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A	

SET-Y

PHD/URS-EE-DEC-2022
SUBJECT : Chemistry

10033

Sr. No. ....

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

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

Name _____ Date of Birth _____

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Date of Examination_____

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

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1. *All questions are compulsory.*

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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.

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PHD/URS-EE-2022/(Chemistry)(SET-Y)/(A)

1. Gelatin added during polarographic measurement carried out using dropping mercury electrode :

   (1) Reduced streaming motion of mercury drop

   (2) Decreases viscosity of the solution

   (3) Eliminates migrating current

   (4) Prevents oxidation of mercury

2. Gel permeation chromatography can be used to separate which of the following ?

   (a) Lanthanides   (b) Alkaline earths

   (c) Fatty acids   (d) Low molecular weight peptides

   Correct answer is :

   (1) (a) & (b)   (2) (b) & (c)   (3) (c) & (d)   (4) (a) & (d)

3. In the EPR spectrum of a methyl radical the number of lines and their relative intensities, respectively are :

   (1) 1 and 1   (2) 3 and 1 : 2 : 1

   (3) 4 and 1 : 2 : 2 :1   (4) 4 and 1 : 3 : 3 : 1

4. Mossbauer spectrum of complex [Fe(1, 10 phenanthroline)$_2$ (NCS)$_2$] shows two lines at 300K four lines at 186 K and again two lines at 77 K. This can be attributed to :

   (a) Change in coordination mode of NCS

   (b) Change in spin state of Iron

   (c) cis-trans isomerism

   (d) Change in metal ligand bond distance

   Correct statements are :

   (1) (a) & (b)   (2) (b) & (c)   (3) (a) & (c)   (4) (b) & (d)

5. The *correct* statement for the molecule CsI_3 is :

   (1) It is a covalent molecule   (2) It contains Cs^+ and I_3^- ions

   (3) It contains Cs^{+3} and I^- ions   (4) It contains Cs^+, I^- and lattice I_2 molecule

6. In compounds of type ECl_3, where $E = B, P, As$ and Bi the angles $Cl - E - Cl$:

   (1) $B > P = As = Bi$ (2) $B > P > As > Bi$

   (3) $B < P = As = Bi$ (4) $B < P < As < Bi$

7. Active catalytic species for hydroformylation is :

   (1) $RuCl_2(PPh_3)_3$

   (2) $HCo(CO)_3$

   (3) $RhCl(PPh_3)_3$

   (4) K_2PtCl_6

8. The correct order of energy level of d-orbital in ferrocene is :

   (1) $d_{x^2-y^2}$, $d_{xy} < d_{z^2} < d_{xz}$, d_{yz}

   (2) $d_{z^2} < d_{xz}\, d_{yz} < d_{x^2-y^2} < d_{xy}$

   (3) $d_{x^2-y^2}$, $d_{xy} < d_{xz}\, d_{yz} < d_{z^2}$

   (4) d_{yz}, $d_{xz} < d_{x^2-y^2}$, $d_{xy} < d_{z^2}$

9. The major product obtained in the reaction of iodobenzene with styrene in presence of palladium acetate and potassium carbonate is :

   (1) 1,2-diphenylethene

   (2) 1,2-diphenylethyne

   (3) 1, 2-diphenylethane

   (4) 4-phenylstyrene

10. The cluster having arachano type structure is :

    (1) $[Os_5(CO)_{16}]$

    (2) $[Os_3(CO)_{12}]$

    (3) $[Ir_4(CO)_{12}]$

    (4) $[Rh_6(CO)_{16}]$

11. The given compound is isolobal with $[Rh_6(CO)_{16}]$

    (1) $C_2B_{10}H_{12}$

    (2) $C_2B_6H_{10}$

    (3) $[Fe_4(CO)_{12}C]^{2-}$

    (4) B_5H_{13}

12. The first ionization potential of Na is 5.1 eV. The value of electron gain enthalpy of Na^+ will be :

    (1) −2.55 eV

    (2) − 5.1 eV

    (3) −11.4 eV

    (4) + 2.50 eV

13. Egyptian blue $CaCuSi_4O_{10}$ is an example of :

    (1) Cyclic silicate

    (2) Sheet silicate

    (3) Pyrosilicate

    (4) Chain silicate

14. Which one of the oxide is neutral ?

    (1) CO

    (2) SnO_2

    (3) ZnO

    (4) SiO_2

15. In compound $N_3P_3F_6$, the geometry around nitrogen and phosphorus, respectively are :

    (1) Pyramidal and tetrahedral

    (2) Planar and tetrahedral

    (3) Pyramidal and planar

    (4) Planar and trigonalbipyramidal

16. In photosynthetic systems the redox metalloproteins involved in electron transfer are cytochrome b (Cyt b), Cytochrome bf complex (Cyt bf) and plastocyanin (PC). The pathway of electron flow is :

    (1) PC → Cyt b → Cyt bf   (2) Cyt bf → Cyt b → PC

    (3) Cyt b → Cyt bf → PC   (4) PC → Cyt bf → Cyt b

17. Molybdoenzyme can both oxidize as well as reduce the substrate, because :

    (1) Mo (VI) is more stable than Mo (IV)

    (2) Mo (IV) can transfer oxygen atom to the substrate and Mo(VI) can abstract oxygen atom from substrate

    (3) Conversion of Mo(VI) to Mo(IV) is not favoured

    (4) Mo(VI) can transfer oxygen atom to the substrate and Mo(IV) can abstract oxygen atom from the substrate

18. The ligand system present in Vitamin B_{12} is :

    (1) Porphyrin   (2) Corrin   (3) Phthalocyanine (4) Crown ether

19. Mercury and its compounds are toxic due to their :

    (1) high affinity for thiols   (2) interference with oxygen transport

    (3) Binding to histidines   (4) Inhibition of vitamin B_{12}

20. Match the items in **Column-A** with the appropriate items in **Column-B** :

    Column-A

    A   Metallothioneins

    B   Plastocyanin

    C   Ferritin

    D   Chemotherapy

    Column-B

    (i)   Cis $[Pd(NH_3)_2 Cl_2]$

    (ii)   Cystein rich protein

    (iii)   Electron transfer

    (iv)   Iron transport

    (v)   Iron storage

    (vi)   Carboplatin

    The *correct* answer is :

    (1) A-(iii), B-(ii), C-(v), D-(iv)

    (2) A-(ii), B-(iii), C-(iv), D-(i)

    (3) A-(ii), B-(iii), C-(v), D-(vi)

    (4) A-(iii), B-(v), C-(vi), D-(ii)

21. Generally the coordination number and the nature of electronic absorption band $[(f - f)$ transition$]$ of lanthanide (III) ion in their complexes are :

    (1) greater than 6 & sharp

    (2) 6 and broad

    (3) less than 6 & sharp

    (4) greater than 6

22. The enrichment of Uranium is carried out in the form of :

    (1) VO_2^{3+}

    (2) VO_2^{2+}

    (3) UF_6

    (4) $[U(acac)_3]^{3+}$

23. The coordination number of Gd in $GdCl_3.6H_2O$ is :

    (1) 3

    (2) 6

    (3) 8

    (4) 9

24. Among the following, strongest oxidizing agent is :

    (1) $[WO_4]^{-2}$

    (2) $[MoO_4]^{-2}$

    (3) $[Cr(O_4)]^{2-}$

    (4) $[ReO_4]^-$

25. The mechanism of reaction between $[Fe(CN)_6]^{4-}$ and $[Fe(bpy)_3]^{3+}$ (bpy = 2, 2' bipyridine) :

    (1) Outer sphere electron transfer

    (2) Inner sphere electron transfer

    (3) Self exchange reaction

    (4) Ligand exchange followed by electron transfer

26. On two sequential electron capture, $_{56}Ba^{131}$ will given :

    (1) $_{54}Xe^{131}$ (2) $_{54}Xe^{130}$ (3) $_{56}Ce^{131}$ (4) $_{56}Ce^{130}$

27. The pH obtained by mixing 10 mL of 0.1 M HCl and 40 mL of 0.2 M H_2SO_4 is :

    (1) 0.47   (2) 0.68   (3) 4.0   (4) 3.7

28. In the reaction : $Cl_2 + ClF + SbF_5 \rightarrow [Cl_3][SbF_6]$ the role of chlorine is to :

    (1) Stabilize Cl^+

    (2) Function as Lewis base

    (3) Function as Lewis acid

    (4) Form the cation

29. H_3BO_3 is :

    (1) Monobasic acid and weak lewis acid

    (2) Monobasic and weak Bronsted acid

    (3) Monobasic and strong lewis acid

    (4) Tribasic and weak Bronsted acid

30. Which of the following metal ions have highest mobility in biological media ?

(1) Zn (II), Ni (II)

(2) Fe(II), Cu(II)

(3) Na(I), K(I)

(4) Mg(II), Ca(II)

31. Wilkinson's catalyst is used for :

(1) Hydrogenation

(2) Epoxidation

(3) Polymerization

(4) Metathesis reaction

32. Bond order is lowest in :

(1) Uncoordinated CO

(2) CO bounded to one metal

(3) CO bridging two metals

(4) CO bridging three metals

33. The correct reagents/catalysts for carrying out the Suzuki reaction with p-bromo anisole are :

(1) Styrene, Pd and a base

(2) Phenylacetylene, Pd and CuI

(3) $PhB(OH)_2$, Na_2CO_3 and $Pd(O)$

(4) Tetraallyltin, $Pd(PPh_3)_4$

34. If the walls of a one-dimensional box are suddenly removed, then :

(1) particle in a box doesn't obey wave equation

(2) particle has continuous energy spectrum

(3) particle vanishes into thin air

(4) none of the above

35. Using Huckel-moleclar orbital theory, secular determinant equation for ethylene molecule is expressed as :

(1) $\begin{vmatrix} 1 & x \\ 1 & x \end{vmatrix} = 0$ (2) $\begin{vmatrix} x & x \\ 1 & x \end{vmatrix} = 0$ (3) $\begin{vmatrix} x & 1 \\ 1 & x \end{vmatrix} = 0$ (4) $\begin{vmatrix} x & 1 \\ -1 & x \end{vmatrix} = 0$

where $x = \dfrac{\alpha - E}{\beta}$; α, β are columbic and resonance integral respectively.

36. Which one of the following relations is *correct* ?

(1) $\left[\hat{L}^2, \hat{L}_z \right] = 0$ (2) $\left[\hat{L}_x, \hat{L}_y \right] = i\hbar\hat{L}_x$ (3) $\left[\hat{L}, \hat{L}_z \right] = 0$ (4) $\left[\hat{L}, \hat{L}_y \right] = i\hbar\hat{L}_y$

37. According to Einstein-Smoluchowski equation, the root mean square distance travelled by diffusing molecule is given by :

(1) $< x^2 >^{\frac{1}{2}} = 2Dt$ (2) $< x^2 >^{\frac{1}{2}} = (2Dt)^3$

(3) $< x^{\frac{1}{2}} >^{\frac{1}{2}} = (2Dt)^{1/3}$ (4) $< x^2 >^{\frac{1}{2}} = (2Dt)^{1/2}$

where D is the diffusion coefficient.

38. Polydisperity index (PI) of a polymer molecule is given by :

(1) $PI = M_w - M_n$ (2) $PI = \dfrac{M_w}{M_n}$

(3) $PI = M_w + M_n$ (4) $PI = M_w M_n$

39. For an isentropic change of state :

(1) $d\in = 0$ (2) $dH = 0$ (3) $dS = 0$ (4) $dS = 1$

40. Equivalent conductance for Alkali metal cations vary in the order :

(1) $Li^+ > Na^+ > K^+ > Rb^+$

(2) $Rb^+ > Na^+ \approx K^+ > Li^+$

(3) $Rb^+ > K^+ > Na^+ > Li^+$

(4) $Rb^+ > Li^+ > Na^+ > K^+$

41. The coefficient of thermal expansion, α is defined by :

(1) $\alpha = \dfrac{1}{V}\left(\dfrac{\partial V}{\partial T}\right)_P$

(2) $\alpha = \left(\dfrac{\partial V}{\partial T}\right)_P$

(3) $\alpha = V\left(\dfrac{\partial V}{\partial T}\right)_P$

(4) $\alpha = \dfrac{1}{T}\left(\dfrac{\partial V}{\partial P}\right)_T$

42. Magnetogyric ratio, r is expressed by :

(1) $r = \dfrac{L}{\mu_m}$

(2) $r = \dfrac{\mu_m}{L}$

(3) $r = \mu_m \times L$

(4) $r = \mu_m + L$

where μ_m and L represent magnetic moment and orbital angular momentum respectively.

43. The NMR signal for a compound is found to be 240 Hz downfield from TMS peak using spectrometer at 60 MHz. The chemical shift relative to TMS will be :

(1) 6 ppm
(2) 8 ppm
(3) 4 ppm
(4) 0.4 ppm

44. Which of the following is a *false* statement ?

(1) Maximum electric work is obtained from a cell which operates reversibly

(2) Use of *KCl* in Agar bridge minimize liquid junction potential

(3) Quinhydrone electrode is not suitable for pH measurement in strongly alkaline solution

(4) The standard electrode potential of hydrogen electrode is not zero at all temperature

45. The fundamental vibrational frequency of *CO* molecule is 2170 cm^{-1}. The force constant of *CO* molecule will be :

(1) $4\pi^2 C^2 \mu (2170)^2 \times 10^4$

(2) $4\pi^2 C \mu^2 (2170)^2 10^4$

(3) $4\pi^2 C^2 \mu^2 (2170)$

(4) $4\pi^2 C^2 \mu (2170)$

All notations have their usual meanings.

46. According to Debye-Huckel theory of strong electrolystes, increase in conductivity on dilution is because of :

(1) Incresae in number of ions

(2) Increase in mobility of ions

(3) Increase in viscosity of the solution

(4) Increase in volume of the solution

47. The electronic partition function of an atom where atomic state is $^2D_{3/2}$ is :

(1) 2   (2) 3   (3) 4   (4) 5

48. The number of micro states for distributing three different atoms among quantum states comprised of three quanta of energy are :

(1) 10   (2) 3   (3) 8   (4) 4

49. In ionic polymerization, living polymer is formed when :

(1) Propagation reactions don't occur

(2) Initiation reactions occur faster than termination reactions

(3) Amino acids are used as monomers

(4) Termination reactions don't occur

50. The region of an infrared spectrum where many absorptions take place is known as :

(1) Thumbprint region   (2) Fingerprint region

(3) Handprint region   (4) Footprint region

51. Saxen's relation is :

(1) $\left(\dfrac{\Delta P}{\Delta \phi}\right)_{J=0} = \left(\dfrac{J}{I}\right)_{\Delta\phi=0}$ (2) $\left(\dfrac{\Delta P}{\Delta \phi}\right)_{J=0} = \left(\dfrac{I}{J}\right)_{\Delta\phi=0}$

(3) $\left(\dfrac{\Delta P}{\Delta \phi}\right)_{J=0} = -\left(\dfrac{I}{J}\right)_{\Delta\phi=0}$ (4) None of these

52. The surface tension of dilute solution of a solute varies linearly with solute concentration C_2 as $r = r_0 - ac_2$, where r_0 is the surface tension of the solvent and 'a' is a constant. Predict correct relation :

(1) $\Gamma_2 = (r_0 - r)/RT$

(2) $\Gamma_2 = \dfrac{(r - r_0)}{RT}$

(3) $F_2 = r_0 - r$

(4) $\Gamma_4 = r - r_0$

53. Miscelles from ionic surfactants can be formed only above a certain temperature called :

(1) Critical temperature

(2) Kraft temperature

(3) Inversion temperature

(4) Boyle temperature

54. The Miller indices of crystal plane which cut through crystal axes at $(6a, 3b, 3c)$ are :

(1) (2 1 2)

(2) (2 2 1)

(3) (1 2 2)

(4) None of these

55. A crystal which possesses no element of symmetry is :

(1) $NaCl$

(2) KCl

(3) $CsCl$

(4) $CuSO_4.5H_2O$

56. If two operators commute, then they are/have :

(1) Linear

(2) Same Eigen functions

(3) Same Eigen values

(4) Hermitian

57. Which of the following point groups doesn't posses centre of Inversion ?

(1) D_{6h}

(2) D_{4h}

(3) D_{2h}

(4) T_d

58. H_2O molecule belongs to point group :

(1) C_{2v}

(2) C_{3v}

(3) D_{2d}

(4) D_{3h}

59. The antiferromagnetic transition occur at :

(1) Curie temperature

(2) Neel temperature

(3) Critical temperature

(4) None of these

60. How many normal modes of vibration are possible for benzene molecule ?

    (1) 11   (2) 8   (3) 30   (4) 12

61. Molecular orbital theory :

    (1) Underestimates the importance of covalent structure

    (2) Overestimates the importance of ionic structures

    (3) Puts equal importance to both ionic and covalent structures

    (4) None of the above

62. Which of the following wave function is normalized ?

    (1) $\psi = \dfrac{1}{\sqrt{2}}(\phi_1 + \phi_2)$ (2) $\psi = \dfrac{1}{\sqrt{3}}(\phi_1 + \phi_2)$

    (3) $\psi_1 = \dfrac{1}{\sqrt{2}}(\phi_1 + \phi_2 + \phi_3)$ (4) $\psi = \dfrac{1}{3}(\phi_1 + \phi_2)$

63. Milk is a/an :

    (1) Suspension   (2) Pure solution   (3) Gel   (4) Emulsion

64. Rotational partition function is related to energy by relation :

    (1) $E_{rot} = RT^2 \left[\dfrac{\partial q}{\partial T} \right]$ (2) $E_{rot} = RT^2 \left[\dfrac{\partial}{\partial T} \ln q_{rot} \right]$

    (3) $E_{rot} = \dfrac{\partial}{\partial T} \ln q_{rot}$ (4) $E_{rot} = RT^2 . \ln . q_{rot}$

65. Stirling approximation applicable to large number of atoms is :

    (1) $\ln N! = N - N \ln N$ (2) $\ln N! = N \ln N$

    (3) $\ln N! = N \ln N - N$ (4) $\ln N! = N \ln N + N$

66. Entropy is related to probability by relation :

    (1) $S = R \ln W$ (2) $S = kW$ (3) $S = \ln W$ (4) $S = k \ln W$

A

67. Compunds given below may be named as :
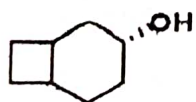
(1) (3R)-bicyclo [4.2.0] octan-3-ol

(2) (3S)-bicyclo [2.4.0] octan-3-ol

(3) (3R)-bicyclo [4.2.0] octan-6-ol

(4) (3S)-bicyclo [2.4.0] octan-6-ol

68. Compound given below may be named as :
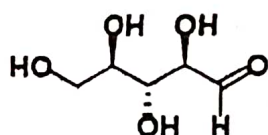
(1) (2S,3S,4S)-2,3,4,5-tetrahydroxypentanal

(2) (2R,3S,4R)-2,3,4,5-tetrahydroxypentanal

(3) (2R,3R,4R)-2,3,4,5-tetrahydroxypentanal

(4) (2S,3R,4R)-2,3,4,5-tetrahydroxypentanal

69. α-D-Glucopyranose and β-D Glucopyranose are :

(1) Anomers

(2) Epimer

(3) Diasteromers

(4) Meso compounds

70. Which of the confomations of n-butane is least stable ?

(1) Gauche

(2) Anti

(3) Eclipsed

(4) Fully eclipsed

71. Which of the following statements is *not* an essential feature of an optically active compound ?

(1) the molecules of an optically active compound will be dissymetric or asymmetric

(2) the molecules of an optically active molecule must have at least one stereogenic site

(3) an optically active compound's molecular configuration will not be identical with its mirror image

(4) an optically active compounds will have at least one stereoisomer

I

72. Identify the aromatic compound(s) amongst I to III :
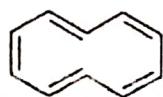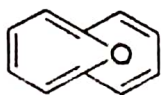
I II III
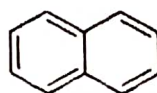
(1) I, II and III

(2) I and II only

(3) II and III only

(4) I and III only

73. The stability of carbanions in the following is in the order of :

$R-C\equiv \overset{\ominus}{C}$ $\overset{\ominus}{} $ $R_2C=\overset{\ominus}{C}H$ $R_3C-\overset{\ominus}{C}H_2$
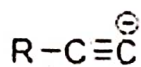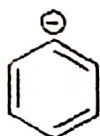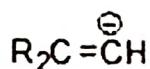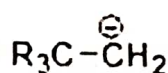
a b c d

(1) $a > c > b > d$

(2) $a > b > c > d$

(3) $b > c > d > a$

(4) $d > b > c > a$

74. The products P and Q in the following reactions, respectively, are :

(1) and

(2) and

(3) and

(4) and

A
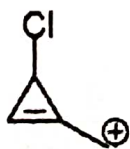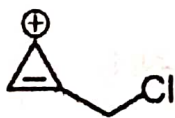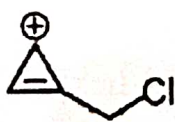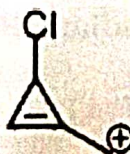
75. The radical halogenation of 2-methylpropane gives two products : $(CH_3)_2 CHCH_2X$ (minor) and $(CH_3)_3CX$ (major). Chlorination gives a larger amount of the minor product than does bromination, Why ?

(1) Bromine is more reactive than chlorine and is able to attack the less reactive 3° C-H.

(2) Bromine atoms are less reactive (more selective) than chlorine, and preferentially attack the weaker 3° C-H bond.

(3) The methyl groups are more hindered to attack by the larger bromine atom.

(4) Bromination is reversible and the more stable 3°-alkyl bromide is formed exclusively.

76. Which one of the following methods is neither meant for the synthesis nor for separation of amines ?

(1) Wurtz reaction

(2) Hofmann method

(3) Hinsberg method

(4) Curtius reaction

77. Which of the following equations shows an unlikely main product ?

**78.** Which reaction conditions would best convert 3-hexyne to *trans*-3-hexene ?

(1) Fe/NaCl

(2) Lindlar's Pd catalyst and H_2

(3) Na in liquid NH_3

(4) DIBAL

79. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reaction (R). Read the statements and choose the correct answer using the code given below.

   Assertion (A) : Alkaline $KMNO_4$ cannot be used for oxidation of allyl alcohol to acrylic acid.

   Reason (R) : Hydroxylation and in some cases cleavage of $C = C$ bond also takes place.

   (1) Both (A) and (R) are true and (R) is the correct explanation of (A)

   (2) Both (A) and (R) are true, but (R) is not the correct explanation of (A)

   (3) (A) is true, but (R) is false

   (4) (A) is false, but (R) is true

80. Which of the following statements is true for the following transformation ?

   (1) I is the major product and it is a Cram product

   (2) I is the major product and it is a anti-Cram product

   (3) II is the major product and it is a Cram product

   (4) II is the major product and it is a anti-Cram product

81. CH_3CHO and $C_6H_5CH_2CHO$ can be destinguished chemically by :

   (1) Tollen's reagent test

   (2) Fehling solution test

   (3) Benedict test

   (4) Iodoform test

82. In the carbylamine reactino, R-X is converted to R-Y via the intermediate Z. R-X, R-Y and Z, respectively are :

   (1) $R\text{-}NH_2$, R-NC, carbene

   (2) $R\text{-}NH_2$, R-NC, nitrene

   (3) R-NC, $R\text{-}NH_2$, carbene

   (4) R-OH, R-NC, nitrene

83. Which of the following statements best describes a disconnection in retrosynthesis ?

    (1) A disconnection involves a theoretical disconnection of a bond in a target structure in order to identify simpler structures that could be linked through the formation of that bond

    (2) A disconnection involves identifying stages where a bond is split in the corresponding synthesis

    (3) A disconnection identifies retrosynthetic stages which would not be feasible in the corresponding synthesis

    (4) A disconnection describes the reaction conditions required to split a target structure into simpler molecules

84. What is meant by a reaction going in 94% enantiometric excess ?

    (1) The product contains 94% of one enantiomer and 6% of the other enantiomer

    (2) The product contains 94% of one enantiomer and 6% of other products

    (3) The product contains an enantiomer which is 94% pure

    (4) The product contains 97% of one enantiomer and 3% of the other enantiomer

85. If a prochiral ketone was converted enantioselectively to a chiral alcohol with a Grignard reagent under asymmetric conditions, which of the following statements would be *false* ?

    (1) The prochiral ketone has different groups linked to the carbonyl group

    (2) A chiral product would be obtained regardless of which Grignard reagent is used

    (3) The reaction centre is an sp^2 hybridised carbon

    (4) "Nucleophilic attack by the Grignard reagent will be selective for one enantiotopic face over the other."
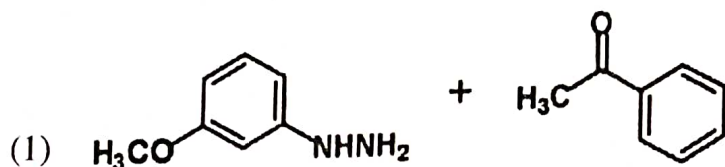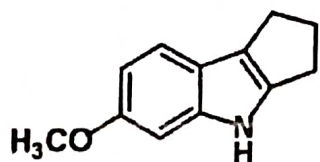
86. Which of the adducts (1)-(4) is the main kinetic product of the following Diels-Alder reaction ?
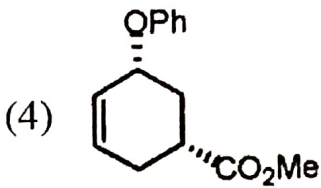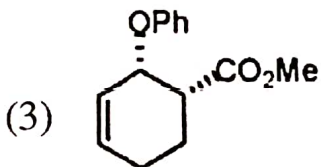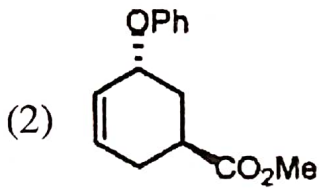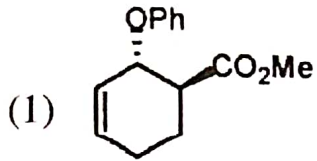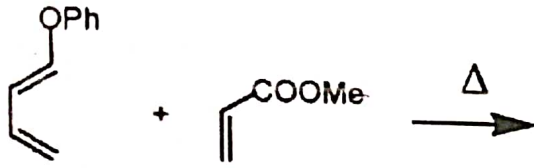
87. Which of the following reactions is classified as a sigmatropic rearrangement ?
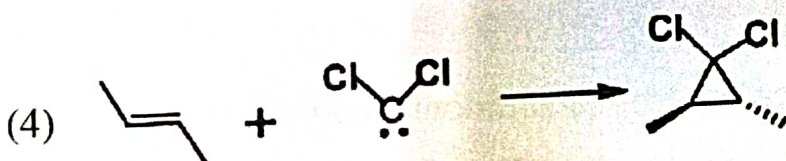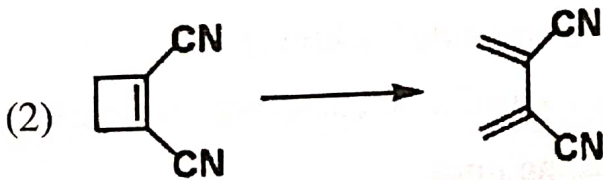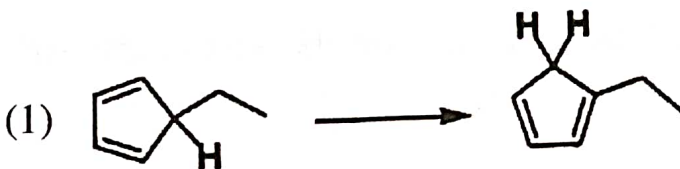
88. From what starting materials could you make the following compound ?

(1)

(2)

(3)

(4)
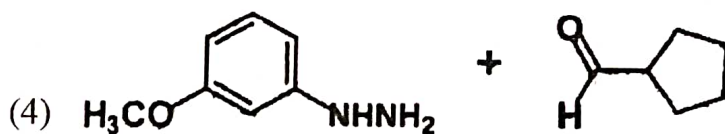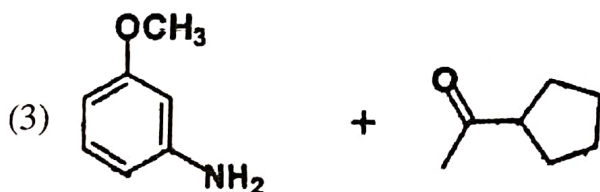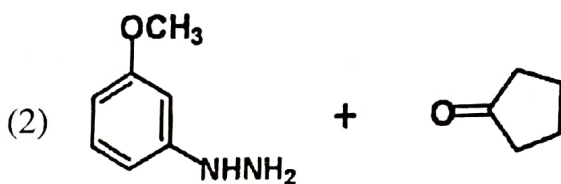
89. Which of the following factors has the least influence on the secondary and tertiary structures of proteins ?

(1) the achiral nature of glycine units.

(2) steric hindrance of bulky side-chai ns on the peptide backbone.

(3) hydrogen bonding of C=O to N-H groups located near each other in space.

(4) conformational restriction imposed by proline units.

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

(1) Natural fatty acids contain even numbers of carbon atoms.

(2) Diterpenes contain 10 carbons.

(3) Eicosanoids have structures derived from arachidonic acid.

(4) Arachidonic acid is a C_{20} unsaturated carboxylic acid.

96. Select the *incorrect* statement from the following options.

    (1) Self-assembly is a top-down manufacturing technique

    (2) In self-assembly, weak interactions play very important role

    (3) Self assembling molecules adopt an organized structure which is thermodynamically more stable than the single, unassembled components.

    (4) Compared to the isolated components, the self-assembled structure has a higher order

97. This 'green' chemical is used in in household cleaners to remove stains and is also a favourite dressing on salads ! :

    (1) Vineger (acetic acid)   (2) Citric acid

    (3) Hydrochloric acid (HCl)   (4) Water

98. Which of the following statements is *true* ?

    (1) Drugs and drug targets generally have similar molecular weights

    (2) Drugs are generally smaller than drug targets

    (3) Drugs are generally larger than drug targets

    (4) There is no general rule regarding the relative size of drugs and their targets

99. What type of guest would a crown ether be able to bind ?

    (1) Cations   (2) Netural species

    (3) Anions   (4) Zwitterions

100. Bio-polymers exemplify a Green Chemistry Principle (of utmost importance for the environment) that can be best expressed as :

    (1) Catalysis   (2) Prevent waster

    (3) Benign solvents & auxiliaries   (4) Design for degradation

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

B

PHD/URS-EE-DEC-2022

SET-Y

SUBJECT : Chemistry

10034

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)

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.*

PHD/URS-EE-2022/(Chemistry)(SET-Y)/(B)

B

1. The given compound is isolobal with $[Rh_6(CO)_{16}]$
   (1) $C_2B_{10}H_{12}$

(2) $C_2B_6H_{10}$
   (3) $[Fe_4(CO)_{12}C]^{2-}$

(4) B_5H_{13}

2. The first ionization potential of Na is 5.1 eV. The value of electron gain enthalpy of Na^+ will be :

   (1) −2.55 eV

(2) − 5.1 eV

(3) −11.4 eV

(4) + 2.50 eV

3. Egyptian blue $CaCuSi_4O_{10}$ is an example of :

   (1) Cyclic silicate

(2) Sheet silicate

(3) Pyrosilicate

(4) Chain silicate

4. Which one of the oxide is neutral ?
   (1) CO

(2) SnO_2

(3) ZnO

(4) SiO_2

5. In compound $N_3P_3F_6$, the geometry around nitrogen and phosphorus, respectively are :

   (1) Pyramidal and tetrahedral

(2) Planar and tetrahedral

   (3) Pyramidal and planar

(4) Planar and trigonalbipyramidal

6. In photosynthetic systems the redox metalloproteins involved in electron transfer are cytochrome b (Cyt b), Cytochrome bf complex (Cyt bf) and plastocyanin (PC). The pathway of electron flow is :

   (1) PC → Cyt b → Cyt bf

(2) Cyt bf → Cyt b → PC

   (3) Cyt b → Cyt bf → PC

(4) PC → Cyt bf → Cyt b

7. Molybdoenzyme can both oxidize as well as reduce the substrate, because :

   (1) Mo (VI) is more stable than Mo (IV)

   (2) Mo (IV) can transfer oxygen atom to the substrate and Mo(VI) can abstract oxygen atom from substrate

   (3) Conversion of Mo(VI) to Mo(IV) is not favoured

   (4) Mo(VI) can transfer oxygen atom to the substrate and Mo(IV) can abstract oxygen atom from the substrate

P. T. O.

8. The ligand system present in Vitamin B_{12} is :

   (1) Porphyrin   (2) Corrin   (3) Phthalocyanine (4) Crown ether

9. Mercury and its compounds are toxic due to their :

   (1) high affinity for thiols   (2) interference with oxygen transport

   (3) Binding to histidines   (4) Inhibition of vitamin B_{12}

10. Match the items in **Column-A** with the appropriate items in **Column-B** :

	Column-A			**Column-B**
A	Metallothioneins		(i)	Cis $[Pd(NH_3)_2 Cl_2]$
B	Plastocyanin		(ii)	Cystein rich protein
C	Ferritin		(iii)	Electron transfer
D	Chemotherapy		(iv)	Iron transport
			(v)	Iron storage
			(vi)	Carboplatin

    The *correct* answer is :

    (1) A-(iii), B-(ii), C-(v), D-(iv)
    (2) A-(ii), B-(iii), C-(iv), D-(i)
    (3) A-(ii), B-(iii), C-(v), D-(vi)
    (4) A-(iii), B-(v), C-(vi), D-(ii)

11. You have three dyes. One is green, one is blue and one is yellow. Which absorbs the shortest wavelength of visible light, and which absorbs the longest ?

    (1) longest = yellow, shortest = blue
    (2) longest = blue; shortest = green
    (3) longest = yellow; shortest = green
    (4) longest = green; shortest = yellow

12. Which C=O function has the lowest stretching frequency in the infrared spectrum ?

    (1) acyl chloride
    (2) aldeyde
    (3) amide
    (4) ester

13. The two sharp signals that constitute the resonance marked A have chemical shifts of 7.82 and 7.95 at 100 MHz. What is the coupling constant, J, for this doublet ?

(1) 0.13 MHz (2) 11.7 Hz (3) 11.7 MHz (4) 13 Hz

14. Which of the following statements regarding mass spectrometry is wrong ?

(1) In a normal mass spectrometer, electron impact causes a molecule to lose an electron and become a molecular radical cation which decomposes into fragment cations and radicals.

(2) Only cations can be detected by a normal mass spectrometer.

(3) A compound whose molecules contain just one bromine atom shows two molecular ion peaks of similar intensity, one at +1 and one at −1 of the average m/z value.

(4) Molecular ion peaks always have even-numbered values of m/z.

15. A $C_5H_{12}O_2$ compound has strong infrared absorption at 3300 to 3400 cm^{-1}. The ^1H NMR spectrum has three singlets at δ 0.9, δ 3.45, and δ 3.2 ppm; relative areas 3 : 2 : 1. Addition of D_2O to the sample eliminates the lower field signal. The ^{13}C NMR spectrum show three signals all at higher field than δ 100 ppm.

Which of the following compounds best fits this data ?

(1) 1, 5-pentanediol (2) 1, 3-dimethoxypropane

(3) 2, 2-dimethyl-1, 3-propanediol (4) 2, 4-pentanediol

16. Select the *incorrect* statement from the following options.

(1) Self-assembly is a top-down manufacturing technique

(2) In self-assembly, weak interactions play very important role

(3) Self assembling molecules adopt an organized structure which is thermodynamically more stable than the single, unassembled components.

(4) Compared to the isolated components, the self-assembled structure has a higher order

17. This 'green' chemical is used in in household cleaners to remove stains and is also a favourite dressing on salads ! :

   (1) Vineger (acetic acid)

   (2) Citric acid

   (3) Hydrochloric acid (*HCl*)

   (4) Water

18. Which of the following statements is *true* ?

   (1) Drugs and drug targets generally have similar molecular weights

   (2) Drugs are generally smaller than drug targets

   (3) Drugs are generally larger than drug targets

   (4) There is no general rule regarding the relative size of drugs and their targets

19. What type of guest would a crown ether be able to bind ?

   (1) Cations

   (2) Netural species

   (3) Anions

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20. Bio-polymers exemplify a Green Chemistry Principle (of utmost importance for the environment) that can be best expressed as :

   (1) Catalysis

   (2) Prevent waster

   (3) Benign solvents & auxiliaries

   (4) Design for degradation

21. Which of the following statements is *not* an essential feature of an optically active compound ?

   (1) the molecules of an optically active compound will be dissymetric or asymmetric

   (2) the molecules of an optically active molecule must have at least one stereogenic site

   (3) an optically active compound's molecular configuration will not be identical with its mirror image

   (4) an optically active compounds will have at least one stereoisomer

B

22. Identify the aromatic compound(s) amongst I to III :
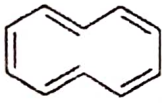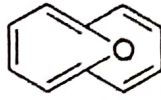
I   II   III
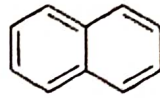
(1) I, II and III   (2) I and II only

(3) II and III only   (4) I and III only

23. The stability of carbanions in the following is in the order of :
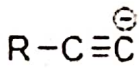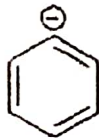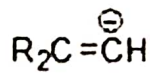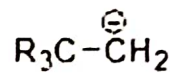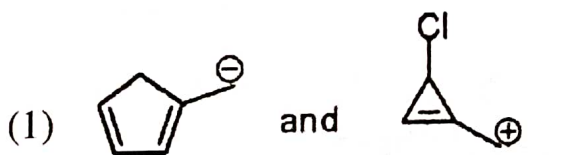

a   b   c   d

(1) $a > c > b > d$ (2) $a > b > c > d$

(3) $b > c > d > a$ (4) $d > b > c > a$

**24.** The products P and Q in the following reactions, respectively, are :

(1)

(2)

(3)

(4)
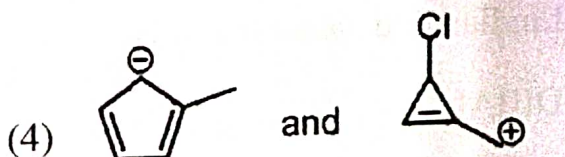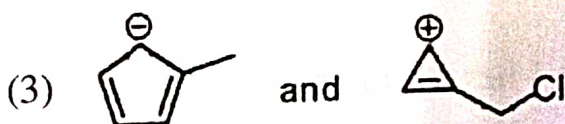
25. The radical halogenation of 2-methylpropane gives two products : $(CH_3)_2 CHCH_2X$ (minor) and $(CH_3)_3CX$ (major). Chlorination gives a larger amount of the minor product than does bromination, Why ?

   (1) Bromine is more reactive than chlorine and is able to attack the less reactive 3° C-H.

   (2) Bromine atoms are less reactive (more selective) than chlorine, and preferentially attack the weaker 3° C-H bond.

   (3) The methyl groups are more hindered to attack by the larger bromine atom.

   (4) Bromination is reversible and the more stable 3°-alkyl bromide is formed exclusively.

26. Which one of the following methods is neither meant for the synthesis nor for separation of amines ?

   (1) Wurtz reaction   (2) Hofmann method

   (3) Hinsberg method   (4) Curtius reaction

27. Which of the following equations shows an unlikely main product ?

   (1)

   (2)

   (3)

   (4)
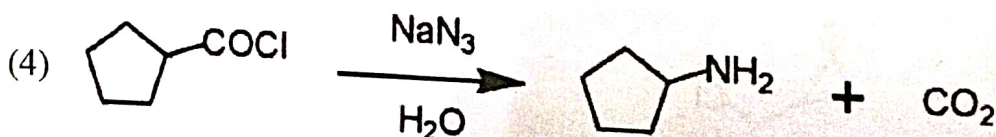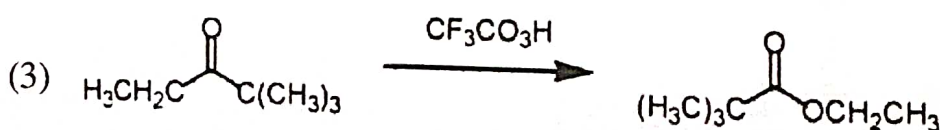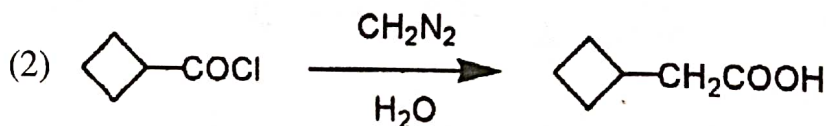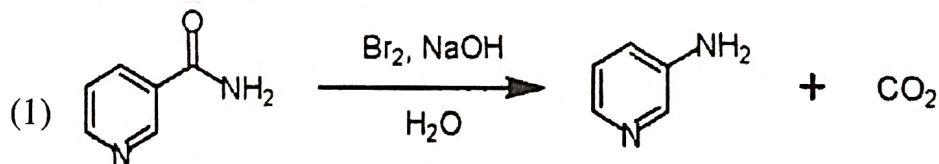
28. Which reaction conditions would best convert 3-hexyne to *trans*-3-hexene ?

   (1) Fe/NaCl

   (2) Lindlar's Pd catalyst and H_2

   (3) Na in liquid NH_3

   (4) DIBAL

29. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reaction (R). Read the statements and choose the correct answer using the code given below.

Assertion (A) : Alkaline $KMNO_4$ cannot be used for oxidation of allyl alcohol to acrylic acid.

Reason (R) : Hydroxylation and in some cases cleavage of $C = C$ bond also takes place.

(1) Both (A) and (R) are true and (R) is the correct explanation of (A)

(2) Both (A) and (R) are true, but (R) is not the correct explanation of (A)

(3) (A) is true, but (R) is false

(4) (A) is false, but (R) is true

30. Which of the following statements is true for the following transformation ?
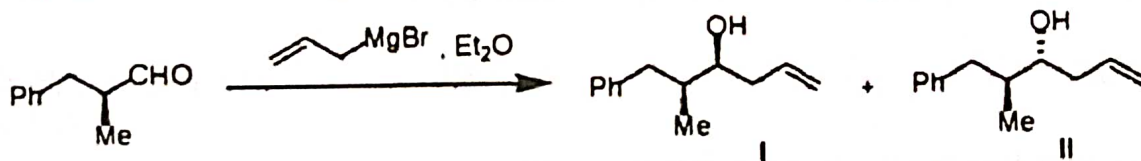
(1) I is the major product and it is a Cram product

(2) I is the major product and it is a anti-Cram product

(3) II is the major product and it is a Cram product

(4) II is the major product and it is a anti-Cram product

31. Saxen's relation is :

(1) $\left(\dfrac{\Delta P}{\Delta \phi}\right)_{J=0} = \left(\dfrac{J}{I}\right)_{\Delta\phi=0}$

(2) $\left(\dfrac{\Delta P}{\Delta \phi}\right)_{J=0} = \left(\dfrac{I}{J}\right)_{\Delta\phi=0}$

(3) $\left(\dfrac{\Delta P}{\Delta \phi}\right)_{J=0} = -\left(\dfrac{I}{J}\right)_{\Delta\phi=0}$

(4) None of these

32. The surface tension of dilute solution of a solute varies linearly with solute concentration C_2 as $r = r_0 - ac_2$, where r_0 is the surface tension of the solvent and 'a' is a constant. Predict correct relation :

(1) $\Gamma_2 = (r_0 - r)/RT$

(2) $\Gamma_2 = \dfrac{(r - r_0)}{RT}$

(3) $F_2 = r_0 - r$

(4) $\Gamma_4 = r - r_0$

33. Miscelles from ionic surfactants can be formed only above a certain temperature called :

(1) Critical temperature

(2) Kraft temperature

(3) Inversion temperature

(4) Boyle temperature

34. The Miller indices of crystal plane which cut through crystal axes at $(6a, 3b, 3c)$ are :

(1) (2 1 2)

(2) (2 2 1)

(3) (1 2 2)

(4) None of these

35. A crystal which possesses no element of symmetry is :

(1) $NaCl$

(2) KCl

(3) $CsCl$

(4) $CuSO_4.5H_2O$

36. If two operators commute, then they are/have :
(1) Linear
(2) Same Eigen functions
(3) Same Eigen values
(4) Hermitian

37. Which of the following point groups doesn't posses centre of Inversion ?
(1) D_{6h}
(2) D_{4h}
(3) D_{2h}
(4) T_d

38. H_2O molecule belongs to point group :
(1) C_{2v}
(2) C_{3v}
(3) D_{2d}
(4) D_{3h}

39. The antiferromagnetic transition occur at :

(1) Curie temperature

(2) Neel temperature

(3) Critical temperature

(4) None of these

40. How many normal modes of vibration are possible for benzene molecule ?

    (1) 11   (2) 8   (3) 30   (4) 12

41. Wilkinson's catalyst is used for :

    (1) Hydrogenation   (2) Epoxidation

    (3) Polymerization   (4) Metathesis reaction

42. Bond order is lowest in :

    (1) Uncoordinated CO

    (2) CO bounded to one metal

    (3) CO bridging two metals

    (4) CO bridging three metals

43. The correct reagents/catalysts for carrying out the Suzuki reaction with p-bromo anisole are :

    (1) Styrene, Pd and a base

    (2) Phenylacetylene, Pd and CuI

    (3) $PhB(OH)_2$, Na_2CO_3 and $Pd(O)$

    (4) Tetraallyltin, $Pd(PPh_3)_4$

44. If the walls of a one-dimensional box are suddenly removed, then :

    (1) particle in a box doesn't obey wave equation

    (2) particle has continuous energy spectrum

    (3) particle vanishes into thin air

    (4) none of the above

45. Using Huckel-moleclar orbital theory, secular determinant equation for ethylene molecule is expressed as :

(1) $\begin{vmatrix} 1 & x \\ 1 & x \end{vmatrix} = 0$ (2) $\begin{vmatrix} x & x \\ 1 & x \end{vmatrix} = 0$ (3) $\begin{vmatrix} x & 1 \\ 1 & x \end{vmatrix} = 0$ (4) $\begin{vmatrix} x & 1 \\ -1 & x \end{vmatrix} = 0$

where $x = \dfrac{\alpha - E}{\beta}$; α, β are columbic and resonance integral respectively.

46. Which one of the following relations is **correct** ?

(1) $\left[\hat{L}^2, \hat{L}_z\right] = 0$ (2) $\left[\hat{L}_x, \hat{L}_y\right] = i\hbar\hat{L}_x$ (3) $\left[\hat{L}, \hat{L}_z\right] = 0$ (4) $\left[\hat{L}, \hat{L}_y\right] = i\hbar\hat{L}_y$

47. According to Einstein-Smoluchowski equation, the root mean square distance travelled by diffusing molecule is given by :

(1) $<x^2>^{\frac{1}{2}} = 2Dt$

(2) $<x^2>^{\frac{1}{2}} = (2Dt)^3$

(3) $<x^{\frac{1}{2}}>^{\frac{1}{2}} = (2Dt)^{1/3}$

(4) $<x^2>^{\frac{1}{2}} = (2Dt)^{1/2}$

where D is the diffusion coefficient.

48. Polydisperity index (PI) of a polymer molecule is given by :

(1) $PI = M_w - M_n$

(2) $PI = \dfrac{M_w}{M_n}$

(3) $PI = M_w + M_n$

(4) $PI = M_w M_n$

49. For an isentropic change of state :

(1) $d\epsilon = 0$ (2) $dH = 0$ (3) $dS = 0$ (4) $dS = 1$

50. Equivalent conductance for Alkali metal cations vary in the order :

(1) $Li^+ > Na^+ > K^+ > Rb^+$

(2) $Rb^+ > Na^+ \approx K^+ > Li^+$

(3) $Rb^+ > K^+ > Na^+ > Li^+$

(4) $Rb^+ > Li^+ > Na^+ > K^+$

51. Generally the coordination number and the nature of electronic absorption band [(f – f) transition] of lanthanide (III) ion in their complexes are :

   (1) greater than 6 & sharp

   (2) 6 and broad

   (3) less than 6 & sharp

   (4) greater than 6

52. The enrichment of Uranium is carried out in the form of :

   (1) VO_2^{3+}

   (2) VO_2^{2+}

   (3) UF_6

   (4) $[U(acac)_3]^{3+}$

53. The coordination number of Gd in $GdCl_3.6H_2O$ is :

   (1) 3

   (2) 6

   (3) 8

   (4) 9

54. Among the following, strongest oxidizing agent is :

   (1) $[WO_4]^{-2}$

   (2) $[MoO_4]^{-2}$

   (3) $[Cr(O_4)]^{2-}$

   (4) $[ReO_4]^-$

55. The mechanism of reaction between $[Fe(CN)_6]^{4-}$ and $[Fe(bpy)_3]^{3+}$ (bpy = 2, 2' bipyridine) :

   (1) Outer sphere electron transfer

   (2) Inner sphere electron transfer

   (3) Self exchange reaction

   (4) Ligand exchange followed by electron transfer

56. On two sequential electron capture, $_{56}Ba^{131}$ will given :

   (1) $_{54}Xe^{131}$

   (2) $_{54}Xe^{130}$

   (3) $_{56}Ce^{131}$

   (4) $_{56}Ce^{130}$

57. The pH obtained by mixing 10 mL of 0.1 M HCl and 40 mL of 0.2 M H_2SO_4 is :

   (1) 0.47

   (2) 0.68

   (3) 4.0

   (4) 3.7

58. In the reaction : $Cl_2 + ClF + SbF_5 \rightarrow [Cl_3][SbF_6]$ the role of chlorine is to :

(1) Stabilize Cl^+

(2) Function as Lewis base

(3) Function as Lewis acid

(4) Form the cation

59. H_3BO_3 is :

(1) Monobasic acid and weak lewis acid

(2) Monobasic and weak Bronsted acid

(3) Monobasic and strong lewis acid

(4) Tribasic and weak Bronsted acid

60. Which of the following metal ions have highest mobility in biological media ?

(1) Zn (II), Ni (II)　　　　　　　　(2) Fe(II), Cu(II)

(3) Na(I), K(I)　　　　　　　　　　(4) Mg(II), Ca(II)

61. The coefficient of thermal expansion, α is defined by :

(1) $\alpha = \dfrac{1}{V}\left(\dfrac{\partial V}{\partial T}\right)_P$

(2) $\alpha = \left(\dfrac{\partial V}{\partial T}\right)_P$

(3) $\alpha = V\left(\dfrac{\partial V}{\partial T}\right)_P$

(4) $\alpha = \dfrac{1}{T}\left(\dfrac{\partial V}{\partial P}\right)_T$

62. Magnetogyric ratio, r is expressed by :

(1) $r = \dfrac{L}{\mu_m}$　　　(2) $r = \dfrac{\mu_m}{L}$　　　(3) $r = \mu_m \times L$　　　(4) $r = \mu_m + L$

where μ_m and L represent magnetic moment and orbital angular momentum respectively.

63. The NMR signal for a compound is found to be 240 Hz downfield from TMS peak using spectrometer at 60 MHz. The chemical shift relative to TMS will be :

    (1) 6 ppm   (2) 8 ppm   (3) 4 ppm   (4) 0.4 ppm

64. Which of the following is a *false* statement ?

    (1) Maximum electric work is obtained from a cell which operates reversibly

    (2) Use of KCl in Agar bridge minimize liquid junction potential

    (3) Quinhydrone electrode is not suitable for pH measurement in strongly alkaline solution

    (4) The standard electrode potential of hydrogen electrode is not zero at all temperature

65. The fundamental vibrational frequency of CO molecule is 2170 cm^{-1}. The force constant of CO molecule will be :

    (1) $4\pi^2 C^2 \mu (2170)^2 \times 10^4$ (2) $4\pi^2 C \mu^2 (2170)^2 10^4$

    (3) $4\pi^2 C^2 \mu^2 (2170)$ (4) $4\pi^2 C^2 \mu (2170)$

    All notations have their usual meanings.

66. According to Debye-Huckel theory of strong electrolystes, increase in conductivity on dilution is because of :

    (1) Incresae in number of ions

    (2) Increase in mobility of ions

    (3) Increase in viscosity of the solution

    (4) Increase in volume of the solution

67. The electronic partition function of an atom where atomic state is $^2D_{3/2}$ is :

    (1) 2   (2) 3   (3) 4   (4) 5

68. The number of micro states for distributing three different atoms among quantum states comprised of three quanta of energy are :

    (1) 10   (2) 3   (3) 8   (4) 4

69. In ionic polymerization, living polymer is formed when :

(1) Propagation reactions don't occur

(2) Initiation reactions occur faster than termination reactions

(3) Amino acids are used as monomers

(4) Termination reactions don't occur

70. The region of an infrared spectrum where many absorptions take place is known as :

(1) Thumbprint region   (2) Fingerprint region

(3) Handprint region   (4) Footprint region

71. Molecular orbital theory :

(1) Underestimates the importance of covalent structure

(2) Overestimates the importance of ionic structures

(3) Puts equal importance to both ionic and covalent structures

(4) None of the above

72. Which of the following wave function is normalized ?

(1) $\psi = \frac{1}{\sqrt{2}}(\phi_1 + \phi_2)$

(2) $\psi = \frac{1}{\sqrt{3}}(\phi_1 + \phi_2)$

(3) $\psi_1 = \frac{1}{\sqrt{2}}(\phi_1 + \phi_2 + \phi_3)$

(4) $\psi = \frac{1}{3}(\phi_1 + \phi_2)$

73. Milk is a/an :

(1) Suspension   (2) Pure solution   (3) Gel   (4) Emulsion

74. Rotational partition function is related to energy by relation :

(1) $E_{rot} = RT^2 \left[\frac{\partial q}{\partial T} \right]$

(2) $E_{rot} = RT^2 \left[\frac{\partial}{\partial T} \ln q_{rot} \right]$

(3) $E_{rot} = \frac{\partial}{\partial T} \ln q_{rot}$

(4) $E_{rot} = RT^2 . \ln . q_{rot}$

75. Stirling approximation applicable to large number of atoms is :

(1) $\ln N! = N - N \ln N$

(2) $\ln N! = N \ln N$

(3) $\ln N! = N \ln N - N$

(4) $\ln N! = N \ln N + N$

76. Entropy is related to probability by relation :

(1) $S = R\ln W$

(2) $S = kW$

(3) $S = \ln W$

(4) $S = k\ln W$

77. Compunds given below may be named as :
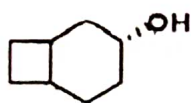
(1) (3R)-bicyclo [4.2.0] octan-3-ol

(2) (3S)-bicyclo [2.4.0] octan-3-ol

(3) (3R)-bicyclo [4.2.0] octan-6-ol

(4) (3S)-bicyclo [2.4.0] octan-6-ol

78. Compound given below may be named as :
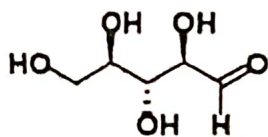
(1) (2S,3S,4S)-2,3,4,5-tetrahydroxypentanal

(2) (2R,3S,4R)-2,3,4,5-tetrahydroxypentanal

(3) (2R,3R,4R)-2,3,4,5-tetrahydroxypentanal

(4) (2S,3R,4R)-2,3,4,5-tetrahydroxypentanal

79. α-D-Glucopyranose and β-D Glucopyranose are :

(1) Anomers

(2) Epimer

(3) Diasteromers

(4) Meso compounds

80. Which of the confomations of n-butane is least stable ?

(1) Gauche

(2) Anti

(3) Eclipsed

(4) Fully eclipsed

81. Gelatin added during polarographic measurement carried out using dropping mercury electrode :
    (1) Reduced streaming motion of mercury drop
    (2) Decreases viscosity of the solution
    (3) Eliminates migrating current
    (4) Prevents oxidation of mercury

82. Gel permeation chromatography can be used to separate which of the following ?
    (a) Lanthanides
    (b) Alkaline earths
    (c) Fatty acids
    (d) Low molecular weight peptides
    Correct answer is :
    (1) (a) & (b)　　　(2) (b) & (c)　　　(3) (c) & (d)　　　(4) (a) & (d)

83. In the EPR spectrum of a methyl radical the number of lines and their relative intensities, respectively are :
    (1) 1 and 1
    (2) 3 and 1 : 2 : 1
    (3) 4 and 1 : 2 : 2 :1
    (4) 4 and 1 : 3 : 3 : 1

84. Mossbauer spectrum of complex [Fe(1, 10 phenanthroline)$_2$ (NCS)$_2$] shows two lines at 300K four lines at 186 K and again two lines at 77 K. This can be attributed to :
    (a) Change in coordination mode of NCS
    (b) Change in spin state of Iron
    (c) cis-trans isomerism
    (d) Change in metal ligand bond distance
    Correct statements are :
    (1) (a) & (b)　　　(2) (b) & (c)　　　(3) (a) & (c)　　　(4) (b) & (d)

85. The *correct* statement for the molecule CsI_3 is :
    (1) It is a covalent molecule
    (2) It contains Cs^+ and I_3^- ions
    (3) It contains Cs^{+3} and I^- ions
    (4) It contains Cs^+, I^- and lattice I_2 molecule

86. In compounds of type ECl_3, where $E = B, P, As$ and Bi the angles $Cl - E - Cl$:
    (1) $B > P = As = Bi$
    (2) $B > P > As > Bi$
    (3) $B < P = As = Bi$
    (4) $B < P < As < Bi$

87. Active catalytic species for hydroformylation is :

(1) $RuCl_2(PPh_3)_3$

(2) $HCo(CO)_3$

(3) $RhCl(PPh_3)_3$

(4) K_2PtCl_6

88. The correct order of energy level of d-orbital in ferrocene is :

(1) $d_{x^2-y^2}, d_{xy} < d_{z^2} < d_{xz}, d_{yz}$

(2) $d_{z^2} < d_{xz} d_{yz} < d_{x^2-y^2} < d_{xy}$

(3) $d_{x^2-y^2}, d_{xy} < d_{xz} d_{yz} < d_{z^2}$

(4) $d_{yz}, d_{xz} < d_{x^2-y^2}, d_{xy} < d_{z^2}$

89. The major product obtained in the reaction of iodobenzene with styrene in presence of palladium acetate and potassium carbonate is :

(1) 1,2-diphenylethene

(2) 1,2-diphenylethyne

(3) 1, 2-diphenylethane

(4) 4-phenylstyrene

90. The cluster having arachano type structure is :

(1) $[Os_5(CO)_{16}]$

(2) $[Os_3(CO)_{12}]$

(3) $[Ir_4(CO)_{12}]$

(4) $[Rh_6(CO)_{16}]$

91. CH_3CHO and $C_6H_5CH_2CHO$ can be destinguished chemically by :

(1) Tollen's reagent test

(2) Fehling solution test

(3) Benedict test

(4) Iodoform test

92. In the carbylamine reactino, R-X is converted to R-Y via the intermediate Z. R-X, R-Y and Z, respectively are :

(1) $R-NH_2$, R-NC, carbene

(2) $R-NH_2$, R-NC, nitrene

(3) R-NC, $R-NH_2$, carbene

(4) R-OH, R-NC, nitrene

93. Which of the following statements best describes a disconnection in retrosynthesis ?

(1) A disconnection involves a theoretical disconnection of a bond in a target structure in order to identify simpler structures that could be linked through the formation of that bond

(2) A disconnection involves identifying stages where a bond is split in the corresponding synthesis

(3) A disconnection identifies retrosynthetic stages which would not be feasible in the corresponding synthesis

(4) A disconnection describes the reaction conditions required to split a target structure into simpler molecules

94. What is meant by a reaction going in 94% enantiometric excess ?

(1) The product contains 94% of one enantiomer and 6% of the other enantiomer

(2) The product contains 94% of one enantiomer and 6% of other products

(3) The product contains an enantiomer which is 94% pure

(4) The product contains 97% of one enantiomer and 3% of the other enantiomer

95. If a prochiral ketone was converted enantioselectively to a chiral alcohol with a Grignard reagent under asymmetric conditions, which of the following statements would be *false* ?

(1) The prochiral ketone has different groups linked to the carbonyl group

(2) A chiral product would be obtained regardless of which Grignard reagent is used

(3) The reaction centre is an sp^2 hybridised carbon

(4) "Nucleophilic attack by the Grignard reagent will be selective for one enantiotopic face over the other."
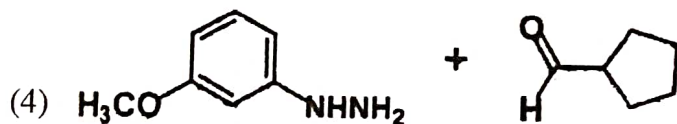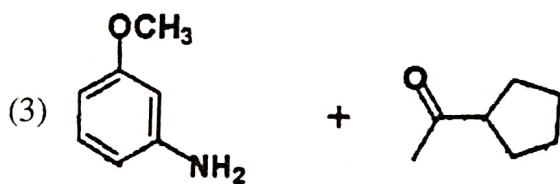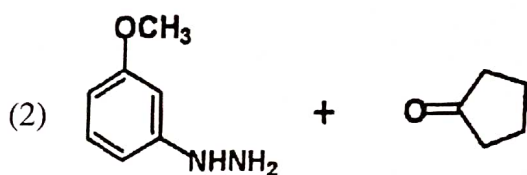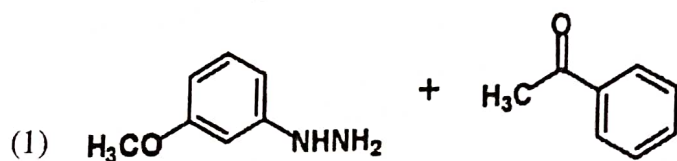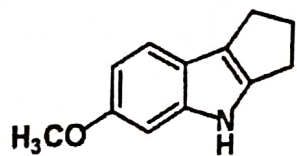
96. Which of the adducts (1)-(4) is the main kinetic product of the following Diels-Alder reaction ?
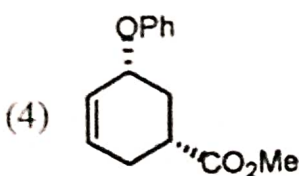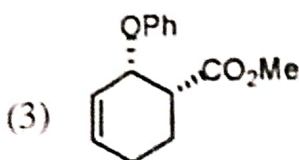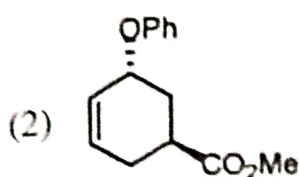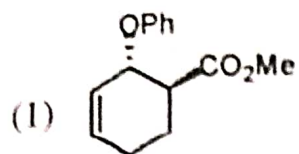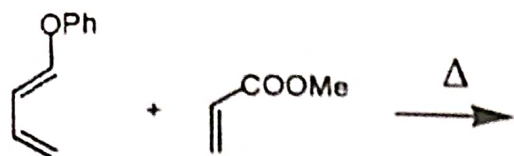
(1)

(2)

(3)

(4)

97. Which of the following reactions is classified as a sigmatropic rearrangement ?

(1)

(2)

(3)

(4)

20
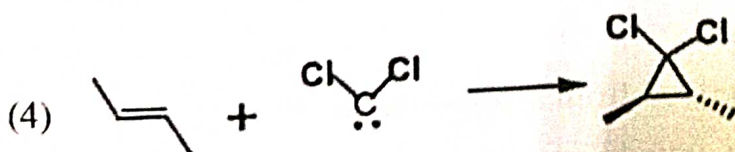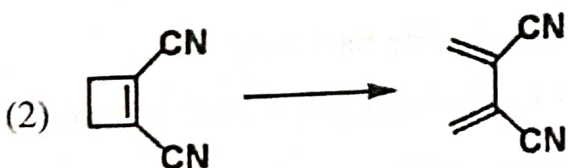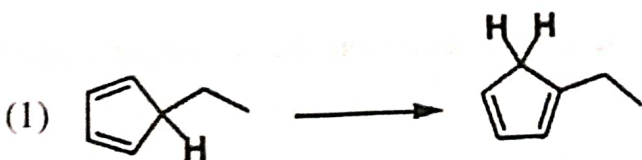
98. From what starting materials could you make the following compound ?

(1) +

(2) +

(3) +

(4) +

99. Which of the following factors has the least influence on the secondary and tertiary structures of proteins ?

(1) the achiral nature of glycine units.

(2) steric hindrance of bulky side-chai ns on the peptide backbone.

(3) hydrogen bonding of C=O to N-H groups located near each other in space.

(4) conformational restriction imposed by proline units.

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

(1) Natural fatty acids contain even numbers of carbon atoms.

(2) Diterpenes contain 10 carbons.

(3) Eicosanoids have structures derived from arachidonic acid.

(4) Arachidonic acid is a C_{20} unsaturated carboxylic acid.

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

C

PHD/URS-EE-DEC-2022

SET-Y

SUBJECT : Chemistry

10031

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)

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.

PHD/URS-EE-2022/(Chemistry)(SET-Y)/(C)

C

1. The coefficient of thermal expansion, α is defined by :

   (1) $\alpha = \dfrac{1}{V}\left(\dfrac{\partial V}{\partial T}\right)_P$

   (2) $\alpha = \left(\dfrac{\partial V}{\partial T}\right)_P$

   (3) $\alpha = V\left(\dfrac{\partial V}{\partial T}\right)_P$

   (4) $\alpha = \dfrac{1}{T}\left(\dfrac{\partial V}{\partial P}\right)_T$

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   (2) $r = \dfrac{\mu_m}{L}$

   (3) $r = \mu_m \times L$

   (4) $r = \mu_m + L$

   where μ_m and L represent magnetic moment and orbital angular momentum respectively.

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   (2) Use of KCl in Agar bridge minimize liquid junction potential

   (3) Quinhydrone electrode is not suitable for pH measurement in strongly alkaline solution

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   (1) $4\pi^2 C^2 \mu (2170)^2 \times 10^4$

   (2) $4\pi^2 C \mu^2 (2170)^2 10^4$

   (3) $4\pi^2 C^2 \mu^2 (2170)$

   (4) $4\pi^2 C^2 \mu (2170)$

   All notations have their usual meanings.

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C

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    (1) Incresae in number of ions

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    (1) 2   (2) 3   (3) 4   (4) 5

8. The number of micro states for distributing three different atoms among quantum states comprised of three quanta of energy are :

    (1) 10   (2) 3   (3) 8   (4) 4

9. In ionic polymerization, living polymer is formed when :

    (1) Propagation reactions don't occur

    (2) Initiation reactions occur faster than termination reactions

    (3) Amino acids are used as monomers

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10. The region of an infrared spectrum where many absorptions take place is known as :

    (1) Thumbprint region   (2) Fingerprint region

    (3) Handprint region   (4) Footprint region

11. Generally the coordination number and the nature of electronic absorption band [(f – f) transition] of lanthanide (III) ion in their complexes are :

    (1) greater than 6 & sharp   (2) 6 and broad

    (3) less than 6 & sharp   (4) greater than 6

12. The enrichment of Uranium is carried out in the form of :

    (1) VO_2^{3+} (2) VO_2^{2+} (3) UF_6 (4) $[U(acac)_3]^{3+}$

13. The coordination number of Gd in $GdCl_3.6H_2O$ is :

    (1) 3   (2) 6   (3) 8   (4) 9

14. Among the following, strongest oxidizing agent is :

    (1) $[WO_4]^{-2}$ (2) $[MoO_4]^{-2}$

    (3) $[Cr(O_4)]^{2-}$ (4) $[ReO_4]^-$

15. The mechanism of reaction between $[Fe(CN)_6]^{4-}$ and $[Fe(bpy)_3]^{3+}$ (bpy = 2, 2' bipyridine) :

    (1) Outer sphere electron transfer

    (2) Inner sphere electron transfer

    (3) Self exchange reaction

    (4) Ligand exchange followed by electron transfer

16. On two sequential electron capture, $_{56}Ba^{131}$ will given :

    (1) $_{54}Xe^{131}$ (2) $_{54}Xe^{130}$ (3) $_{56}Ce^{131}$ (4) $_{56}Ce^{130}$

17. The pH obtained by mixing 10 mL of 0.1 M HCl and 40 mL of 0.2 M H_2SO_4 is :

    (1) 0.47   (2) 0.68   (3) 4.0   (4) 3.7

18. In the reaction : $Cl_2 + ClF + SbF_5 \rightarrow [Cl_3][SbF_6]$ the role of chlorine is to :

    (1) Stabilize Cl^+

    (2) Function as Lewis base

    (3) Function as Lewis acid

    (4) Form the cation

4

19. H_3BO_3 is :

   (1) Monobasic acid and weak lewis acid

   (2) Monobasic and weak Bronsted acid

   (3) Monobasic and strong lewis acid

   (4) Tribasic and weak Bronsted acid

20. Which of the following metal ions have highest mobility in biological media ?

   (1) Zn (II), Ni (II)

   (2) Fe(II), Cu(II)

   (3) Na(I), K(I)

   (4) Mg(II), Ca(II)

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   (1) Reduced streaming motion of mercury drop

   (2) Decreases viscosity of the solution

   (3) Eliminates migrating current

   (4) Prevents oxidation of mercury

22. Gel permeation chromatography can be used to separate which of the following ?

   (a) Lanthanides

   (b) Alkaline earths

   (c) Fatty acids

   (d) Low molecular weight peptides

   Correct answer is :

   (1) (a) & (b)   (2) (b) & (c)   (3) (c) & (d)   (4) (a) & (d)

23. In the EPR spectrum of a methyl radical the number of lines and their relative intensities, respectively are :

   (1) 1 and 1

   (2) 3 and 1 : 2 : 1

   (3) 4 and 1 : 2 : 2 :1

   (4) 4 and 1 : 3 : 3 : 1

C

24. Mossbauer spectrum of complex [Fe(1, 10 phenanthroline)₂ (NCS)₂] shows two lines at 300K four lines at 186 K and again two lines at 77 K. This can be attributed to :

   (a) Change in coordination mode of NCS

   (b) Change in spin state of Iron

   (c) cis-trans isomerism

   (d) Change in metal ligand bond distance

   Correct statements are :

   (1) (a) & (b)   (2) (b) & (c)   (3) (a) & (c)   (4) (b) & (d)

25. The *correct* statement for the molecule CsI_3 is :

   (1) It is a covalent molecule

   (2) It contains Cs^+ and I_3^- ions

   (3) It contains Cs^{+3} and I^- ions

   (4) It contains Cs^+, I^- and lattice I_2 molecule

26. In compounds of type ECl_3, where $E = B, P, As$ and Bi the angles $Cl - E - Cl$:

   (1) $B > P = As = Bi$ (2) $B > P > As > Bi$

   (3) $B < P = As = Bi$ (4) $B < P < As < Bi$

27. Active catalytic species for hydroformylation is :

   (1) $RuCl_2(PPh_3)_3$ (2) $HCo(CO)_3$

   (3) $RhCl(PPh_3)_3$ (4) K_2PtCl_6

28. The correct order of energy level of d-orbital in ferrocene is :

   (1) $d_{x^2-y^2}, d_{xy} < d_{z^2} < d_{xz}, d_{yz}$

   (2) $d_{z^2} < d_{xz} d_{yz} < d_{x^2-y^2} < d_{xy}$

   (3) $d_{x^2-y^2}, d_{xy} < d_{xz} d_{yz} < d_{z^2}$

   (4) $d_{yz}, d_{xz} < d_{x^2-y^2}, d_{xy} < d_{z^2}$

29. The major product obtained in the reaction of iodobenzene with styrene in presence of palladium acetate and potassium carbonate is :

   (1) 1,2-diphenylethene   (2) 1,2-diphenylethyne

   (3) 1, 2-diphenylethane   (4) 4-phenylstyrene

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30. The cluster having arachano type structure is :
   (1) $[Os_5(CO)_{16}]$
   (2) $[Os_3(CO)_{12}]$
   (3) $[Ir_4(CO)_{12}]$
   (4) $[Rh_6(CO)_{16}]$

31. You have three dyes. One is green, one is blue and one is yellow. Which absorbs the shortest wavelength of visible light, and which absorbs the longest ?
   (1) longest = yellow, shortest = blue
   (2) longest = blue; shortest = green
   (3) longest = yellow; shortest = green
   (4) longest = green; shortest = yellow

32. Which C=O function has the lowest stretching frequency in the infrared spectrum ?
   (1) acyl chloride
   (2) aldeyde
   (3) amide
   (4) ester

33. The two sharp signals that constitute the resonance marked A have chemical shifts of 7.82 and 7.95 at 100 MHz. What is the coupling constant, J, for this doublet ?
   (1) 0.13 MHz
   (2) 11.7 Hz
   (3) 11.7 MHz
   (4) 13 Hz

34. Which of the following statements regarding mass spectrometry is wrong ?

   (1) In a normal mass spectrometer, electron impact causes a molecule to lose an electron and become a molecular radical cation which decomposes into fragment cations and radicals.

   (2) Only cations can be detected by a normal mass spectrometer.

   (3) A compound whose molecules contain just one bromine atom shows two molecular ion peaks of similar intensity, one at +1 and one at –1 of the average m/z value.

   (4) Molecular ion peaks always have even-numbered values of m/z.

35. A $C_5H_{12}O_2$ compound has strong infrared absorption at 3300 to 3400 cm^{-1}. The ^1H NMR spectrum has three singlets at δ 0.9, δ 3.45, and δ 3.2 ppm; relative areas 3 : 2 : 1. Addition of D_2O to the sample eliminates the lower field signal. The ^{13}C NMR spectrum show three signals all at higher field than δ 100 ppm.
   Which of the following compounds best fits this data ?
   (1) 1, 5-pentanediol
   (2) 1, 3-dimethoxypropane
   (3) 2, 2-dimethyl-1, 3-propanediol
   (4) 2, 4-pentanediol

36. Select the *incorrect* statement from the following options.

(1) Self-assembly is a top-down manufacturing technique

(2) In self-assembly, weak interactions play very important role

(3) Self assembling molecules adopt an organized structure which is thermodynamically more stable than the single, unassembled components.

(4) Compared to the isolated components, the self-assembled structure has a higher order

37. This 'green' chemical is used in in household cleaners to remove stains and is also a favourite dressing on salads ! :

(1) Vineger (acetic acid)   (2) Citric acid

(3) Hydrochloric acid (*HCl*)   (4) Water

38. Which of the following statements is *true* ?

(1) Drugs and drug targets generally have similar molecular weights

(2) Drugs are generally smaller than drug targets

(3) Drugs are generally larger than drug targets

(4) There is no general rule regarding the relative size of drugs and their targets

39. What type of guest would a crown ether be able to bind ?

(1) Cations   (2) Netural species

(3) Anions   (4) Zwitterions

40. Bio-polymers exemplify a Green Chemistry Principle (of utmost importance for the environment) that can be best expressed as :

(1) Catalysis   (2) Prevent waster

(3) Benign solvents & auxiliaries   (4) Design for degradation

41. Molecular orbital theory :

(1) Underestimates the importance of covalent structure

(2) Overestimates the importance of ionic structures

(3) Puts equal importance to both ionic and covalent structures

(4) None of the above

8

42. Which of the following wave function is normalized ?

(1) $\psi = \dfrac{1}{\sqrt{2}}(\phi_1 + \phi_2)$

(2) $\psi = \dfrac{1}{\sqrt{3}}(\phi_1 + \phi_2)$

(3) $\psi_1 = \dfrac{1}{\sqrt{2}}(\phi_1 + \phi_2 + \phi_3)$

(4) $\psi = \dfrac{1}{3}(\phi_1 + \phi_2)$

43. Milk is a/an :

(1) Suspension   (2) Pure solution   (3) Gel   (4) Emulsion

44. Rotational partition function is related to energy by relation :

(1) $E_{rot} = RT^2\left[\dfrac{\partial q}{\partial T}\right]$

(2) $E_{rot} = RT^2\left[\dfrac{\partial}{\partial T}\ln q_{rot}\right]$

(3) $E_{rot} = \dfrac{\partial}{\partial T}\ln q_{rot}$

(4) $E_{rot} = RT^2.\ln.q_{rot}$

45. Stirling approximation applicable to large number of atoms is :

(1) $\ln N! = N - N \ln N$

(2) $\ln N! = N \ln N$

(3) $\ln N! = N \ln N - N$

(4) $\ln N! = N \ln N + N$

46. Entropy is related to probability by relation :

(1) $S = R \ln W$ (2) $S = kW$ (3) $S = \ln W$ (4) $S = k \ln W$

47. Compunds given below may be named as :
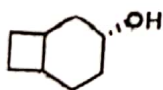
(1) (3R)-bicyclo [4.2.0] octan-3-ol

(2) (3S)-bicyclo [2.4.0] octan-3-ol

(3) (3R)-bicyclo [4.2.0] octan-6-ol

(4) (3S)-bicyclo [2.4.0] octan-6-ol

48. Compound given below may be named as :
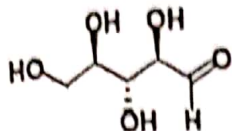
(1) (2S,3S,4S)-2,3,4,5-tetrahydroxypentanal

(2) (2R,3S,4R)-2,3,4,5-tetrahydroxypentanal

(3) (2R,3R,4R)-2,3,4,5-tetrahydroxypentanal

(4) (2S,3R,4R)-2,3,4,5-tetrahydroxypentanal

49. α-D-Glucopyranose and β-D Glucopyranose are :

(1) Anomers   (2) Epimer

(3) Diasteromers   (4) Meso compounds

50. Which of the confomations of n-butane is least stable ?

(1) Gauche   (2) Anti

(3) Eclipsed   (4) Fully eclipsed

51. Wilkinson's catalyst is used for :

(1) Hydrogenation   (2) Epoxidation

(3) Polymerization   (4) Metathesis reaction

52. Bond order is lowest in :

(1) Uncoordinated CO (2) CO bounded to one metal

(3) CO bridging two metals   (4) CO bridging three metals

53. The correct reagents/catalysts for carrying out the Suzuki reaction with p-bromo anisole are :

(1) Styrene, Pd and a base   (2) Phenylacetylene, Pd and CuI

(3) $PhB(OH)_2$, Na_2CO_3 and $Pd(O)$ (4) Tetraallyltin, $Pd(PPh_3)_4$

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54. If the walls of a one-dimensional box are suddenly removed, then :

(1) particle in a box doesn't obey wave equation

(2) particle has continuous energy spectrum

(3) particle vanishes into thin air

(4) none of the above

55. Using Huckel-moleclar orbital theory, secular determinant equation for ethylene molecule is expressed as :

(1) $\begin{vmatrix} 1 & x \\ 1 & x \end{vmatrix} = 0$
(2) $\begin{vmatrix} x & x \\ 1 & x \end{vmatrix} = 0$
(3) $\begin{vmatrix} x & 1 \\ 1 & x \end{vmatrix} = 0$
(4) $\begin{vmatrix} x & 1 \\ -1 & x \end{vmatrix} = 0$

where $x = \dfrac{\alpha - E}{\beta}$; α, β are columbic and resonance integral respectively.

56. Which one of the following relations is *correct* ?

(1) $\left[\hat{L}^2, \hat{L}_z\right] = 0$
(2) $\left[\hat{L}_x, \hat{L}_y\right] = i\hbar \hat{L}_x$
(3) $\left[\hat{L}, \hat{L}_z\right] = 0$
(4) $\left[\hat{L}, \hat{L}_y\right] = i\hbar \hat{L}_y$

57. According to Einstein-Smoluchowski equation, the root mean square distance travelled by diffusing molecule is given by :

(1) $<x^2>^{\frac{1}{2}} = 2Dt$

(2) $<x^2>^{\frac{1}{2}} = (2Dt)^3$

(3) $<x^2>^{\frac{1}{2}} = (2Dt)^{1/3}$

(4) $<x^2>^{\frac{1}{2}} = (2Dt)^{1/2}$

where D is the diffusion coefficient.

58. Polydisperity index (PI) of a polymer molecule is given by :

(1) $PI = M_w - M_n$

(2) $PI = \dfrac{M_w}{M_n}$

(3) $PI = M_w + M_n$

(4) $PI = M_w M_n$

59. For an isentropic change of state :

(1) $d\epsilon = 0$
(2) $dH = 0$
(3) $dS = 0$
(4) $dS = 1$

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C

60. Equivalent conductance for Alkali metal cations vary in the order :

(1) $Li^+ > Na^+ > K^+ > Rb^+$

(2) $Rb^+ > Na^+ \approx K^+ > Li^+$

(3) $Rb^+ > K^+ > Na^+ > Li^+$

(4) $Rb^+ > Li^+ > Na^+ > K^+$

61. Which of the following statements is *not* an essential feature of an optically active compound ?

(1) the molecules of an optically active compound will be dissymetric or asymmetric

(2) the molecules of an optically active molecule must have at least one stereogenic site

(3) an optically active compound's molecular configuration will not be identical with its mirror image

(4) an optically active compounds will have at least one stereoisomer

62. Identify the aromatic compound(s) amongst I to III :
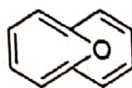
I   II   III
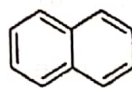
(1) I, II and III

(2) I and II only

(3) II and III only

(4) I and III only

63. The stability of carbanions in the following is in the order of :

    $R-C\equiv \overset{\ominus}{C}$ $R_2C=\overset{\ominus}{C}H$ $R_3C-\overset{\ominus}{C}H_2$
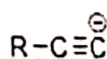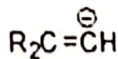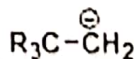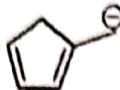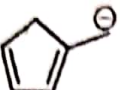
     a   b   c   d
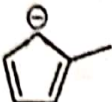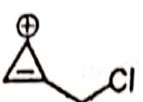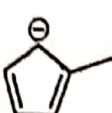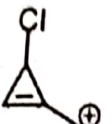
(1) $a > c > b > d$

(2) $a > b > c > d$

(3) $b > c > d > a$

(4) $d > b > c > a$

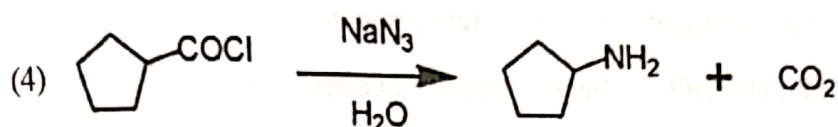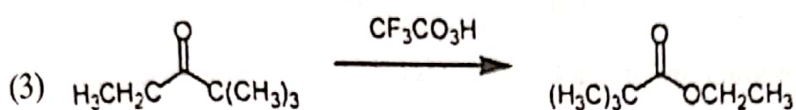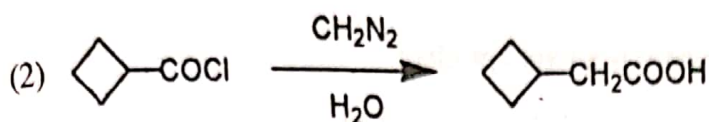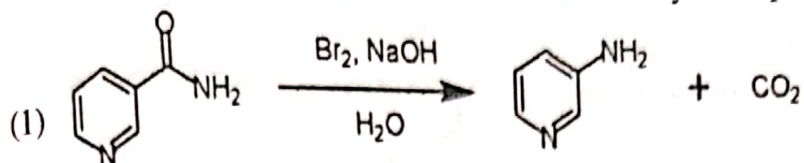**64.** The products P and Q in the following reactions, respectively, are :

(1) and

(2) and

(3) and

(4) and

65. The radical halogenation of 2-methylpropane gives two products : $(CH_3)_2 CHCH_2X$ (minor) and $(CH_3)_3CX$ (major). Chlorination gives a larger amount of the minor product than does bromination, Why ?

(1) Bromine is more reactive than chlorine and is able to attack the less reactive 3° C-H.

(2) Bromine atoms are less reactive (more selective) than chlorine, and preferentially attack the weaker 3° C-H bond.

(3) The methyl groups are more hindered to attack by the larger bromine atom.

(4) Bromination is reversible and the more stable 3°-alkyl bromide is formed exclusively.

66. Which one of the following methods is neither meant for the synthesis nor for separation of amines ?

(1) Wurtz reaction

(2) Hofmann method

(3) Hinsberg method

(4) Curtius reaction

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67. Which of the following equations shows an unlikely main product ?

(1)

$$\xrightarrow[\text{H}_2\text{O}]{\text{Br}_2,\ \text{NaOH}}$$

(2)

$$\xrightarrow[\text{H}_2\text{O}]{\text{CH}_2\text{N}_2}$$

(3) $H_3CH_2C\overset{O}{\underset{}{C}}C(CH_3)_3$

$$\xrightarrow{\text{CF}_3\text{CO}_3\text{H}}$$

$(H_3C)_3C\overset{O}{\underset{}{C}}OCH_2CH_3$

(4)

$$\xrightarrow[\text{H}_2\text{O}]{\text{NaN}_3}$$

68. Which reaction conditions would best convert 3-hexyne to *trans*-3-hexene ?

(1) Fe/NaCl

(2) Lindlar's Pd catalyst and H_2
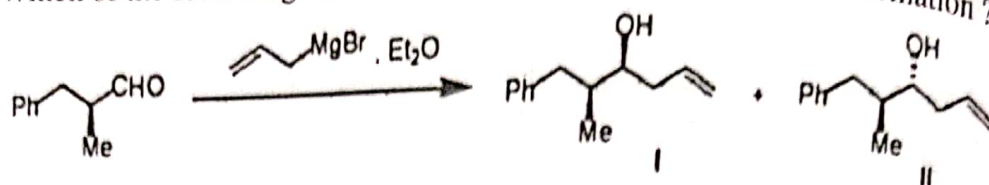
(3) Na in liquid NH_3

(4) DIBAL

69. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reaction (R). Read the statements and choose the correct answer using the code given below.

Assertion (A) : Alkaline $KMNO_4$ cannot be used for oxidation of allyl alcohol to acrylic acid.

**Reason (R) :** Hydroxylation and in some cases cleavage of $C = C$ bond also takes place.

(1) Both (A) and (R) are true and (R) is the correct explanation of (A)

(2) Both (A) and (R) are true, but (R) is not the correct explanation of (A)

(3) (A) is true, but (R) is false

(4) (A) is false, but (R) is true

14

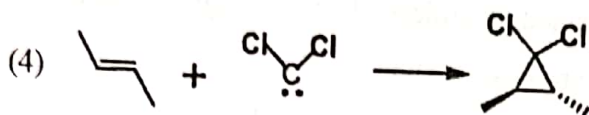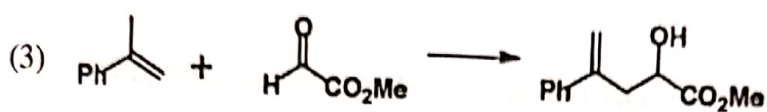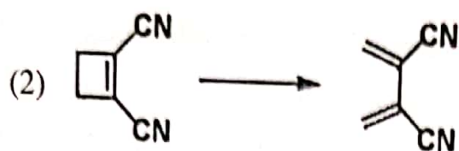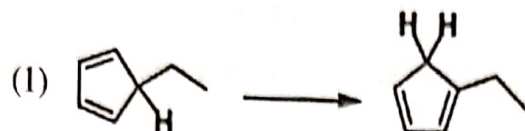70. Which of the following statements is true for the following transformation ?

(1) I is the major product and it is a Cram product

(2) I is the major product and it is a anti-Cram product

(3) II is the major product and it is a Cram product

(4) II is the major product and it is a anti-Cram product

71. CH_3CHO and $C_6H_5CH_2CHO$ can be destinguished chemically by :

(1) Tollen's reagent test

(2) Fehling solution test

(3) Benedict test

(4) Iodoform test

72. In the carbylamine reactino, R-X is converted to R-Y via the intermediate Z. R-X, R-Y and Z, respectively are :

(1) $R-NH_2$, R-NC, carbene

(2) $R-NH_2$, R-NC, nitrene

(3) R-NC, $R-NH_2$, carbene

(4) R-OH, R-NC, nitrene

73. Which of the following statements best describes a disconnection in retrosynthesis ?

(1) A disconnection involves a theoretical disconnection of a bond in a target structure in order to identify simpler structures that could be linked through the formation of that bond

(2) A disconnection involves identifying stages where a bond is split in the corresponding synthesis

(3) A disconnection identifies retrosynthetic stages which would not be feasible in the corresponding synthesis

(4) A disconnection describes the reaction conditions required to split a target structure into simpler molecules

74. What is meant by a reaction going in 94% enantiometric excess ?

(1) The product contains 94% of one enantiomer and 6% of the other enantiomer

(2) The product contains 94% of one enantiomer and 6% of other products

(3) The product contains an enantiomer which is 94% pure

(4) The product contains 97% of one enantiomer and 3% of the other enantiomer

75. If a prochiral ketone was converted enantioselectively to a chiral alcohol with a Grignard reagent under asymmetric conditions, which of the following statements would be *false* ?

(1) The prochiral ketone has different groups linked to the carbonyl group

(2) A chiral product would be obtained regardless of which Grignard reagent is used

(3) The reaction centre is an sp^2 hybridised carbon

(4) "Nucleophilic attack by the Grignard reagent will be selective for one enantiotopic face over the other."

76. Which of the adducts (1)-(4) is the main kinetic product of the following Diels-Alder reaction ?
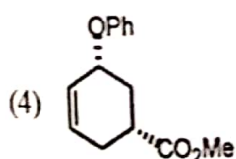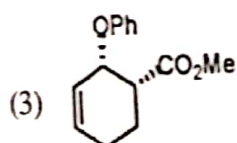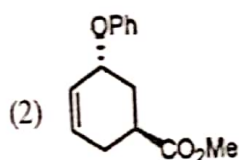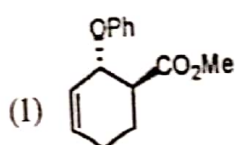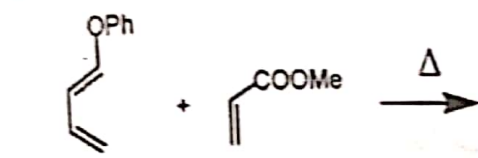
77. Which of the following reactions is classified as a sigmatropic rearrangement ?

(1)

(2)

(3)

(4)

78. From what starting materials could you make the following compound ?

(1)

(2)

(3)

(4)

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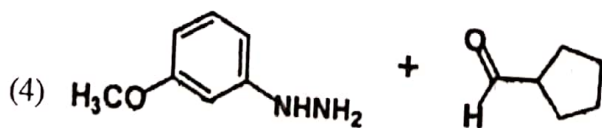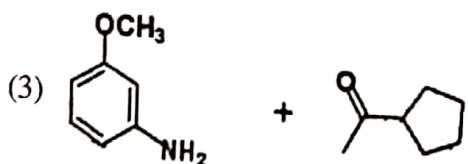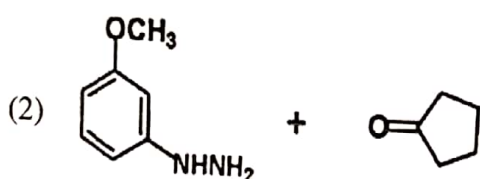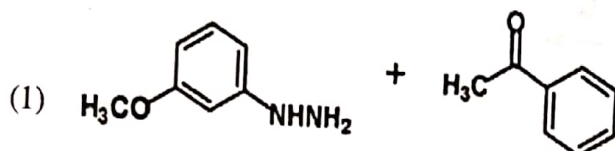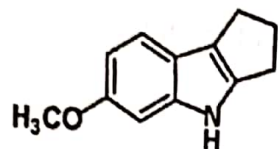
79. Which of the following factors has the least influence on the secondary and tertiary structures of proteins ?

(1) the achiral nature of glycine units.

(2) steric hindrance of bulky side-chai ns on the peptide backbone.

(3) hydrogen bonding of C=O to N-H groups located near each other in space.

(4) conformational restriction imposed by proline units.

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

(1) Natural fatty acids contain even numbers of carbon atoms.

(2) Diterpenes contain 10 carbons.

(3) Eicosanoids have structures derived from arachidonic acid.

(4) Arachidonic acid is a C_{20} unsaturated carboxylic acid.

81. The given compound is isolobal with $[Rh_6(CO)_{16}]$
    (1) $C_2B_{10}H_{12}$ (2) $C_2B_6H_{10}$
    (3) $[Fe_4(CO)_{12}C]^{2-}$ (4) B_5H_{13}

82. The first ionization potential of Na is 5.1 eV. The value of electron gain enthalpy of Na^+ will be :

    (1) –2.55 eV   (2) – 5.1 eV   (3) –11.4 eV   (4) + 2.50 eV

83. Egyptian blue $CaCuSi_4O_{10}$ is an example of :

    (1) Cyclic silicate   (2) Sheet silicate

    (3) Pyrosilicate   (4) Chain silicate

84. Which one of the oxide is neutral ?
    (1) CO (2) SnO_2 (3) ZnO (4) SiO_2

P. T. O.

Scanned with CamScanner

85. In compound $N_3P_3F_6$, the geometry around nitrogen and phosphorus, respectively are :

(1) Pyramidal and tetrahedral

(2) Planar and tetrahedral

(3) Pyramidal and planar

(4) Planar and trigonalbipyramidal

86. In photosynthetic systems the redox metalloproteins involved in electron transfer are cytochrome b (Cyt b), Cytochrome bf complex (Cyt bf) and plastocyanin (PC). The pathway of electron flow is :

(1) PC → Cyt b → Cyt bf

(2) Cyt bf → Cyt b → PC

(3) Cyt b → Cyt bf → PC

(4) PC → Cyt bf → Cyt b

87. Molybdoenzyme can both oxidize as well as reduce the substrate, because :

(1) Mo (VI) is more stable than Mo (IV)

(2) Mo (IV) can transfer oxygen atom to the substrate and Mo(VI) can abstract oxygen atom from substrate

(3) Conversion of Mo(VI) to Mo(IV) is not favoured

(4) Mo(VI) can transfer oxygen atom to the substrate and Mo(IV) can abstract oxygen atom from the substrate

88. The ligand system present in Vitamin B_{12} is :

(1) Porphyrin   (2) Corrin   (3) Phthalocyanine   (4) Crown ether

89. Mercury and its compounds are toxic due to their :

(1) high affinity for thiols

(2) interference with oxygen transport

(3) Binding to histidines

(4) Inhibition of vitamin B_{12}

90. Match the items in **Column-A** with the appropriate items in **Column-B** :

	Column-A			Column-B
A	Metallothioneins		(i)	$Cis[Pd(NH_3)_2Cl_2]$
B	Plastocyanin		(ii)	Cystein rich protein
C	Ferritin		(iii)	Electron transfer
D	Chemotherapy		(iv)	Iron transport
			(v)	Iron storage
			(vi)	Carboplatin

The *correct* answer is :

(1) A-(iii), B-(ii), C-(v), D-(iv)

(2) A-(ii), B-(iii), C-(iv), D-(i)

(3) A-(ii), B-(iii), C-(v), D-(vi)

(4) A-(iii), B-(v), C-(vi), D-(ii)

91. Saxen's relation is :

(1) $\left(\dfrac{\Delta P}{\Delta \phi}\right)_{J=0} = \left(\dfrac{J}{I}\right)_{\Delta \phi=0}$

(2) $\left(\dfrac{\Delta P}{\Delta \phi}\right)_{J=0} = \left(\dfrac{I}{J}\right)_{\Delta \phi=0}$

(3) $\left(\dfrac{\Delta P}{\Delta \phi}\right)_{J=0} = -\left(\dfrac{I}{J}\right)_{\Delta \phi=0}$

(4) None of these

92. The surface tension of dilute solution of a solute varies linearly with solute concentration C_2 as $r = r_0 - ac_2$, where r_0 is the surface tension of the solvent and 'a' is a constant. Predict correct relation :

(1) $\Gamma_2 = (r_0 - r)/RT$

(2) $\Gamma_2 = \dfrac{(r - r_0)}{RT}$

(3) $F_2 = r_0 - r$

(4) $\Gamma_4 = r - r_0$

93. Miscelles from ionic surfactants can be formed only above a certain temperature called :

(1) Critical temperature

(2) Kraft temperature

(3) Inversion temperature

(4) Boyle temperature

94. The Miller indices of crystal plane which cut through crystal axes at $(6a, 3b, 3c)$ are : C

    (1) (2 1 2)   (2) (2 2 1)   (3) (1 2 2)   (4) None of these

95. A crystal which possesses no element of symmetry is :

    (1) $NaCl$ (2) KCl (3) $CsCl$ (4) $CuSO_4.5H_2O$

96. If two operators commute, then they are/have :
    (1) Linear   (2) Same Eigen functions
    (3) Same Eigen values   (4) Hermitian

97. Which of the following point groups doesn't posses centre of Inversion ?

    (1) D_{6h} (2) D_{4h} (3) D_{2h} (4) T_d

98. H_2O molecule belongs to point group :
    (1) C_{2v} (2) C_{3v} (3) D_{2d} (4) D_{3h}

99. The antiferromagnetic transition occur at :

    (1) Curie temperature   (2) Neel temperature

    (3) Critical temperature   (4) None of these

100. How many normal modes of vibration are possible for benzene molecule ?

    (1) 11   (2) 8   (3) 30   (4) 12

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

D

PHD/URS-EE-DEC-2022

SET-Y

SUBJECT : Chemistry

10032

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)

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.*

PHD/URS-EE-2022/(Chemistry)(SET-Y)/(D)

1. Which of the following statements is **not** an essential feature of an optically active compound ?

   (1) the molecules of an optically active compound will be dissymetric or asymmetric

   (2) the molecules of an optically active molecule must have at least one stereogenic site

   (3) an optically active compound's molecular configuration will not be identical with its mirror image

   (4) an optically active compounds will have at least one stereoisomer

2. Identify the aromatic compound(s) amongst I to III :
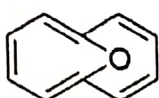
I	II	III
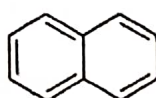
   (1) I, II and III   (2) I and II only

   (3) II and III only   (4) I and III only

3. The stability of carbanions in the following is in the order of :
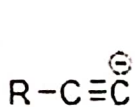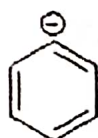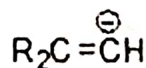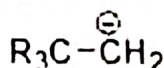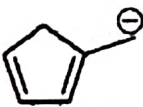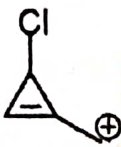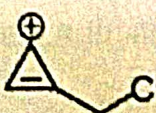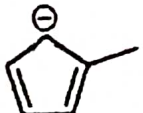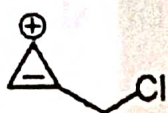
a	b	c	d

   (1) $a > c > b > d$ (2) $a > b > c > d$ (3) $b > c > d > a$ (4) $d > b > c > a$

4. The products P and Q in the following reactions, respectively, are :

5. The radical halogenation of 2-methylpropane gives two products : $(CH_3)_2 CHCH_2X$ (minor) and $(CH_3)_3CX$ (major). Chlorination gives a larger amount of the minor product than does bromination, Why ?

   (1) Bromine is more reactive than chlorine and is able to attack the less reactive 3° C-H.

   (2) Bromine atoms are less reactive (more selective) than chlorine, and preferentially attack the weaker 3° C-H bond.

   (3) The methyl groups are more hindered to attack by the larger bromine atom.

   (4) Bromination is reversible and the more stable 3°-alkyl bromide is formed exclusively.

6. Which one of the following methods is neither meant for the synthesis nor for separation of amines ?

   (1) Wurtz reaction   (2) Hofmann method

   (3) Hinsberg method   (4) Curtius reaction

7. Which of the following equations shows an unlikely main product ?
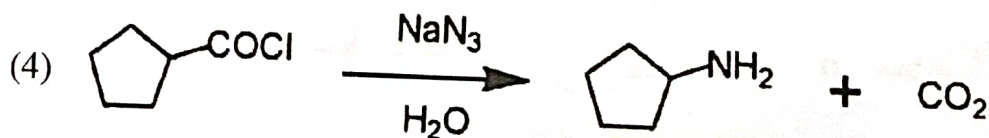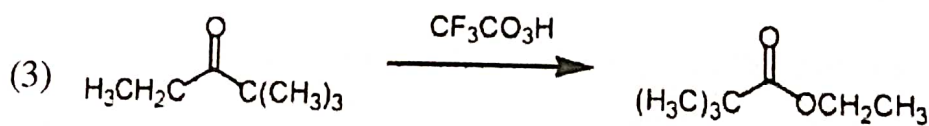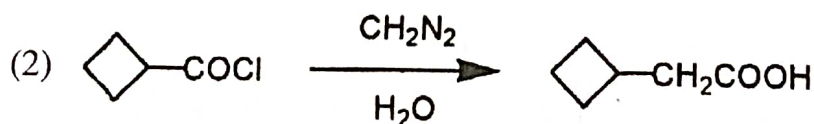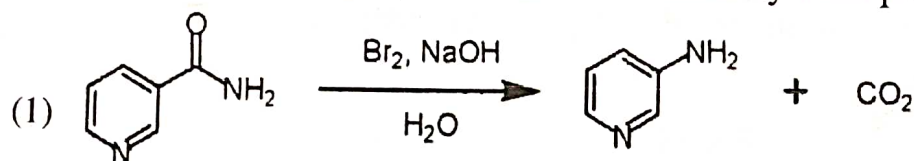
8. Which reaction conditions would best convert 3-hexyne to *trans*-3-hexene ?

   (1) Fe/NaCl

   (2) Lindlar's Pd catalyst and H_2

   (3) Na in liquid NH_3

   (4) DIBAL

9. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reaction (R). Read the statements and choose the correct answer using the code given below.

   Assertion (A) : Alkaline $KMNO_4$ cannot be used for oxidation of allyl alcohol to acrylic acid.

   Reason (R) : Hydroxylation and in some cases cleavage of C = C bond also takes place.

   (1) Both (A) and (R) are true and (R) is the correct explanation of (A)

   (2) Both (A) and (R) are true, but (R) is not the correct explanation of (A)

   (3) (A) is true, but (R) is false

   (4) (A) is false, but (R) is true

10. Which of the following statements is true for the following transformation ?
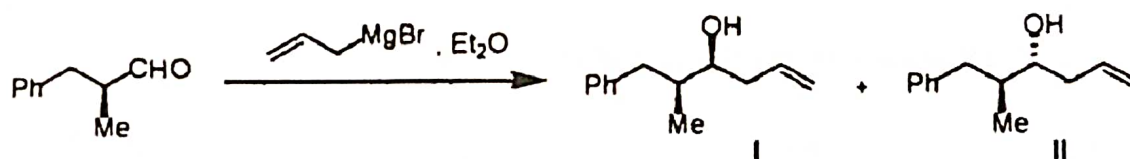
   (1) I is the major product and it is a Cram product

   (2) I is the major product and it is a anti-Cram product

   (3) II is the major product and it is a Cram product

   (4) II is the major product and it is a anti-Cram product

11. Saxen's relation is :

   (1) $\left(\dfrac{\Delta P}{\Delta \phi}\right)_{J=0} = \left(\dfrac{J}{I}\right)_{\Delta\phi=0}$

   (2) $\left(\dfrac{\Delta P}{\Delta \phi}\right)_{J=0} = \left(\dfrac{I}{J}\right)_{\Delta\phi=0}$

   (3) $\left(\dfrac{\Delta P}{\Delta \phi}\right)_{J=0} = -\left(\dfrac{I}{J}\right)_{\Delta\phi=0}$

   (4) None of these

12. The surface tension of dilute solution of a solute varies linearly with solute concentration C_2 as $r = r_0 - ac_2$, where r_0 is the surface tension of the solvent and 'a' is a constant. Predict correct relation :

(1) $\Gamma_2 = (r_0 - r)/RT$

(2) $\Gamma_2 = \dfrac{(r - r_0)}{RT}$

(3) $F_2 = r_0 - r$

(4) $\Gamma_4 = r - r_0$

13. Miscelles from ionic surfactants can be formed only above a certain temperature called :

(1) Critical temperature

(2) Kraft temperature

(3) Inversion temperature

(4) Boyle temperature

14. The Miller indices of crystal plane which cut through crystal axes at $(6a, 3b, 3c)$ are :

(1) (2 1 2)

(2) (2 2 1)

(3) (1 2 2)

(4) None of these

15. A crystal which possesses no element of symmetry is :

(1) $NaCl$

(2) KCl

(3) $CsCl$

(4) $CuSO_4.5H_2O$

16. If two operators commute, then they are/have :

(1) Linear

(2) Same Eigen functions

(3) Same Eigen values

(4) Hermitian

17. Which of the following point groups doesn't posses centre of Inversion ?

(1) D_{6h}

(2) D_{4h}

(3) D_{2h}

(4) T_d

18. H_2O molecule belongs to point group :

(1) C_{2v}

(2) C_{3v}

(3) D_{2d}

(4) D_{3h}

19. The antiferromagnetic transition occur at :

(1) Curie temperature

(2) Neel temperature

(3) Critical temperature

(4) None of these

20. How many normal modes of vibration are possible for benzene molecule ?

    (1) 11   (2) 8   (3) 30   (4) 12

21. Wilkinson's catalyst is used for :

    (1) Hydrogenation   (2) Epoxidation

    (3) Polymerization   (4) Metathesis reaction

22. Bond order is lowest in :

    (1) Uncoordinated CO (2) CO bounded to one metal

    (3) CO bridging two metals   (4) CO bridging three metals

23. The correct reagents/catalysts for carrying out the Suzuki reaction with p-bromo anisole are :

    (1) Styrene, Pd and a base   (2) Phenylacetylene, Pd and CuI

    (3) $PhB(OH)_2$, Na_2CO_3 and $Pd(O)$ (4) Tetraallyltin, $Pd(PPh_3)_4$

24. If the walls of a one-dimensional box are suddenly removed, then :

    (1) particle in a box doesn't obey wave equation

    (2) particle has continuous energy spectrum

    (3) particle vanishes into thin air

    (4) none of the above

25. Using Huckel-moleclar orbital theory, secular determinant equation for ethylene molecule is expressed as :

    (1) $\begin{vmatrix} 1 & x \\ 1 & x \end{vmatrix} = 0$ (2) $\begin{vmatrix} x & x \\ 1 & x \end{vmatrix} = 0$ (3) $\begin{vmatrix} x & 1 \\ 1 & x \end{vmatrix} = 0$ (4) $\begin{vmatrix} x & 1 \\ -1 & x \end{vmatrix} = 0$

    where $x = \dfrac{\alpha - E}{\beta}$; α, β are columbic and resonance integral respectively.

26. Which one of the following relations is **correct** ?

   (1) $\left[\hat{L}^2, \hat{L}_z\right] = 0$ (2) $\left[\hat{L}_x, \hat{L}_y\right] = i\hbar\hat{L}_x$ (3) $\left[\hat{L}, \hat{L}_z\right] = 0$ (4) $\left[\hat{L}, \hat{L}_y\right] = i\hbar\hat{L}_y$

27. According to Einstein-Smoluchowski equation, the root mean square distance travelled by diffusing molecule is given by :

   (1) $<x^2>^{\frac{1}{2}} = 2Dt$

   (2) $<x^2>^{\frac{1}{2}} = (2Dt)^3$

   (3) $<x^2>^{\frac{1}{2}} = (2Dt)^{1/3}$

   (4) $<x^2>^{\frac{1}{2}} = (2Dt)^{1/2}$

   where D is the diffusion coefficient.

28. Polydisperity index (PI) of a polymer molecule is given by :

   (1) $PI = M_w - M_n$

   (2) $PI = \dfrac{M_w}{M_n}$

   (3) $PI = M_w + M_n$

   (4) $PI = M_w M_n$

29. For an isentropic change of state :

   (1) $d\in = 0$ (2) $dH = 0$ (3) $dS = 0$ (4) $dS = 1$

30. Equivalent conductance for Alkali metal cations vary in the order :

   (1) $Li^+ > Na^+ > K^+ > Rb^+$

   (2) $Rb^+ > Na^+ \approx K^+ > Li^+$

   (3) $Rb^+ > K^+ > Na^+ > Li^+$

   (4) $Rb^+ > Li^+ > Na^+ > K^+$

31. The given compound is isolobal with $[Rh_6(CO)_{16}]$

   (1) $C_2B_{10}H_{12}$

   (2) $C_2B_6H_{10}$

   (3) $[Fe_4(CO)_{12}C]^{2-}$

   (4) B_5H_{13}

32. The first ionization potential of Na is 5.1 eV. The value of electron gain enthalpy of Na^+ will be :

    (1) -2.55 eV   (2) -5.1 eV   (3) -11.4 eV   (4) $+2.50$ eV

33. Egyptian blue $CaCuSi_4O_{10}$ is an example of :

    (1) Cyclic silicate   (2) Sheet silicate   (3) Pyrosilicate   (4) Chain silicate

34. Which one of the oxide is neutral ?
    (1) CO (2) SnO_2 (3) ZnO (4) SiO_2

35. In compound $N_3P_3F_6$, the geometry around nitrogen and phosphorus, respectively are :

    (1) Pyramidal and tetrahedral

    (2) Planar and tetrahedral

    (3) Pyramidal and planar

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36. In photosynthetic systems the redox metalloproteins involved in electron transfer are cytochrome b (Cyt b), Cytochrome bf complex (Cyt bf) and plastocyanin (PC). The pathway of electron flow is :

    (1) PC → Cyt b → Cyt bf   (2) Cyt bf → Cyt b → PC

    (3) Cyt b → Cyt bf → PC   (4) PC → Cyt bf → Cyt b

37. Molybdoenzyme can both oxidize as well as reduce the substrate, because :

    (1) Mo (VI) is more stable than Mo (IV)

    (2) Mo (IV) can transfer oxygen atom to the substrate and Mo(VI) can abstract oxygen atom from substrate

    (3) Conversion of Mo(VI) to Mo(IV) is not favoured

    (4) Mo(VI) can transfer oxygen atom to the substrate and Mo(IV) can abstract oxygen atom from the substrate

38. The ligand system present in Vitamin B_{12} is :

    (1) Porphyrin   (2) Corrin   (3) Phthalocyanine   (4) Crown ether

39. Mercury and its compounds are toxic due to their :

    (1) high affinity for thiols

    (2) interference with oxygen transport

    (3) Binding to histidines

    (4) Inhibition of vitamin B_{12}

40. Match the items in **Column-A** with the appropriate items in **Column-B** :

	Column-A		**Column-B**
A	Metallothioncins	(i)	$Cis[Pd(NH_3)_2Cl_2]$
B	Plastocyanin	(ii)	Cystein rich protein
C	Ferritin	(iii)	Electron transfer
D	Chemotherapy	(iv)	Iron transport
		(v)	Iron storage
		(vi)	Carboplatin

    The *correct* answer is :

    (1) A-(iii), B-(ii), C-(v), D-(iv)

    (2) A-(ii), B-(iii), C-(iv), D-(i)

    (3) A-(ii), B-(iii), C-(v), D-(vi)

    (4) A-(iii), B-(v), C-(vi), D-(ii)

41. You have three dyes. One is green, one is blue and one is yellow. Which absorbs the shortest wavelength of visible light, and which absorbs the longest ?

    (1) longest = yellow, shortest = blue

    (2) longest = blue; shortest = green

    (3) longest = yellow; shortest = green

    (4) longest = green; shortest = yellow

42. Which C=O function has the lowest stretching frequency in the infrared spectrum ?

    (1) acyl chloride

    (2) aldeyde

    (3) amide

    (4) ester

43. The two sharp signals that constitute the resonance marked A have chemical shifts of 7.82 and 7.95 at 100 MHz. What is the coupling constant, J, for this doublet ?

(1) 0.13 MHz (2) 11.7 Hz (3) 11.7 MHz (4) 13 Hz

44. Which of the following statements regarding mass spectrometry is wrong ?

(1) In a normal mass spectrometer, electron impact causes a molecule to lose an electron and become a molecular radical cation which decomposes into fragment cations and radicals.

(2) Only cations can be detected by a normal mass spectrometer.

(3) A compound whose molecules contain just one bromine atom shows two molecular ion peaks of similar intensity, one at +1 and one at −1 of the average m/z value.

(4) Molecular ion peaks always have even-numbered values of m/z.

45. A $C_5H_{12}O_2$ compound has strong infrared absorption at 3300 to 3400 cm^{-1}. The ^1H NMR spectrum has three singlets at δ 0.9, δ 3.45, and δ 3.2 ppm; relative areas 3 : 2 : 1. Addition of D_2O to the sample eliminates the lower field signal. The ^{13}C NMR spectrum show three signals all at higher field than δ 100 ppm.

Which of the following compounds best fits this data ?

(1) 1, 5-pentanediol (2) 1, 3-dimethoxypropane

(3) 2, 2-dimethyl-1, 3-propanediol (4) 2, 4-pentanediol

46. Select the *incorrect* statement from the following options.

(1) Self-assembly is a top-down manufacturing technique

(2) In self-assembly, weak interactions play very important role

(3) Self assembling molecules adopt an organized structure which is thermodynamically more stable than the single, unassembled components.

(4) Compared to the isolated components, the self-assembled structure has a higher order

47. This 'green' chemical is used in in houschold cleaners to remove stains and is also a favourite dressing on salads ! :

(1) Vineger (acetic acid)

(2) Citric acid

(3) Hydrochloric acid (HCl)

(4) Water

48. Which of the following statements is *true* ?

(1) Drugs and drug targets generally have similar molecular weights

(2) Drugs are generally smaller than drug targets

(3) Drugs are generally larger than drug targets

(4) There is no general rule regarding the relative size of drugs and their targets

49. What type of guest would a crown ether be able to bind ?

(1) Cations

(2) Netural species

(3) Anions

(4) Zwitterions

50. Bio-polymers exemplify a Green Chemistry Principle (of utmost importance for the environment) that can be best expressed as :

(1) Catalysis

(2) Prevent waster

(3) Benign solvents & auxiliaries

(4) Design for degradation

51. Molecular orbital theory :

(1) Underestimates the importance of covalent structure

(2) Overestimates the importance of ionic structures

(3) Puts equal importance to both ionic and covalent structures

(4) None of the above

52. Which of the following wave function is normalized ?

(1) $\psi = \dfrac{1}{\sqrt{2}}(\phi_1 + \phi_2)$

(2) $\psi = \dfrac{1}{\sqrt{3}}(\phi_1 + \phi_2)$

(3) $\psi_1 = \dfrac{1}{\sqrt{2}}(\phi_1 + \phi_2 + \phi_3)$

(4) $\psi = \dfrac{1}{3}(\phi_1 + \phi_2)$

53. Milk is a/an :

(1) Suspension　　(2) Pure solution　　(3) Gel　　　　　(4) Emulsion

54. Rotational partition function is related to energy by relation :

(1) $E_{rot} = RT^2 \left[\dfrac{\partial q}{\partial T} \right]$

(2) $E_{rot} = RT^2 \left[\dfrac{\partial}{\partial T} \ln q_{rot} \right]$

(3) $E_{rot} = \dfrac{\partial}{\partial T} \ln q_{rot}$

(4) $E_{rot} = RT^2 . \ln . q_{rot}$

55. Stirling approximation applicable to large number of atoms is :
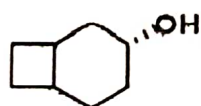
(1) $\ln N! = N - N \ln N$

(2) $\ln N! = N \ln N$

(3) $\ln N! = N \ln N - N$

(4) $\ln N! = N \ln N + N$

56. Entropy is related to probability by relation :

(1) $S = R \ln W$　　(2) $S = kW$　　(3) $S = \ln W$　　(4) $S = k \ln W$

57. Compunds given below may be named as :
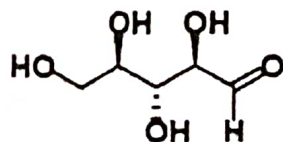

(1) (3R)-bicyclo [4.2.0] octan-3-ol

(2) (3S)-bicyclo [2.4.0] octan-3-ol

(3) (3R)-bicyclo [4.2.0] octan-6-ol

(4) (3S)-bicyclo [2.4.0] octan-6-ol

58. Compound given below may be named as :

(1) (2S,3S,4S)-2,3,4,5-tetrahydroxypentanal

(2) (2R,3S,4R)-2,3,4,5-tetrahydroxypentanal

(3) (2R,3R,4R)-2,3,4,5-tetrahydroxypentanal

(4) (2S,3R,4R)-2,3,4,5-tetrahydroxypentanal

59. α-D-Glucopyranose and β-D Glucopyranose are :

    (1) Anomers

    (2) Epimer

    (3) Diasteromers

    (4) Meso compounds

60. Which of the confomations of n-butane is least stable ?

    (1) Gauche

    (2) Anti

    (3) Eclipsed

    (4) Fully eclipsed

61. CH_3CHO and $C_6H_5CH_2CHO$ can be destinguished chemically by :

    (1) Tollen's reagent test

    (2) Fehling solution test

    (3) Benedict test

    (4) Iodoform test

62. In the carbylamine reactino, R-X is converted to R-Y via the intermediate Z. R-X, R-Y and Z, respectively are :

    (1) $R-NH_2$, R-NC, carbene

    (2) $R-NH_2$, R-NC, nitrene

    (3) R-NC, $R-NH_2$, carbene

    (4) R-OH, R-NC, nitrene

63. Which of the following statements best describes a disconnection in retrosynthesis ?

    (1) A disconnection involves a theoretical disconnection of a bond in a target structure in order to identify simpler structures that could be linked through the formation of that bond

    (2) A disconnection involves identifying stages where a bond is split in the corresponding synthesis

    (3) A disconnection identifies retrosynthetic stages which would not be feasible in the corresponding synthesis

    (4) A disconnection describes the reaction conditions required to split a target structure into simpler molecules

64. What is meant by a reaction going in 94% enantiometric excess ?

(1) The product contains 94% of one enantiomer and 6% of the other enantiomer

(2) The product contains 94% of one enantiomer and 6% of other products

(3) The product contains an enantiomer which is 94% pure

(4) The product contains 97% of one enantiomer and 3% of the other enantiomer

65. If a prochiral ketone was converted enantioselectively to a chiral alcohol with a Grignard reagent under asymmetric conditions, which of the following statements would be *false* ?

(1) The prochiral ketone has different groups linked to the carbonyl group

(2) A chiral product would be obtained regardless of which Grignard reagent is used

(3) The reaction centre is an sp^2 hybridised carbon

(4) "Nucleophilic attack by the Grignard reagent will be selective for one enantiotopic face over the other."

66. Which of the adducts (1)-(4) is the main kinetic product of the following Diels-Alder reaction ?
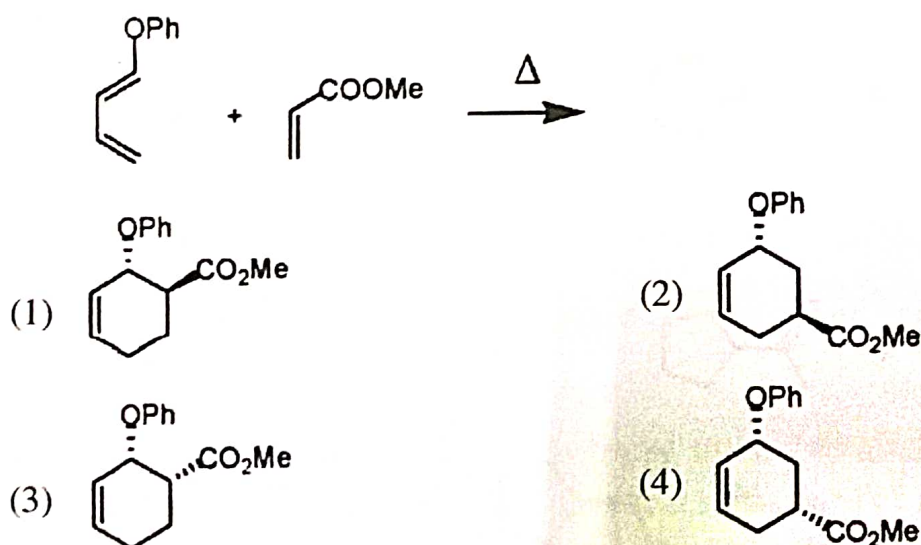
67. Which of the following reactions is classified as a sigmatropic rearrangement ?

(1)

(2)

(3)

(4)
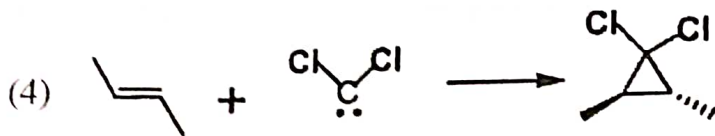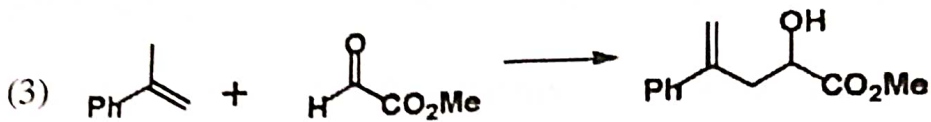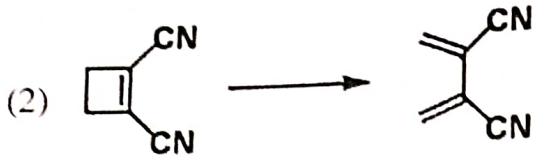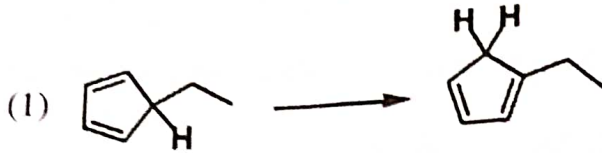
68. From what starting materials could you make the following compound ?

(1)

(2)

(3)

(4)
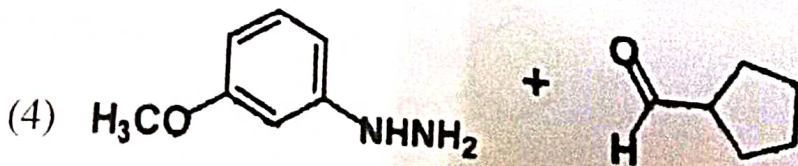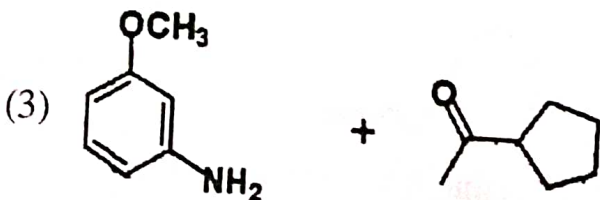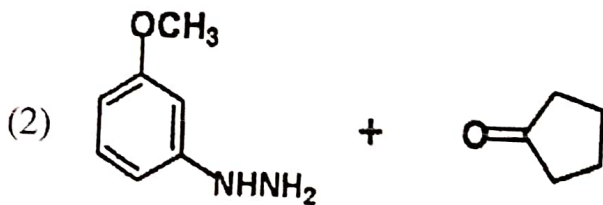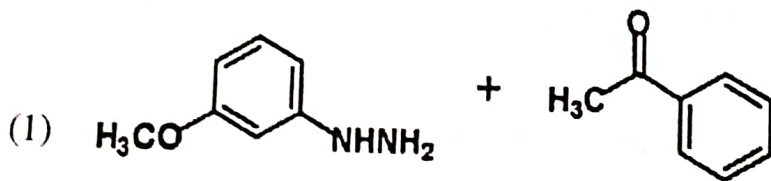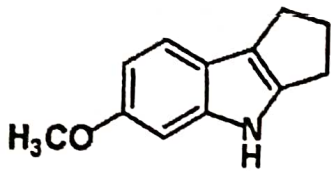
69. Which of the following factors has the least influence on the secondary and tertiary structures of proteins ?

    (1) the achiral nature of glycine units.

    (2) steric hindrance of bulky side-chai ns on the peptide backbone.

    (3) hydrogen bonding of C=O to N-H groups located near each other in space.

    (4) conformational restriction imposed by proline units.

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

    (1) Natural fatty acids contain even numbers of carbon atoms.

    (2) Diterpenes contain 10 carbons.

    (3) Eicosanoids have structures derived from arachidonic acid.

    (4) Arachidonic acid is a C_{20} unsaturated carboxylic acid.

71. The coefficient of thermal expansion, α is defined by :

    (1) $\alpha = \dfrac{1}{V}\left(\dfrac{\partial V}{\partial T}\right)_P$

    (2) $\alpha = \left(\dfrac{\partial V}{\partial T}\right)_P$

    (3) $\alpha = V\left(\dfrac{\partial V}{\partial T}\right)_P$

    (4) $\alpha = \dfrac{1}{T}\left(\dfrac{\partial V}{\partial P}\right)_T$

72. Magnetogyric ratio, r is expressed by :

    (1) $r = \dfrac{L}{\mu_m}$

    (2) $r = \dfrac{\mu_m}{L}$

    (3) $r = \mu_m \times L$

    (4) $r = \mu_m + L$

    where μ_m and L represent magnetic moment and orbital angular momentum respectively.

73. The NMR signal for a compound is found to be 240 Hz downfield from TMS peak using spectrometer at 60 MHz. The chemical shift relative to TMS will be :

    (1) 6 ppm
    (2) 8 ppm
    (3) 4 ppm
    (4) 0.4 ppm

74. Which of the following is a *false* statement ?

    (1) Maximum electric work is obtained from a cell which operates reversibly

    (2) Use of KCl in Agar bridge minimize liquid junction potential

    (3) Quinhydrone electrode is not suitable for pH measurement in strongly alkaline solution

    (4) The standard electrode potential of hydrogen electrode is not zero at all temperature

75. The fundamental vibrational frequency of CO molecule is 2170 cm^{-1}. The force constant of CO molecule will be :

    (1) $4\pi^2 C^2 \mu (2170)^2 \times 10^4$

    (2) $4\pi^2 C \mu^2 (2170)^2 10^4$

    (3) $4\pi^2 C^2 \mu^2 (2170)$

    (4) $4\pi^2 C^2 \mu (2170)$

    All notations have their usual meanings.

76. According to Debye-Huckel theory of strong electrolystes, increase in conductivity on dilution is because of :

    (1) Incresae in number of ions

    (2) Increase in mobility of ions

    (3) Increase in viscosity of the solution

    (4) Increase in volume of the solution

77. The electronic partition function of an atom where atomic state is $^2D_{3/2}$ is :

    (1) 2   (2) 3   (3) 4   (4) 5

78. The number of micro states for distributing three different atoms among quantum states comprised of three quanta of energy are :

    (1) 10   (2) 3   (3) 8   (4) 4

D 17

79. In ionic polymerization, living polymer is formed when :

(1) Propagation reactions don't occur

(2) Initiation reactions occur faster than termination reactions

(3) Amino acids are used as monomers

(4) Termination reactions don't occur

80. The region of an infrared spectrum where many absorptions take place is known as :

(1) Thumbprint region
(2) Fingerprint region

(3) Handprint region
(4) Footprint region

81. Generally the coordination number and the nature of electronic absorption band [(f − f) transition] of lanthanide (III) ion in their complexes are :

(1) greater than 6 & sharp
(2) 6 and broad

(3) less than 6 & sharp
(4) greater than 6

82. The enrichment of Uranium is carried out in the form of :

(1) VO_2^{3+}
(2) VO_2^{2+}
(3) UF_6
(4) $[U(acac)_3]^{3+}$

83. The coordination number of Gd in $GdCl_3.6H_2O$ is :

(1) 3
(2) 6
(3) 8
(4) 9

84. Among the following, strongest oxidizing agent is :

(1) $[WO_4]^{-2}$
(2) $[MoO_4]^{-2}$
(3) $[Cr(O_4)]^{2-}$
(4) $[ReO_4]^-$

85. The mechanism of reaction between $[Fe(CN)_6]^{4-}$ and $[Fe(bpy)_3]^{3+}$ (bpy = 2, 2' bipyridine) :

(1) Outer sphere electron transfer

(2) Inner sphere electron transfer

(3) Self exchange reaction

(4) Ligand exchange followed by electron transfer

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86. On two sequential electron capture, $_{56}Ba^{131}$ will given :

(1) $_{54}Xe^{131}$ (2) $_{54}Xe^{130}$ (3) $_{56}Ce^{131}$ (4) $_{56}Ce^{130}$

87. The pH obtained by mixing 10 mL of 0.1 M HCl and 40 mL of 0.2 M H_2SO_4 is :

(1) 0.47   (2) 0.68   (3) 4.0   (4) 3.7

88. In the reaction : $Cl_2 + ClF + SbF_5 \rightarrow [Cl_3][SbF_6]$ the role of chlorine is to :

(1) Stabilize Cl^+

(2) Function as Lewis base

(3) Function as Lewis acid

(4) Form the cation

89. H_3BO_3 is :

(1) Monobasic acid and weak lewis acid

(2) Monobasic and weak Bronsted acid

(3) Monobasic and strong lewis acid

(4) Tribasic and weak Bronsted acid

90. Which of the following metal ions have highest mobility in biological media ?

(1) Zn (II), Ni (II)   (2) Fe(II), Cu(II)

(3) Na(I), K(I)   (4) Mg(II), Ca(II)

91. Gelatin added during polarographic measurement carried out using dropping mercury electrode :

(1) Reduced streaming motion of mercury drop

(2) Decreases viscosity of the solution

(3) Eliminates migrating current

(4) Prevents oxidation of mercury

PH

92. Gel permeation chromatography can be used to separate which of the following ?

(a) Lanthanides

(b) Alkaline earths

(c) Fatty acids

(d) Low molecular weight peptides

Correct answer is :

(1) (a) & (b)   (2) (b) & (c)   (3) (c) & (d)   (4) (a) & (d)

93. In the EPR spectrum of a methyl radical the number of lines and their relative intensities, respectively are :

(1) 1 and 1

(2) 3 and 1 : 2 : 1

(3) 4 and 1 : 2 : 2 : 1

(4) 4 and 1 : 3 : 3 : 1

94. Mossbauer spectrum of complex [Fe(1, 10 phenanthroline)$_2$ (NCS)$_2$] shows two lines at 300K four lines at 186 K and again two lines at 77 K. This can be attributed to :

(a) Change in coordination mode of NCS

(b) Change in spin state of Iron

(c) cis-trans isomerism

(d) Change in metal ligand bond distance

Correct statements are :

(1) (a) & (b)   (2) (b) & (c)   (3) (a) & (c)   (4) (b) & (d)

95. The *correct* statement for the molecule CsI_3 is :

(1) It is a covalent molecule

(2) It contains Cs^+ and I_3^- ions

(3) It contains Cs^{+3} and I^- ions

(4) It contains Cs^+, I^- and lattice I_2 molecule

96. In compounds of type ECl_3, where $E = B, P, As$ and Bi the angles $Cl - E - Cl$:

(1) $B > P = As = Bi$

(2) $B > P > As > Bi$

(3) $B < P = As = Bi$

(4) $B < P < As < Bi$

97. Active catalytic species for hydroformylation is :

(1) $RuCl_2(PPh_3)_3$

(2) $HCo(CO)_3$

(3) $RhCl(PPh_3)_3$

(4) K_2PtCl_6

98. The correct order of energy level of d-orbital in ferrocene is :

(1) $d_{x^2-y^2}$, $d_{xy} < d_{z^2} < d_{xz}$, d_{yz}

(2) $d_{z^2} < d_{xz}$ $d_{yz} < d_{x^2-y^2} < d_{xy}$

(3) $d_{x^2-y^2}$, $d_{xy} < d_{xz}$ $d_{yz} < d_{z^2}$

(4) d_{yz}, $d_{xz} < d_{x^2-y^2}$, $d_{xy} < d_{z^2}$

99. The major product obtained in the reaction of iodobenzene with styrene in presence of palladium acetate and potassium carbonate is :

(1) 1,2-diphenylethene

(2) 1,2-diphenylethyne

(3) 1, 2-diphenylethane

(4) 4-phenylstyrene

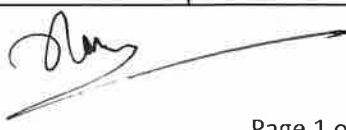**100.** The cluster having arachano type structure is :

(1) $[Os_5(CO)_{16}]$

(2) $[Os_3(CO)_{12}]$

(3) $[Ir_4(CO)_{12}]$

(4) $[Rh_6(CO)_{16}]$

ANSWER KEYS OF CHEMISTRY FOR SESSION 2022-23

Q. NO.	A	B	C	D
1	1	1	1	2
2	4	2	2	3
3	4	2	3	2
4	4	1	4	3
5	2	2	1	2
6	2	1	2	1
7	2	4	3	3
8	1	2	1	3
9	1	1	4	1
10	2	3	2	1
11	1	4	1	3
12	2	3	3	1
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47	3	4	1	1
48	1	2	3	3
49	4	3	1	1
50	2	3	4	3

Q. NO.	A	B	C	D
		ANSWER KEYS OF CHEMISTRY FOR SESSION 2022-23		
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99	1	1	2	1
100	3	2	3	2