesses the net number of bonds between two atoms in the molecular orbital formalism

8. Metallic hydrides are :
   (a) Non-volatile, electrically non-conducting, crystalline solids
   (b) Non-stoichiometric, electrically conducting solids
   (c) Binary compounds of an element and hydrogen in the form of individual, discrete molecules
   (d) All of the above

9. The compound which is not formed by xenon is :
   (a) XeO_3 (b) XeF_4
   (c) $XeCl_4$ (d) $XeOF_4$

10. Which of the following is incorrect :
   (a) NO_3^- and NO_2^- ions are both strong oxidizing agents
   (b) Hydrazine and hydroxylamine are both good reducing agents
   (c) Hydrazine is a good oxidizing agent but hydroxylamine is a reducing agent
   (d) NO_2 is stable with respect to oxidation in air

11. Saline carbides :
    (a) are ionic solids, formed by the high electropositive elements of group 1 and 2
    (b) are formed by d-block elements and possess metallic conductivity and lustre
    (c) are hard covalent solids, formed by boron and silicon
    (d) are not formed by direct reaction of a metal oxide and carbon at a high temperature

12. Which of the following is not a gas filled radiation detector ?
    (a) Ionization chamber (b) Proportional counter
    (c) G-M counter (d) ZnS Scintillater

13. The radio isotope used in the treatment of hyperthyroidism is :
    (a) Co-60 (b) Na-24
    (c) I-131 (d) I-123

14. Sodium hydroxide can not be used as a primary standard for acid base titration, because :
    (a) It is corrosive and reacts with glass
    (b) The dissolution of sodium hydroxide in water is highly exothermic and, thus, changes its concentration
    (c) It is hygroscopic and also reacts with atmospheric CO_2
    (d) Hydroxides can not be used as primary standards

15. $KMnO_4$ reacts with oxalic acid according to the equation : $2KMnO_4 + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$. Here 20ml of 0.1 M $KMnO_4$ will react with
    (a) 20ml of 0.5M $H_2C_2O_4$ (b) 50ml of 0.1M $H_2C_2O_4$
    (c) 50ml of 0.5M $H_2C_2O_4$ (d) 20ml of 0.1M $H_2C_2O_4$

16. IUPAC name for $K_3[Al(C_2H_4)_3]$ is :
    (a) Potassium trioxalato aluminate (III)
    (b) Potassium aluminium oxalate
    (c) Potassium trioxalato aluminium (III)
    (d) Potassium trisoxalato aluminate (III)

17. The CFSE of a Cr3+ ion in an octahedral complex will be equal to :
    (a) 0.4 Δ 0 (b) 0.8 Δ 0
    (c) 1.2 Δ 0 (d) 1.6 Δ 0

18. Chromium has the lowest oxidation state in :

(a) Chromium sulphate (b) Chromium trioxide

(c) Potassium chromate (d) Potassium dichromate

19. Lanthanide contraction occurs due to :

(a) Poor shielding properties of F-orbitals

(b) Increase in effective nuclear charge

(c) Both of the above

(d) Decrease in effective nuclear charge

20. Common salt is important for physiological activity of human body, because :

(a) It contains ions, each having eight electrons in its outermost shell and, therefore, acts as an inert nutrient

(b) It is involved in the carbohydrate metabolism

(c) It has a high lattice energy and is one of the sources of energy in the body

(d) It helps in maintaining the osmotic balance among the body fluids

21. The increasing order of strength of secondary forces is :

(a) Vander Wall forces, H-bonding, London forces, Dipole-dipole interaction

(b) H-bonding, Vander Wall forces, London forces, Dipole interaction

(c) London forces, Dipole-Dipole interaction, H-bonding, covalent bonding

(d) Vander Wall forces, London forces, Dipole-dipole interaction and H-bonding

22. Which of the following reaction involves retention of configuration ?

(a) $N \equiv \overset{\ominus}{C}: + CH_3CH_2CH_2B_r \longrightarrow$ (b) $C_2H_5ONa + C_6H_5-\underset{\displaystyle CH_2CH_3}{\overset{\displaystyle CH3}{\overset{|}{\underset{|}{C}}}}-B_r \longrightarrow$

(c) $CH_3-\underset{\displaystyle CH_2-CH_3}{\overset{\displaystyle CH=CH_2}{\overset{|}{\underset{|}{C}}}}-OH + SoCl_2 \longrightarrow$ (d) D (+) Glucose $\underset{H_2O}{\overset{\ominus OH}{\rightleftharpoons}}$ D(+) Mannose

23. Which of the following conformations of methyl cyclohexane will have maximum steric interaction :

(a) 1,a-H: 2,a-CH_3 (b) 1,e-H: 2,e-CH_3

(c) 1,a-H: 3-a-CH_3 (d) 1,e-CH_3: 3-a-H

24. Which amongst the following will not be a reactant in Diels Alder reaction ?
    (a) 1: 3 butadiene & butane (b) 2-butene and propylene
    (c) 1-butene and 2-Methyl propylene (d) 1: 3 butadiene and propylene

25. Which amongst the following metal catalyst reduction process represent Birch reduction :
    (a) Toluene $\xrightarrow{Ni/H_2}$ Methyl Cyclohexane
    (b) Benzene $\xrightarrow[NH_3, EtOH]{Na}$ Cyclohexene
    (c) p – xylene $\xrightarrow{Sn/HCl}$ 1,4dimethy Cyclohexane
    (d) Isopropyl benzene $\xrightarrow[\text{liquid } NH_3/C_2H_5OH]{Na}$ 3 – isopropyl, 1,4 Cyclohaxadiene

26. Which amongst the following conversions represents claisen rearrangement ?
    (a) Intermolecular conversion of Allyl phenyl ethers to allyl phenols
    (b) Interamolecular conversions of Allyl phenyl ethers to allyl phenols
    (c) Intramolecular conversion between two molecules of ethyl acetate in presence of sodium ethoxide to ethyl acetoacetate
    (d) Reaction of ethyl benzoate with ethyl acetate in presence of sodium ethoxide to Ethyl benzoyl acetate

27. Which amongst the following will be a preferential product during conversion of 1,2 epoxy cyclohexane under acidic conditions ?
    (a) Trans 1,2, cyclohexane diol
    (b) Cis, 1,2, cyclohexanediol
    (c) 50% trans product and 50% Cis product
    (d) 1-Hydroxymethyl cyclochexanol

28. Which amongst the following name reactions does not involve Hydride shift ?
    (a) Cannizzaro's reaction
    (b) Meervin Pond Off Verly reduction
    (c) Mannich reaction
    (d) Oppenauer oxidation

29. Which amongst the following compounds would undero Hell-volhard zelinsky reaction ?
    (a) Propionic acid $\xrightarrow[P]{Br_2}$
    (b) 2, 2, dimethyl Propionic acid $\xrightarrow[P]{Br2}$
    (c) p – hydroxybenzoic acid $\xrightarrow{Br_2}$
    (d) Formic acid $\xrightarrow{Br_2}$

30. Propionic acid on treatment with carbon monoxide and steam under pressure at 300-400° C in presence of phosphoric acid yields :
    (a) Propiolic acid (b) 2-methyl propionic acid
    (c) Isobutyric acid (d) n-butyric acid

31. The product of reaction between maleic acid and $KMnO_4$ is :
    (a) (+) Tartaric acid (b) (–) Tartaric acid
    (c) (±) Tartartic acid (d) Succinic acid

32. Pyrrole on chlorination with sulphuryl chloride in ether at 0° C yields :
    (a) 2,3,4,5, tetrachloropyrole (b) 2-Chloropyrole
    (c) 3-Chloropyrole (d) 2,3, dichloropyrole

33. The UV absorption maxima of 2,4, cholestadiene is :
    (a) 258 nm (b) 275 nm
    (c) 220 nm (d) 270 nm

34. The absorption due to carbonyl group in acetophenone will be displayed at :
    (a) 1705 cm^{-1} (b) 1735 cm^{-1}
    (c) 1690 cm^{-1} (d) 1650 cm^{-1}

35. The number and nature of signals in HNMR spectra of P-xylene will be :
    (a) 4-signals; as singlets
    (b) 3-signals; as 1-singlet & 2-doublets
    (c) 2-signals; as 1-singlet & pair of doublets
    (d) 1-signal ; as double doublet only

36. Which amongst the following compound will display most deshielded signal ?
    (a) Ethanol (b) Acetaldelyde
    (c) Acetophenone (d) Acetone

37. The geometry of substitutents at the anomeric carbon w.r.t. CH_2OH in case of -D- Glucopyranose is :-
    (a) Trans (b) Cis
    (c) Both Cis & trans (d) Neither Cis nor trans

38. Amino acids are synthesized by :
    (a) HVZ reaction (b) Gabrial Pthalimide synthesis
    (c) Strecker synthesis (d) All the above

39. The sex hormone which does not display enone system in its structure is :

(a) Androsterone (b) Estrone

(c) Testosterone (d) Progesterone

40. The nature of the bond in an organo-metallic compound is :-

(a) Covalent (b) Ionic

(c) Partially covalent (d) Partially ionic

41. The derivative of $e^{6x} - 3x^{-2}$ is :

(a) $6e^{6x} - 6x^{-3}$ (b) $e^{6x} + 6x^{-3}$

(c) $6e^{6x} + 6x^{-3}$ (d) $6e^{6x} - 6/x$

42. The van der Waals constant b, the actual volume V and the critical volume V_c of molecules in a gas are related as :

(a) $V_c = 3b = 2V$ (b) $V_c = 3b$, $V = b$

(c) $V_c/3 = 4V = b$ (d) $V_c = 4b$, $V = b/3$

43. The dipole moment of CO_3^{-} ion is zero. The structure of the ion should be :

(a) tetrahedral (b) trigonal planar

(c) pyramidal (d) linear

44. A plane that diagonally bisects a cubic unit cell into two prisms has the miller index :

(a) 100 (b) 101

(c) 200 (d) 111

45. The rate of O_2 production in the reaction $2O_3 \rightarrow 3O_2$ is $1.32 \times 10^{-3}\ Ms^{-1}$ at 373 K when the concentration of ozone is 0.10 M and the rate law is $v = k[O_3]^n$. What is the order of the reaction if the rate constant is $4.4 \times 10^{-2}\ M^{-1}\ s^{-1}$

(a) 1 (b) 0

(c) 2 (d) 2.5

46. For the reaction $N_2O_5 \rightarrow 2NO_2 + \frac{1}{2} O_2$ what is the correct expression for representing the reaction rate ?

(a) $d[N_2O_5]/dt$ (b) $d[NO_2]/dt$

(c) $\frac{1}{2}\, d[NO_2]/dt$ (d) $\frac{1}{2}\, d[O_2]/dt$

47. In an isolated system :

(a) ΔG is always negative (b) ΔS is always positive

(c) both (a) & (b) are correct (d) All (a), (b) & (c) are incorrect

48. The statement of third law of thermodynamics that entropy of a substance is zero at zero Kelvin :
    (a) is always true
    (b) is true for all crystalline substances
    (c) is true only for substances with only one arrangement of atoms in the crystalline state
    (d) none of the above is true

49. The depression in freezing point method was used to determine the molar mass of benzoic acid in water. The result was found to be :
    (a) Correct
    (b) Lower than the correct value
    (c) Higher than the correct value
    (d) Molar mass of benzoic acid cannot be found by this method

50. The degree of dissociation of a very weak acid in water is α. Its dissociation constant in water is related to its concentration by the relation :
    (a) $K = c\,\alpha$ (b) $K = c\sqrt{\alpha}$
    (c) $K = \alpha\sqrt{c}$ (d) $\alpha = \sqrt{(K/c)}$

51. The solubility S of Ag_2S in water is related to its solubility product K_{sp} as :
    (a) $K_{sp} = 3S^2$ (b) $K_{sp} = 4S^3$
    (c) $K_{sp} = S^2$ (d) $K_{sp} = S^3$

52. The half cell Hg (1) | Hg_2Cl_2 (s), KCl (aq, 1.0 M) represents which electrode ?
    (a) redox electrode (b) metal/metal ion electrode
    (c) saturated calomel electrode (d) normal calomel electrode

53. The energy of a beam of light depends on its intensity. Higher intensity of the light beam means :
    (a) higher photon density
    (b) larger wavelength of the light rays
    (c) larger frequency of the light rays
    (d) smaller wavelength of the light rays

54. The statement that each observable property of a system is represented in quantum mechanics by an operator is :
    (a) the first postulate of quantum mechanics
    (b) the second postulate of quantum mechanics
    (c) the third postulate of quantum mechanics
    (d) is not a postulate of quantum mechanics

55. In which of the energy levels in the particle in a one-dimensional box has the particle wave wavelength equal to half the box length ?

(a) 1st level (b) 2nd level

(c) 3rd level (d) 4th level

56. The correct wave function for a system should be normalized. Which one of the following expressions represents the normalization condition ?

(a) $\int \psi_1^* \psi_2 d\tau = n$ (b) $\int \psi_1^* \psi_2 d\tau = 1$

(c) $\int \psi_1^* \psi_2 d\tau = 0$ (d) $\int \psi_1^* \psi_1 d\tau = 1$

57 The angular part of the hydrogen like wave function is the product of a theta part and a phi part. The phi part is $\Phi_m(\Phi) = \frac{1}{\sqrt{2\pi}} e^{im\Phi}$ where $i = \sqrt{-1}$, m is the magnetic quantum number and ϕ is the azimuthal angle. What is the correct function for the 2s electron ?

(a) $\Phi_m(\varphi) = \frac{1}{\sqrt{2\pi}} e^{-i\phi}$ (b) $\Phi_m(\phi) = \frac{1}{\sqrt{2\pi}} e^{i\phi}$

(c) $\Phi_m(\phi) = \frac{1}{\sqrt{2\pi}}$ (d) $\Phi_m(\phi) = \frac{1}{\sqrt{2\pi}} e^{2i\phi}$

58. Which one of the following molecules will not give rotational spectrum ?

(a) HCl (b) O_2

(c) H_2O (d) NH_3

59 The selection rules for spectral transitions in atomic spectra are i) $\Delta n = 1,2,3$ ..... and ii) $\Delta l = \pm 1$. Which of the following transitions are allowed ?

(a) $1s \rightarrow 3p$ (b) $3p \rightarrow 3d$

(c) $2p \rightarrow 3p$ (d) none of these

60. Using the equipartition principle what is the average energy of CH_4 at a temperature T ?

(a) 5 kT (b) 6 kT

(c) 9 kT (d) 12 kT

CHEMISTRY

1. The effective nuclear charge decreases due to :

   (a) decrease in the number of intervening electrons

   (b) increase in the size of the atom

   (c) decrease in the screening constant

   (d) less number of valence electrons

2. Which quantum number exhibits Zeeman effect ?

   (a) Principal quantum number

   (b) Azimuthal quantum number

   (c) Magnetic quantum number

   (d) Spin quantum number

3. In square planar geometry, four square planar dsp^2 hybrids are formed by mixing :

   (a) s, p_x, p_y and d_{z^2} orbitals

   (b) s, p_x, p_y and $d_{x^2-y^2}$ orbitals

   (c) s, p_x, p_y and d_{xy} orbitals

   (d) s, p_x, p_y and d_{xz} orbitals

4. On the basis of MOT, the ionisation energy of N_2 molecule is higher than that of NO molecule because during ionisation of N_2 molecule, the electron is to be removed from :

   (a) Antibonding molecular orbital

   (b) Bonding molecular orbital

   (c) Non-bonding orbital

   (d) π bonding orbital

5. In the given reaction; $I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$; the equivalent weight of iodine will be equal to :

(a) Its molecular weight

(b) $\frac{1}{2}$ of its molecular weight

(c) $\frac{1}{4}$ of its molecular weight

(d) Twice its molecular weight

6. When $KMnO_4$ is reduced with oxalic acid in acidic medium, the oxidation number of Mn changes from :

(a) 7 to 4

(b) 6 to 4

(c) 7 to 2

(d) 4 to 2

7. What is the *correct* order of the following ions as Bronsted bases ?

(a) $F^- > OH^- > NH_2^- > CH_3$

(b) $CH_3^- < NH_2^- < OH < F^-$

(c) $F^- < NH_2^- < CH_3^- < OH^-$

(d) $CH_3^- > NH_2^- > OH^- > F^-$

8. Amongst the trihalides of boron, BF_3 has a weak Lewis acid character because :

(a) BF_3 is a small molecule

(b) BF_3 does not exhibit back bonding

(c) Effectiveness of $p\pi - p\pi$ bonding is maximum in BF_3

(d) BF_3 molecule shows double bond character

9. Lithium nitrate on heating gives :

(a) LiO_2, NO_2 and O_2

(b) $LiNO_2$ and O_2

(c) Li_3N, NO and O_2

(d) Li_2O, N_2 and O_2

10. The hydroxides of which of the following pairs of elements are insoluble in water and amphoteric :

(a) Ca, Sr

(b) Ba, Sr

(c) Be, Mg

(d) Mg, Ca

11. The relative order of basic strength of trihydrides of the elements of group 15 varies as follows :

(a) $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$

(b) $NH_3 > PH_3 < AsH_3 < SbH_3 < BiH_3$

(c) $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

(d) $NH_3 < PH_3 > AsH_3 > SbH_3 > BiH_3$

12. What would be the value of effective magnetic moment (μ_{eff}) for a complex ion, whose central metal ion has four unpaired electrons in it ?

(a) 4.90 BM

(b) 5.92 BM

(c) 3.87 BM

(d) 2.83 BM

13. Catalytic activity exhibited by transition metals and their compounds is due to :

(a) Vacant orbitals available in these metals

(b) Variable oxidation states shown by these metals

(c) Availability of large surface area on which the reactants may be adsorbed

(d) All of the above reasons

14. The aqueous solution of the salt will be coloured in case of :

(a) $Zn(NO_3)_2$

(b) $LiNO_3$

(c) $Co(NO_3)_2$

(d) $Ca(NO_3)_2$

15. One of the characteristic of the transition metals to form the complex ion is :

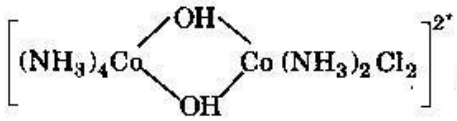
(a) having unpaired electrons in *d*-sub-shell

(b) having paired electrons in *d*-sub-shell

(c) having small charge and size ratio

(d) having empty *d*-orbitals

16. What type of isomerism would you assign to the following pair of compounds ?



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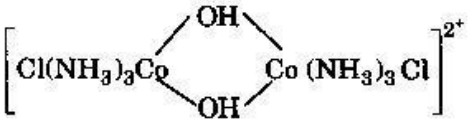


(a) Coordination isomerism

(b) Coordination position isomerism

(c) Linkage isomerism

(d) Ligand isomerism

17. The total pairing energy for $[Cr(OH_2)_6]^{2+}$ ion in high spin state is :

(a) 0

(b) 1P

(c) 2P

(d) 3P

18. Which one of the following is the bulk structural and essential element ?

(a) Carbon

(b) Sodium

(c) Iron

(d) Manganese

19. The elements of Group 13 like Boron and Aluminium form :

(a) Inorganic organometallic compounds

(b) Sigma covalent organometallic compounds

(c) Pi-covalent organometallic compounds

(d) Sandwich organometallic compounds

20. In metal alkenes, the bond length of C=C bond in coordinated olefin :

(a) remains unchanged

(b) decreases

(c) increases

(d) depends on the nature olefins coordinated to the metal

21. The reactive intermediate which displays trigonal planar geometry is :

(a) Carbocation

(b) Carbanion

(c) Carbene

(d) Benzyne

22. The stereoisomer which exhibits different physical and chemical properties on reaction with both chiral and achiral reagents is :

(a) A pair of enantiomers

(b) Meso compounds

(c) A pair of diastereoisomers

(d) An enantiomer and its racemic form

23. Which amongst the following compounds will exhibit Meso form ?

(a) 2, 3, dibromobutane

(b) 3, 3, dibromobutane

(c) 2, 3 dibromopentane

(d) 2, 4 dibromopentane

24. The base catalysed dehydrobromination of which of the following compounds would be governed by Saytzef's rule :

(a) 1, bromopropane

(b) 2, bromopropane

(c) 1, bromobutane

(d) 2, bromobutane

25. The alkyl bromide which will display the slowest rate of nucleophilic substitution reaction (Hydrolysis) in 80% water and 20% ethanol at 25°C is :

(a) CH_3Br

(b) CH_3CH_2Br

(c) $(CH_3)_3C-Br$

(d) $(CH_3)_2CHBr$

26. Treatment of optically pure (R)-2-butanol with thionyl chloride gives predominantly (R)-2-chlorobutane. The reaction proceeds through :

(a) S_N^1 mechanism

(b) S_N^2 mechanism

(c) S_N^i mechanism

(d) Neighbouring group participation

27. The acid catalysed condensation between a carbonyl compound and a secondary amine leads to formation of :

(a) an enamine

(b) an imine

(c) an aminol

(d) a hydrazone

28. The product that would be formed when benzaldehyde is treated with formaldehyde in 50% NaOH is :

(a) $C_6H_5CH_2OH$ and $C_6H_5COO^-Na^+$

(b) $C_6H_5CH_2OH$ and $HCOO^-Na^+$

(c) $C_6H_5COO^-Na^+$ and CH_3OH

(d) $C_6H_5CH_2OH$ and HCOOH

29. The compound which will undergo Pinacol-Pinacolone rearrangement is :

(a) 1, 2, ethanediol

(b) 1, 2, 3, propanediol

(c) 2, methyl, 2, 3, butanediol

(d) 2, 3, dimethyl, 2, 3, butanediol

30. The reaction between the following sequence chemical compounds which will lead to the formation of Mannich bases through Mannich reaction is :

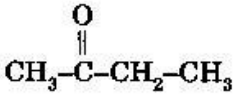
(a) $CH_3COCH_3 + CH_2O + NH_3$

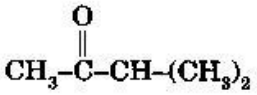
(b) $C_6H_5COCH_3 + CH_3CHO + CH_3NH_2$

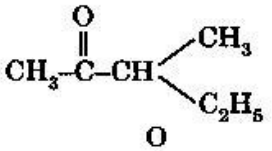
(c) $C_6H_5COCH_3 + HCHO + HN(CH_3)_2$

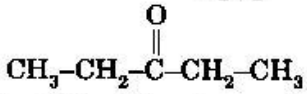
(d) $C_6H_5COC_6H_5 + HCHO + HN(C_2H_5)_2$

31. Which of the following ketones can not be prepared starting from acetoacetic ester ?

(a) 

(b) 

(c) 

(d) 

32. Which of the following amines upon interaction with a proton, would give rise to strongest conjugate acid ?

(a) $(CH_3)_3\ddot{N}$

(b) $(CH_3)_2\ddot{N}H$

(c) $C_6H_5-\ddot{N}H_2$

(d) $CH_3\ddot{N}H_2$

33. The correct increasing order of basicity of following different amines is :

(a) Pyrrole < Pyridine < Piperidine

(b) Pyrrole < Piperidine < Pyridine

(c) Pyridine < Pyrrole < Piperidine

(d) Piperidine < Pyridine < Pyrrole

34. The product that is obtained due to reaction between pyrrole and methyl magnesium bromide is :

(a) N-Methylpyrrole

(b) 2-Methylpyrrole

(c) Pyrrole magnesium iodide and Methane

(d) 3-Methyl pyrrole

35. The ultraviolet spectrum of a simple carbonyl compound shows two peaks at 280 nm and 190 nm. These could be attributed respectively to :

(a) $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ transitions

(b) $n \rightarrow \pi^*$ and $\pi \rightarrow \pi^*$ transitions

(c) $\sigma \rightarrow \pi^*$ and $\pi \rightarrow \sigma^*$ transitions

(d) $n \rightarrow \sigma^*$ and $\pi \rightarrow \pi^*$ transitions

36. An organic compound displays a strong carbonyl group absorption in the infra-red spectrum at 1750 cm^{-1} due to the presence of :

(a) Ester carbonyl group

(b) Amide carbonyl group

(c) Acid carbonyl group

(d) Aldehydic carbonyl group

37. In the NMR spectra, which of the following underlined protons would be most highly deshielded :

(a) $CH_3CH_2O\underline{H}$

(b) $CH_3-\overset{\overset{O}{\|}}{C}-\underline{H}$

(c) $C_6H_5-\underline{CH_3}$

(d) $CH_3\underline{CH_2}-Br$

38. Which of the following amino acids can *not* participate in H-bonding involved in the α-helix structure of proteins ?

(a) Glycine

(b) Proline

(c) Leucine

(d) Histidine

39. The invert sugar is chemically composed of :

(a) 100% D-Glucose

(b) 100% D-Fructose

(c) 50 : 50 Mixture of Glucose and Fructose

(d) 100% Sucrose only

40. Which amongst the following compounds on reaction with a Grignard reagent will not yield an alcohol ?

(a) Formaldehyde

(b) Acetone

(c) Acetic acid

(d) Acetaldehyde

41. The differential and integral of which of the functions is equal to the function itself :

(a) $\sin x$

(b) $\log (x)$

(c) $\exp (x)$

(d) $k \cdot x$.

42. The binary equivalent of the chemical number 11 is :

(a) 1010

(b) 1011

(c) 1100

(d) 1001

43. If V is the actual volume of a gas molecule, its effective volume is :

(a) 4 V

(b) 2 V

(c) V

(d) 8 V

44. At a pressure P the collision frequency and mean free path of molecules in a gas are n and l. If the pressure is reduced to $p/3$, keeping the temperature constant, the new values of n and l will be :

(a) $3n, 3l$

(b) $3n, \frac{l}{3}$

(c) $\frac{n}{3}, l$

(d) $\frac{n}{3}, 3l$

45. Liquid crystals can be distinguished by the arrangement of molecules in the liquid. Which of the liquid phases shows a stacked helical structure :

(a) Nematic

(b) Smectic

(c) Cholesteric

(d) Both (a) and (b)

46. The Miller index of a diagonal plane that divides a cubic unit cell into two equal prisms is :

(a) 101

(b) 111

(c) 100

(d) 210

47. The slope of the plot of lnk *vs* $\frac{1}{T}$ of decomposition of acetaldehyde was found to be -2.27×10^4K. What is the approximate activation energy of the reaction ?

(a) 190 kJ/mol

(b) 380 kJ/mol

(c) 100 kJ/mol

(d) 95 kJ/mol

48. Two moles of an ideal gas are heated at constant volume from 100°C to 200°C. The change in its internal energy will be :

(a) 100 R

(b) 200 R

(c) 150 R

(d) 300 R

49. An adiabatic process is :

(a) isobaric

(b) isochoric

(c) isenthalpic

(d) isentropic

50. A Carnot engine with an efficiency of 80% is operating between a sink and a source at 150°. The temperature of the sink is :

(a) 100°C

(b) 80°C

(c) 50°C

(d) 30°C

51. One mole of oxygen is mixed with 2 moles of Hydrogen under standard temperature and pressure. The accompanying entropy change is :

(a) Zero

(b) 16 JK^{-1}

(c) 10 JK^{-1}

(d) 30 JK^{-1}

52. Which of the following thermodynamic functions represents the arrow of the time ?

(a) H

(b) A

(c) S

(d) G

53. The equilibrium constant of the reaction :

$$\text{cis } C_2H_2Cl_2 \rightleftharpoons \text{trans } C_2H_2Cl_2$$

is 0.608 at 500 K. Equilibrium constant of the reverse reaction would be :

(a) 1.64

(b) 0.392

(c) 3.98

(d) 0.608

54. Absolute alcohol cannot be obtained by fractional distillation of industrial alcohol because :

(a) Alcohol and water are completely miscible

(b) Alcohol forms hydrogen bonds with water

(c) Alcohol and water forms an azeotropic mixture

(d) None of the above

55. The solubility product of a sparingly soluble salt in water is 4×10^{-12} dm^9 mol^{-3}. Its solubility at the given temperature is :

(a) 4×10^{-12} mol/dm^3

(b) 2×10^{-6} mol/dm^3

(c) 1×10^{-4} mol/dm^3

(d) 1.58×10^{-4} mol/dm^3

56. The electrode potential of the half cell

$$Pt/H_2(g,\ 1\ atm)/H^+\ (aq,\ 0.1\ M)$$

is :

(a) $\frac{2.3\ RT}{F}$

(b) $-\frac{2.3\ RT}{F}$

(c) $\frac{RT}{F}$

(d) $-\frac{RT}{F}$

57. A quantum mechanical operator must be :

(a) Hamiltonian

(b) Commutative

(c) Hermitian

(d) All of the above

58. Which of the following molecules will *not* give rotational spectrum ?

(a) CO_2

(b) HCl

(c) H_2O

(d) NO

59. The absorbance A and the transmittance T of light in a medium are related as :

(a) $A = 1 - T$

(b) $A = - \log T$

(c) $A = \log T$

(d) $T = - \log A$

60. The freezing point of a solution of $NaNO_3$ prepared by dissolving 2.83 g in 100 g of water is :

(a) –0.52°C

(b) –1.0°C

(c) –1.24°C

(d) –2.0°C

CHEMISTRY

(Inorganic Section)

1. Which of the following statements is *incorrect* ?

   (A) The ground state of an atom will be the one having the greatest spin multiplicity

   (B) The product of the uncertainty in the energy of an excited state and the lifetime of an excited state is greater than $h/2\pi$

   (C) The number of nodal surfaces passing through the nucleus is equal to the value of n, the principal quantum number

   (D) A radial distribution function (P), gives the probability that an electron will be found at a given distance from the nucleus regardless of the direction and is equal to $4\pi r^2\psi^2$.

2. As a result of the combined effects of penetration and shielding, the order of energy levels in an electron atom is :

   (A) $ns < np < nd < nf$

   (B) $nf < nd < np < ns$

   (C) $ns < nd < np < nf$

   (D) $ns < np < nf < nd$

3. Using a Boron Haber cycle, and the given data, determine which of the following is the correct value of the lattice enthalpy ΔH_L° of KCl (s) :

   Data :

   ΔH° (sublimation of K(s)) = + 89 kJ mol^{-1},
   ΔH° (ionisation of K(g)) = + 425 kJ mol^{-1},
   ΔH° (dissociation of Cl_2(g)) = + 244,
   ΔH° (electron gain by Cl(g)) = − 355,
   ΔH° (formation of KCl(s)) = − 438

   (A) 310 kJ mol^{-1}

   (B) 524 kJ mol^{-1}

   (C) 719 kJ mol^{-1}

   (D) 905 kJ mol^{-1}

4. Bond order of NO and NO^+ are respectively :

(A) 2.5 and 3

(B) 2 and 4

(C) 3.5 and 2.5

(D) 3 and 2

5. The configuration of superoxide ion O_2^- is :

(A) $\sigma_g^2, 1\sigma_4^2, 2\sigma_g^2, 1\pi_4^4, 1\pi_g^2$

(B) $1\sigma_g^2, 1\sigma_4^2, 2\sigma_g^2, 1\pi_4^4, 1\pi_g^3$

(C) $1\sigma_g^2, 1\sigma_4^2, 2\sigma_g^2, 1\pi_4^4, 1\pi_g^4$

(D) None of the above

6. The standard reduction potential of Cu^{2+}, Zn^{2+}, Sn^{2+} and Ag^+ are 0.34, – 0.76, – 0.14 and 0.80 V respectively, the storage that is possible without any reaction is for :

(A) $CuSO_4$ solution in a zinc vessel

(B) $AgNO_3$ solution in a zinc vessel

(C) $AgNO_3$ solution in a tin vessel

(D) $CuSO_4$ solution in a silver vessel

7. Consider various species generated when H_3PO_4 is dissolved in water. Among these, the conjugate acid of HPO_4^{2-} is :

(A) H_3PO_4

(B) $H_2PO_4^-$

(C) PO_4^{3-}

(D) H_3O^+

8. The reaction of XeF_4 with the Lewis base F^- in cyanomethane solution produces the XeF_5^- ion which has :

(A) square pyramidal shape

(B) planar-pentagonal shape

(C) trigonal bipyramidal shape

(D) distorted octahedral shape

9. The diagonal relationship of elements in the periodic table arises because of similarity in :

(A) ionic radius

(B) electronic configuration

(C) crystal structure

(D) charge/radius ratio of the corresponding ion

10. According to Wade's rules boron hydrides of formula B_nH_{n+4} and $n + 2$ pairs of skeletal electron have :

(A) Closo structure

(B) Nido structure

(C) Arachno structure

(D) Hypho structure

11. Which pseudo-halogen does *not* have dimeric nature ?

(A) cyanogen

(B) azide

(C) thiozene

(D) selenothigen

12. Identify the *incorrect* statement :

(A) The largest change in stability of highest oxidation state of an element on descending a group occurs between 3*d* and 4*d* series of the *d*-block elements

(B) The 4*d* and 5*d* elements often have higher coordination numbers than their 3*d* congeners

(C) The conversion of an aquoligand to an oxoligand is favoured by a high pH and by a high oxidation state of the central metal atom

(D) Oxidation state +2 is more common for the 3*d* metal from the middle to the left of the block

13. The theory which utilises pure electrostatic bonding between metal and ligand is :

(A) valence bond theory

(B) molecular orbital theory

(C) crystal field theory

(D) ligand field theory

14. The theoretical value of the magnetic moment of $[Fe(H_2O)_6]^{3+}$ at 273 K is :

(A) 2.83 B.M.

(B) 3.87 B.M.

(C) 4.90 B.M.

(D) 5.92 B.M.

15. Eriochrome Black T is used as indicator in the quantitative estimation of Mg with EDTA titration. The pH of the solution should be maintained at :

(A) pH 3

(B) pH 6.7

(C) pH 10

(D) pH 01

16. Consider the following cyanide exchange reactions :

$[Ni(CN)_4^{2-}] + 4\,^{14}CN^- \rightarrow [Ni(^{14}CN)_4]^{2-} + 4CN^-$, $t_{1/2} \approx 30$ s

$[Mn(CN)_6]^{3-} + 6\,^{14}CN^- \rightarrow [Mn(^{14}CN)_6]^{3-} + 6CN^-$, $t_{1/2} \approx 1$ h

$[Cr(CN)_6]^{3-} + 6\,^{14}CN^- \rightarrow [Cr(^{14}CN)_6]^{3-} + 6CN^-$, $t_{1/2} \approx 24$ days

All the above three cyanide complexes are thermodynamically stable but not equally inert, which one is the most labile :

(A) $[Ni(CN)_4]^{2-}$

(B) $[Mn(CN)_6]^{3-}$

(C) $[Cr(CN)_6]^{3-}$

(D) None of the above

17. The methods of separation of lanthanides include :

(A) fractional crystallisation, ion exchange and solvent extraction

(B) only ion exchange and solvent extraction

(C) solvent extraction only

(D) fractional crystallisation

18. Haemoglobin, Haemocyanin and Cytochromes are :

(A) storage metalloproteins

(B) transport metalloproteins

(C) enzymes

(D) none of the above

19. Transport of oxygen is an important function of blood. Partial pressure of oxygen is the highest and the lowest in :

(A) Muscles and Heart

(B) Lungs and Muscles

(C) Heart and Lungs

(D) Muscles and Lungs

20. Gadolinium (^{153}Gd) which has a half-life of 242 days, is used to detect osteoporosis. The percentage of ^{153}Gd left in a patient's system after 2 years will be :

(A) 33.0

(B) 25.0

(C) 12.5

(D) 6.25

(Organic Section)

21. Give the *correct* order of strength of the following carboxylic acids :

(i) CH_3CH_2COOH, (ii) $(CH_3)_2CHCOOH$

(iii) $Cl–CH_2.COOH$ (iv) $Br–CH_2COOH$

(A) (i) > (ii) > (iii) > (iv)

(B) (iii) > (iv) > (i) > (ii)

(C) (iv) > (iii) > (ii) > (i)

(D) (ii) > (i) > (iv) > (iii)

22. Which of the following is a *wrong* statement ?

(A) Inductive effect is a permanent effect and involves π electrons

(B) A singlet carbene being paramagnetic, can be detected by ESR

(C) Due to presence of lone pair of electrons on nitrogen, nitrenes act as Lewis bases

(D) All the statements are wrong

23. Stereoisomers that are *not* mirror images of each other are called as :

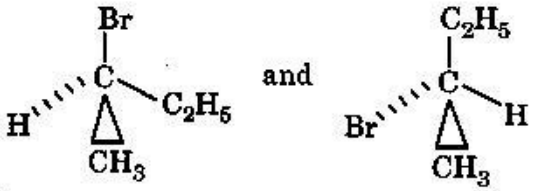
(A) Anomers

(B) Enantiomers

(C) Diastereoisomers

(D) Epimers

24. The relationship that exist between the following compounds is that of :



(A) Enantiomers

(B) Same compound

(C) Conformational isomers

(D) Position isomers

25. Hydroxylation of alkenes, with alk. $KMnO_4$ and OsO_4 produce :

(A) Syn 1, 2 diols

(B) Syn 1, 3, diols

(C) Anti 1, 2, diols

(D) Anti 1, 3, diols

26. Order of stability of cyclopropene(1), salt of cyclopropenyl cation(2), and salt of cyclopropenyl anion(3) is :

(A) 1 > 2 > 3

(B) 1 > 3 > 2

(C) 2 > 1 > 3

(D) 2 > 3 > 1

27. Rate of S_N1 reaction of alkyl halides does *not* depend on :

(A) Structure of alkyl halide

(B) Nature of leaving group

(C) Polarity of solvent

(D) Strength of nucleophile

28. For the reaction :

$$\text{Phenol} + CCl_4 \xrightarrow[(ii)\ H_3O^+]{(i)\ NaOH,\ \Delta} \text{'A'}$$

, the main product 'A' will be :

(A) salicyldehyde

(B) *p*-hydroxybenzaldehyde

(C) salicyclic acid

(D) *m*-hydroxybenzoic acid

29. The reaction between an aldehyde or a ketone with a phosphorous ylide to give a substituted alkene is called as :

(A) Mannich reaction

(B) Wittig reaction

(C) Perkin reaction

(D) Cannizzaro's reaction

30. When benzaldehyde is heated with an ethanolic solution of KCN, the product obtained is :

(A) Benzoic acid

(B) Benzoin

(C) Benzil

(D) Benzamide

31. Which of the following carboxylic acids does *not* have any stereocentre ?

(A) Malic acid

(B) Tartaric acid

(C) Oxalic acid

(D) Citric acid

32. Carbylamine or Isocyanide test is used to distinguish :

(A) 1° amine from 2° and 3° amines

(B) 2° amine from 1° and 3° amines

(C) 3° amine from 1° and 2° amines

(D) Aromatic amines from aliphatic amines

33. Order of basicity of the following is :

(A) Pyridine > Piperidine > Pyrrole

(B) Piperidine > Pyridine > Pyrrole

(C) Pyrrole > Pyridine > Piperidine

(D) None of the above

34. Which of the following absorptions in the IR region represent carbonyl group absorption of amides ?

(A) 1685 cm^{-1}

(B) 1725 cm^{-1}

(C) 1760 cm^{-1}

(D) 1700 cm^{-1}

35. A compound shows ^{1}HNMR peak at 270 Hz downfield from TMS peak in a spectrometer operating at 60 MHz. The value of chemical shift δ in PPM is :

(A) 2.7

(B) 6.0

(C) 4.5

(D) 5.7

36. Vinylic protons which are trans to each other have a coupling constant (J) of the order of :

(A) 0–2 Hz

(B) 2–5 Hz

(C) 6–14 Hz

(D) 11–18 Hz

37. Sulphur containing amino acid is :
(A) Histidine
(B) Methionine
(C) Serine
(D) Proline

38. Which of the following nitrogenous bases is 6-aminopurine ?
(A) Guanine
(B) Uracil
(C) Thymine
(D) Adenine

39. Which of the following is a disaccharide of D-glucose and D-fructose ?
(A) Maltose
(B) Lactose
(C) Sucrose
(D) Amylose

40. Choose the *wrong* statement :
(A) For basic amino acids, the isoelectric point is at pH higher than 6, while as for acidic amino acids it is less than 6
(B) Salting out of proteins is a reversible process
(C) All natural amino acids belong to L-series
(D) Sanger's method is used for determination of G-terminal amino acid residue of polypeptide chain

(Physical Section)

41. The decimal equivalents of the binary numbers $(10111)_2$ and $(0.0101)_2$ are :
(A) 32, 0.312
(B) 23, 0.3125
(C) 23, 0.452
(D) 3.2; 0.0312

42. According to Bohr's model, the energy of the 1*s* electron in hydrogen atom is -13.6 eV. What is the energy of the 2*s* electron in lithium atom ?
(A) 30.6 eV
(B) 13.6 eV
(C) 3.4 eV
(D) 122.4 eV

43. For a particle in a one-dimensional box of length l, what are the number of nodes in the wave function and where is the maximum probability in the first excited level ?

(A) 1, $\frac{l}{2}$

(B) 2, $\frac{l}{2}$

(C) 0, $\frac{l}{4}$ and $\frac{l}{2}$

(D) 1, $\frac{l}{4}$ and $\frac{3l}{4}$

44. Which of the following molecules can be regarded as the best example of a particle in one-dimensional box ?

(A) Ethane

(B) Butane

(C) Ethylene

(D) 1, 3, butadiene

45. Which of the following two molecular pairs will give both a rotational and vibrational spectrum ?

(A) HCl and CO_2

(B) CO_2 and O_2

(C) HCl and H_2O

(D) CO_2 and H_2O

46. The selection rules for spectral transitions in atomic spectra are :

(*i*) $\Delta x = 1, 2, 3, 4....$

(*ii*) $\Delta l = \pm 1$

Determine, which of the following transitions are allowed :

(A) $1s \rightarrow 3p$

(B) $3p \rightarrow 3d$

(C) $3p \rightarrow 4p$

(D) All of the above three

47. The quantum yield for the photochemical combination of $H_2(g)$ and $Cl_2(g)$ to form HCl(g) is 1.0×10^5 at a wavelength of 600 nm. What is the number of moles of HCl produced per joule of radiant energy absorbed ?

(A) 5.01

(B) 0.501

(C) 50.0

(D) 10.02

48. Using equipartition principles, what are the average energies of these molecules : He, H_2 and CO_2.

(A) $\frac{3}{2}RT, \frac{7}{2}RT, \frac{15}{2}RT$

(B) $\frac{3}{2}RT, \frac{5}{2}RT, \frac{7}{2}RT$

(C) $\frac{5}{2}RT, \frac{7}{2}RT, 9RT$

(D) $\frac{5}{2}RT, \frac{5}{2}RT, \frac{7}{2}RT$

49. The root mean square speed of the molecules of a perfect gas at 27°C is 0.4 ms^{-1}. What is the speed at 327°C ?

(A) 0.80 ms^{-1}

(B) 1.20 ms^{-1}

(C) 0.125 ms^{-1}

(D) 0.565 ms^{-1}

50. The van der Waals constant a for the gases N_2, O_2, NH_3 and CH_4 are : 1.39, 1.36, 4.0 and 2.25 dm^{+6} atm. mol^{-2}. Which of the gases can most easily be liquefied ?

(A) N_2

(B) NH_3

(C) CH_4

(D) O_2

51. The edge length of the unit cell in a cubic crystal is a. What is the spacing between (100) planes ?

(A) a

(B) $a\sqrt{2}$

(C) $\frac{a}{\sqrt{3}}$

(D) $a\sqrt{3}$

52. For an adiabatic process, which of the following statements is *true* ?

(A) $\Delta T = 0$

(B) $q = 0$

(C) q = constant

(D) $w = 0$

53. The value of K_p for the reaction :

$$2A(g) + 2B(g) \rightleftharpoons 4C(g) + D(g)$$

at 500 K is 0.4 atm. Assuming R = 0.081 atm. K^{-1} mol, the value of K_c will be :

(A) 10^{-4} mol L^{-1}

(B) 0.16 mol L^{-1}

(C) 9.8×10^{-3} mol L^{-1}

(D) 1.6 mol L^{-1}

54. Equal volumes of two gases are mixed at constant temperature and pressure. The changes in enthalpy and entropy respectively are :

(A) 0, 0

(B) 0, 5.76 JK^{-1} mol^{-1}

(C) 5.76 J mol^{-1}, 0

(D) -10.0 J mol^{-1}, 5.76 JK^{-1}

55. The rate of a gaseous reaction is doubled when the temperature is raised from 27° to 40°C. The activation energy of the reaction (in kJ mol^{-1}) is :

(A) 50.15

(B) 65.50

(C) 100.20

(D) 86.65

56. Identify the reaction order in each of the following rate constant expressions :

$k_1 = 5.6 \times 10^{-4}$ mol dm^{-3} s^{-1}, $k_2 = 3.2 \times 10^{-3}$ s^{-1}

(A) 0, 1

(B) 1, 0

(C) 1, 2

(D) 2, 1

57. 10 g of each of the following substances are dissolved in 1 kg of water :

$NaCl$, $C_6H_{12}O_6$, $Co(NH_2)_2$ and CH_3OH

Which will produce the highest depression in the freezing point ?

(A) CH_3OH

(B) $NaCl$

(C) $Co(NH_2)_2$

(D) $C_6H_{12}O_6$

58. The number of degrees of freedom in the water system at its triple point and freezing point are :

(A) 1, 0

(B) 0, 0

(C) 0, 1

(D) 1, 1

59. When the pH of the solution in the standard hydrogen electrode is increased by one pH unit, its electrode potential :

(A) decreases by 59 mV

(B) increases by 59 mV

(C) decreases by 29.5 mV

(D) becomes zero

60. For the oxygen half cell reaction :

$$O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$$

$\Delta G^\circ/FE^\circ$ is equal to :

(A) 1

(B) 2

(C) 4

(D) – 4

CHEMISTRY

(Inorganic Chemistry)

1. Which quantum number exhibits Zeeman effect ?

   (A) Principal quantum number

   (B) Azimuthal quantum number

   (C) Magnetic quantum number

   (D) Spin quantum number

2. LiF is insoluble in water while LiI is soluble because ?

   (A) Fluoride is more electronegative than iodide

   (B) Size of iodide is greater than that of fluoride

   (C) The internuclear distance in LiF is smaller than that in LiI

   (D) Lattice energy of LiF is more than that of LiI

3. Which one of the following factors would decrease the stability of clathrates ?

   (A) The guest molecules are tightly held in the cavities of host molecules

   (B) The guest molecules within the cavities are at maximum potential energy

   (C) The guest molecules within the cavities are at minimum potential energy

   (D) The size of guest molecules fits into the cavities of host molecules

4. VCl_2 is ionic, VCl_3 is less ionic, while VCl_4 is covalent, because ?

   (A) With increase in oxidation state of a given transition metal, the ionic character of its compound increases

   (B) With the increase in oxidation state of a given transition metal, the covalent character of its compound increases

   (C) With the decrease in oxidation state of a given transition metal, the covalent character of its compound increases.

   (D) With the decrease in oxidation state of given transition metal, the ionic character of its compound decreases

5. Which one of the following statements is *not* correct ?

(A) In lanthanides, the additional electron enters 4*f* orbitals

(B) The mutual shielding effect between two electrons residing in 5*f* orbitals (actinides) is poor

(C) Actinides form complexes with π-bonding ligands

(D) The compounds of lanthanides are more basic

6. The isotope that finds use in the pressure vessels for nuclear reactors is :

(A) $^{35}_{16}S$

(B) $^{74}_{34}Se$

(C) $^{131}_{53}I$

(D) $^{60}_{27}Co$

7. The element which is required in trace amount by the living organism is :

(A) Mn

(B) Mo

(C) Alo

(D) Zn

8. The compound which is used as red phosphorus in television and computer-terminal display is :

(A) Xenotime

(B) Uranite

(C) Monazite

(D) Europium oxide

9. The Fe^{2+} changes from high spin to low spin state during its conversion form deoxyhaemoglobin to oxyhaemoglobin, this result is decrease in its size by :

(A) 22%

(B) 25%

(C) 33%

(D) 36%

10. The orbitals of the central metal which will hybridize to give a complex of trigonal bipyramidal geometry is :

(A) $d_{x^2-y^2}, s, p^3$

(B) $d_{z^2}, d_{x^2-y^2}, s, p^2$

(C) d_{z^2}, s, p^3

(D) $d_{z^2}, d_{x^2-y^2}, d_{xy}, p^3$

11. The normality of 70% (w/w) HNO_3 having specific gravity of 1.40 will be :

(A) 7.00 N

(B) 11.11 N

(C) 15.56 N

(D) 15.77 N

12. The oxyacid of chlorine which has the pKa_2 value equal to that of pKa, of H_2SO_4 is :

(A) HClO

(B) $HClO_2$

(C) $HClO_3$

(D) $HClO_4$

13. Sodium sesqui-carbonate is represented by the formula :

(A) $NaHCO_3$

(B) $Na_2CO_3—H_2O$

(C) $Na_2CO_3—10H_2O$

(D) $Na_2CO_3—NaHCO_3 \cdot 2H_2O$

14. Sodium iodide (Iodine-131, half life — 8.05 days) is used in the treatment of thyroid cancer. If one begins with 25.0 mg of $Na^{131}I$, the number of milligrams of radioactive material remaining after about a month (32.2 days) will be :

(A) 6.25

(B) 1.56

(C) 3.12

(D) 0.78

15. The complex that violates the EAN rules is :

(A) Potassium ferricyanide

(B) Potassium ferrocyanide

(C) Nickel carbonyl

(D) Cobalt hexamine chloride

16. EDTA forms stable complexes with divalent metals in :

(A) Acidic medium

(B) Ammonical solution

(C) Aqueous medium

(D) All of the above

17. According to autoionisation concept, acetic acid in liquid ammonia is a :

(A) weak acid

(B) base

(C) strong base

(D) strong acid

18. Which among the following will be classified as the softest base ?

(A) H^-

(B) OH^-

(C) O^{-2}

(D) $SS_2O_3^{2-}$

19. The lanthanide element which *does not* occur in nature, is :

(A) Dysprosium

(B) Praseodymium

(C) Promethium

(D) Neodymium

20. The metal which is involved in the formation of oxygen during photosynthesis in green plants is :

(A) Mg

(B) Ca

(C) Mn

(D) Fe

(Organic Chemistry)

21. Alkaline hydrolysis of 2-bromo, 2-ethyl pentane yields of opposite stereochemistry. This is due to :

(A) inversion

(B) racemisation

(C) retention

(D) oxidation

22. The major product of the reaction between 2-bromo, 2-methyl butane and sodium ethoxide in the presence of ethyl alcohol is :

(A) 2-methyl butanol

(B) 2-methyl, 2-butene

(C) 2-methyl, 1-butene

(D) 2-hydroxy, 2-methyl butane

23. Phenol on treatment with acetic anhydride in the presence of aqueous NaOH, gives phenyl acetate, which on heating with $AlCl_3$ gives a mixture of ortho and para-hydroxy acetophenone. The name of reaction involved, is :

(A) Fries rearrangement

(B) Friedel-Crafts Alkylation

(C) Friedel-Crafts Acylation

(D) Fischer Indole Reaction

24. Which of the following compounds will *not* be a reduction product of Nitrobenzene in acidic, alkaline and neutral medium ?

(A) Aniline

(B) Phenyl hydroxylamine

(C) Azobenzene

(D) P-aminophenol

25. Which amongst the following methods for the preparation of 1° amines involves intermediate formation of a nitrene with a descent of a homologus series ?

(A) Gabriel's phthalimide reaction

(B) Hoffman bromide reaction

(C) Reductive amination of acetaldehyde or acetone

(D) Azo-coupling

26. Which amongst the following name reactions is *not* a method for the preparation of nitrogen heterocyclics ?

(A) Skraup's synthesis

(B) Bischler—Napieralski reaction

(C) Fischer Indole synthesis

(D) Hell Volhard Zelinsky reaction

27. Glucose displays mutarotation due to the presence of :

(A) Asymmetric carbon

(B) Hemiacetal formation

(C) Anomeric centre

(D) Acetal formation

28. When treated with sodium ethoxide in ethanol at 25°C, which of the following alkyl bromides would give predominantly elimination product ?

(A) CH_3CH_2Br

(B) $(CH_3)_2CHBr$

(C) $(CH_3)_3CBr$

(D) $(CH_3)_3CCH_2Br$

29. Which of the following stereochemical relationship exists between alpha and beta-D-glucopyranoses ?

(A) Enantiomeric

(B) Anomeric

(C) Epimeric

(D) Diastereoisomeric

30. Which amongst the following conjugated proteins has cholesterol as a non-amino acid residue ?

(A) Glycoproteins

(B) Phosphoproteins

(C) Nucleoproteins

(D) Lipoproteins

31. Which amongst the following drugs has anti-inflammatory action ?

(A) Phenylbutazone

(B) Aspirin

(C) Paracetamol

(D) Sulphapyridine

32. Which of the following is the *correct* order of decreasing nucleophilic strength of different halides ?

(A) $I^{\odot} > F^{\odot} > Cl^{\odot} > Br^{\odot}$

(B) $I^{\odot} > Br^{\odot} > Cl^{\odot} > F^{\odot}$

(C) $I^{\odot} > Cl^{\odot} > Br^{\odot} > F^{\odot}$

(D) $I^{\odot} > Cl^{\odot} > F^{\odot} > Br^{\odot}$

33. How many geometrical isomers are possible for 2, 4-hexadiene ?

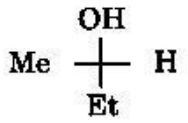
(A) None

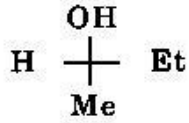
(B) Two

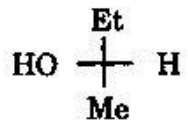
(C) Four

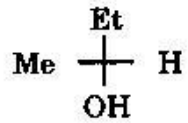
(D) Six

34. Which of the following Fischer Projection formula is that of (R) 2-butanol ?

(A) 

(B) 

(C) 

(D) 

35. Methylcyclohexane exists in two conformational forms which are rapidly converting into one another. The ratio of methylcyclohexanes having methyl equatorial and methyl axial at equilibrium is :

(A) 50 : 50

(B) 95 : 6

(C) 5 : 95

(D) 40 : 60

36. The relative rates of reaction of alkyl halides CH_3X, CH_3CH_2X, $(CH_3)_2CHX$ and $(CH_3)_3$ CX are randomly given below. Which of them you would attribute to CH_3X :

(A) Zero

(B) 0.02

(C) 1.00

(D) 30

37. Which of the following sugars *does not* respond to either Tollen's, Benedict's or Fehling's tests ?

(A) Maltose

(B) Cellobiose

(C) Sucrose

(D) Fructose

38. The methyl protons in the nmr spectrum of toluene appear at σ :

(A) 2.30 as doublet

(B) 0.9 as singlet

(C) 5.0 as singlet

(D) 2.30 as singlet

39. The range of fingerprint regions in the infrared spectrum lies between :

(A) 666—1444 cm^{-1}

(B) 1650—1800 cm^{-1}

(C) 3300—3610 cm^{-1}

(D) 1050—1400 cm^{-1}

40. A neat sample of ethanol at –40°C, will display the following multiplicity in proton magnetic spectra :

(A) Triplet, quarter

(B) Triplet, multiplet, triplet

(C) Double doublet

(D) Triplet, quartet, triplet

(Physical Chemistry)

41. The slope of a line whose inclination is 45° will be :

(A) 1

(B) $\sqrt{3}$

(C) $1/\sqrt{3}$

(D) $\sqrt{2}$

42. The decimal equivalent of the binary number $(1101)_2$ is :

(A) $(53)_{10}$

(B) $(13)_{10}$

(C) $(54)_{10}$

(D) $(4)_{10}$

43. The temperature at which a real gas shows ideal behaviour is known as :

(A) Critical temperature

(B) Inversion temperature

(C) Boyle's temperature

(D) Charles temperature

44. The values of the van der Waals' constants "a" for the gases A_2, B_2, C_2 and D_2 are 2, 3, 4 and 5 dm^3 atm mol^{-2} respectively. The gas which can be most easily liquefied is :

(A) A_2

(B) B_2

(C) C_2

(D) D_2

45. The Miller indices of a crystal plane which cuts through crystal axes at 6a, 3b, 3c are :

(A) 326

(B) 111

(C) 122

(D) 211

46. The rate law for the reaction A + 2B → Products is, rate = k [A] $[B]^2$. If B is present in large excess, then the order of the reaction will be :

(A) 2

(B) 1

(C) 3

(D) 0

47. The probability factor existing in the collision theory of reaction rates is related to which of the following thermodynamic parameters.

(A) Enthalpy of activation

(B) Entropy of activation

(C) Gibbs free energy of activation

(D) Helmholtz free energy of activation

48. Which of the following thermodynamic functions is *not* equal to zero for an element in its most stable form ?

(A) Standard enthalpy

(B) Standard Gibbs free energy

(C) Standard entropy

(D) Standard Helmholtz free energy

49. For an ideal gas, Joule-Thomson coefficient is :

(A) positive

(B) negative

(C) zero

(D) unity

50. At the triple point in the phase diagram of a one component system, which of the following is *correct* ?

(A) Three components are in equilibrium

(B) The number of degrees of freedom is zero

(C) The number of degrees of freedom is three

(D) The number of degrees of freedom is one

51. The number of components, number of phases and the degrees of freedom for the system $CaCO_{3(s)} \rightleftharpoons CaO(s) + CO_2(g)$.

(A) 1, 3, 0

(B) 2, 1, 3

(C) 1, 1, 2

(D) 2, 3, 1

52. The molar conductivity of a given solution of $MgCl_2$ at infinite dilution, given that $\sqrt{\alpha}\ Mg^2 = 106\ ohm^{-1}\ cm^2\ mol^{-1}$ and $\sqrt{\alpha}\ Cl^- = 76\ ohm^{-1}\ cm^2\ mol^{-1}$, will be :

(A) $25.8\ ohm^{-1}\ cm^2\ mol^{-1}$

(B) $2.58\ ohm^{-1}\ cm^2\ mol^{-1}$

(C) $258\ ohm^{-1}\ cm^2\ mol^{-1}$

(D) $182\ ohm^{-1}\ cm^2\ mol^{-1}$

53. The molar conductance of a weak electrolyte at room temperature is 1×10^{-6} Sm^2 and the molar conductance at infinite dilution is 500 Sm^2 mol^{-1}. The degree of dissociation of the electrolyte is :

(A) 1×10^{-9}

(B) 1×10^{-8}

(C) 2×10^{-8}

(D) 2×10^{-9}

54. For which values of "n", the principal quantum number, the wave functions for a particle in one-dimensional box are symmetric ?

(A) Odd values of n

(B) Even values of n

(C) Zero values of n

(D) All values of n

55. The operator for the potential energy of electron in hydrogen atom is :

(A) e^2/r

(B) $-e^2/r$

(C) $2e^2/r$

(D) $-e^2/2r$

56. The molecular orbital which has two nodal planes amongst the following is :

(A) σIS

(B) $\sigma_2 pz$

(C) πPx

(D) $\pi^2 Px^*$

57. Which of the following molecules is said to be microwave inactive but infra-red active ?

(A) HCl

(B) H_2

(C) CO_2

(D) O_2

58. The transitions which are usually non-radioactive involve :

(A) Internal conversion

(B) Fluorescence

(C) Phosphorescence

(D) Chemiluminescence

59. In which of the following molecules, the molar polarization will be independent of temperature :

(A) HCl

(B) CH_3Cl

(C) CO

(D) CH_4

60. Cryoscopic constant is a characteristic of :

(A) solute

(B) solvent

(C) solution

(D) both solute and solvent