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A

SET-Y

PHD-EE-2023-24

Chemistry

10005

Sr. No. .....

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

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SEAL

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1. The decreasing order of heat of hydration of Ca^{2+}, Sr^{2+} and Ba^{2+} is :

(1) $Sr^{2+} > Ba^{2+} > Ca^{2+}$ (2) $Ba^{2+} > Sr^{2+} > Ca^{2+}$

(3) $Ca^{2+} > Ba^{2+} > Sr^{2+}$ (4) $Ca^{2+} > Sr^{2+} > Ba^{2+}$

2. Melting point is maximum for which of the following compound ?

(1) $LiCl$ (2) $NaCl$ (3) $RbCl$ (4) KCl

3. Shape of $TeCl_4$ molecule is :

(1) Trigonal pyramidal (2) Tetrahedral

(3) Square pyramidal (4) Square planar

4. According to VSEPR theory, which of the following is non-linear ?

(1) $[ClF_2]^+$ (2) CO_2 (3) $[I_3]^-$ (4) $[N_3]^-$

5. Which of the following species have bond order of 3 ?

(a) N_2 (b) NO^+ (c) NO^- (d) C_2^{2-}

Select the ***correct*** answer using the options given below :

(1) (a) and (b) (2) (a), (b) and (c)

(3) (a), (b) and (d) (4) (a), (c) and (d)

6. Which of the following is most basic ?

(1) CH_3^- (2) H_2O (3) F^- (4) OH^-

7. Which of the following statements is ***false*** ?

(1) Water is a differential solvent for HF and HCl

(2) H_2O has levelling effect on strength of HF and HCl

(3) Liquid ammonia has a levelling effect on strength of HF and HCl

(4) CH_3COOH has a levelling effect on strength of HF, HCl, HBr and HI

8. Which of the following is ***not*** a Lewis acid ?

(1) SO_3 (2) NH_3 (3) $AlCl_3$ (4) SiF_4

9. Using Wade's rule, predict the structure and number of isomers of $B_{10}C_2H_{12}$:

(1) nido and two (2) closo and three

(3) nido and one (4) closo and two

10. Nitrogen is prepared by heating a mixture of :

(1) NH_4Cl and KOH (2) NH_4OH and KCl

(3) NH_4Cl and $NaNO_2$ (4) NH_4Cl and KNO_3

11. The STYX code for diborane is :

(1) 2022 (2) 2002 (3) 2202 (4) 0220

12. Which of the following is colored and paramagnetic ?

(1) Sc^{3+} (2) Cu^{+} (3) Cu^{2+} (4) Zn^{2+}

13. Metal-Metal bond is present in :

(1) Stannic chloride (2) Cupric chloride

(3) Mercurous chloride (4) Mercuric chloride

14. Which of the following has highest CFSE ?

(1) $[CoF_6]^{3-}$ (2) $[Mn(H_2O)_6]^{2+}$ (3) $Co(H_2O)_6]^{2+}$ (4) $[Co(NH_3)_6]^{3+}$

15. Which of the following is thermodynamically unstable and kinetically labile ?

(1) $[Co(H_2O)_6]^{3+}$ (2) $[Co(H_2O)_6]^{2+}$

(3) $[Co(NH_3)_6]^{3+}$ (4) $[Co(NH_3)_6]^{2+}$

16. The electronic configuration of Gd is :

(1) $[Xe]4f^8 5d^9 6s^2$ (2) $[Xe]4f^7 5d^1 6s^2$

(3) $[Xe]4f^6 5d^2 6s^2$ (4) $[Xe]4f^3 5d^3 6s^2$

17. Term symbol of Ce^{3+} is :

(1) $^2F_2$ (2) $^2F_5$ (3) $^2F_{5/2}$ (4) $^2F_0$

18. Which of the following is colorless ?

(1) Pr^{3+} (2) Ce^{3+} (3) Eu^{3+} (4) Sm^{3+}

19. The intense blue color of Prussian blue salt arises due to :

(1) d-d transition

(2) inter valence electron transfer

(3) ligand to metal charge transfer

(4) metal to ligand charge transfer

20. The number of ESR lines for anthracene ion are :

(1) 35 (2) 25 (3) 60 (4) 75

21. Compound which does ***not*** obey 18 electron rule is ?

(1) $Co_2(CO)_8$ (2) $Fe_2(CO)_9$

(3) $V(CO)_6$ (4) $Cr(CO)_6$

22. Which of the following solvent has maximum eluting power ?

(1) pyridine (2) acetone (3) chloroform (4) methanol

23. Which of the following chromatographic techniques may involve solid as well as liquid as stationary phase and liquid as mobile phase ?

(1) Thin layer chromatography (2) Column chromatography

(3) Paper chromatography (4) All of the above

24. In biological system, the metal ions involved in electron transport are :

(1) Na^{+} and K^{+} (2) Zn^{2+} and Mg^{2+}

(3) Cu^{2+} and Fe^{2+} (4) Ca^{2+} and Mg^{2+}

25. Iron-sulphur clusters in biological systems are involved in :

(1) proton transfer (2) atom transfer

(3) group transfer (4) electron transfer

26. Carboxypeptidase contains which of the following element ?

(1) Fe (2) Mn (3) Zn (4) Cu

27. The number of α and β particles emitted when ${}_{92}U^{238}$ changes to ${}_{82}Pb^{206}$ are :

(1) $6\alpha, 6\beta$ (2) $6\alpha, 8\beta$

(3) $8\alpha, 6\beta$ (4) $8\alpha, 8\beta$

28. What will be the energy released in a nuclear reactor, in which the total mass loss is 0.01 amu ?

(1) 0.931 MeV (2) 9.31 MeV

(3) 93.1 MeV (4) 931 MeV

29. A symmetric top molecule among the following is :

(1) ethylene (2) butadiene (3) allene (4) hexatriene

30. The g-factor off ${}^{1}H$ and ${}^{13}C$ are 5.6 and 1.4 respectively. For the same value of magnetic field strength, if the ${}^{1}H$ resonantes at 600 MHz, the ${}^{13}C$ would resonates at :

(1) 2400 MHz (2) 600 MHz (3) 150 MHz (4) 250 MHz

31. To record Mossbauer spectrum of Fe containing samples, a source X is used. X after nuclear transformation (Y), gives γ-radiation used in Mossbauer spectroscopy. X and Y respectively are :

(1) ${}^{57}Fe$, β-emission (2) ${}^{57}Co$, β-emission

(3) ${}^{57}Co$, e^- capture (4) ${}^{57}Fe$, e^- capture

32. The cluster with closo based skeletal structure is :

(1) $Os_5(CO)_{16}$ (2) $Ni_5(CO)_{12}$

(3) $[Ru_3N(CO)_{14}]^-$ (4) $Fe_5C(CO)_{15}$

33. The bond order for metal-metal bond in $[Mo_2Cl_8]^{4-}$ is :

(1) 1 (2) 2 (3) 3 (4) 4

34. Identify the ***correct*** statement :

(i) Physical state of a system at time, t is described by the wave function $\psi(x, y, z, t)$.

(ii) Wave function in one-dimension, $\psi(x, t)$ and its first derivative are continuous and single valued for all values of x.

(iii) The expectation value of an observable A, $<A>$ corresponding to an operator $\hat{A}$ is $< A >= \int_{-\infty}^{\infty} \psi^*(x)\hat{A}\psi(x)dx$.

(1) (i), (ii) (2) (ii), (iii)

(3) (i), (iii) (4) All of the above

35. The expression for the operator, $\left(\frac{d}{dx} - x\right)\left(\frac{d}{dx} + x\right)$ is :

(1) $\frac{d^2}{dx^2} - x^2$ (2) $\frac{d^2}{dx^2} - x^2 + 1$

(3) $\frac{d^2}{dx^2} - x^2 - 1$ (4) None of the above

36. Degeneracy of a particle with mass 'm' in a 3-dimensional box of width 'a' having energy equal to $11\ h^2/8ma^2$ is :

(1) 1 (2) 3 (3) 6 (4) None of the above

37. Acceptable wave function(s) in quantum mechanics when x range from 0 to 2π is :

(i) $\sin x$ (ii) $\tan x$ (iii) $\text{cosec } x$

(1) (i), (ii) (2) (ii), (iii) (3) (i), (iii) (4) All of the above

38. Identify the ***correct*** statement :

(i) According to classical mechanics, the particle must reflect when it has less energy than the energy of the potential barrier.

(ii) According to quantum mechanics, particle with energy less than that of potential energy barrier has a finite probability of penetrating potential energy barrier.

(iii) According to classical mechanics particle with less than potential energy barrier has a finite probability of penetrating the potential energy barrier.

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

39. Function(s) which coluld be used as a trial variation function for the particle in a one-dimensional box of width *'a'* is/are :

(i) $\sin(\pi x/a)$ (ii) x^2/a (iii) $\cos(\pi x/a)$

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

40. Hamiltonian for H_2^+ can be :

(1) $\hat{H} = \frac{\hbar^2}{2m}\nabla^2 + \frac{1}{4\pi\epsilon_0}\left[-\frac{e^2}{r_A} - \frac{e^2}{r_\beta} + \frac{e^2}{r_{AB}}\right]$

(2) $\hat{H} = \frac{h}{\sin^2 m}\nabla^2 + \frac{1}{4\pi\epsilon_0}\left[\frac{e^2}{r_A} + \frac{e^2}{r_\beta} - \frac{e^2}{r_{AB}}\right]$

(3) $\hat{H} = \frac{\hbar^2}{2m}\nabla^2 + \frac{1}{4\pi\epsilon_0}\left[-\frac{e^2}{r_A} + \frac{e^2}{r_\beta} + \frac{e^2}{r_{AB}}\right]$

(4) None of the above

41. ABMO wave function for 1, 3-butadiene is/are :

(i) $A(\phi_1 - \phi_4) + B(\phi_2 - \phi_3)$

(ii) $A(\phi_1 + \phi_4) - B(\phi_2 + \phi_3)$

(iii) $A(\phi_1 - \phi_4) - B(\phi_2 - \phi_3)$

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

42. The molecule(s) which can be assigned $D_{\alpha h}$ point group is/are :

(i) N_2O (ii) CO_2 (iii) C_2H_2

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

43. Identify the ***incorrect*** statement :

(i) Sum of the squares of the dimensions of the irreducible representations of the group is equal to the order of the group.

(ii) Irreducible representations of the group are orthogonal to each other.

(iii) The number of symmetry operations in a group is equal to the number of classes in the group.

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

44. A one-dimensional irreducible representation symmetrical w.r.t. main symmetry axis and unsymmetrical w.r.t. centre of symmetry has the Mulliken's symbol as :

(1) A_u (2) B_g

(3) A_{1u} (4) B_{1g}

45. Rotational line at 108 cm^{-1} in a microwave spectrum occur due to ..... transition. (rotational constant being 9 cm^{-1})

(1) $J = 6 \leftarrow J = 5$ (2) $J = 7 \leftarrow J = 6$

(3) $J = 5 \leftarrow J = 4$ (4) None of the above

46. Which of the following are microwave active ?

(i) N_2 (ii) NO (iii) O_2

(1) (i) (2) (i), (ii)

(3) (ii) (4) (ii), (iii)

47. Rotational and vibrational degrees of freedom in N_2O are respectively ....., ...

(1) 3, 3 (2) 2, 3

(3) 2, 4 (4) 4, 2

48. Match the following :

i. NMR spectrum	(a) Microwave
ii. Rotational spectrum	(b) UV
iii. Raman spectrum	(c) IR
iv. Electronic spectrum	(d) Radiofrequency
	(e) vis

(1) i-a, ii-c, iii-b, iv-e (2) i-d, ii-a, iii-b, iv-e

(3) i-d, ii-a, iii-e, iv-b (4) i-d, ii-c, iii-e, iv-b

49. Identify the ***correct*** statement :

(i) Entropy of perfectly crystalline solid becomes zero at absolute zero.

(ii) It is not possible to reduce the temperature of any system to absolute zero by any process.

(iii) For a process to be spontaneous, $\Delta S_{total} > 0$.

(1) (i), (ii) (2) (ii), (iii)

(3) (i), (iii) (4) All of the above

50. Identify the intensive property from the following :

(i) Pressure

(ii) Volume

(iii) Energy

(1) (i) (2) (i), (ii)

(3) (ii) (4) (ii), (iii)

51. Identify the ***correct*** statement :

(i) For a chemical equilibrium, increasing the conc. of reactants results in shifting the equilibrium in favour of reactants.

(ii) For a chemical equilibrium, increasing the conc. of products results in shifting the equilibrium in favour of reactants.

(iii) For a thermochemical reaction.

$$N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g),\ \Delta H = -92.4\,kJ$$

The reverse reaction will be endothermic.

(1) (i) (2) (i), (ii)

(3) (ii) (4) (ii), (iii)

52. Number of components, number of phases and digrees of freedom for the system $H_2O(s) \rightleftharpoons H_2O(l) \rightleftharpoons H_2O(g)$, resp. is :

(1) 1, 3, 1 (2) 2, 3, 0 (3) 1, 1, 3 (4) None of the above

53. Temperature at which the following process may ***not*** be spontaneous :

$B(g) \rightarrow B(l),\ \Delta H = -24$ kJ, $\Delta S = -60$ Jk^{-1}

(i) >400 k (ii) >450 k (iii) >350 k

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

54. Identify the ***incorrect*** statement :

(1) Canonical ensemble represents isolated system.

(2) Microcanonical ensemble represents open isothermal system.

(3) Grand canonical ensemble represents closed isothermal system.

(4) All of the above

55. Identify the ***incorrect*** statement :

(1) Equal volumes of all gases under the same conditions of temp. and pressure contains equal number of molecules.

(2) Rate of diffusion of a gas is inversely proportional to the square root of the density of a gas at constant pressure.

(3) The most probable velocity of a gas increases with rise of temperature.

(4) None of the above

56. 'Conductance of weak electrolytes increases with dilution.' This is :

(1) Arrhenius law (2) Ostwald's law

(3) Gibb's law (4) Kohlrausch's law

57. A zinc rod dipped in 0.1 M solution of $ZnSO_4$ at 25°C. The potential of this electrode at this temperature is ..... . (Assume the salt to be dissociated to the extent of 95%), $E^{\circ}_{Zn^{2+},Zn} = -0.76\ V$

(1) $-0.76\ V$ (2) $-0.79\ V$ (3) $0.79\ V$ (4) None of the above

58. Standard electrode potential for the half cell reaction are as

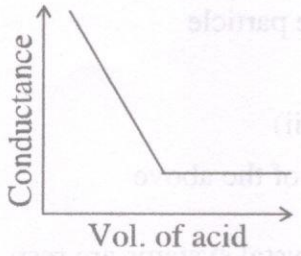
$$Zn \rightarrow Zn^{2+} + 2e^{-},\ E^{\circ} = -0.76V$$

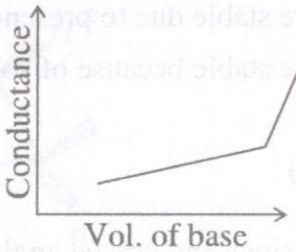
$$Fe \rightarrow Fe^{2+} + 2e^{-},\ E^{\circ} = 0.41V$$

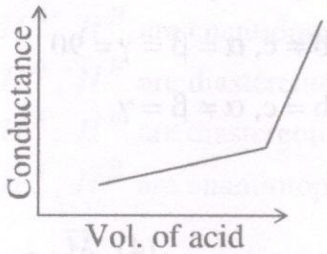
e.m.f. of the cell reaction, $Fe^{2+} + Zn \rightarrow Zn^{2+} + Fe$ is :

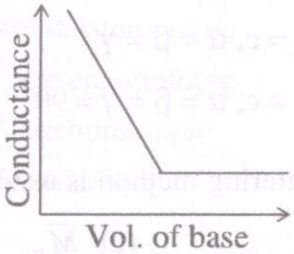
(1) $-0.35\ V$ (2) $+0.35\ V$ (3) $+1.17\ V$ (4) $-1.17\ V$

59. Which of the following represents a plot for conductance titration between strong base and a weak acid ?

(i) 

(ii) 

(iii) 

(iv) 

(1) (i), (ii) (2) (iii), (iv) (3) (i), (iv) (4) (ii), (iii)

60. Which of the following is/are the theory of unimolecular reaction ?

(i) Activated complex theory (ii) Hinshalwood theory

(iii) RRK theory

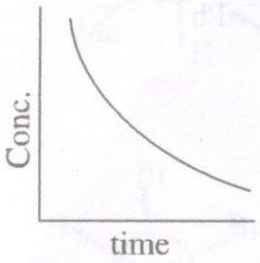
(1) (i), (ii) (2) (ii), (iii) (3) (i), (iii) (4) All of the above

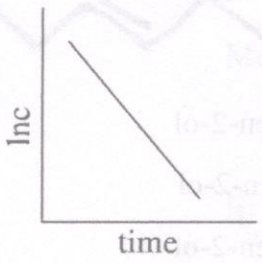
61. Activation energy of a reaction can be :

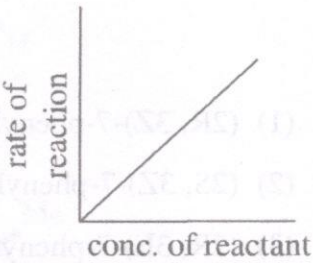
(1) zero (2) negative

(3) can neither be zero or negative (4) can be zero or negative

62. Which of the following represents a 1st order reaction ?

(i) 

(ii) 

(iii) 

(1) (i), (ii) (2) (ii), (iii)

(3) (i), (iii) (4) All of the above

63. Which one of the following about lyophillic colloids is ***not*** true ?

(i) they are stable an account of strong solute-solvent interaction

(ii) they are stable due to presence of change on the particle

(iii) they are stable because of solvation

(1) (i), (ii)
(2) (ii), (iii)
(3) (i), (iii)
(4) None of the above

64. Cell dimensions and crystal angles for tetragonal crystal systems are resp. :

(1) $a = b = c, \alpha = \beta \neq \gamma$
(2) $a = b \neq c, \alpha = \beta = \gamma = 90$
(3) $a \neq b \neq c, \alpha = \beta = \gamma \neq 90$
(4) $a \neq b = c, \alpha \neq \beta = \gamma$

65. Light scattering method is used to obtain :

(1) $\overline{M}_v$ (2) $\overline{M}_n$ (3) $\overline{M}_w$ (4) $\overline{M}_z$

66. Covariance :

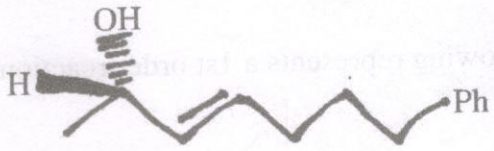
(i) is a measure of relationship between two random variables.

(ii) is zero if two random variables are independent.

(iii) is non-negative.

(1) (i), (ii)
(2) (ii), (iii)
(3) (i), (iii)
(4) All of the above

67. The IUPAC name for the given organic compound is :



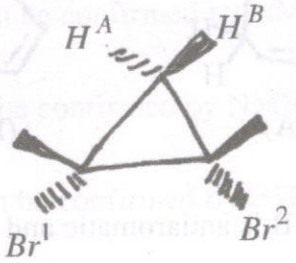
(1) (2R, 3Z)-7-phenylhept-3-en-2-ol

(2) (2S, 3Z)-7-phenylhept-3-en-2-ol

(3) (2R, 3E)-7-phenylhept-3-en-2-ol

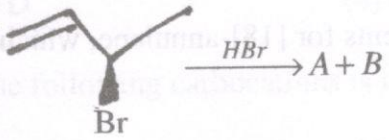
(4) (2S, 3E)-7-phenylhept-3-en-2-ol

68. In the compound given below, the relation between H^A, H^B; and between Br^1, Br^2 is :



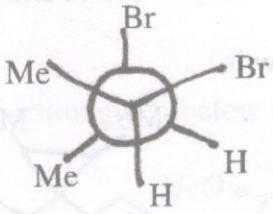
(1) H^A, H^B are enantiotopic; and Br^1, Br^2 are diastereotopic
(2) H^A, H^B are diastereotopic; and Br^1, Br^2 are enantiotopic
(3) H^A, H^B are diastereotopic; and Br^1, Br^2 are homotopic
(4) H^A, H^B are enantiotopic; and Br^1, Br^2 are homotopic

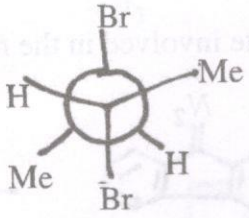
69. In the following Markownikov addition reaction, the products *A* and *B* are :

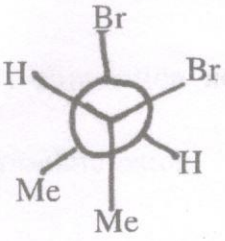


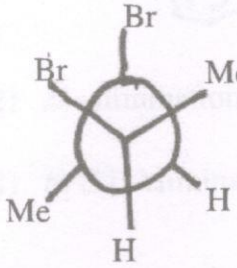
(1) homomers (2) enantiomers (3) diastereomers (4) regioisomers

70. The gauche interaction values for Me/Me, Me/Br and Br/Br are 3.3, 0.8 and 3.0 kJ/mol, respectively. Among the following the most stable conformation of 2,3-dibromobutane is :

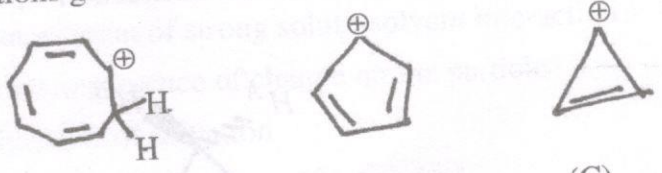
(1)


(2)


(3)


(4)


71. Among the carbocations given below (A, B, C) :



(A) (B) (C)

(1) A is homoaromatic, B is antiaromatic and C is aromatic

(2) A is aromatic, B is antiaromatic and C is homoaromatic

(3) A is antiaromatic, B is aromatic and C is homoaromatic

(4) A is homoaromatic, B is aromatic and C is antiaromatic

72. Considering the following statements for [18]-annulene, which one is ***correct*** ?

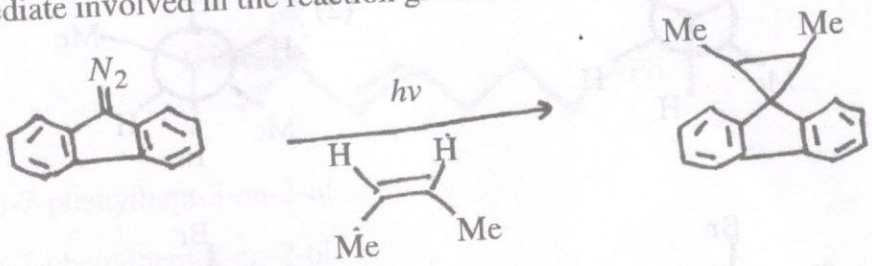
(A) It is aromatic.

(B) The inner protons resonate at δ 9.28 in its ^{1}H NMR spectrum.

(C) There are six protons in the shielded zone.

(1) A, B, C (2) A and B only (3) B and C only (4) A and C only

73. The intermediate involved in the reaction given below is :



(1) Free radical (2) Carbocation

(3) Carbene (4) Carbanion

74. Consider the following statements :

(A) Formation of carbocation can be confirmed by NMR.

(B) Formation of carbanion can be confirmed by NMR.

(C) Formation of free radical can be confirmed by ESR.

(D) Formation of enol can be confirmed by PMR.

Of these the ***correct*** statements are :

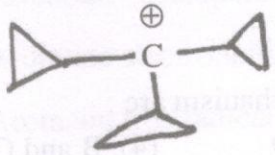
(1) A and B only

(2) A, B and D only

(3) A, B, C and D

(4) B, C and D

75. Which among the following carbocations is most stable ?

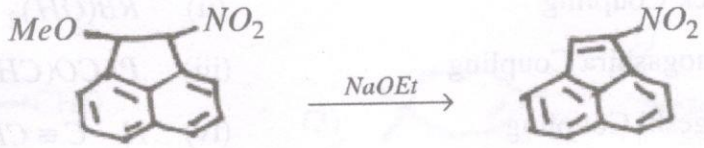
(1) 

(2) $C_6H_5-\overset{\oplus}{C}H_2$

(3) $C_6H_5-\overset{\oplus}{C}H-C_6H_5$

(4) $H_3C-\underset{\displaystyle CH_3}{\overset{\oplus}{\underset{|}{C}}}-CH_3$

76. The reaction given below is an example of :



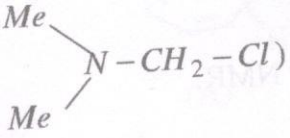
(1) E_2-elimination

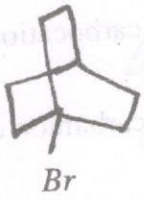
(2) E_1-elimination

(3) Syn-elimination

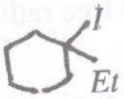
(4) E_1 C B-elimination

77. Which of the following compounds will ***not*** react by unimolecular nucleophilic substitution mechanism ?

(1) 

(2) 

(3) 

(4) 

78. Consider the following reactions :

(A) $CH_3-CH=CH_2 \xrightarrow{NBS\,/\,CCl_4} \underset{\underset{Br}{|}}{CH_2-CH}=CH_2$

(B) $CH_3-CH=CH_2 \xrightarrow{HBr} CH_3-\underset{\underset{Br}{|}}{CH}-CH_3$

(C) $C_6H_5-CH_3 \xrightarrow[h\nu]{Br_2} C_6H_5CH_2-Br$

(D) $C_6H_6 \xrightarrow[Fe]{Br_2} C_6H_5-Br$

The reactions which proceed through free radical mechanism are :

(1) A and B (2) A and C (3) C and D (4) B and C

79. Match **Column-A** (Coupling reactions) with **Column-B** (Reagents) :

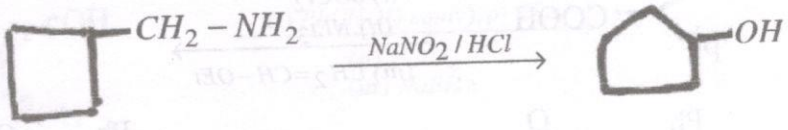
Column-A (Coupling reactions)	**Column-B (Reagents)**
(a) Suzuki Coupling	(i) $H_2C=CHCOOCH_3$
(b) Heck Coupling	(ii) $RB(OH)_2$
(c) Sonogashira Coupling	(iii) $PhCO(CH_2)_3ZnI$
(d) Negeshi Coupling	(iv) $H-C\equiv CR$
	(v) SnR_4

The ***correct*** match is :

(1) (a)-(ii); (b)-(i);(c)-(iv);(d)-(iii) (2) (a)-(i); (b)-(v);(c)-(iii);(d)-(iv)

(3) (a)-(iv); (b)-(iii);(c)-(ii);(d)-(i) (4) (a)-(ii); (b)-(iii);(c)-(iv);(d)-(v)

80. Consider the reaction :

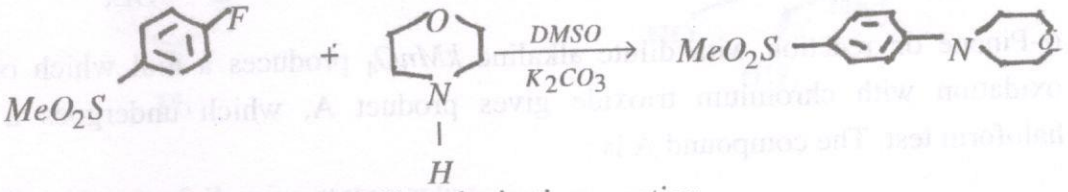


The reaction is known as :

(1) Pinacol-Pinacolone rearrangement (2) Benzidine rearrangement

(3) Demjanov rearrangement (4) Wagner-Meerwein rearrangement

81. The ***correct*** statement for the following reaction is :



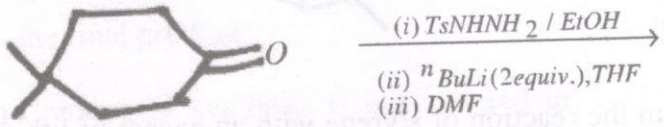
(1) Aromatic ipso electrophilic substitution reaction

(2) Aromatic nucleophilic substitution

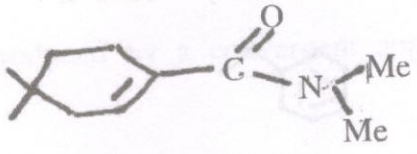
(3) Aromatic electrophilic substitution

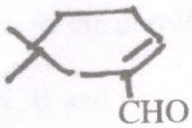
(4) Aromatic free radical reaction through aryne formation

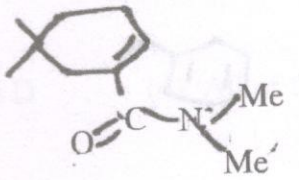
82. The major product formed in the following reaction is :



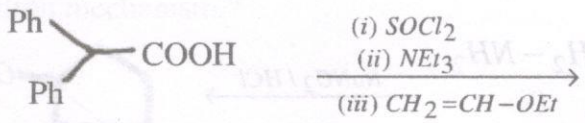
(1) 

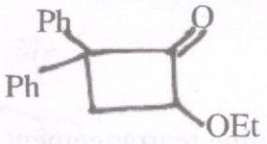
(2) 

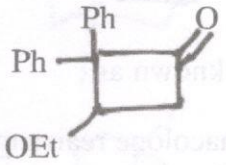
(3) 

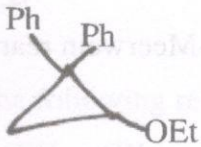
(4) 

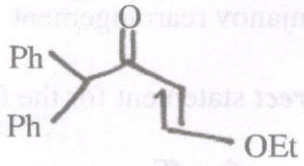
83. The major product in the following react sequence is :



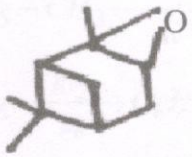
(1) 

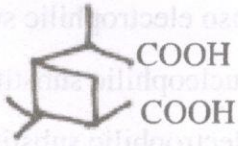
(2) 

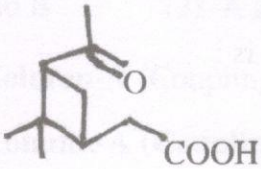
(3) 

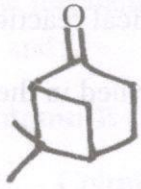
(4) 

84. α-Pinene on reaction with dilute alkaline $kMnO_4$ produces a diol which on further oxidation with chromium trioxide gives product A, which undergoes a positive haloform test. The compound A is :

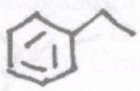
(1) 

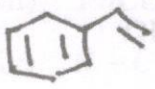
(2) 

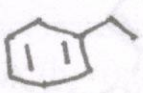
(3) 

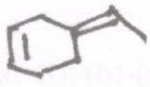
(4) 

85. The major product formed in the reaction of styrene with an excess of lithium in liquid ammonia and t-butyl alcohol is :

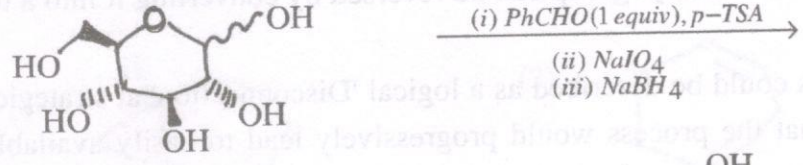
(1) 

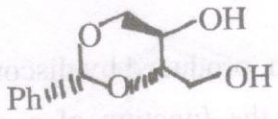
(2) 

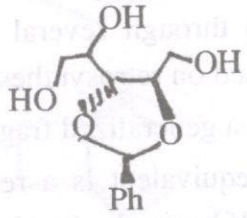
(3) 

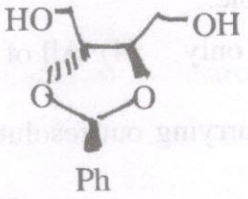
(4) 

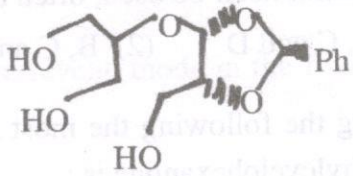
86. The major product in the following reaction sequence is :



(1) 

(2) 

(3) 

(4) 

87. Consider the following statements :

(A) In a linear synthesis several steps are performed one after another until the final molecule is complete and the chemical compounds made in each step are called synthetic intermediates.

(B) In a convergent synthesis several individual pieces of a complex molecule are synthesized in stage one, and then in stage two these pieces are combined to form the final product.

(C) Convergent synthesis is encountered in dendrimer synthesis where branches are connected to the central core.

(D) Proteins upto 300 amino acids are produced by a convergent approach using chemical ligation.

Which of the above statements is/are ***correct*** ?

(1) A, B and C (2) B, C and D (3) A and D (4) All of these

88. Which of the following statements is/are ***correct*** ?

(A) The polarity of a carbonyl group can be reversed by converting it into a dithiane or a thioacetal.

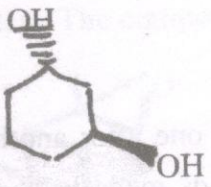
(B) Retrosynthesis could be described as a logical 'Disconnection' at strategic bonds in such a way that the process would progressively lead to easily available starting material(s) through several synthetic plans; each plan thus evolved describes a 'Route' based on retrosynthesis.

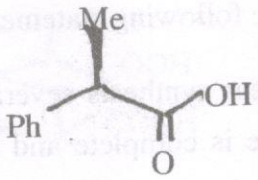
(C) Synthon is a generalized fragment, usually an ion, produced by disconnection.

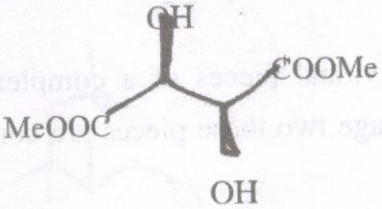
(D) Synthetic equivalent is a reagent carrying out the function of a synthon which cannot itself be used, often because it is too unstable.

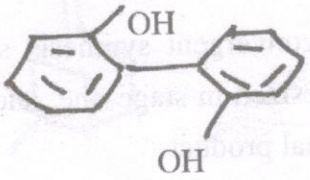
(1) A, C and D (2) B, C and D (3) C and D only (4) All of these

89. Among the following the most suitable reagent for carrying out resolution of racemic 3-methylcyclohexanone is :

(1) 

(2) 

(3) 

(4) 

90. Enantiomeric excess (ee%) is :

(A) $\frac{100 \times \text{optical rotation}}{\text{specific rotation}}$

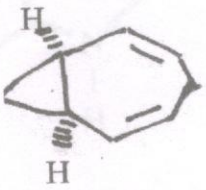
(B) % major enantiomer – % minor enantiomer

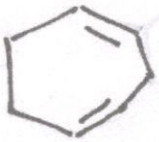
(C) it is a measurement of purity used for chiral substances

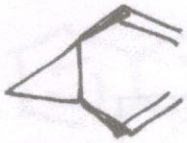
(D) equals to de% i.e. % of diasteromeric excess

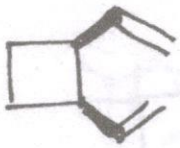
(1) A and D (2) A, B and C (3) B, C and D (4) All of these

91. Among the following dienes, the one that undergoes degenerate cope rearrangement is :

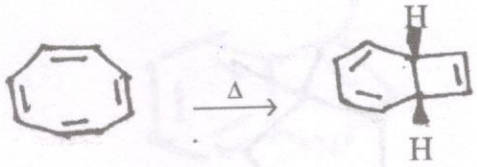
(1) 

(2) 

(3) 

(4) 

92. The number of π-electrons participating and pericyclic mode in the following reaction are :



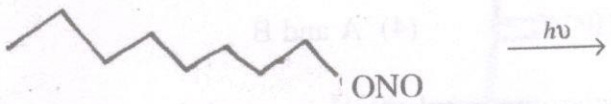
(1) 4 and conrotatory

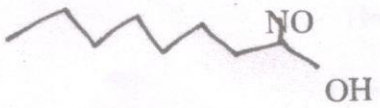
(2) 4 and disrotatory

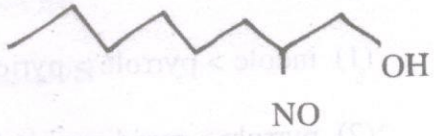
(3) 6 and conrotatory

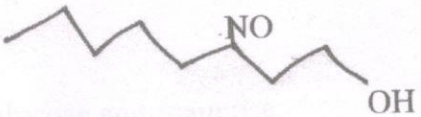
(4) 6 and disrotatory

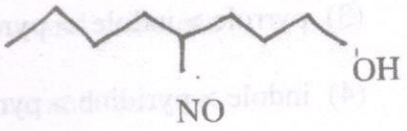
93. The major product formed in the following reaction is :



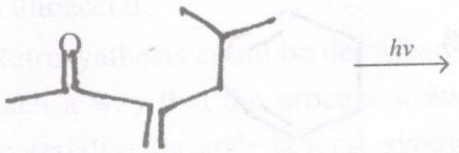
(1) 

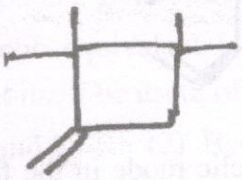
(2) 

(3) 

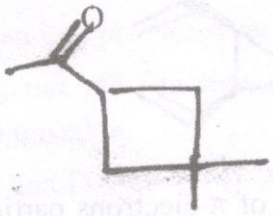
(4) 

94. Amongst the following, the major products formed in the following photochemical reactions are :

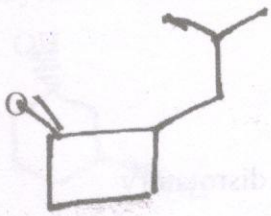




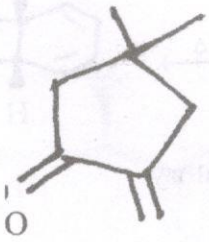
(A)



(B)



(C)



(D)

(1) A and C

(2) B and C

(3) A and D

(4) A and B

95. With respect to electrophilic aromatic substitution, reactivity order of pyrrole, pyridine and indole is :

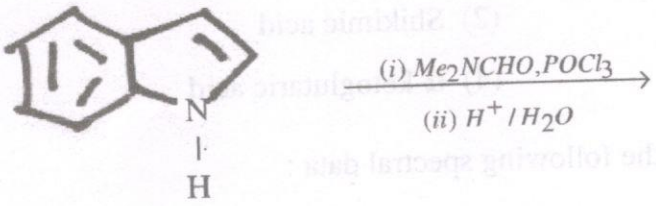
(1) indole > pyrrole > pyridine

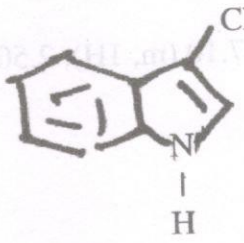
(2) pyrrole > pyridine > indole

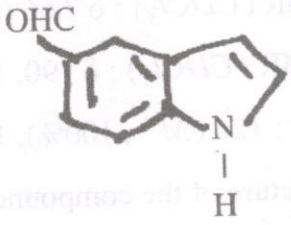
(3) pyrrole > indole > pyridine

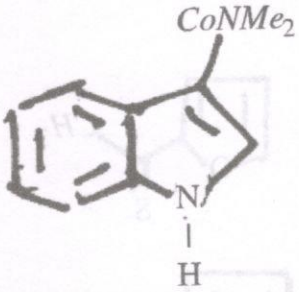
(4) indole > pyridine > pyrrole

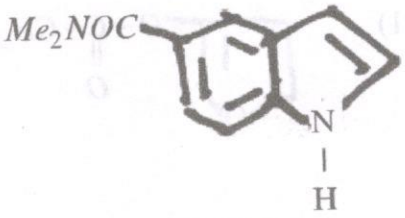
96. The major product formed in the following reaction is :



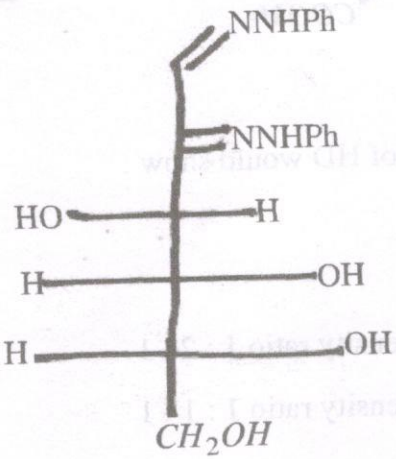
(1) 

(2) 

(3) 

(4) 

97. The osazone given below could be obtained from :



(1) glucose and mannose

(2) mannose and galactose

(3) glucose and galactose

(4) galactose and fructose

98. The biosynthetic precursor for the steroids is :

(1) Secologanin

(2) Shikimic acid

(3) Mevalonic acid

(4) α-ketoglutaric acid

99. An organic compound shows the following spectral data :

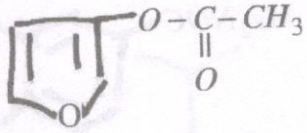
^1R ($\upsilon\ cm^{-1}$) : 1680

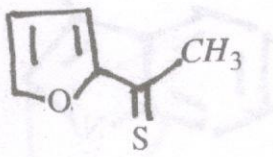
^1H NMR ($CDCl_3$) : δ 7.66 (m, 1H), 7.60 (m, 1H), 7.10 (m, 1H), 2.50 (s, 3H)

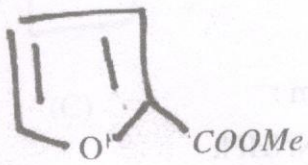
^{13}C NMR ($CDCl_3$) : δ 190, 144, 134, 132, 128, 28

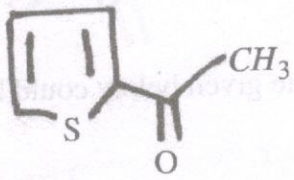
m/z (EI) : 126 (M^+, 100%), 128(M^++2, 4.9%)

The structure of the compound is :

(1) 

(2) 

(3) 

(4) 

100. ^1H NMR spectrum of HD would show :

(1) a singlet

(2) a doublet

(3) a triplet with intensity ratio 1 : 2 : 1

(4) a triplet with intensity ratio 1 : 1 : 1

Total No. of Printed Pages : 25

(DO NOT OPEN THIS QUESTION BOOKLET BEFORE TIME OR UNTIL YOU ARE ASKED TO DO SO)

B

PHD-EE-2023-24

Chemistry

SET-Y

10010

Sr. No. .....

Time : 1¼ Hours | Max. Marks : 100 | Total Questions : 100

Roll No. (in figures)_____ (in words) _____

Name _____ Date of Birth_____

Father's Name _____ Mother's Name _____

Date of Examination _____

_____ _____

(Signature of the Candidate) (Signature of the Invigilator)

SEAL

CANDIDATES MUST READ THE FOLLOWING INFORMATION/INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

1. ***All questions are compulsory.***
2. The candidates ***must return*** the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.
4. Question Booklet along with answer key of all the A, B, C & D code shall be got uploaded on the University Website immediately after the conduct of Entrance Examination. Candidates may raise valid objection/complaint if any, with regard to discrepancy in the question booklet/answer key within 24 hours of uploading the same on the University Website. The complaint be sent by the students to the Controller of Examinations by hand or through email. Thereafter, no complaint in any case, will be considered.
5. The candidate ***must not*** do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers ***must not*** be ticked in the question booklet.
6. ***There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.***
7. Use only **Black** or **Blue Ball Point Pen** of good quality in the OMR Answer-Sheet.
8. *Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained* **30** *minutes after starting of the examination.*

1. ABMO wave function for 1, 3-butadiene is/are :

(i) $A(\phi_1 - \phi_4) + B(\phi_2 - \phi_3)$

(ii) $A(\phi_1 + \phi_4) - B(\phi_2 + \phi_3)$

(iii) $A(\phi_1 - \phi_4) - B(\phi_2 - \phi_3)$

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

2. The molecule(s) which can be assigned $D_{\infty h}$ point group is/are :

(i) N_2O (ii) CO_2 (iii) C_2H_2

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

3. Identify the ***incorrect*** statement :

(i) Sum of the squares of the dimensions of the irreducible representations of the group is equal to the order of the group.

(ii) Irreducible representations of the group are orthogonal to each other.

(iii) The number of symmetry operations in a group is equal to the number of classes in the group.

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

4. A one-dimensional irreducible representation symmetrical w.r.t. main symmetry axis and unsymmetrical w.r.t. centre of symmetry has the Mulliken's symbol as :

(1) A_u (2) B_g (3) A_{1u} (4) B_{1g}

5. Rotational line at 108 cm^{-1} in a microwave spectrum occur due to ..... transition. (rotational constant being 9 cm^{-1})

(1) $J = 6 \leftarrow J = 5$ (2) $J = 7 \leftarrow J = 6$

(3) $J = 5 \leftarrow J = 4$ (4) None of the above

6. Which of the following are microwave active ?

(i) N_2 (ii) NO (iii) O_2

(1) (i) (2) (i), (ii)

(3) (ii) (4) (ii), (iii)

7. Rotational and vibrational degrees of freedom in N_2O are respectively ....., ...

(1) 3, 3
(2) 2, 3
(3) 2, 4
(4) 4, 2

8. Match the following :

i. NMR spectrum	(a) Microwave
ii. Rotational spectrum	(b) UV
iii. Raman spectrum	(c) IR
iv. Electronic spectrum	(d) Radiofrequency
	(e) vis

(1) i-a, ii-c, iii-b, iv-e
(2) i-d, ii-a, iii-b, iv-e
(3) i-d, ii-a, iii-e, iv-b
(4) i-d, ii-c, iii-e, iv-b

9. Identify the ***correct*** statement :

(i) Entropy of perfectly crystalline solid becomes zero at absolute zero.

(ii) It is not possible to reduce the temperature of any system to absolute zero by any process.

(iii) For a process to be spontaneous, $\Delta S_{total} > 0$.

(1) (i), (ii)
(2) (ii), (iii)
(3) (i), (iii)
(4) All of the above

10. Identify the intensive property from the following :

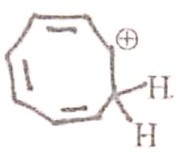
(i) Pressure

(ii) Volume

(iii) Energy

(1) (i)
(2) (i), (ii)
(3) (ii)
(4) (ii), (iii)

11. Among the carbocations given below (A, B, C) :



(A)

(B)

(C)

(1) A is homoaromatic, B is antiaromatic and C is aromatic

(2) A is aromatic, B is antiaromatic and C is homoaromatic

(3) A is antiaromatic, B is aromatic and C is homoaromatic

(4) A is homoaromatic, B is aromatic and C is antiaromatic

12. Considering the following statements for [18]-annulene, which one is *correct* ?

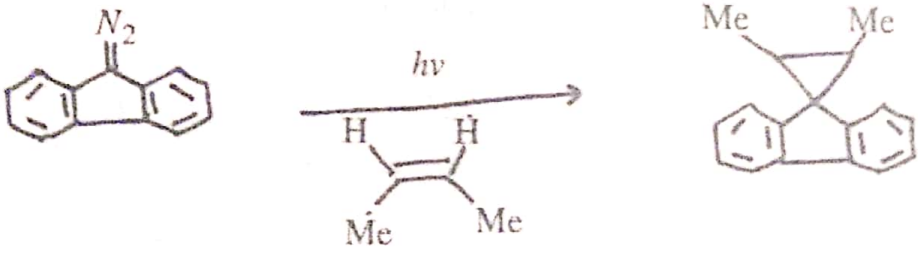
(A) It is aromatic.

(B) The inner protons resonate at δ 9.28 in its ^1H NMR spectrum.

(C) There are six protons in the shielded zone.

(1) A, B, C (2) A and B only (3) B and C only (4) A and C only

13. The intermediate involved in the reaction given below is :



(1) Free radical (2) Carbocation

(3) Carbene (4) Carbanion

14. Consider the following statements :

(A) Formation of carbocation can be confirmed by NMR.

(B) Formation of carbanion can be confirmed by NMR.

(C) Formation of free radical can be confirmed by ESR.

(D) Formation of enol can be confirmed by PMR.

Of these the *correct* statements are :

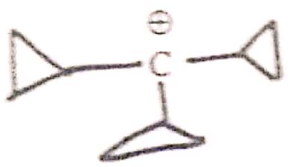
(1) A and B only

(2) A, B and D only

(3) A, B, C and D

(4) B, C and D

15. Which among the following carbocations is most stable ?

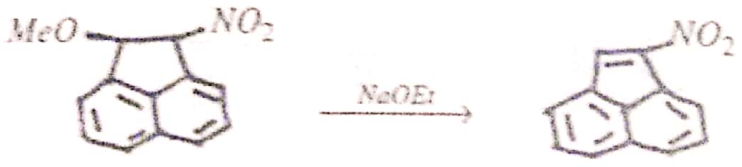
(1) 

(2) $C_6H_5-\overset{\oplus}{C}H_2$

(3) $C_6H_5-\overset{\oplus}{C}H-C_6H_5$

(4) $H_3C-\underset{\underset{CH_3}{|}}{\overset{\oplus}{C}}-CH_3$

16. The reaction given below is an example of :



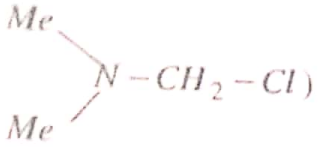
(1) E_2-elimination

(2) E_1-elimination

(3) Syn-elimination

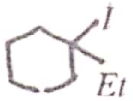
(4) E_1 C B-elimination

17. Which of the following compounds will ***not*** react by unimolecular nucleophilic substitution mechanism ?

(1) 

(2) 

(3) 

(4) 

18. Consider the following reactions :

(A) $CH_3-CH=CH_2 \xrightarrow{NBS/CCl_4} \underset{\displaystyle Br}{\underset{|}{CH_2}}-CH=CH_2$

(B) $CH_3-CH=CH_2 \xrightarrow{HBr} CH_3-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_3$

(C) $C_6H_5-CH_3 \xrightarrow[h\nu]{Br_2} C_6H_5CH_2-Br$

(D) $C_6H_6 \xrightarrow[Fe]{Br_2} C_6H_5-Br$

The reactions which proceed through free radical mechanism are :

(1) A and B (2) A and C (3) C and D (4) B and C

19. Match **Column-A** (Coupling reactions) with **Column-B** (Reagents) :

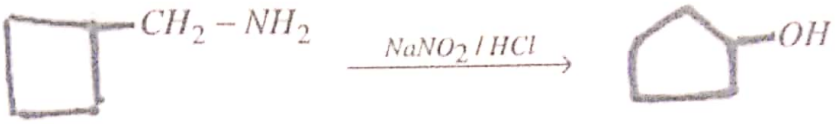
Column-A (Coupling reactions)		**Column-B (Reagents)**	
(a)	Suzuki Coupling	(i)	$H_2C=CHCOOCH_3$
(b)	Heck Coupling	(ii)	$RB(OH)_2$
(c)	Sonogashira Coupling	(iii)	$PhCO(CH_2)_3ZnI$
(d)	Negeshi Coupling	(iv)	$H-C\equiv CR$
		(v)	SnR_4

The ***correct*** match is :

(1) (a)-(ii); (b)-(i);(c)-(iv);(d)-(iii) (2) (a)-(i); (b)-(v);(c)-(iii);(d)-(iv)

(3) (a)-(iv); (b)-(iii);(c)-(ii);(d)-(i) (4) (a)-(ii); (b)-(iii);(c)-(iv);(d)-(v)

20. Consider the reaction :

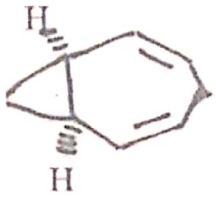


The reaction is known as :

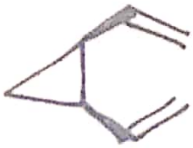
(1) Pinacol-Pinacolone rearrangement (2) Benzidine rearrangement

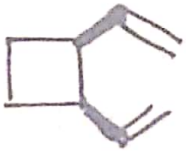
(3) Demjanov rearrangement (4) Wagner-Meerwein rearrangement

21. Among the following dienes, the one that undergoes degenerate cope rearrangement is :

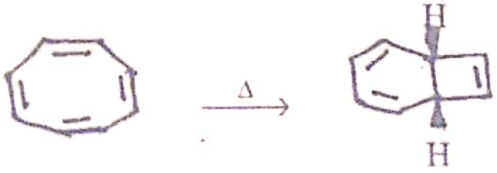
(1) 

(2) 

(3) 

(4) 

22. The number of π-electrons participating and pericyclic mode in the following reaction are :



(1) 4 and conrotatory

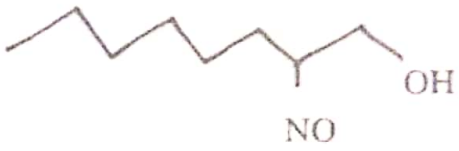
(2) 4 and disrotatory

(3) 6 and conrotatory

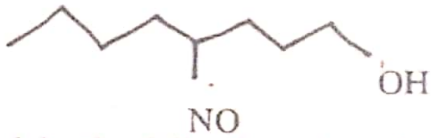
(4) 6 and disrotatory

23. The major product formed in the following reaction is :

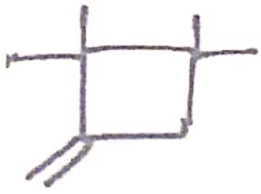
(1) 

(2) 

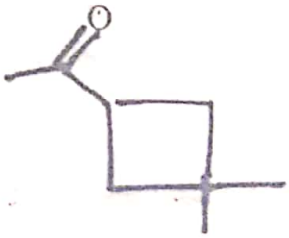
(3) 

(4) 

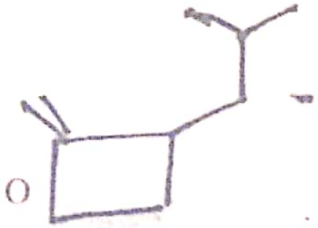
24. Amongst the following, the major products formed in the following photochemical reactions are :



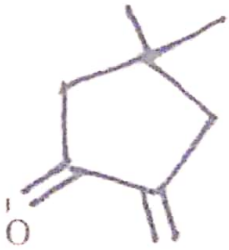
(A)



(B)



(C)



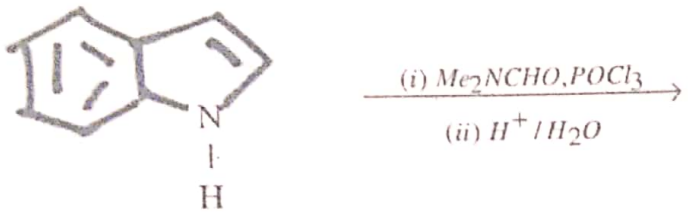
(D)

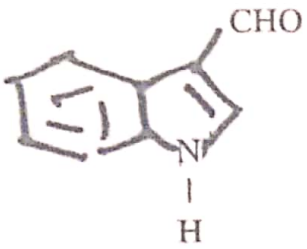
(1) A and C (2) B and C (3) A and D (4) A and B

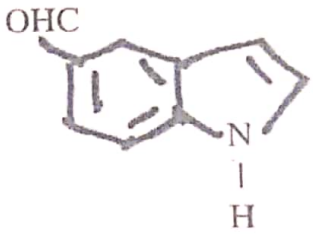
25. With respect to electrophilic aromatic substitution, reactivity order of pyrrole, pyridine and indole is :

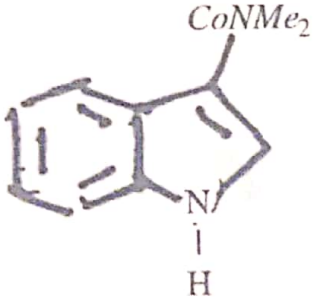
(1) indole > pyrrole > pyridine
(2) pyrrole > pyridine > indole
(3) pyrrole > indole > pyridine
(4) indole > pyridine > pyrrole

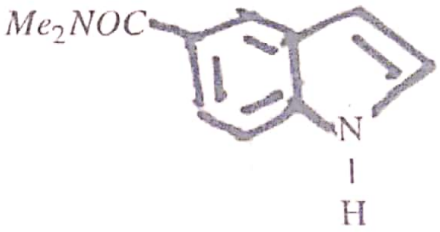
26. The major product formed in the following reaction is :



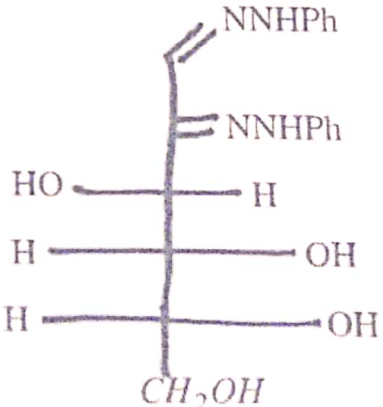
(1) 

(2) 

(3) 

(4) 

27. The osazone given below could be obtained from :



(1) glucose and mannose
(2) mannose and galactose
(3) glucose and galactose
(4) galactose and fructose

28. The biosynthetic precursor for the steroids is :

(1) Secologanin (2) Shikimic acid

(3) Mevalonic acid (4) α-ketoglutaric acid

29. An organic compound shows the following spectral data :

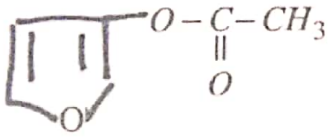
^{1}R (υ cm^{-1}) : 1680

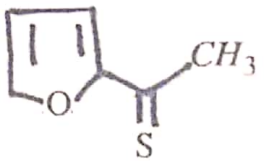
^{1}H NMR ($CDCl_3$) : δ 7.66 (m, 1H), 7.60 (m, 1H), 7.10 (m, 1H), 2.50 (s, 3H)

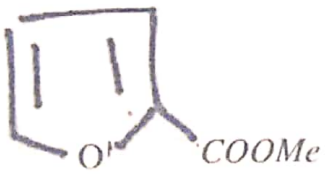
^{13}C NMR ($CDCl_3$) : δ 190, 144, 134, 132, 128, 28

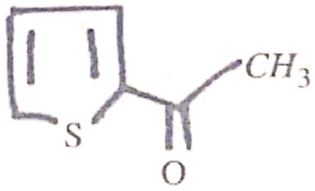
m/z (EI) : 126 (M^+, 100%), 128(M^++2, 4.9%)

The structure of the compound is :

(1) 

(2) 

(3) 

(4) 

30. ^{1}H NMR spectrum of HD would show :

(1) a singlet

(2) a doublet

(3) a triplet with intensity ratio 1 : 2 : 1

(4) a triplet with intensity ratio 1 : 1 : 1

31. The decreasing order of heat of hydration of Ca^{2+}, Sr^{2+} and Ba^{2+} is :

(1) $Sr^{2+} > Ba^{2+} > Ca^{2+}$ (2) $Ba^{2+} > Sr^{2+} > Ca^{2+}$

(3) $Ca^{2+} > Ba^{2+} > Sr^{2+}$ (4) $Ca^{2+} > Sr^{2+} > Ba^{2+}$

32. Melting point is maximum for which of the following compound ?

(1) $LiCl$ (2) $NaCl$ (3) $RbCl$ (4) KCl

33. Shape of $TeCl_4$ molecule is :

(1) Trigonal pyramidal (2) Tetrahedral

(3) Square pyramidal (4) Square planar

34. According to VSEPR theory, which of the following is non-linear ?

(1) $[ClF_2]^+$ (2) CO_2 (3) $[I_3]^-$ (4) $[N_3]^-$

35. Which of the following species have bond order of 3 ?

(a) N_2 (b) NO^+ (c) NO^- (d) C_2^{2-}

Select the ***correct*** answer using the options given below :

(1) (a) and (b) (2) (a), (b) and (c)

(3) (a), (b) and (d) (4) (a), (c) and (d)

36. Which of the following is most basic ?

(1) CH_3^- (2) H_2O (3) F^- (4) OH^-

37. Which of the following statements is ***false*** ?

(1) Water is a differential solvent for HF and HCl

(2) H_2O has levelling effect on strength of HF and HCl

(3) Liquid ammonia has a levelling effect on strength of HF and HCl

(4) CH_3COOH has a levelling effect on strength of HF, HCl, HBr and HI

38. Which of the following is ***not*** a Lewis acid ?

(1) SO_3 (2) NH_3 (3) $AlCl_3$ (4) SiF_4

39. Using Wade's rule, predict the structure and number of isomers of $B_{10}C_2H_{12}$:

(1) nido and two (2) closo and three

(3) nido and one (4) closo and two

40. Nitrogen is prepared by heating a mixture of :

(1) NH_4Cl and KOH (2) NH_4OH and KCl

(3) NH_4Cl and $NaNO_2$ (4) NH_4Cl and KNO_3

41. Identify the ***correct*** statement :

(i) For a chemical equilibrium, increasing the conc. of reactants results in shifting the equilibrium in favour of reactants.

(ii) For a chemical equilibrium, increasing the conc. of products results in shifting the equilibrium in favour of reactants.

(iii) For a thermochemical reaction.

$$N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g), \Delta H = -92.4 kJ$$

The reverse reaction will be endothermic.

(1) (i) (2) (i), (ii)

(3) (ii) (4) (ii), (iii)

42. Number of components, number of phases and digrees of freedom for the system $H_2O(s) \rightleftharpoons H_2O(l) \rightleftharpoons H_2O(g)$, resp. is :

(1) 1, 3, 1 (2) 2, 3, 0 (3) 1, 1, 3 (4) None of the above

43. Temperature at which the following process may ***not*** be spontaneous :

$B(g) \rightarrow B(l)$, $\Delta H = -24$ kJ, $\Delta S = -60$ Jk^{-1}

(i) >400 k (ii) >450 k (iii) >350 k

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

44. Identify the ***incorrect*** statement :

(1) Canonical ensemble represents isolated system.

(2) Microcanonical ensemble represents open isothermal system.

(3) Grand canonical ensemble represents closed isothermal system.

(4) All of the above

45. Identify the ***incorrect*** statement :
(1) Equal volumes of all gases under the same conditions of temp. and pressure contains equal number of molecules.
(2) Rate of diffusion of a gas is inversely proportional to the square root of the density of a gas at constant pressure.
(3) The most probable velocity of a gas increases with rise of temperature.
(4) None of the above

46. 'Conductance of weak electrolytes increases with dilution.' This is :
(1) Arrhenius law (2) Ostwald's law (3) Gibb's law (4) Kohlrausch's law

47. A zinc rod dipped in 0.1 M solution of $ZnSO_4$ at 25°C. The potential of this electrode at this temperature is ..... . (Assume the salt to be dissociated to the extent of 95%), $E^{\circ}_{zn^{2+},zn} = -0.76\ V$
(1) $-0.76\ V$ (2) $-0.79\ V$ (3) $0.79\ V$ (4) None of the above

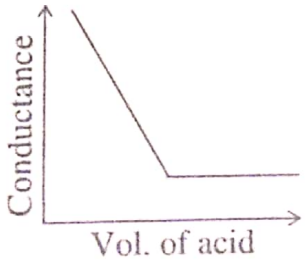
48. Standard electrode potential for the half cell reaction are as

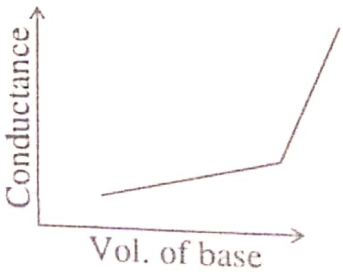
$$Zn \rightarrow Zn^{2+} + 2e^{-}, \quad E^{\circ} = -0.76V$$

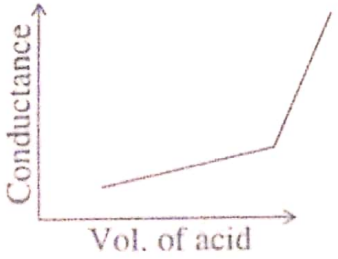
$$Fe \rightarrow Fe^{2+} + 2e^{-}, \quad E^{\circ} = 0.41V$$

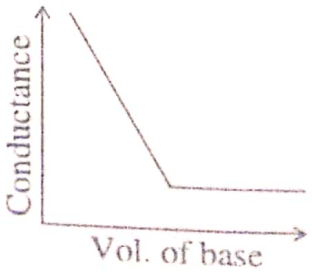
e.m.f. of the cell reaction, $Fe^{2+} + Zn \rightarrow Zn^{2+} + Fe$ is :
(1) $-0.35\ V$ (2) $+0.35\ V$ (3) $+1.17\ V$ (4) $-1.17\ V$

49. Which of the following represents a plot for conductance titration between strong base and a weak acid ?

(i)


(ii)


(iii)


(iv)


(1) (i), (ii) (2) (iii), (iv) (3) (i), (iv) (4) (ii), (iii)

50. Which of the following is/are the theory of unimolecular reaction ?

(i) Activated complex theory (ii) Hinshalwood theory

(iii) RRK theory

(1) (i), (ii) (2) (ii), (iii) (3) (i), (iii) (4) All of the above

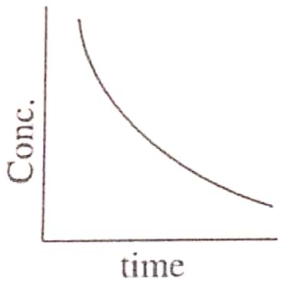
51. Activation energy of a reaction can be :

(1) zero (2) negative

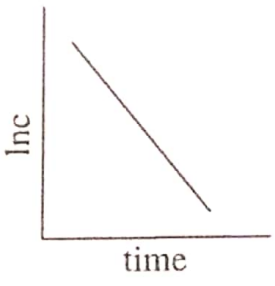
(3) can neither be zero or negative (4) can be zero or negative

52. Which of the following represents a 1st order reaction ?

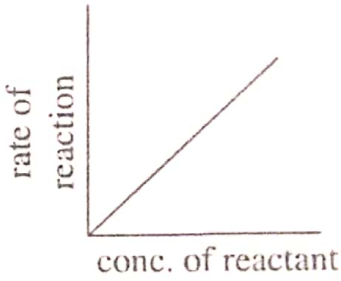
(i)



(ii)



(iii)



(1) (i), (ii) (2) (ii), (iii)

(3) (i), (iii) (4) All of the above

53. Which one of the following about lyophillic colloids is ***not*** true ?

(i) they are stable an account of strong solute-solvent interaction

(ii) they are stable due to presence of change on the particle

(iii) they are stable because of solvation

(1) (i), (ii) (2) (ii), (iii)

(3) (i), (iii) (4) None of the above

54. Cell dimensions and crystal angles for tetragonal crystal systems are resp. :

(1) $a = b = c, \alpha = \beta \neq \gamma$ (2) $a = b \neq c, \alpha = \beta = \gamma = 90$

(3) $a \neq b \neq c, \alpha = \beta = \gamma \neq 90$ (4) $a \neq b = c, \alpha \neq \beta = \gamma$

55. Light scattering method is used to obtain :

(1) $\overline{M}_v$ (2) $\overline{M}_n$ (3) $\overline{M}_w$ (4) $\overline{M}_z$

56. Covariance :

(i) is a measure of relationship between two random variables.

(ii) is zero if two random variables are independent.

(iii) is non-negative.

(1) (i), (ii) (2) (ii), (iii)

(3) (i), (iii) (4) All of the above

57. The IUPAC name for the given organic compound is :

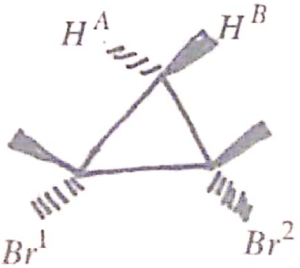
(1) (2R, 3Z)-7-phenylhept-3-en-2-ol

(2) (2S, 3Z)-7-phenylhept-3-en-2-ol

(3) (2R, 3E)-7-phenylhept-3-en-2-ol

(4) (2S, 3E)-7-phenylhept-3-en-2-ol

58. In the compound given below, the relation between H^A, H^B; and between Br^1, Br^2 is :



(1) H^A, H^B are enantiotopic; and Br^1, Br^2 are diastereotopic

(2) H^A, H^B are diastereotopic; and Br^1, Br^2 are enantiotopic

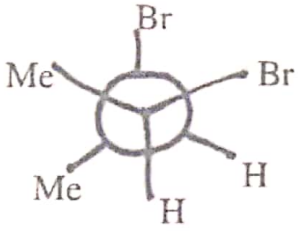
(3) H^A, H^B are diastereotopic; and Br^1, Br^2 are homotopic

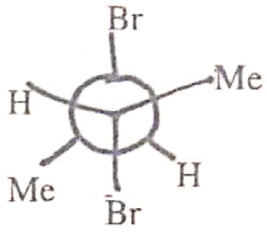
(4) H^A, H^B are enantiotopic; and Br^1, Br^2 are homotopic

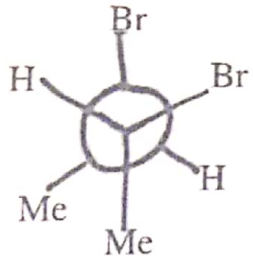
59. In the following Markownikov addition reaction, the products *A* and *B* are :

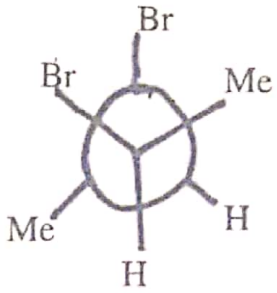
(1) homomers (2) enantiomers (3) diastereomers (4) regioisomers

60. The gauche interaction values for Me/Me, Me/Br and Br/Br are 3.3, 0.8 and 3.0 kJ/mol, respectively. Among the following the most stable conformation of 2,3-dibromobutane is :

(1) 

(2) 

(3) 

(4) 

61. Compound which does ***not*** obey 18 electron rule is ?

(1) $Co_2(CO)_8$ (2) $Fe_2(CO)_9$

(3) $V(CO)_6$ (4) $Cr(CO)_6$

62. Which of the following solvent has maximum eluting power ?

(1) pyridine (2) acetone (3) chloroform (4) methanol

63. Which of the following chromatographic techniques may involve solid as well as liquid as stationary phase and liquid as mobile phase ?

(1) Thin layer chromatography (2) Column chromatography

(3) Paper chromatography (4) All of the above

64. In biological system, the metal ions involved in electron transport are :

(1) Na^+ and K^+ (2) Zn^{2+} and Mg^{2+}

(3) Cu^{2+} and Fe^{2+} (4) Ca^{2+} and Mg^{2+}

65. Iron-sulphur clusters in biological systems are involved in :

(1) proton transfer (2) atom transfer

(3) group transfer (4) electron transfer

66. Carboxypeptidase contains which of the following element ?

(1) Fe (2) Mn (3) Zn (4) Cu

67. The number of α and β particles emitted when ${}_{92}U^{238}$ changes to ${}_{82}Pb^{206}$ are :

(1) 6α, 6β (2) 6α, 8β

(3) 8α, 6β (4) 8α, 8β

68. What will be the energy released in a nuclear reactor, in which the total mass loss is 0.01 amu ?

(1) 0.931 MeV (2) 9.31 MeV

(3) 93.1 MeV (4) 931 MeV

69. A symmetric top molecule among the following is :

(1) ethylene (2) butadiene (3) allene (4) hexatriene

70. The g-factor off ${}^1H$ and ${}^{13}C$ are 5.6 and 1.4 respectively. For the same value of magnetic field strength, if the ${}^1H$ resonantes at 600 MHz, the ${}^{13}C$ would resonates at :

(1) 2400 MHz (2) 600 MHz (3) 150 MHz (4) 250 MHz

71. The STYX code for diborane is :

(1) 2022 (2) 2002 (3) 2202 (4) 0220

72. Which of the following is colored and paramagnetic ?

(1) Sc^{3+} (2) Cu^{+} (3) Cu^{2+} (4) Zn^{2+}

73. Metal-Metal bond is present in :

(1) Stannic chloride (2) Cupric chloride

(3) Mercurous chloride (4) Mercuric chloride

74. Which of the following has highest CFSE ?

(1) $[CoF_6]^{3-}$ (2) $[Mn(H_2O)_6]^{2+}$ (3) $Co(H_2O)_6]^{2+}$ (4) $[Co(NH_3)_6]^{3+}$

75. Which of the following is thermodynamically unstable and kinetically labile ?

(1) $[Co(H_2O)_6]^{3+}$ (2) $[Co(H_2O)_6]^{2+}$

(3) $[Co(NH_3)_6]^{3+}$ (4) $[Co(NH_3)_6]^{2+}$

76. The electronic configuration of Gd is :

(1) $[Xe]4f^8 5d^9 6s^2$ (2) $[Xe]4f^7 5d^1 6s^2$

(3) $[Xe]4f^6 5d^2 6s^2$ (4) $[Xe]4f^3 5d^3 6s^2$

77. Term symbol of Ce^{3+} is :

(1) $^2F_2$ (2) $^2F_5$ (3) $^2F_{5/2}$ (4) $^2F_0$

78. Which of the following is colorless ?

(1) Pr^{3+} (2) Ce^{3+} (3) Eu^{3+} (4) Sm^{3+}

79. The intense blue color of Prussian blue salt arises due to :

(1) d-d transition

(2) inter valence electron transfer

(3) ligand to metal charge transfer

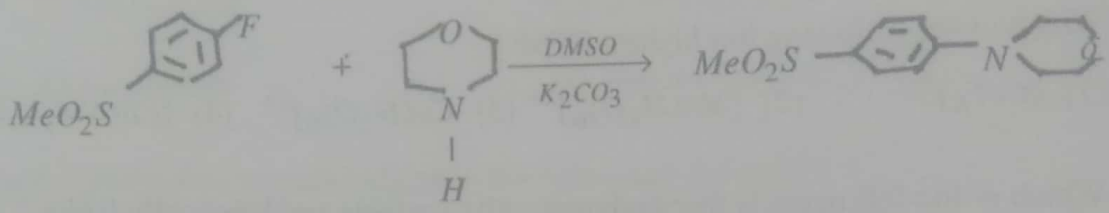
(4) metal to ligand charge transfer

80. The number of ESR lines for anthracene ion are :

(1) 35 (2) 25

(3) 60 (4) 75

81. The *correct* statement for the following reaction is :



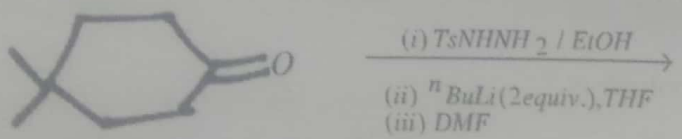
(1) Aromatic ipso electrophilic substitution reaction

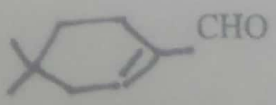
(2) Aromatic nucleophilic substitution

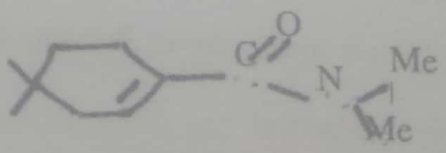
(3) Aromatic electrophilic substitution

(4) Aromatic free radical reaction through aryne formation

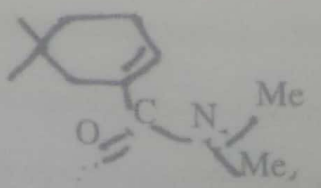
82. The major product formed in the following reaction is :



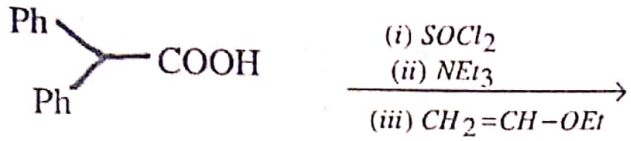
(1) 

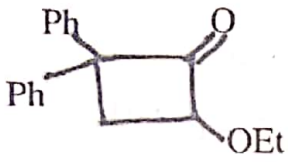
(2) 

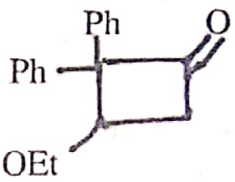
(3) 

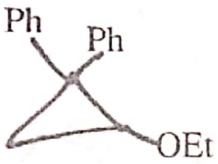
(4) 

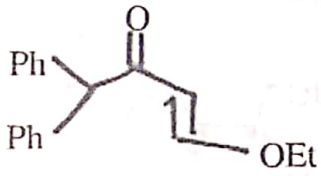
83. The major product in the following react sequence is :



(1) 

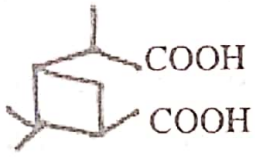
(2) 

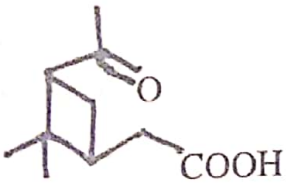
(3) 

(4) 

84. α-Pinene on reaction with dilute alkaline $kMnO_4$ produces a diol which on further oxidation with chromium trioxide gives product A, which undergoes a positive haloform test. The compound A is :

(1) 

(2) 

(3) 

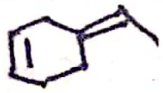
(4) 

85. The major product formed in the reaction of styrene with an excess of lithium in liquid ammonia and t-butyl alcohol is :

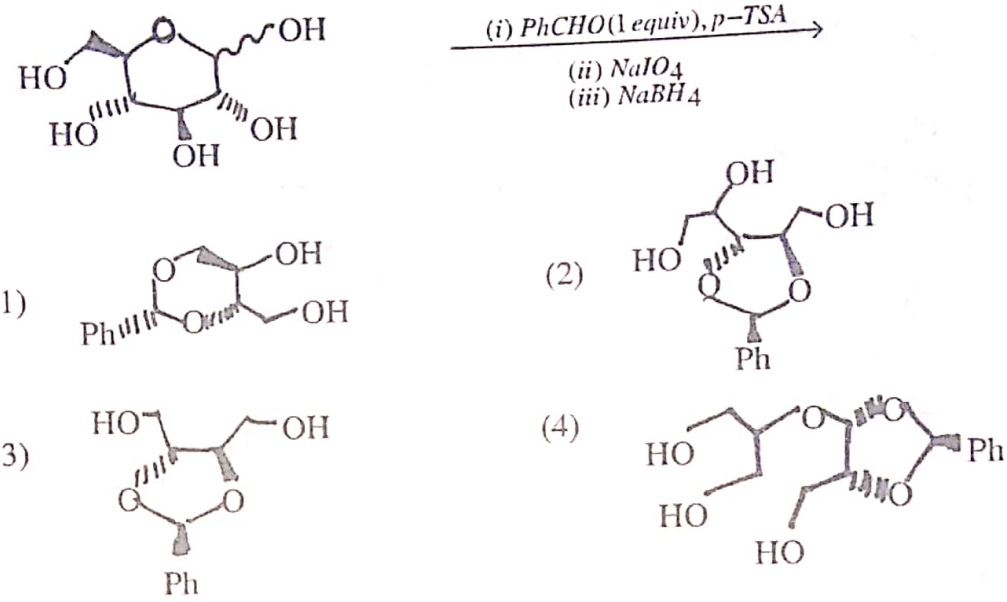
(1) 

(2) 

(3) 

(4) 

86. The major product in the following reaction sequence is :



87. Consider the following statements :

(A) In a linear synthesis several steps are performed one after another until the final molecule is complete and the chemical compounds made in each step are called synthetic intermediates.

(B) In a convergent synthesis several individual pieces of a complex molecule are synthesized in stage one, and then in stage two these pieces are combined to form the final product.

(C) Convergent synthesis is encountered in dendrimer synthesis where branches are connected to the central core.

(D) Proteins upto 300 amino acids are produced by a convergent approach using chemical ligation.

Which of the above statements is/are ***correct*** ?

(1) A, B and C (2) B, C and D (3) A and D (4) All of these

88. Which of the following statements is/are ***correct*** ?

(A) The polarity of a carbonyl group can be reversed by converting it into a dithiane or a thioacetal.

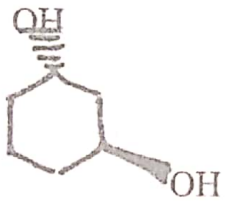
(B) Retrosynthesis could be described as a logical 'Disconnection' at strategic bonds in such a way that the process would progressively lead to easily available starting material(s) through several synthetic plans; each plan thus evolved describes a 'Route' based on retrosynthesis.

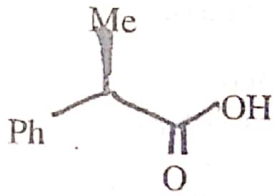
(C) Synthon is a generalized fragment, usually an ion, produced by disconnection.

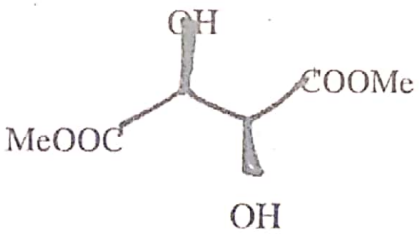
(D) Synthetic equivalent is a reagent carrying out the function of a synthon which cannot itself be used, often because it is too unstable.

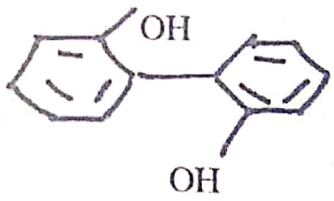
(1) A, C and D (2) B, C and D (3) C and D only (4) All of these

89. Among the following the most suitable reagent for carrying out resolution of racemic 3-methylcyclohexanone is :

(1) 

(2) 

(3) 

(4) 

90. Enantiomeric excess (ee%) is :

(A) $\dfrac{100 \times \text{optical rotation}}{\text{specific rotation}}$

(B) % major enantiomer $-$% minor enantiomer

(C) it is a measurement of purity used for chiral substances

(D) equals to de% i.e. % of diasteromeric excess

(1) A and D (2) A, B and C (3) B, C and D (4) All of these

91. To record Mossbauer spectrum of *Fe* containing samples, a source X is used. X after nuclear transformation (Y), gives γ-radiation used in Mossbauer spectroscopy. X and Y respectively are :

(1) ^{57}Fe, β-emission (2) ^{57}Co, β-emission

(3) ^{57}Co, e^- capture (4) ^{57}Fe, e^- capture

92. The cluster with closo based skeletal structure is :

(1) $Os_5(CO)_{16}$ (2) $Ni_5(CO)_{12}$

(3) $[Ru_3N(CO)_{14}]^-$ (4) $Fe_5C(CO)_{15}$

93. The bond order for metal-metal bond in $[Mo_2Cl_8]^{4-}$ is :

(1) 1 (2) 2 (3) 3 (4) 4

94. Identify the ***correct*** statement :

(i) Physical state of a system at time, t is described by the wave function $\psi(x, y, z, t)$.

(ii) Wave function in one-dimension, $\psi(x, t)$ and its first derivative are continuous and single valued for all values of x.

(iii) The expectation value of an observable A, $<A>$ corresponding to an operator $\hat{A}$ is

$$<A> = \int_{-\infty}^{\infty} \psi^*(x)\hat{A}\psi(x)dx.$$

(1) (i), (ii) (2) (ii), (iii)

(3) (i), (iii) (4) All of the above

95. The expression for the operator, $\left(\frac{d}{dx} - x\right)\left(\frac{d}{dx} + x\right)$ is :

(1) $\frac{d^2}{dx^2} - x^2$ (2) $\frac{d^2}{dx^2} - x^2 + 1$

(3) $\frac{d^2}{dx^2} - x^2 - 1$ (4) None of the above

96. Degeneracy of a particle with mass 'm' in a 3-dimensional box of width 'a' having energy equal to $11\ h^2/8ma^2$ is :

(1) 1
(2) 3
(3) 6
(4) None of the above

97. Acceptable wave function(s) in quantum mechanics when x range from 0 to 2π is :

(i) $\sin x$ (ii) $\tan x$ (iii) $\text{cosec}\ x$

(1) (i), (ii)
(2) (ii), (iii)
(3) (i), (iii)
(4) All of the above

98. Identify the ***correct*** statement :

(i) According to classical mechanics, the particle must reflect when it has less energy than the energy of the potential barrier.

(ii) According to quantum mechanics, particle with energy less than that of potential energy barrier has a finite probability of penetrating potential energy barrier.

(iii) According to classical mechanics particle with less than potential energy barrier has a finite probability of penetrating the potential energy barrier.

(1) (i)
(2) (i), (ii)
(3) (ii)
(4) (ii), (iii)

99. Function(s) which coluld be used as a trial variation function for the particle in a one-dimensional box of width *'a'* is/are :

(i) $\sin(\pi x/a)$ (ii) x^2/a (iii) $\cos(\pi x/a)$

(1) (i)
(2) (i), (ii)
(3) (ii)
(4) (ii), (iii)

100. Hamiltonian for H_2^+ can be :

(1) $\hat{H} = \frac{\hbar^2}{2m}\nabla^2 + \frac{1}{4\pi\epsilon_0}\left[-\frac{e^2}{r_A} - \frac{e^2}{r_\beta} + \frac{e^2}{r_{AB}}\right]$

(2) $\hat{H} = \frac{h}{\sin^2 m}\nabla^2 + \frac{1}{4\pi\epsilon_0}\left[\frac{e^2}{r_A} + \frac{e^2}{r_\beta} - \frac{e^2}{r_{AB}}\right]$

(3) $\hat{H} = \frac{\hbar^2}{2m}\nabla^2 + \frac{1}{4\pi\epsilon_0}\left[-\frac{e^2}{r_A} + \frac{e^2}{r_\beta} + \frac{e^2}{r_{AB}}\right]$

(4) None of the above

Total No. of Printed Pages : 25

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C

SET-Y

PHD-EE-2023-24

Chemistry

10007

Sr. No. .....

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

Roll No. (in figures)_____ (in words) _____

Name _____ Date of Birth_____

Father's Name _____ Mother's Name_____

Date of Examination _____

_____ _____

(Signature of the Candidate) (Signature of the Invigilator)

SEAL

CANDIDATES MUST READ THE FOLLOWING INFORMATION/INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

1. ***All questions are compulsory.***
2. The candidates ***must return*** the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.
4. Question Booklet along with answer key of all the A, B, C & D code shall be got uploaded on the University Website immediately after the conduct of Entrance Examination. Candidates may raise valid objection/complaint if any, with regard to discrepancy in the question booklet/answer key within 24 hours of uploading the same on the University Website. The complaint be sent by the students to the Controller of Examinations by hand or through email. Thereafter, no complaint in any case, will be considered.
5. The candidate ***must not*** do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers ***must not*** be ticked in the question booklet.
6. ***There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.***
7. Use only **Black** or **Blue Ball Point Pen** of good quality in the OMR Answer-Sheet.
8. *Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained* **30** *minutes after starting of the examination.*

1. Compound which does ***not*** obey 18 electron rule is ?

   (1) $Co_2(CO)_8$ (2) $Fe_2(CO)_9$

   (3) $V(CO)_6$ (4) $Cr(CO)_6$

2. Which of the following solvent has maximum eluting power ?

   (1) pyridine (2) acetone (3) chloroform (4) methanol

3. Which of the following chromatographic techniques may involve solid as well as liquid as stationary phase and liquid as mobile phase ?

   (1) Thin layer chromatography

   (2) Column chromatography

   (3) Paper chromatography

   (4) All of the above

4. In biological system, the metal ions involved in electron transport are :

   (1) Na^+ and K^+ (2) Zn^{2+} and Mg^{2+}

   (3) Cu^{2+} and Fe^{2+} (4) Ca^{2+} and Mg^{2+}

5. Iron-sulphur clusters in biological systems are involved in :

   (1) proton transfer (2) atom transfer

   (3) group transfer (4) electron transfer

6. Carboxypeptidase contains which of the following element ?

   (1) Fe (2) Mn (3) Zn (4) Cu

7. The number of α and β particles emitted when ${}_{92}U^{238}$ changes to ${}_{82}Pb^{206}$ are :

   (1) 6α, 6β (2) 6α, 8β

   (3) 8α, 6β (4) 8α, 8β

8. What will be the energy released in a nuclear reactor, in which the total mass loss is 0.01 amu ?

(1) 0.931 MeV (2) 9.31 MeV

(3) 93.1 MeV (4) 931 MeV

9. A symmetric top molecule among the following is :

(1) ethylene (2) butadiene

(3) allene (4) hexatriene

10. The g-factor off ^{1}H and ^{13}C are 5.6 and 1.4 respectively. For the same value of magnetic field strength, if the ^{1}H resonantes at 600 MHz, the ^{13}C would resonates at :

(1) 2400 MHz (2) 600 MHz

(3) 150 MHz (4) 250 MHz

11. Identify the ***correct*** statement :

(i) For a chemical equilibrium, increasing the conc. of reactants results in shifting the equilibrium in favour of reactants.

(ii) For a chemical equilibrium, increasing the conc. of products results in shifting the equilibrium in favour of reactants.

(iii) For a thermochemical reaction.

$$N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g),\ \Delta H = -92.4\,kJ$$

The reverse reaction will be endothermic.

(1) (i) (2) (i), (ii)

(3) (ii) (4) (ii), (iii)

12. Number of components, number of phases and digrees of freedom for the system $H_2O(s) \rightleftharpoons H_2O(l) \rightleftharpoons H_2O(g)$, resp. is :

(1) 1, 3, 1 (2) 2, 3, 0 (3) 1, 1, 3 (4) None of the above

13. Temperature at which the following process may ***not*** be spontaneous :

$B(g) \rightarrow B(l)$, $\Delta H = -24$ kJ, $\Delta S = -60$ Jk^{-1}

(i) >400 k (ii) >450 k (iii) >350 k

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

14. Identify the ***incorrect*** statement :

(1) Canonical ensemble represents isolated system.

(2) Microcanonical ensemble represents open isothermal system.

(3) Grand canonical ensemble represents closed isothermal system.

(4) All of the above

15. Identify the ***incorrect*** statement :

(1) Equal volumes of all gases under the same conditions of temp. and pressure contains equal number of molecules.

(2) Rate of diffusion of a gas is inversely proportional to the square root of the density of a gas at constant pressure.

(3) The most probable velocity of a gas increases with rise of temperature.

(4) None of the above

16. 'Conductance of weak electrolytes increases with dilution.' This is :

(1) Arrhenius law (2) Ostwald's law

(3) Gibb's law (4) Kohlrausch's law

17. A zinc rod dipped in 0.1 M solution of $ZnSO_4$ at 25°C. The potential of this electrode at this temperature is ..... . (Assume the salt to be dissociated to the extent of 95%), $E^{\circ}_{zn^{2+},zn} = -0.76\ V$

(1) $-0.76\ V$ (2) $-0.79\ V$

(3) $0.79\ V$ (4) None of the above

18. Standard electrode potential for the half cell reaction are as

$$Zn \rightarrow Zn^{2+} + 2e^-, \quad E^\circ = -0.76V$$

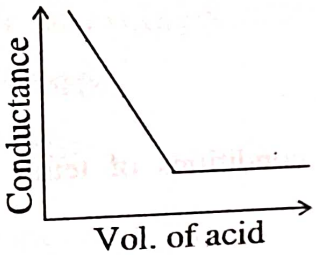
$$Fe \rightarrow Fe^{2+} + 2e^-, \quad E^\circ = 0.41V$$

e.m.f. of the cell reaction, $Fe^{2+} + Zn \rightarrow Zn^{2+} + Fe$ is :

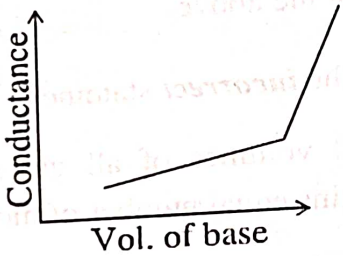
(1) $-0.35\ V$ (2) $+0.35\ V$ (3) $+1.17\ V$ (4) $-1.17\ V$

19. Which of the following represents a plot for conductance titration between strong base and a weak acid ?

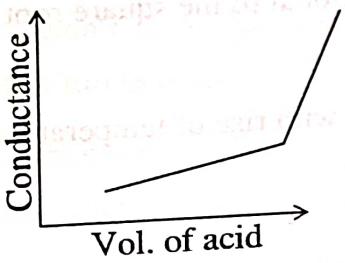
(i)



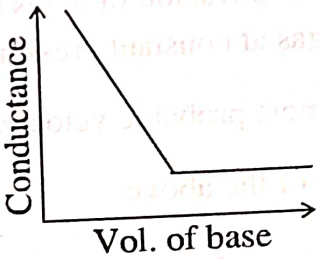
(ii)



(iii)



(iv)



(1) (i), (ii) (2) (iii), (iv) (3) (i), (iv) (4) (ii), (iii)

20. Which of the following is/are the theory of unimolecular reaction ?

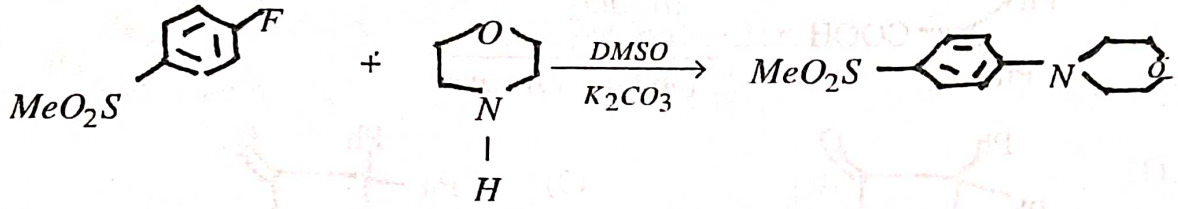
(i) Activated complex theory (ii) Hinshalwood theory

(iii) RRK theory

(1) (i), (ii) (2) (ii), (iii)

(3) (i), (iii) (4) All of the above

21. The ***correct*** statement for the following reaction is :



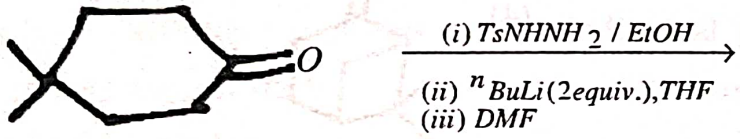
(1) Aromatic ipso electrophilic substitution reaction

(2) Aromatic nucleophilic substitution

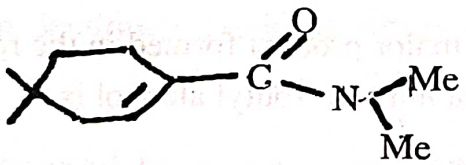
(3) Aromatic electrophilic substitution

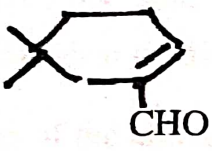
(4) Aromatic free radical reaction through aryne formation

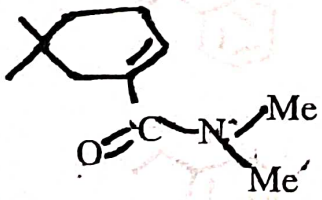
22. The major product formed in the following reaction is :



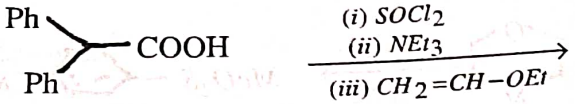
(1) 

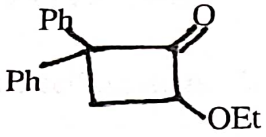
(2) 

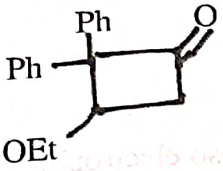
(3) 

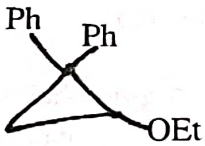
(4) 

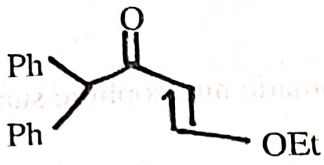
23. The major product in the following react sequence is :



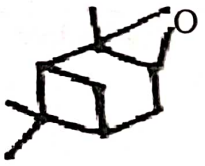
(1) 

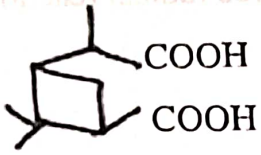
(2) 

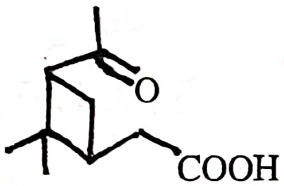
(3) 

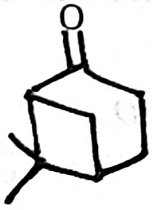
(4) 

24. α-Pinene on reaction with dilute alkaline $kMnO_4$ produces a diol which on further oxidation with chromium trioxide gives product A, which undergoes a positive haloform test. The compound A is :

(1) 

(2) 

(3) 

(4) 

25. The major product formed in the reaction of styrene with an excess of lithium in liquid ammonia and t-butyl alcohol is :

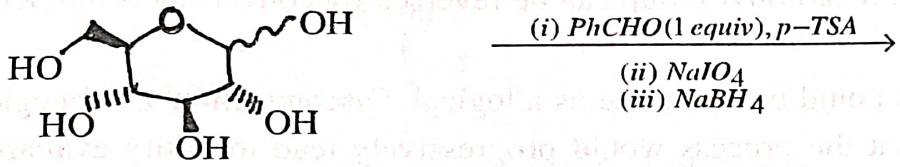
(1) 

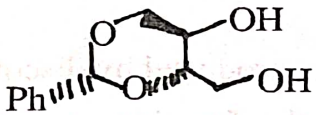
(2) 

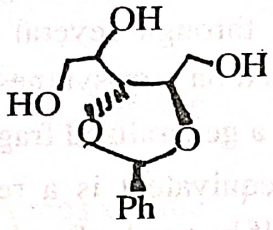
(3) 

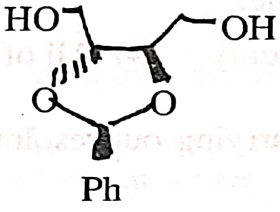
(4) 

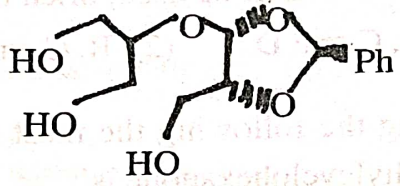
26. The major product in the following reaction sequence is :



(1) 

(2) 

(3) 

(4) 

27. Consider the following statements :

(A) In a linear synthesis several steps are performed one after another until the final molecule is complete and the chemical compounds made in each step are called synthetic intermediates.

(B) In a convergent synthesis several individual pieces of a complex molecule are synthesized in stage one, and then in stage two these pieces are combined to form the final product.

(C) Convergent synthesis is encountered in dendrimer synthesis where branches are connected to the central core.

(D) Proteins upto 300 amino acids are produced by a convergent approach using chemical ligation.

Which of the above statements is/are ***correct*** ?

(1) A, B and C (2) B, C and D (3) A and D (4) All of these

28. Which of the following statements is/are ***correct*** ?

(A) The polarity of a carbonyl group can be reversed by converting it into a dithiane or a thioacetal.

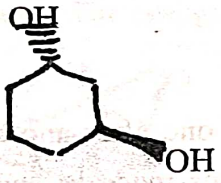
(B) Retrosynthesis could be described as a logical 'Disconnection' at strategic bonds in such a way that the process would progressively lead to easily available starting material(s) through several synthetic plans; each plan thus evolved describes a 'Route' based on retrosynthesis.

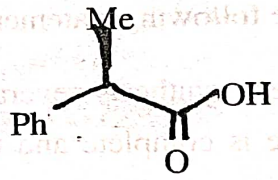
(C) Synthon is a generalized fragment, usually an ion, produced by disconnection.

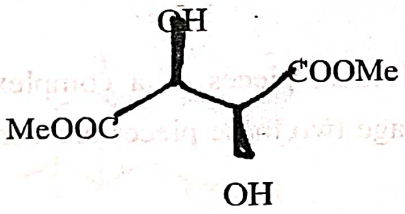
(D) Synthetic equivalent is a reagent carrying out the function of a synthon which cannot itself be used, often because it is too unstable.

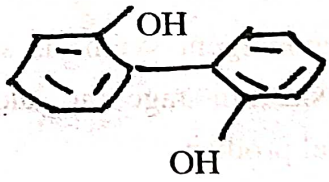
(1) A, C and D (2) B, C and D (3) C and D only (4) All of these

29. Among the following the most suitable reagent for carrying out resolution of racemic 3-methylcyclohexanone is :

(1) 

(2) 

(3) 

(4) 

30. Enantiomeric excess (ee%) is :

(A) $\frac{100 \times \text{optical rotation}}{\text{specific rotation}}$

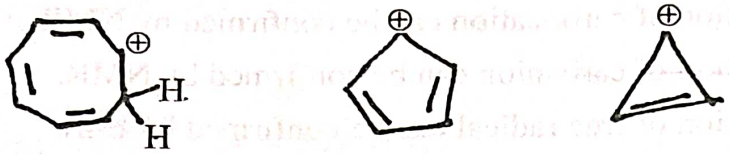
(B) % major enantiomer $-$% minor enantiomer

(C) it is a measurement of purity used for chiral substances

(D) equals to de% i.e. % of diasteromeric excess

(1) A and D (2) A, B and C (3) B, C and D (4) All of these

31. Among the carbocations given below (A, B, C) :



(A) (B) (C)

(1) A is homoaromatic, B is antiaromatic and C is aromatic

(2) A is aromatic, B is antiaromatic and C is homoaromatic

(3) A is antiaromatic, B is aromatic and C is homoaromatic

(4) A is homoaromatic, B is aromatic and C is antiaromatic

32. Considering the following statements for [18]-annulene, which one is ***correct*** ?

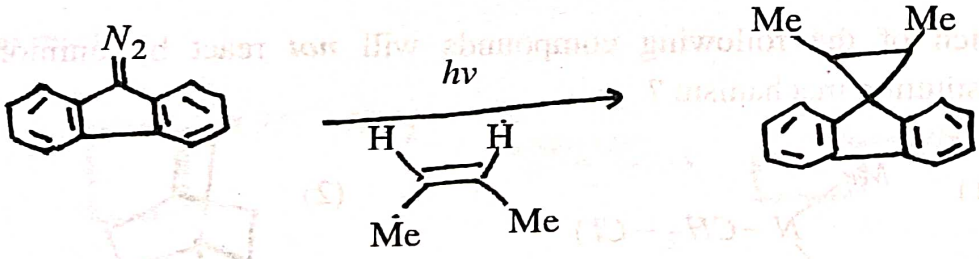
(A) It is aromatic.

(B) The inner protons resonate at δ 9.28 in its ^{1}H NMR spectrum.

(C) There are six protons in the shielded zone.

(1) A, B, C (2) A and B only (3) B and C only (4) A and C only

33. The intermediate involved in the reaction given below is :



(1) Free radical (2) Carbocation

(3) Carbene (4) Carbanion

34. Consider the following statements :

(A) Formation of carbocation can be confirmed by NMR.

(B) Formation of carbanion can be confirmed by NMR.

(C) Formation of free radical can be confirmed by ESR.

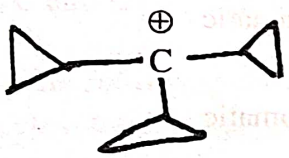
(D) Formation of enol can be confirmed by PMR.

Of these the ***correct*** statements are :

(1) A and B only (2) A, B and D only

(3) A, B, C and D (4) B, C and D

35. Which among the following carbocations is most stable ?

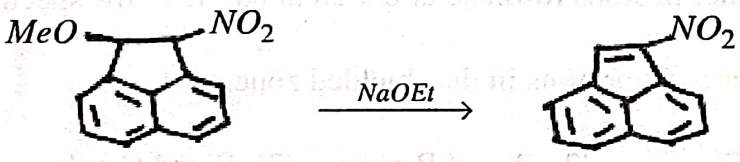
(1) 

(2) $C_6H_5-\overset{\oplus}{C}H_2$

(3) $C_6H_5-\overset{\oplus}{C}H-C_6H_5$

(4) $H_3C-\overset{\oplus}{\underset{\displaystyle CH_3}{\underset{|}{C}}}-CH_3$

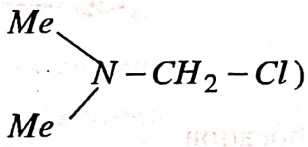
36. The reaction given below is an example of :

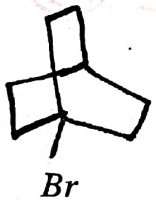


(1) E_2-elimination (2) E_1-elimination

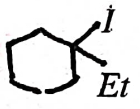
(3) Syn-elimination (4) E_1 C B-elimination

37. Which of the following compounds will ***not*** react by unimolecular nucleophilic substitution mechanism ?

(1) 

(2) 

(3) 

(4) 

38. Consider the following reactions :

(A) $CH_3-CH=CH_2 \xrightarrow{NBS/CCl_4} CH_2(Br)-CH=CH_2$

(B) $CH_3-CH=CH_2 \xrightarrow{HBr} CH_3-CH(Br)-CH_3$

(C) $C_6H_5-CH_3 \xrightarrow[h\nu]{Br_2} C_6H_5CH_2-Br$

(D) $C_6H_6 \xrightarrow[Fe]{Br_2} C_6H_5-Br$

The reactions which proceed through free radical mechanism are :

(1) A and B (2) A and C (3) C and D (4) B and C

39. Match **Column-A** (Coupling reactions) with **Column-B** (Reagents) :

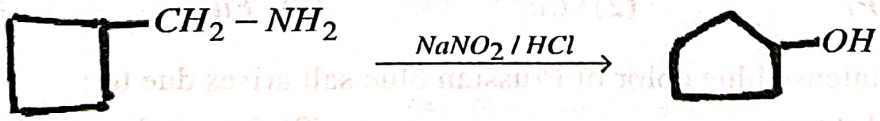
Column-A (Coupling reactions)	**Column-B (Reagents)**
(a) Suzuki Coupling	(i) $H_2C=CHCOOCH_3$
(b) Heck Coupling	(ii) $RB(OH)_2$
(c) Sonogashira Coupling	(iii) $PhCO(CH_2)_3ZnI$
(d) Negeshi Coupling	(iv) $H-C\equiv CR$
	(v) SnR_4

The ***correct*** match is :

(1) (a)-(ii); (b)-(i);(c)-(iv);(d)-(iii) (2) (a)-(i); (b)-(v);(c)-(iii);(d)-(iv)

(3) (a)-(iv); (b)-(iii);(c)-(ii);(d)-(i) (4) (a)-(ii); (b)-(iii);(c)-(iv);(d)-(v)

40. Consider the reaction :



The reaction is known as :

(1) Pinacol-Pinacolone rearrangement (2) Benzidine rearrangement

(3) Demjanov rearrangement (4) Wagner-Meerwein rearrangement

41. The STYX code for diborane is :

(1) 2022 (2) 2002 (3) 2202 (4) 0220

42. Which of the following is colored and paramagnetic ?

(1) Sc^{3+} (2) Cu^{+} (3) Cu^{2+} (4) Zn^{2+}

43. Metal-Metal bond is present in :

(1) Stannic chloride (2) Cupric chloride
(3) Mercurous chloride (4) Mercuric chloride

44. Which of the following has highest CFSE ?

(1) $[CoF_6]^{3-}$ (2) $[Mn(H_2O)_6]^{2+}$ (3) $Co(H_2O)_6]^{2+}$ (4) $[Co(NH_3)_6]^{3+}$

45. Which of the following is thermodynamically unstable and kinetically labile ?

(1) $[Co(H_2O)_6]^{3+}$ (2) $[Co(H_2O)_6]^{2+}$
(3) $[Co(NH_3)_6]^{3+}$ (4) $[Co(NH_3)_6]^{2+}$

46. The electronic configuration of Gd is :

(1) $[Xe]4f^8 5d^9 6s^2$ (2) $[Xe]4f^7 5d^1 6s^2$
(3) $[Xe]4f^6 5d^2 6s^2$ (4) $[Xe]4f^3 5d^3 6s^2$

47. Term symbol of Ce^{3+} is :

(1) $^2F_2$ (2) $^2F_5$ (3) $^2F_{5/2}$ (4) $^2F_0$

48. Which of the following is colorless ?

(1) Pr^{3+} (2) Ce^{3+} (3) Eu^{3+} (4) Sm^{3+}

49. The intense blue color of Prussian blue salt arises due to :

(1) d-d transition (2) inter valence electron transfer
(3) ligand to metal charge transfer (4) metal to ligand charge transfer

50. The number of ESR lines for anthracene ion are :

(1) 35 (2) 25 (3) 60 (4) 75

51. To record Mossbauer spectrum of *Fe* containing samples, a source X is used. X after nuclear transformation (Y), gives γ-radiation used in Mossbauer spectroscopy. X and Y respectively are :

(1) ^{57}Fe, β-emission
(2) ^{57}Co, β-emission
(3) ^{57}Co, e^- capture
(4) ^{57}Fe, e^- capture

52. The cluster with closo based skeletal structure is :

(1) $Os_5(CO)_{16}$
(2) $Ni_5(CO)_{12}$
(3) $[Ru_3N(CO)_{14}]^-$
(4) $Fe_5C(CO)_{15}$

53. The bond order for metal-metal bond in $[Mo_2Cl_8]^{4-}$ is :

(1) 1 (2) 2 (3) 3 (4) 4

54. Identify the ***correct*** statement :

(i) Physical state of a system at time, t is described by the wave function $\psi(x, y, z, t)$.

(ii) Wave function in one-dimension, $\psi(x, t)$ and its first derivative are continuous and single valued for all values of x.

(iii) The expectation value of an observable A, $<A>$ corresponding to an operator $\hat{A}$ is

$$<A> = \int_{-\infty}^{\infty} \psi^*(x)\hat{A}\psi(x)dx.$$

(1) (i), (ii)
(2) (ii), (iii)
(3) (i), (iii)
(4) All of the above

55. The expression for the operator, $\left(\frac{d}{dx} - x\right)\left(\frac{d}{dx} + x\right)$ is :

(1) $\frac{d^2}{dx^2} - x^2$
(2) $\frac{d^2}{dx^2} - x^2 + 1$
(3) $\frac{d^2}{dx^2} - x^2 - 1$
(4) None of the above

56. Degeneracy of a particle with mass 'm' in a 3-dimensional box of width 'a' having energy equal to $11\ h^2/8ma^2$ is :

(1) 1 (2) 3 (3) 6 (4) None of the above

57. Acceptable wave function(s) in quantum mechanics when x range from 0 to 2π is :

(i) $\sin x$ (ii) $\tan x$ (iii) $\text{cosec } x$

(1) (i), (ii) (2) (ii), (iii) (3) (i), (iii) (4) All of the above

58. Identify the ***correct*** statement :

(i) According to classical mechanics, the particle must reflect when it has less energy than the energy of the potential barrier.

(ii) According to quantum mechanics, particle with energy less than that of potential energy barrier has a finite probability of penetrating potential energy barrier.

(iii) According to classical mechanics particle with less than potential energy barrier has a finite probability of penetrating the potential energy barrier.

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

59. Function(s) which coluld be used as a trial variation function for the particle in a one-dimensional box of width *'a'* is/are :

(i) $\sin(\pi x/a)$ (ii) x^2/a (iii) $\cos(\pi x/a)$

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

60. Hamiltonian for H_2^+ can be :

(1) $\hat{H} = \frac{\hbar^2}{2m}\nabla^2 + \frac{1}{4\pi\epsilon_0}\left[-\frac{e^2}{r_A} - \frac{e^2}{r_\beta} + \frac{e^2}{r_{AB}}\right]$

(2) $\hat{H} = \frac{h}{\sin^2 m}\nabla^2 + \frac{1}{4\pi\epsilon_0}\left[\frac{e^2}{r_A} + \frac{e^2}{r_\beta} - \frac{e^2}{r_{AB}}\right]$

(3) $\hat{H} = \frac{\hbar^2}{2m}\nabla^2 + \frac{1}{4\pi\epsilon_0}\left[-\frac{e^2}{r_A} + \frac{e^2}{r_\beta} + \frac{e^2}{r_{AB}}\right]$

(4) None of the above

61. The decreasing order of heat of hydration of Ca^{2+}, Sr^{2+} and Ba^{2+} is :

(1) $Sr^{2+} > Ba^{2+} > Ca^{2+}$ (2) $Ba^{2+} > Sr^{2+} > Ca^{2+}$

(3) $Ca^{2+} > Ba^{2+} > Sr^{2+}$ (4) $Ca^{2+} > Sr^{2+} > Ba^{2+}$

62. Melting point is maximum for which of the following compound ?

(1) $LiCl$ (2) $NaCl$ (3) $RbCl$ (4) KCl

63. Shape of $TeCl_4$ molecule is :

(1) Trigonal pyramidal (2) Tetrahedral

(3) Square pyramidal (4) Square planar

64. According to VSEPR theory, which of the following is non-linear ?

(1) $[ClF_2]^+$ (2) CO_2 (3) $[I_3]^-$ (4) $[N_3]^-$

65. Which of the following species have bond order of 3 ?

(a) N_2 (b) NO^+ (c) NO^- (d) C_2^{2-}

Select the ***correct*** answer using the options given below :

(1) (a) and (b) (2) (a), (b) and (c)

(3) (a), (b) and (d) (4) (a), (c) and (d)

66. Which of the following is most basic ?

(1) CH_3^- (2) H_2O (3) F^- (4) OH^-

67. Which of the following statements is ***false*** ?

(1) Water is a differential solvent for *HF* and *HCl*

(2) H_2O has levelling effect on strength of *HF* and *HCl*

(3) Liquid ammonia has a levelling effect on strength of *HF* and *HCl*

(4) CH_3COOH has a levelling effect on strength of *HF*, *HCl*, *HBr* and *HI*

68. Which of the following is ***not*** a Lewis acid ?

(1) SO_3 (2) NH_3 (3) $AlCl_3$ (4) SiF_4

C

69. Using Wade's rule, predict the structure and number of isomers of $B_{10}C_2H_{12}$:

(1) nido and two
(2) closo and three
(3) nido and one
(4) closo and two

70. Nitrogen is prepared by heating a mixture of :

(1) NH_4Cl and KOH
(2) NH_4OH and KCl
(3) NH_4Cl and $NaNO_2$
(4) NH_4Cl and KNO_3

71. ABMO wave function for 1, 3-butadiene is/are :

(i) $A(\phi_1 - \phi_4) + B(\phi_2 - \phi_3)$

(ii) $A(\phi_1 + \phi_4) - B(\phi_2 + \phi_3)$

(iii) $A(\phi_1 - \phi_4) - B(\phi_2 - \phi_3)$

(1) (i)
(2) (i), (ii)
(3) (ii)
(4) (ii), (iii)

72. The molecule(s) which can be assigned $D_{\infty h}$ point group is/are :

(i) N_2O
(ii) CO_2
(iii) C_2H_2

(1) (i)
(2) (i), (ii)
(3) (ii)
(4) (ii), (iii)

73. Identify the ***incorrect*** statement :

(i) Sum of the squares of the dimensions of the irreducible representations of the group is equal to the order of the group.
(ii) Irreducible representations of the group are orthogonal to each other.
(iii) The number of symmetry operations in a group is equal to the number of classes in the group.

(1) (i)
(2) (i), (ii)
(3) (ii)
(4) (ii), (iii)

74. A one-dimensional irreducible representation symmetrical w.r.t. main symmetry axis and unsymmetrical w.r.t. centre of symmetry has the Mulliken's symbol as :

(1) A_u
(2) B_g
(3) A_{1u}
(4) B_{1g}

75. Rotational line at 108 cm^{-1} in a microwave spectrum occur due to ..... transition. (rotational constant being 9 cm^{-1})

(1) $J = 6 \leftarrow J = 5$ (2) $J = 7 \leftarrow J = 6$

(3) $J = 5 \leftarrow J = 4$ (4) None of the above

76. Which of the following are microwave active ?

(i) N_2 (ii) NO (iii) O_2

(1) (i) (2) (i), (ii)

(3) (ii) (4) (ii), (iii)

77. Rotational and vibrational degrees of freedom in N_2O are respectively ....., ...

(1) 3, 3 (2) 2, 3

(3) 2, 4 (4) 4, 2

78. Match the following :

i. NMR spectrum	(a) Microwave
ii. Rotational spectrum	(b) UV
iii. Raman spectrum	(c) IR
iv. Electronic spectrum	(d) Radiofrequency
	(e) vis

(1) i-a, ii-c, iii-b, iv-e (2) i-d, ii-a, iii-b, iv-e

(3) i-d, ii-a, iii-e, iv-b (4) i-d, ii-c, iii-e, iv-b

79. Identify the ***correct*** statement :

(i) Entropy of perfectly crystalline solid becomes zero at absolute zero.

(ii) It is not possible to reduce the temperature of any system to absolute zero by any process.

(iii) For a process to be spontaneous, $\Delta S_{total} > 0$.

(1) (i), (ii) (2) (ii), (iii)

(3) (i), (iii) (4) All of the above

80. Identify the intensive property from the following :

(i) Pressure

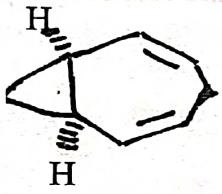
(ii) Volume

(iii) Energy

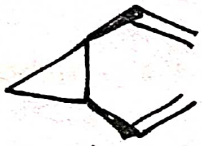
(1) (i) (2) (i), (ii)

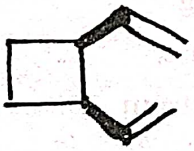
(3) (ii) (4) (ii), (iii)

81. Among the following dienes, the one that undergoes degenerate cope rearrangement is :

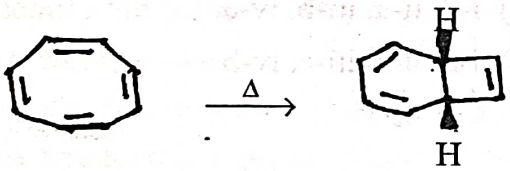
(1) 

(2) 

(3) 

(4) 

82. The number of π-electrons participating and pericyclic mode in the following reaction are :



(1) 4 and conrotatory

(2) 4 and disrotatory

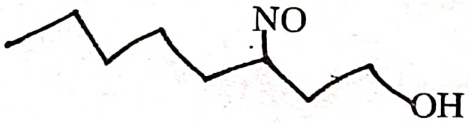
(3) 6 and conrotatory

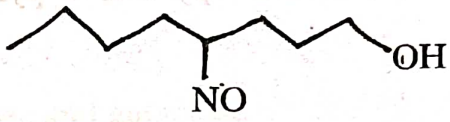
(4) 6 and disrotatory

83. The major product formed in the following reaction is :

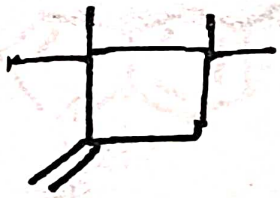
(1) 

(2) 

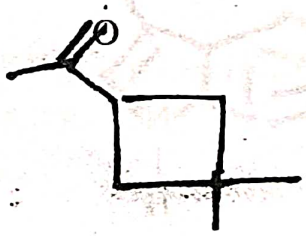
(3) 

(4) 

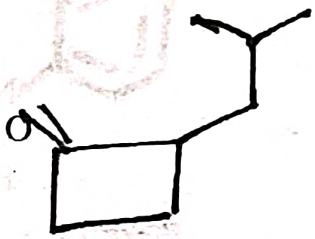
84. Amongst the following, the major products formed in the following photochemical reactions are :



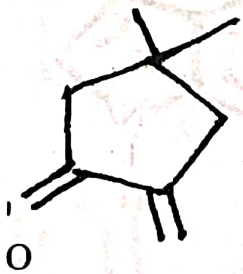
(A)



(B)



(C)



(D)

(1) A and C (2) B and C (3) A and D (4) A and B

85. With respect to electrophilic aromatic substitution, reactivity order of pyrrole, pyridine and indole is :

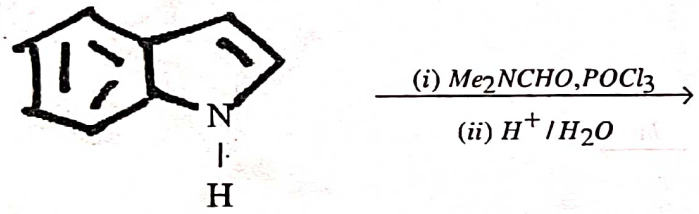
(1) indole > pyrrole > pyridine

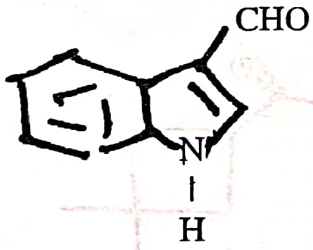
(2) pyrrole > pyridine > indole

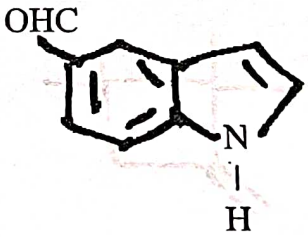
(3) pyrrole > indole > pyridine

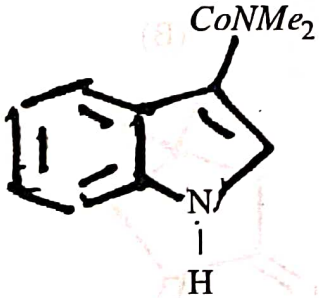
(4) indole > pyridine > pyrrole

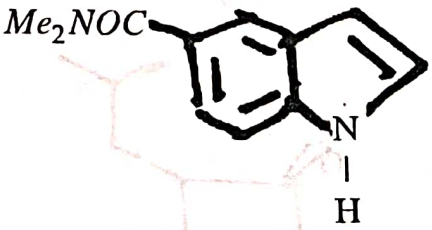
86. The major product formed in the following reaction is :



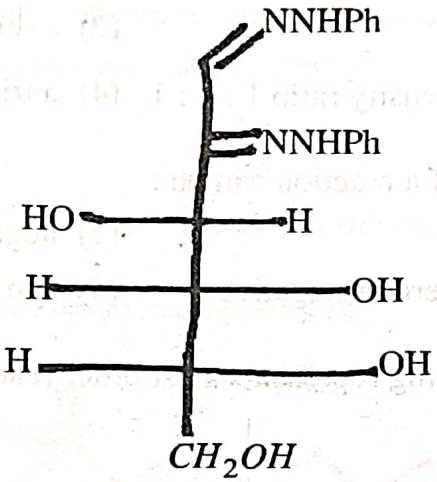
(1) 

(2) 

(3) 

(4) 

87. The osazone given below could be obtained from :



(1) glucose and mannose
(2) mannose and galactose
(3) glucose and galactose
(4) galactose and fructose

88. The biosynthetic precursor for the steroids is :

(1) Secologanin
(2) Shikimic acid
(3) Mevalonic acid
(4) α-ketoglutaric acid

89. An organic compound shows the following spectral data :

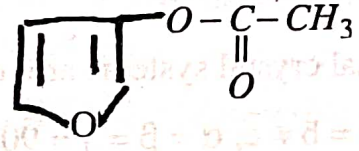
^1R (υ cm^{-1}) : 1680

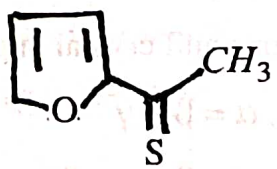
^1H NMR ($CDCl_3$) : δ 7.66 (m, 1H), 7.60 (m, 1H), 7.10 (m, 1H), 2.50 (s, 3H)

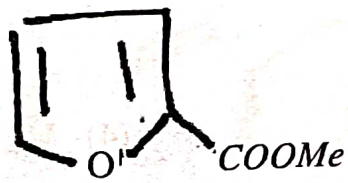
^{13}C NMR ($CDCl_3$) : δ 190, 144, 134, 132, 128, 28

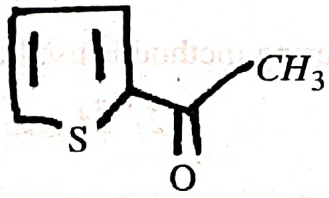
m/z (EI) : 126 (M^+, 100%), 128(M^++2, 4.9%)

The structure of the compound is :

(1) 

(2) 

(3) 

(4) 

90. ^1H NMR spectrum of HD would show :

(1) a singlet (2) a doublet

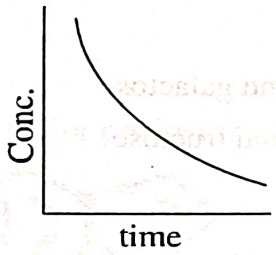
(3) a triplet with intensity ratio 1 : 2 : 1 (4) a triplet with intensity ratio 1 : 1 : 1

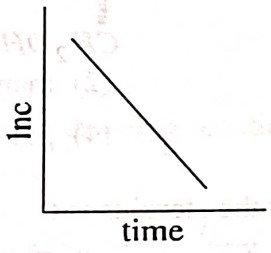
91. Activation energy of a reaction can be :

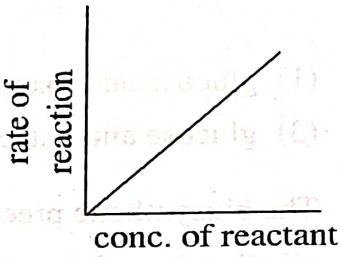
(1) zero (2) negative

(3) can neither be zero or negative (4) can be zero or negative

92. Which of the following represents a 1st order reaction ?

(i) 

(ii) 

(iii) 

(1) (i), (ii) (2) (ii), (iii)

(3) (i), (iii) (4) All of the above

93. Which one of the following about lyophillic colloids is ***not*** true ?

(i) they are stable an account of strong solute-solvent interaction

(ii) they are stable due to presence of change on the particle

(iii) they are stable because of solvation

(1) (i), (ii) (2) (ii), (iii)

(3) (i), (iii) (4) None of the above

94. Cell dimensions and crystal angles for tetragonal crystal systems are resp. :

(1) $a = b = c, \alpha = \beta \neq \gamma$ (2) $a = b \neq c, \alpha = \beta = \gamma = 90$

(3) $a \neq b \neq c, \alpha = \beta = \gamma \neq 90$ (4) $a \neq b = c, \alpha \neq \beta = \gamma$

95. Light scattering method is used to obtain :

(1) $\overline{M}_v$ (2) $\overline{M}_n$ (3) $\overline{M}_w$ (4) $\overline{M}_z$

96. Covariance :

(i) is a measure of relationship between two random variables.

(ii) is zero if two random variables are independent.

(iii) is non-negative.

(1) (i), (ii) (2) (ii), (iii)

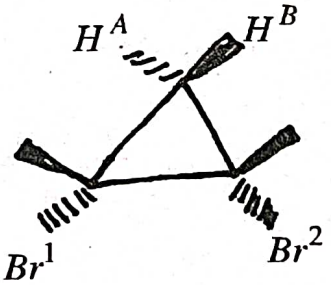
(3) (i), (iii) (4) All of the above

97. The IUPAC name for the given organic compound is :

(1) (2R, 3Z)-7-phenylhept-3-en-2-ol (2) (2S, 3Z)-7-phenylhept-3-en-2-ol

(3) (2R, 3E)-7-phenylhept-3-en-2-ol (4) (2S, 3E)-7-phenylhept-3-en-2-ol

98. In the compound given below, the relation between H^A, H^B; and between Br^1, Br^2 is :



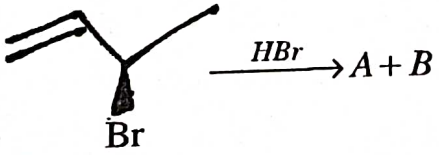
(1) H^A, H^B are enantiotopic; and Br^1, Br^2 are diastereotopic

(2) H^A, H^B are diastereotopic; and Br^1, Br^2 are enantiotopic

(3) H^A, H^B are diastereotopic; and Br^1, Br^2 are homotopic

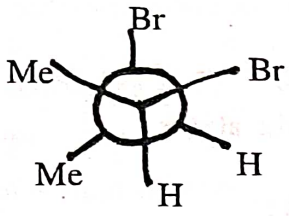
(4) H^A, H^B are enantiotopic; and Br^1, Br^2 are homotopic

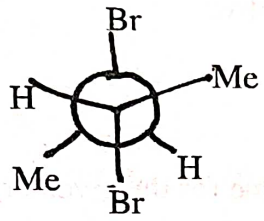
99. In the following Markownikov addition reaction, the products A and B are :

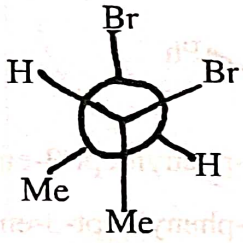


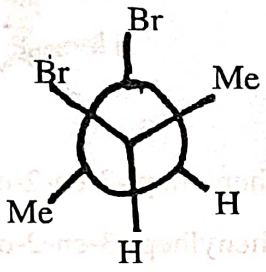
(1) homomers (2) enantiomers (3) diastereomers (4) regioisomers

100. The gauche sinteraction values for Me/Me, Me/Br and Br/Br are 3.3, 0.8 and 3.0 kJ/mol, respectively. Among the following the most stable conformation of 2,3-dibromobutane is :

(1) 

(2) 

(3) 

(4) 

Total No. of Printed Pages : 25

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D

SET-Y

PHD-EE-2023-24

Chemistry

10012

Sr. No. .....

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

Roll No. (in figures)_____ (in words) _____

Name _____ Date of Birth_____

Father's Name _____ Mother's Name_____

Date of Examination_____

_____ _____

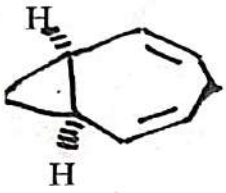
(Signature of the Candidate) (Signature of the Invigilator)

SEAL

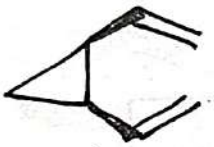
CANDIDATES MUST READ THE FOLLOWING INFORMATION/INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

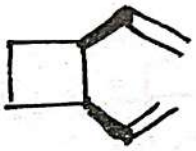
1. ***All questions are compulsory.***
2. The candidates ***must return*** the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.
4. Question Booklet along with answer key of all the A, B, C & D code shall be got uploaded on the University Website immediately after the conduct of Entrance Examination. Candidates may raise valid objection/complaint if any, with regard to discrepancy in the question booklet/answer key within 24 hours of uploading the same on the University Website. The complaint be sent by the students to the Controller of Examinations by hand or through email. Thereafter, no complaint in any case, will be considered.
5. The candidate ***must not*** do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers ***must not*** be ticked in the question booklet.
6. ***There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.***
7. Use only **Black** or **Blue Ball Point Pen** of good quality in the OMR Answer-Sheet.
8. *Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained* **30** *minutes after starting of the examination.*

1. Among the following dienes, the one that undergoes degenerate cope rearrangement is :

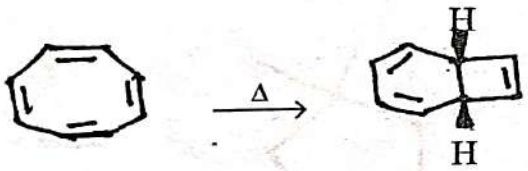
(1) 

(2) 

(3) 

(4) 

2. The number of π-electrons participating and pericyclic mode in the following reaction are :



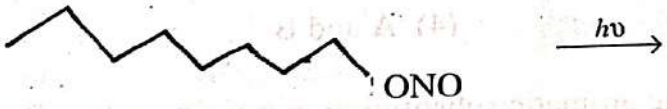
(1) 4 and conrotatory

(2) 4 and disrotatory

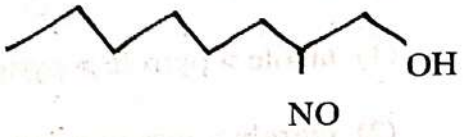
(3) 6 and conrotatory

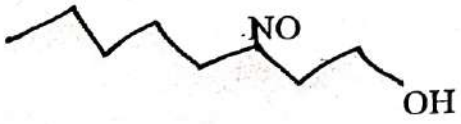
(4) 6 and disrotatory

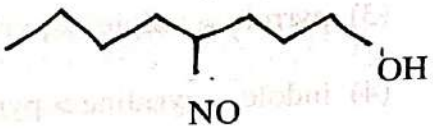
3. The major product formed in the following reaction is :



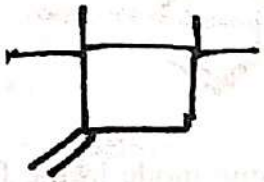
(1) 

(2) 

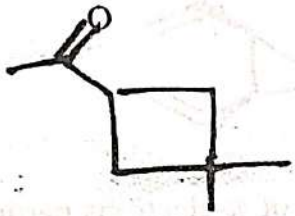
(3) 

(4) 

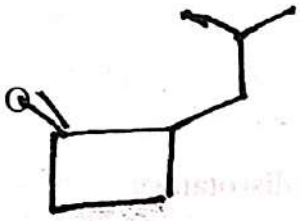
4. Amongst the following, the major products formed in the following photochemical reactions are :



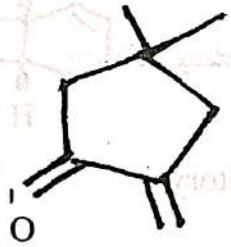
(A)



(B)



(C)



(D)

(1) A and C

(2) B and C

(3) A and D

(4) A and B

5. With respect to electrophilic aromatic substitution, reactivity order of pyrrole, pyridine and indole is :

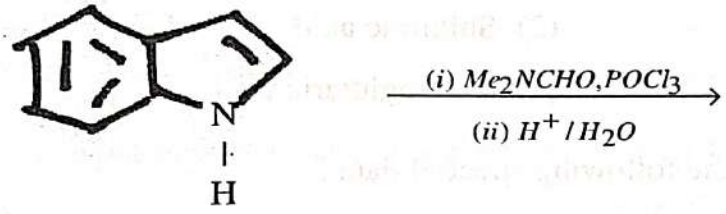
(1) indole > pyrrole > pyridine

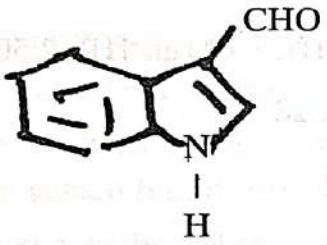
(2) pyrrole > pyridine > indole

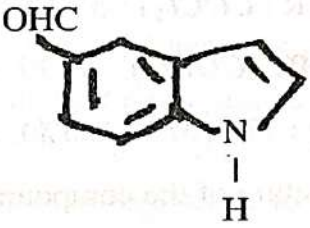
(3) pyrrole > indole > pyridine

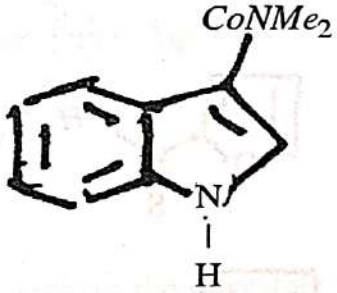
(4) indole > pyridine > pyrrole

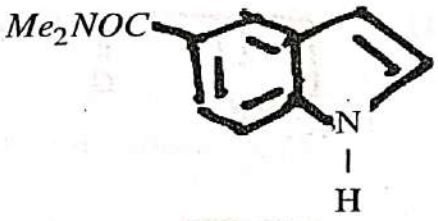
6. The major product formed in the following reaction is :



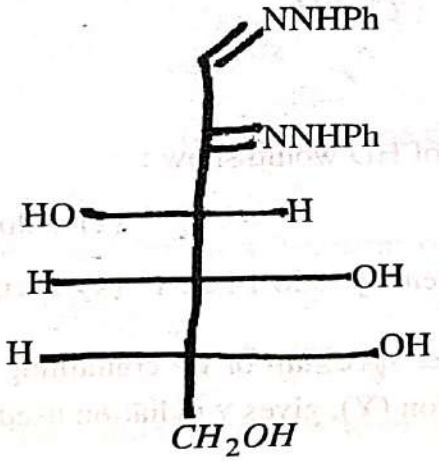
(1) 

(2) 

(3) 

(4) 

7. The osazone given below could be obtained from :



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9. An organic compound shows the following spectral data :

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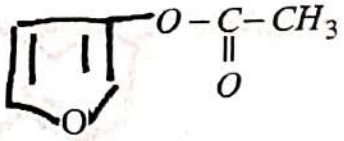
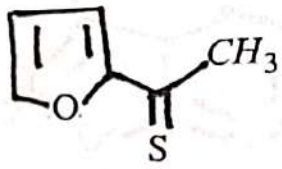
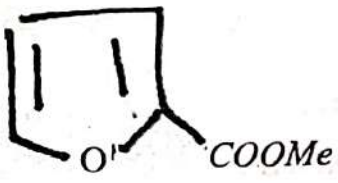
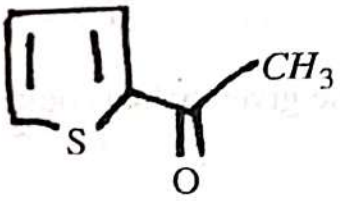
m/z (EI) : 126 (M^+, 100%), 128(M^++2, 4.9%)

The structure of the compound is :

(1) 

(2) 

(3) 

(4) 

10. ^1H NMR spectrum of HD would show :

(1) a singlet
(2) a doublet
(3) a triplet with intensity ratio 1 : 2 : 1
(4) a triplet with intensity ratio 1 : 1 : 1

11. To record Mossbauer spectrum of *Fe* containing samples, a source X is used. X after nuclear transformation (Y), gives γ-radiation used in Mossbauer spectroscopy. X and Y respectively are :

(1) ^{57}Fe, β-emission
(2) ^{57}Co, β-emission
(3) ^{57}Co, e^- capture
(4) ^{57}Fe, e^- capture

12. The cluster with closo based skeletal structure is :

(1) $Os_5(CO)_{16}$ (2) $Ni_5(CO)_{12}$

(3) $[Ru_3N(CO)_{14}]^-$ (4) $Fe_5C(CO)_{15}$

13. The bond order for metal-metal bond in $[Mo_2Cl_8]^{4-}$ is :

(1) 1 (2) 2 (3) 3 (4) 4

14. Identify the ***correct*** statement :

(i) Physical state of a system at time, t is described by the wave function $\psi(x, y, z, t)$.

(ii) Wave function in one-dimension, $\psi(x, t)$ and its first derivative are continuous and single valued for all values of x.

(iii) The expectation value of an observable A, $<A>$ corresponding to an operator $\hat{A}$ is $< A > = \int_{-\infty}^{\infty} \psi^*(x)\hat{A}\psi(x)dx$.

(1) (i), (ii) (2) (ii), (iii)

(3) (i), (iii) (4) All of the above

15. The expression for the operator, $\left(\frac{d}{dx} - x\right)\left(\frac{d}{dx} + x\right)$ is :

(1) $\frac{d^2}{dx^2} - x^2$ (2) $\frac{d^2}{dx^2} - x^2 + 1$

(3) $\frac{d^2}{dx^2} - x^2 - 1$ (4) None of the above

16. Degeneracy of a particle with mass 'm' in a 3-dimensional box of width 'a' having energy equal to $11\ h^2/8ma^2$ is :

(1) 1 (2) 3 (3) 6 (4) None of the above

17. Acceptable wave function(s) in quantum mechanics when x range from 0 to 2π is :

(i) $\sin x$ (ii) $\tan x$ (iii) $\text{cosec}\ x$

(1) (i), (ii) (2) (ii), (iii) (3) (i), (iii) (4) All of the above

18. Identify the ***correct*** statement :

(i) According to classical mechanics, the particle must reflect when it has less energy than the energy of the potential barrier.

(ii) According to quantum mechanics, particle with energy less than that of potential energy barrier has a finite probability of penetrating potential energy barrier.

(iii) According to classical mechanics particle with less than potential energy barrier has a finite probability of penetrating the potential energy barrier.

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

19. Function(s) which coluld be used as a trial variation function for the particle in a one-dimensional box of width *'a'* is/are :

(i) $\sin(\pi x/a)$ (ii) x^2/a (iii) $\cos(\pi x/a)$

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

20. Hamiltonian for H_2^+ can be :

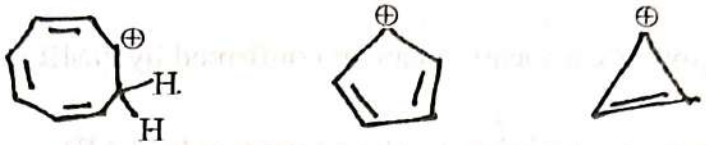
(1) $\hat{H} = \frac{\hbar^2}{2m}\nabla^2 + \frac{1}{4\pi\epsilon_0}\left[-\frac{e^2}{r_A} - \frac{e^2}{r_\beta} + \frac{e^2}{r_{AB}}\right]$

(2) $\hat{H} = \frac{h}{\sin^2 m}\nabla^2 + \frac{1}{4\pi\epsilon_0}\left[\frac{e^2}{r_A} + \frac{e^2}{r_\beta} - \frac{e^2}{r_{AB}}\right]$

(3) $\hat{H} = \frac{\hbar^2}{2m}\nabla^2 + \frac{1}{4\pi\epsilon_0}\left[-\frac{e^2}{r_A} + \frac{e^2}{r_\beta} + \frac{e^2}{r_{AB}}\right]$

(4) None of the above

21. Among the carbocations given below (A, B, C) :



(A) (B) (C)

(1) A is homoaromatic, B is antiaromatic and C is aromatic

(2) A is aromatic, B is antiaromatic and C is homoaromatic

(3) A is antiaromatic, B is aromatic and C is homoaromatic

(4) A is homoaromatic, B is aromatic and C is antiaromatic

22. Considering the following statements for [18]-annulene, which one is ***correct*** ?

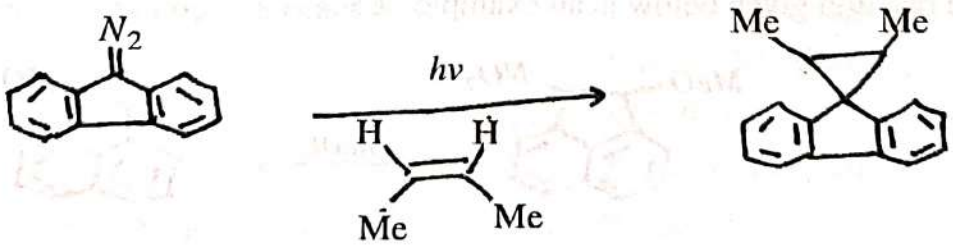
(A) It is aromatic.

(B) The inner protons resonate at δ 9.28 in its ^1H NMR spectrum.

(C) There are six protons in the shielded zone.

(1) A, B, C (2) A and B only (3) B and C only (4) A and C only

23. The intermediate involved in the reaction given below is :



(1) Free radical (2) Carbocation

(3) Carbene (4) Carbanion

24. Consider the following statements :

(A) Formation of carbocation can be confirmed by NMR.

(B) Formation of carbanion can be confirmed by NMR.

(C) Formation of free radical can be confirmed by ESR.

(D) Formation of enol can be confirmed by PMR.

Of these the ***correct*** statements are :

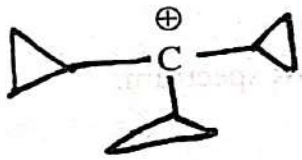
(1) A and B only

(2) A, B and D only

(3) A, B, C and D

(4) B, C and D

25. Which among the following carbocations is most stable ?

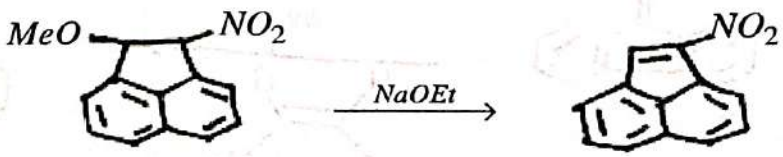
(1) 

(2) $C_6H_5-\overset{\oplus}{C}H_2$

(3) $C_6H_5-\overset{\oplus}{C}H-C_6H_5$

(4) $H_3C-\underset{\displaystyle CH_3}{\overset{\oplus}{\underset{|}{C}}}-CH_3$

26. The reaction given below is an example of :



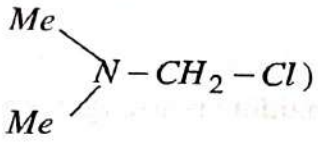
(1) E_2 -elimination

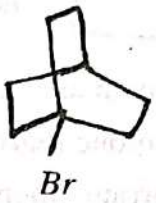
(2) E_1 -elimination

(3) Syn-elimination

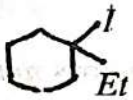
(4) E_1 C B-elimination

27. Which of the following compounds will ***not*** react by unimolecular nucleophilic substitution mechanism ?

(1) 

(2) 

(3) 

(4) 

28. Consider the following reactions :

(A) $CH_3-CH=CH_2 \xrightarrow{NBS/CCl_4} \underset{\displaystyle Br}{\underset{|}{CH_2-CH=CH_2}}$

(B) $CH_3-CH=CH_2 \xrightarrow{HBr} \underset{\displaystyle Br}{\underset{|}{CH_3-CH-CH_3}}$

(C) $C_6H_5-CH_3 \xrightarrow[h\nu]{Br_2} C_6H_5CH_2-Br$

(D) $C_6H_6 \xrightarrow[Fe]{Br_2} C_6H_5-Br$

The reactions which proceed through free radical mechanism are :

(1) A and B (2) A and C (3) C and D (4) B and C

29. Match **Column-A** (Coupling reactions) with **Column-B** (Reagents) :

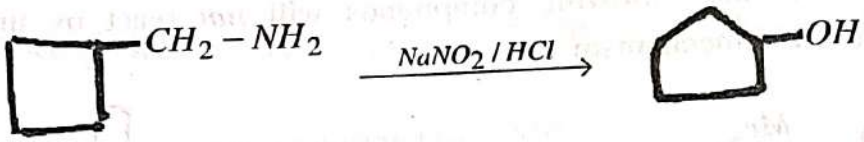
	Column-A (Coupling reactions)		**Column-B (Reagents)**
(a)	Suzuki Coupling	(i)	$H_2C=CHCOOCH_3$
(b)	Heck Coupling	(ii)	$RB(OH)_2$
(c)	Sonogashira Coupling	(iii)	$PhCO(CH_2)_3ZnI$
(d)	Negeshi Coupling	(iv)	$H-C\equiv CR$
		(v)	SnR_4

The ***correct*** match is :

(1) (a)-(ii); (b)-(i);(c)-(iv);(d)-(iii) (2) (a)-(i); (b)-(v);(c)-(iii);(d)-(iv)

(3) (a)-(iv); (b)-(iii);(c)-(ii);(d)-(i) (4) (a)-(ii); (b)-(iii);(c)-(iv);(d)-(v)

30. Consider the reaction :



The reaction is known as :

(1) Pinacol-Pinacolone rearrangement (2) Benzidine rearrangement

(3) Demjanov rearrangement (4) Wagner-Meerwein rearrangement

31. Compound which does ***not*** obey 18 electron rule is ?

(1) $Co_2(CO)_8$ (2) $Fe_2(CO)_9$

(3) $V(CO)_6$ (4) $Cr(CO)_6$

32. Which of the following solvent has maximum eluting power ?

(1) pyridine (2) acetone (3) chloroform (4) methanol

33. Which of the following chromatographic techniques may involve solid as well as liquid as stationary phase and liquid as mobile phase ?

(1) Thin layer chromatography (2) Column chromatography

(3) Paper chromatography (4) All of the above

34. In biological system, the metal ions involved in electron transport are :

(1) Na^+ and K^+ (2) Zn^{2+} and Mg^{2+}

(3) Cu^{2+} and Fe^{2+} (4) Ca^{2+} and Mg^{2+}

35. Iron-sulphur clusters in biological systems are involved in :

(1) proton transfer (2) atom transfer

(3) group transfer (4) electron transfer

36. Carboxypeptidase contains which of the following element ?

(1) Fe (2) Mn (3) Zn (4) Cu

37. The number of α and β particles emitted when $_{92}U^{238}$ changes to $_{82}Pb^{206}$ are :

(1) 6α, 6β (2) 6α, 8β

(3) 8α, 6β (4) 8α, 8β

38. What will be the energy released in a nuclear reactor, in which the total mass loss is 0.01 amu ?

(1) 0.931 MeV (2) 9.31 MeV

(3) 93.1 MeV (4) 931 MeV

39. A symmetric top molecule among the following is :

(1) ethylene (2) butadiene (3) allene (4) hexatriene

40. The g-factor off ^{1}H and ^{13}C are 5.6 and 1.4 respectively. For the same value of magnetic field strength, if the ^{1}H resonantes at 600 MHz, the ^{13}C would resonates at :

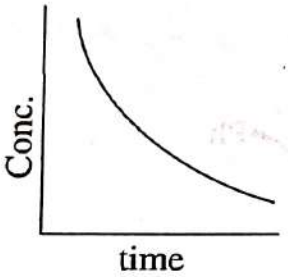
(1) 2400 MHz (2) 600 MHz (3) 150 MHz (4) 250 MHz

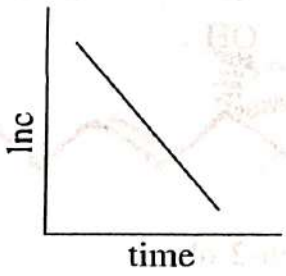
41. Activation energy of a reaction can be :

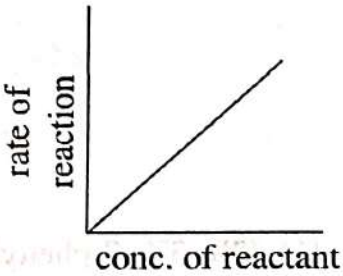
(1) zero (2) negative

(3) can neither be zero or negative (4) can be zero or negative

42. Which of the following represents a 1st order reaction ?

(i) 

(ii) 

(iii) 

(1) (i), (ii) (2) (ii), (iii)

(3) (i), (iii) (4) All of the above

43. Which one of the following about lyophillic colloids is *not* true ?

(i) they are stable an account of strong solute-solvent interaction

(ii) they are stable due to presence of change on the particle

(iii) they are stable because of solvation

(1) (i), (ii)
(2) (ii), (iii)
(3) (i), (iii)
(4) None of the above

44. Cell dimensions and crystal angles for tetragonal crystal systems are resp. :

(1) $a = b = c, \alpha = \beta \neq \gamma$
(2) $a = b \neq c, \alpha = \beta = \gamma = 90$
(3) $a \neq b \neq c, \alpha = \beta = \gamma \neq 90$
(4) $a \neq b = c, \alpha \neq \beta = \gamma$

45. Light scattering method is used to obtain :

(1) $\overline{M}_v$
(2) $\overline{M}_n$
(3) $\overline{M}_w$
(4) $\overline{M}_z$

46. Covariance :

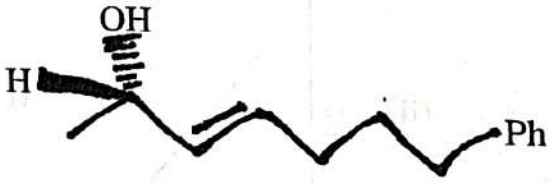
(i) is a measure of relationship between two random variables.

(ii) is zero if two random variables are independent.

(iii) is non-negative.

(1) (i), (ii)
(2) (ii), (iii)
(3) (i), (iii)
(4) All of the above

47. The IUPAC name for the given organic compound is :



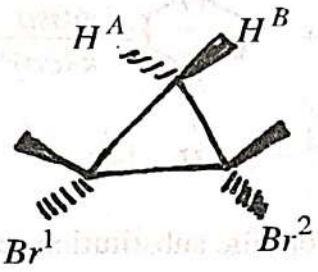
(1) (2R, 3Z)-7-phenylhept-3-en-2-ol

(2) (2S, 3Z)-7-phenylhept-3-en-2-ol

(3) (2R, 3E)-7-phenylhept-3-en-2-ol

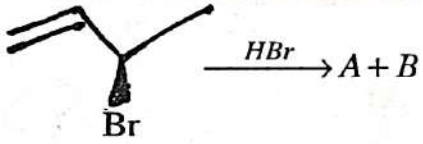
(4) (2S, 3E)-7-phenylhept-3-en-2-ol

48. In the compound given below, the relation between H^A, H^B; and between Br^1, Br^2 is :



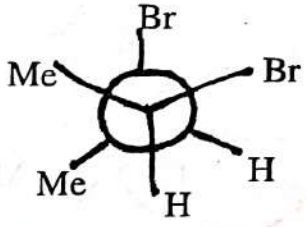
(1) H^A, H^B are enantiotopic; and Br^1, Br^2 are diastereotopic
(2) H^A, H^B are diastereotopic; and Br^1, Br^2 are enantiotopic
(3) H^A, H^B are diastereotopic; and Br^1, Br^2 are homotopic
(4) H^A, H^B are enantiotopic; and Br^1, Br^2 are homotopic

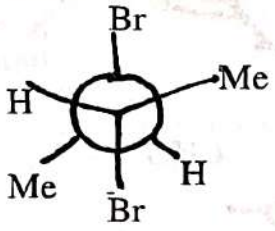
49. In the following Markownikov addition reaction, the products A and B are :

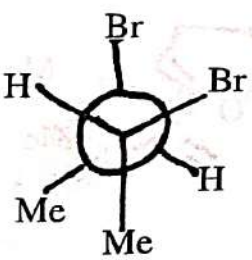


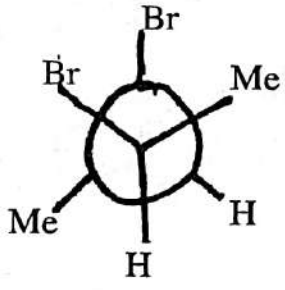
(1) homomers (2) enantiomers (3) diastereomers (4) regioisomers

50. The gauche interaction values for Me/Me, Me/Br and Br/Br are 3.3, 0.8 and 3.0 kJ/mol, respectively. Among the following the most stable conformation of 2,3-dibromobutane is :

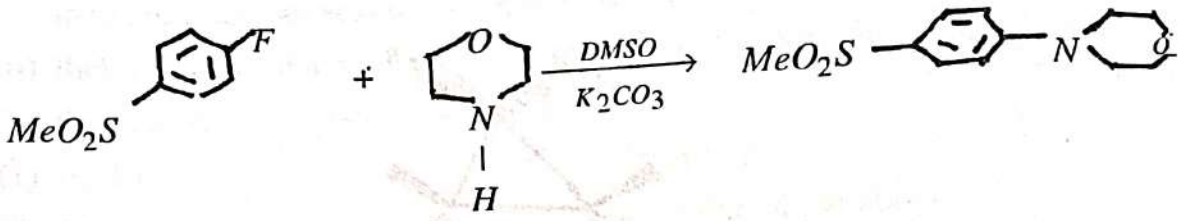
(1) 

(2) 

(3) 

(4) 

51. The ***correct*** statement for the following reaction is :



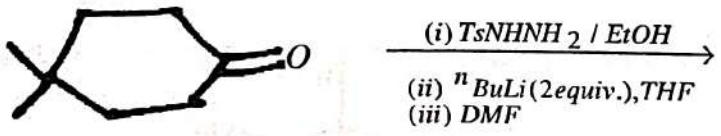
(1) Aromatic ipso electrophilic substitution reaction

(2) Aromatic nucleophilic substitution

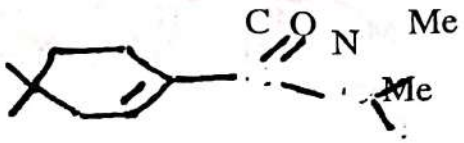
(3) Aromatic electrophilic substitution

(4) Aromatic free radical reaction through aryne formation

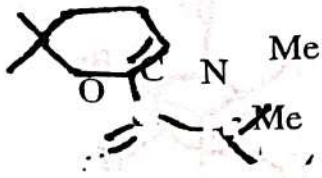
52. The major product formed in the following reaction is :



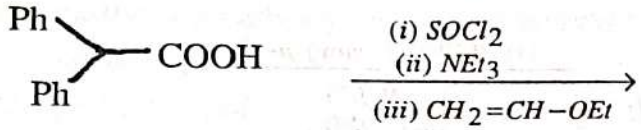
(1) 

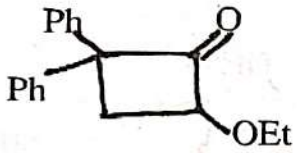
(2) 

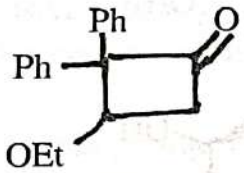
(3) 

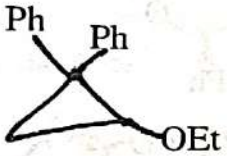
(4) 

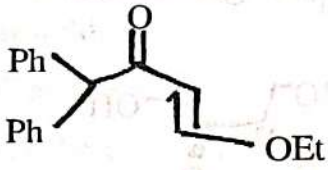
53. The major product in the following react sequence is :



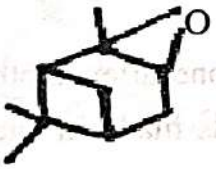
(1) 

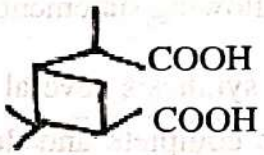
(2) 

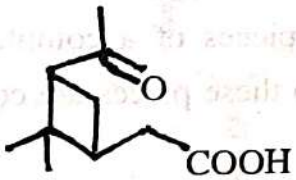
(3) 

(4) 

54. α-Pinene on reaction with dilute alkaline $kMnO_4$ produces a diol which on further oxidation with chromium trioxide gives product A, which undergoes a positive haloform test. The compound A is :

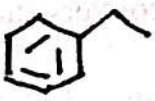
(1) 

(2) 

(3) 

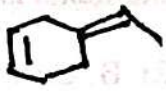
(4) 

55. The major product formed in the reaction of styrene with an excess of lithium in liquid ammonia and t-butyl alcohol is :

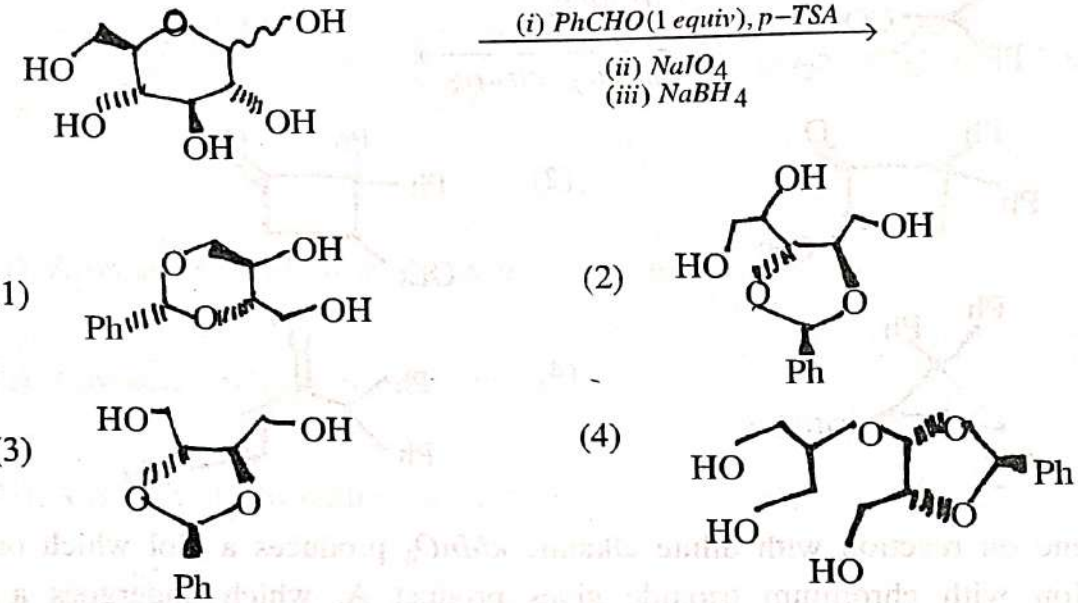
(1) 

(2) 

(3) 

(4) 

56. The major product in the following reaction sequence is :



57. Consider the following statements :

(A) In a linear synthesis several steps are performed one after another until the final molecule is complete and the chemical compounds made in each step are called synthetic intermediates.

(B) In a convergent synthesis several individual pieces of a complex molecule are synthesized in stage one, and then in stage two these pieces are combined to form the final product.

(C) Convergent synthesis is encountered in dendrimer synthesis where branches are connected to the central core.

(D) Proteins upto 300 amino acids are produced by a convergent approach using chemical ligation.

Which of the above statements is/are ***correct*** ?

(1) A, B and C (2) B, C and D (3) A and D (4) All of these

58. Which of the following statements is/are ***correct*** ?

(A) The polarity of a carbonyl group can be reversed by converting it into a dithiane or a thioacetal.

(B) Retrosynthesis could be described as a logical 'Disconnection' at strategic bonds in such a way that the process would progressively lead to easily available starting material(s) through several synthetic plans; each plan thus evolved describes a 'Route' based on retrosynthesis.

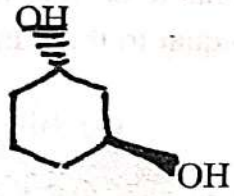
(C) Synthon is a generalized fragment, usually an ion, produced by disconnection.

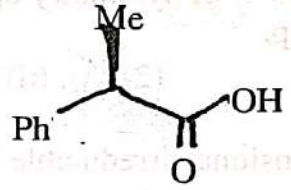
(D) Synthetic equivalent is a reagent carrying out the function of a synthon which cannot itself be used, often because it is too unstable.

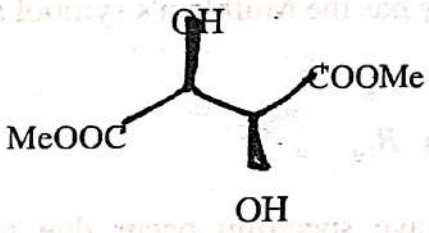
(1) A, C and D (2) B, C and D

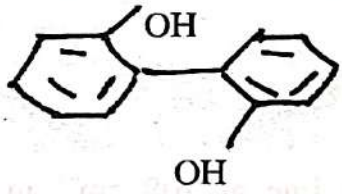
(3) C and D only (4) All of these

59. Among the following the most suitable reagent for carrying out resolution of racemic 3-methylcyclohexanone is :

(1) 

(2) 

(3) 

(4) 

60. Enantiomeric excess (ee%) is :

(A) $\frac{100 \times \text{optical rotation}}{\text{specific rotation}}$

(B) % major enantiomer $-$ % minor enantiomer

(C) it is a measurement of purity used for chiral substances

(D) equals to de% i.e. % of diasteromeric excess

(1) A and D (2) A, B and C (3) B, C and D (4) All of these

61. ABMO wave function for 1, 3-butadiene is/are :

(i) $A(\phi_1 - \phi_4) + B(\phi_2 - \phi_3)$

(ii) $A(\phi_1 + \phi_4) - B(\phi_2 + \phi_3)$

(iii) $A(\phi_1 - \phi_4) - B(\phi_2 - \phi_3)$

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

62. The molecule(s) which can be assigned $D_{\infty h}$ point group is/are :

(i) N_2O (ii) CO_2 (iii) C_2H_2

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

63. Identify the ***incorrect*** statement :

(i) Sum of the squares of the dimensions of the irreducible representations of the group is equal to the order of the group.

(ii) Irreducible representations of the group are orthogonal to each other.

(iii) The number of symmetry operations in a group is equal to the number of classes in the group.

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

64. A one-dimensional irreducible representation symmetrical w.r.t. main symmetry axis and unsymmetrical w.r.t. centre of symmetry has the Mulliken's symbol as :

(1) A_u (2) B_g

(3) A_{1u} (4) B_{1g}

65. Rotational line at 108 cm^{-1} in a microwave spectrum occur due to ..... transition. (rotational constant being 9 cm^{-1})

(1) $J = 6 \leftarrow J = 5$ (2) $J = 7 \leftarrow J = 6$

(3) $J = 5 \leftarrow J = 4$ (4) None of the above

66. Which of the following are microwave active ?

(i) N_2 (ii) NO (iii) O_2

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

67. Rotational and vibrational degrees of freedom in N_2O are respectively ....., ...

(1) 3, 3 (2) 2, 3 (3) 2, 4 (4) 4, 2

68. Match the following :

i. NMR spectrum	(a) Microwave
ii. Rotational spectrum	(b) UV
iii. Raman spectrum	(c) IR
iv. Electronic spectrum	(d) Radiofrequency
	(e) vis

(1) i-a, ii-c, iii-b, iv-e
(2) i-d, ii-a, iii-b, iv-e
(3) i-d, ii-a, iii-e, iv-b
(4) i-d, ii-c, iii-e, iv-b

69. Identify the ***correct*** statement :

(i) Entropy of perfectly crystalline solid becomes zero at absolute zero.
(ii) It is not possible to reduce the temperature of any system to absolute zero by any process.
(iii) For a process to be spontaneous, $\Delta S_{total} > 0$.

(1) (i), (ii) (2) (ii), (iii)
(3) (i), (iii) (4) All of the above

70. Identify the intensive property from the following :

(i) Pressure
(ii) Volume
(iii) Energy

(1) (i) (2) (i), (ii)
(3) (ii) (4) (ii), (iii)

71. Identify the ***correct*** statement :

(i) For a chemical equilibrium, increasing the conc. of reactants results in shifting the equilibrium in favour of reactants.
(ii) For a chemical equilibrium, increasing the conc. of products results in shifting the equilibrium in favour of reactants.
(iii) For a thermochemical reaction.

$$N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g),\ \Delta H = -92.4\,kJ$$

The reverse reaction will be endothermic.

(1) (i) (2) (i), (ii)
(3) (ii) (4) (ii), (iii)

72. Number of components, number of phases and digrees of freedom for the system $H_2O(s) \rightleftharpoons H_2O(l) \rightleftharpoons H_2O(g)$, resp. is :

(1) 1, 3, 1 (2) 2, 3, 0 (3) 1, 1, 3 (4) None of the above

73. Temperature at which the following process may ***not*** be spontaneous :

$B(g) \rightarrow B(l)$, $\Delta H = -24$ kJ, $\Delta S = -60$ Jk^{-1}

(i) >400 k (ii) >450 k (iii) >350 k

(1) (i) (2) (i), (ii) (3) (ii) (4) (ii), (iii)

74. Identify the ***incorrect*** statement :

(1) Canonical ensemble represents isolated system.

(2) Microcanonical ensemble represents open isothermal system.

(3) Grand canonical ensemble represents closed isothermal system.

(4) All of the above

75. Identify the ***incorrect*** statement :

(1) Equal volumes of all gases under the same conditions of temp. and pressure contains equal number of molecules.

(2) Rate of diffusion of a gas is inversely proportional to the square root of the density of a gas at constant pressure.

(3) The most probable velocity of a gas increases with rise of temperature.

(4) None of the above

76. 'Conductance of weak electrolytes increases with dilution.' This is :

(1) Arrhenius law (2) Ostwald's law

(3) Gibb's law (4) Kohlrausch's law

77. A zinc rod dipped in 0.1 M solution of $ZnSO_4$ at 25°C. The potential of this electrode at this temperature is ..... . (Assume the salt to be dissociated to the extent of 95%), $E^{\circ}_{zn^{2+},zn} = -0.76\ V$

(1) $-0.76\ V$ (2) $-0.79\ V$ (3) $0.79\ V$ (4) None of the above

78. Standard electrode potential for the half cell reaction are as

$$Zn \rightarrow Zn^{2+} + 2e^-, \quad E^\circ = -0.76V$$

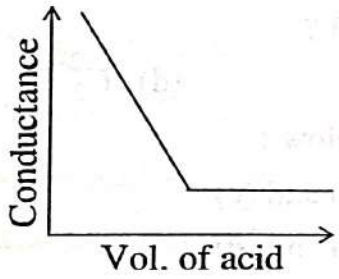
$$Fe \rightarrow Fe^{2+} + 2e^-, \quad E^\circ = 0.41V$$

e.m.f. of the cell reaction, $Fe^{2+} + Zn \rightarrow Zn^{2+} + Fe$ is :

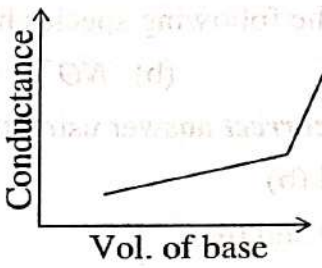
(1) $-0.35\ V$ (2) $+0.35\ V$ (3) $+1.17\ V$ (4) $-1.17\ V$

79. Which of the following represents a plot for conductance titration between strong base and a weak acid ?

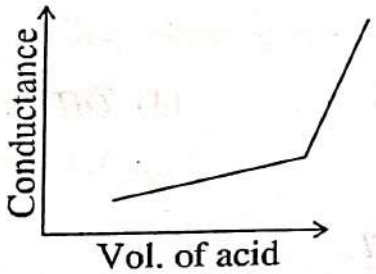
(i)



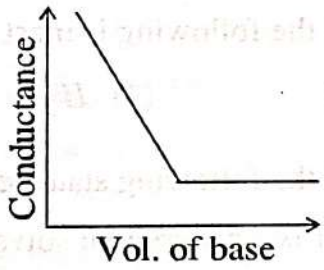
(ii)



(iii)



(iv)



(1) (i), (ii) (2) (iii), (iv) (3) (i), (iv) (4) (ii), (iii)

80. Which of the following is/are the theory of unimolecular reaction ?

(i) Activated complex theory (ii) Hinshalwood theory

(iii) RRK theory

(1) (i), (ii) (2) (ii), (iii) (3) (i), (iii) (4) All of the above

81. The decreasing order of heat of hydration of Ca^{2+}, Sr^{2+} and Ba^{2+} is :

(1) $Sr^{2+} > Ba^{2+} > Ca^{2+}$ (2) $Ba^{2+} > Sr^{2+} > Ca^{2+}$

(3) $Ca^{2+} > Ba^{2+} > Sr^{2+}$ (4) $Ca^{2+} > Sr^{2+} > Ba^{2+}$

82. Melting point is maximum for which of the following compound ?

(1) $LiCl$ (2) $NaCl$ (3) $RbCl$ (4) KCl

83. Shape of $TeCl_4$ molecule is :

(1) Trigonal pyramidal (2) Tetrahedral

(3) Square pyramidal (4) Square planar

84. According to VSEPR theory, which of the following is non-linear ?

(1) $[ClF_2]^+$ (2) CO_2 (3) $[I_3]^-$ (4) $[N_3]^-$

85. Which of the following species have bond order of 3 ?

(a) N_2 (b) NO^+ (c) NO^- (d) C_2^{2-}

Select the ***correct*** answer using the options given below :

(1) (a) and (b) (2) (a), (b) and (c)

(3) (a), (b) and (d) (4) (a), (c) and (d)

86. Which of the following is most basic ?

(1) CH_3^- (2) H_2O (3) F^- (4) OH^-

87. Which of the following statements is ***false*** ?

(1) Water is a differential solvent for HF and HCl

(2) H_2O has levelling effect on strength of HF and HCl

(3) Liquid ammonia has a levelling effect on strength of HF and HCl

(4) CH_3COOH has a levelling effect on strength of HF, HCl, HBr and HI

88. Which of the following is ***not*** a Lewis acid ?

(1) SO_3 (2) NH_3 (3) $AlCl_3$ (4) SiF_4

89. Using Wade's rule, predict the structure and number of isomers of $B_{10}C_2H_{12}$:

(1) nido and two (2) closo and three

(3) nido and one (4) closo and two

90. Nitrogen is prepared by heating a mixture of :

(1) NH_4Cl and KOH
(2) NH_4OH and KCl
(3) NH_4Cl and $NaNO_2$
(4) NH_4Cl and KNO_3

91. The STYX code for diborane is :

(1) 2022 (2) 2002 (3) 2202 (4) 0220

92. Which of the following is colored and paramagnetic ?

(1) Sc^{3+} (2) Cu^{+} (3) Cu^{2+} (4) Zn^{2+}

93. Metal-Metal bond is present in :

(1) Stannic chloride
(2) Cupric chloride
(3) Mercurous chloride
(4) Mercuric chloride

94. Which of the following has highest CFSE ?

(1) $[CoF_6]^{3-}$
(2) $[Mn(H_2O)_6]^{2+}$
(3) $Co(H_2O)_6]^{2+}$
(4) $[Co(NH_3)_6]^{3+}$

95. Which of the following is thermodynamically unstable and kinetically labile ?

(1) $[Co(H_2O)_6]^{3+}$
(2) $[Co(H_2O)_6]^{2+}$
(3) $[Co(NH_3)_6]^{3+}$
(4) $[Co(NH_3)_6]^{2+}$

96. The electronic configuration of Gd is :

(1) $[Xe]4f^8 5d^9 6s^2$
(2) $[Xe]4f^7 5d^1 6s^2$
(3) $[Xe]4f^6 5d^2 6s^2$
(4) $[Xe]4f^3 5d^3 6s^2$

97. Term symbol of Ce^{3+} is :

(1) $^2F_2$ (2) $^2F_5$ (3) $^2F_{5/2}$ (4) $^2F_0$

98. Which of the following is colorless ?

(1) Pr^{3+} (2) Ce^{3+} (3) Eu^{3+} (4) Sm^{3+}

99. The intense blue color of Prussian blue salt arises due to :

(1) d-d transition

(2) inter valence electron transfer

(3) ligand to metal charge transfer

(4) metal to ligand charge transfer

100. The number of ESR lines for anthracene ion are :

(1) 35 (2) 25 (3) 60 (4) 75

Answer keys of PHD-EE-2023-24 (CHEMISTRY) entrance exam dated 22.03.2024				
Q. NO.	A	B	C	D
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2	2	4	1	4
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6	1	3	3	1
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45	1	4	4	3
46	3	2	2	1
47	3	2	3	4
48	3	3	2	2
49	4	1	2	3
50	1	2	4	2

Komal 22/3/24 Jangra 22/03/24 22/03/24 22/3/24 Saluja 22/03/24

Answer keys of PHD-EE-2023-24 (CHEMISTRY) entrance exam dated 22.03.2024				
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95	3	3	3	4
96	1	2	1	2
97	1	3	4	3
98	3	2	2	2
99	4	1	3	2
100	4	1	2	4

Komal 22/3/24 Jayant 22/03/24 22/03/24 Rahul 22/03/2024 Saluha 22/03/24