1. The extent to which a real gas departs from ideal behaviour may be depicted in terms of a function called compressibility factor (Z), which is defined as (where V is molar volume)
   a. $\frac{pV}{RT}$
   b. $\frac{RV}{pV}$
   c. $\frac{2pV}{RT}$
   d. $\frac{RT}{M}$
   e. a

2. NH_3 gas is liquefied more easily than N_2. Which one of the following is correct? (where a and b are van der Waals' constants)
   a. $a(NH_3) > a(N_2)$ and $b(NH_3) > b(N_2)$
   b. $a(NH_3) < a(N_2)$ and $b(NH_3) < b(N_2)$
   c. $a(NH_3) > a(N_2)$ but $b(NH_3) < b(N_2)$
   d. $a(NH_3) < a(N_2)$ but $b(NH_3) > b(N_2)$
   e. a

3. Consider the following statements
   1. The distribution of the components of molecular speeds is described by a Gaussian distribution.
   2. The distribution of molecular speeds is given by the Maxwell-Boltzmann distribution.
   3. The Maxwell-Boltzmann distribution is verifiable experimentally.
   Which of the statements given above are correct?
   a. 1 and 2 only
   b. 2 and 3 only
   c. 1 and 3 only
   d. 1, 2 and 3
   e. b

4. In which case of mixing of a strong acid and a base each of 1 N concentration, the temperature increase is the highest?
   a. 20 ml acid–30 ml alkali
   b. 10 ml acid–40 ml alkali
   c. 25 ml acid–25 ml alkali
   d. 35 ml acid–15 ml alkali
   e. c

5. What is the standard molar enthalpy of formation of acetylene from its elements? [Given, heat of formation of CO_2 (g), H_2O(1) are respectively -393.5 kJ mol^{-1} and -285.8 kJ mol^{-1} and $2C_2H_2(g)+5O_2(g) \rightarrow 4CO_2(g)+2H_2O(l)$ $\Delta H = -2598.8$ kJ mol^{-1}]
   a. -453.2 kJ mol^{-1}
   b. $+453.2$ kJ mol^{-1}
   c. -226.6 kJ mol^{-1}
   d. $+226.6$ kJ mol^{-1}
   e. d

6. At 300 K, 2 moles of an ideal gas expand reversibly and isothermally from 1 L to 10 L. What is the entropy change for the process? (R = 2 cal K^{-1} mol^{-1} and ln 10 = 2.303)
   a. 9.2 cal K^{-1} mol^{-1}
   b. 4.6 cal K^{-1} mol^{-1}
   c. 2.76 cal K^{-1} mol^{-1}
   d. 0
   e. a

7. One mole of an ideal gas expands reversibly and isothermally from 10 L to 100 L at 400 K. What is the enthalpy change in tiffs process?
   a. -10.2 kJ
   b. -2.5 kJ
   c. -2.5 kJ
   d. 0
   e. d

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8. What is the molar heat capacity of water in equilibrium with ice at constant temperature?
   a. 0
   b. 3.73 JK^{-1} mol^{-1}
   c. 37.3 JK^{-1} mol^{-1}
   d. Infinity
   e. a

9. Which of the following thermo dynamical relations are correct for one mole of an ideal gas?
   1. $\left(\frac{\partial U}{\partial V}\right)_T = 0$
   2. $\left(\frac{\partial H}{\partial V}\right)_T = 0$
   3. $\left(\frac{\partial C_v}{\partial V}\right)_T > 0$
   4. $\left(\frac{\partial P}{\partial T}\right)_T = 0$

   Select the correct answer using the code given below:
   Code:
   a. 1 and 4
   b. 1 and 2
   c. 2 and 3
   d. 3 and 4
   e. b

10. Water is heated to boiling under a pressure of 1 atm. When an electric current of 1 A from a 12 V supply is passed for 5 minutes through a resistance in thermal contact with it, it is found that 1 g of water is vapourized. What is the molar internal energy change at the boiling point of water (R = 8.314 JK^{-1} mol^{-1})
    a. –61.7 kJ mol^{-1}
    b. –64.8 kJ mol^{-1}
    c. –61.7 kJ mol^{-1}
    d. –64.8 kJ mol^{-1}
    e. b

11. Consider the following:
    1. 1 mole of $H_2O(l)$ at 15°C and 1 atm pressure
    2. 1 mole of $H_2O(s)$ at 0°C and 1 atm pressure
    3. 1 mole of $H_2O(l)$ at 0°C and 1 atm pressure

    What is the correct order of increasing entropy?
    a. 2 < 1 < 3
    b. 2 < 3 < 1
    c. 1 < 3 < 2
    d. 1 < 2 < 3
    e. b

12. Consider the following :

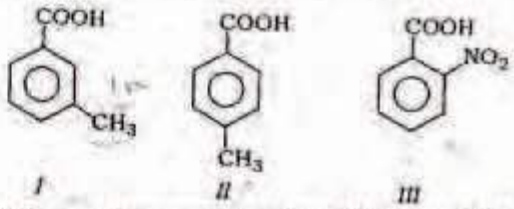
    What is the correct order of their stability?
    a. I > II > III
    b. III > II > I
    c. III > I > II
    d. II > I > III
    e. d

13. Which of the following pairs are correctly matched?

Isomeric hexanes	Number of monochlorinated Products
1. 3-methyle pentane	: Four
2. 2,2-dimethyl butane	: Five
3. 2, 3-dimethyl butane	: Two

    Select the correct answer using the code given below:
    Code:
    a. 1, 2 and 3
    b. 1 and 2 only
    c. 1 and 3 only
    d. 2 and 3 only
    e. c

14. Consider the following compounds:



    What is the correct order of their acidity?
    a. III > I > III
    b. III > I > II
    c. II > III > I
    d. III > II > I
    e. d

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15. An organic compound (A) C_4H_8 decolourises bromine water and on treatment with CO and H_2 in presence of suitable catalyst undergoes oxo-reaction to give aldehydes (B) and (C). (B) on reduction forms pentan-1-ol while (C) gives 2-methyl-butan-1 -ol on reduction. What is the structure of the compound (A)?

a. $CH_3 - CH_2 - CH = CH_2$

b. $CH_3 - CH = CH - CH_3$

c. $CH_3-\underset{\displaystyle CH_3}{\overset{|}{C}}=CH_2$

d. □

e. a

16. Match List–I with List–II and select the correct answer using the code given below the Lists

List I

A. $CH_3-COOH \rightarrow CH_2Br$

B. $CH_3-COOH \rightarrow Br-CH_2-COOH$

C. $CH_3-COOH \rightarrow CH_3COCH_3$

List – II

1. (i) CH_3Li (ii) $H_3\overset{+}{O}$
2. Br_2 | red P
3. (i) Ag NO_3 (ii) Br_2 | Δ
4. Soda lime | Δ

Codes

	A	B	C
a.	3	2	4
b.	2	3	1
c.	2	1	4
d.	3	2	1

e. c

17. Which of the following statements is/are correct for a compound having molecular formula $C_6H_{14}O$ showing three proton-NMR signals?

1. The compound is a symmetrical ether.
2. It gives iodopropane with hot HI and does not react at all with Na metal.

Select the correct answer using the code given below:

Code:

a. 1 only

b. 2 only

c. Both 1 and 2

d. Neither 1 nor 2

e. c

18. Which of the following pairs are correctly matched?

Reagent	Reaction
1. Na metal	: Witting reaction
2. $(C_6H_5)_3P=CR_2$	: Wurtz reaction
3. $NaOH/NH_2-NH_2$	: Lucas reagent/ reaction
4. ZnCl2 + HCl	: Lucas reagent/ reaction

Select the correct answer using the code given below:

Codes:

a. 1 and 2

b. 2 and 3

c. 3 and 4

d. 1 and 4

e. c

19. What is the dihedral angle between the hydroxyl groups in the most stable conformation of 1, 2-ethanediol?

a. 180°

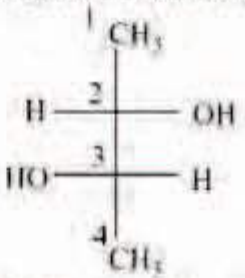
b. 90°

c. 60°

d. 0°

e. c

20. Consider the following molecule:



What are the configurations at chiral centres in the molecule shown above?

a. 2R and 3R

b. 2R and 3S

c. 2S and 3R

d. 2S and 3S

e. d

21. Consider the following compound:

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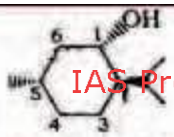
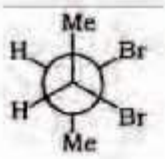


Which one of the following are the correct RS configurations of the above compound?

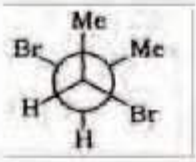
a. 1(R), 2(R), 5(S)
b. 1(S), 2(R), 5(S)
c. 1(R), 2(S), 5(R)
d. 1(S), 2(R), 5(R)
e. b

22. Which one of the following Newman projections represents a mesocompound?

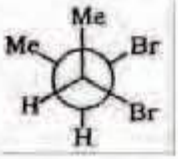
a.



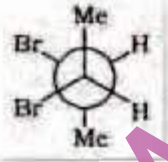
b.



c

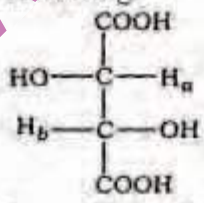


d.



e. c

23. Consider the following statements in respect of the following:



1. H_a and H_b have threo-relationship
2. H_a and H_b are homotopic
3. H_a and H_b are distereotopic
4. H_a and H_b are enantiotopic

Which of the above statements are correct?

a. 1 and 2
b. 2 and 3
c. 1 and 4
d. 1 and 3
e. a

24. What is the maximum number of possible geometrical isomers of $CH_3CH=CHCH=CHCH=CHOH$?

a. 2
b. 4
c. 6
d. 8
e. d

25. Which quantum number gives the information about degenerate orbitals?

a. Principal quantum number
b. Azimuthal quantum number
c. Magnetic quantum number
d. Spin quantum number
e. c

26. What is the number of nearest neighbours of an atom in the bcc type of packing?

a. 6
b. 8
c. 12
d. 24
e. b

27. The electronic configuration $[Ar]3d^6$ stands for

a. Ni^{2+}
b. Co^{3+}
c. Xe^0
d. Fe^{2+}
e. d

28. In square planar complexes, the hybrid orbitals are dsp^2. The atomic orbitals which give rise to dsp^2 hybrid orbitals are

a. $d_{x^2-y^2}$, s, Px and Py
b. d_{z^2}, s, Px and Py
c. $d_{x^2-y^2}$, s, Pz and Py
d. d_{z^2}, s, Pz and Py
e. a

29. Sigma bonds are formed between two atoms X and Y by the overlap of

1. $sp^3(X) - sp^3(Y)$
2. $sp^3(X) - 1s(Y)$
3. $1s(X) - 1s(Y)$

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What is the correct order of the energy released in the above three processes?

a. 1 > 2 > 3
b. 3 > 2 > 1
c. 2 > 1 > 3
d. 1 > 3 > 2
e. b

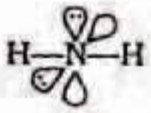
30. In which one of the following pairs of orbitals does overlapping result in hyper conjugation?

a. σ – σ
b. p – p
c. σ – p
d. π – π
e. a

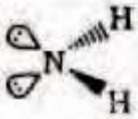
31. Which one of the following best represents the three-dimensional view of $H_2N^{\ominus}$?

a.

b.



c.



d.

e. c

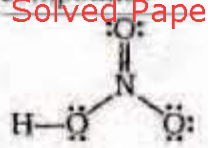
32. Square antiprism symmetry of a transition metal complex belongs to point group

a. C_{4v}
b. D_{4}
c. D_{4h}
d. D_{2d}
e.

33. ν_{NO} stretching vibration (cm^{-1}) in $NO[ClO_4]$ and NO respectively occurs at which wave numbers?

a. 2313 and 1876
b. 2313 and 2313
c. 1876 and 2313
d. 1876 and 1876
e. a

34. What is the charge on the nitrogen atom in the following compound?



(All valence electrons are shown in the figure)

a. +1
b. +2
c. -1
d. -2
e. a

35. Which one of the following is the softest acid according to HSAB principle?

a. Pb^{2+}
b. Fe^{2+}
c. Cu^{2+}
d. Cu
e. d

36. What are the number of protons, number of electrons and number of neutrons respectively in a molecule of heavy water?

a. 10, 10, 10
b. 8, 10, 11
c. 12, 10, 10
d. 12, 10, 12
e. a

37. Which one of the following is the most basic oxide?

a. Ga_2O_3
b. In_2O
c. Tl_2O
d. Tl_2O_3
e. d

38. When sodium is dissolved in liquid ammonia, it will produce

a. ammonium ion
b. amide ion
c. ammoniated electron
d. sodium ion
e. c

39. The rate constant for a reaction A → B is 3.84×10^{-2} min^{-1}. If the initial concentration of A is 1M what will be the rate of reaction after 1hour?

a. 3.84×10^{-2} mol L^{-1} min^{-1}

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b. 3.84×10^{-3} mol L^{-1} min^{-1}
c. 1.92×10^{-3} mol L^{-1} min^{-1}
d. 1.92×10^{-2} mol L^{-1} min^{-1}
e. **c**

40. The rate of a reaction depends on
a. Enthalpy of reaction only
b. Entropy and temperature of reaction only
c. Enthalpy and temperature of reaction only
d. Enthalpy entropy and temperature of reaction
e. **d**

41. The rate of reaction at fixed temperature will certainly increase, if
a. Only enthalpy of activation decreases
b. Enthalpy of activation increases
c. Enthalpy of activation decreases and entropy of activation increases
d. Both enthalpy and entropy of activation decrease
e. **a**

42. The rate constant for the reaction $2N_2O_5 \rightarrow 4NO_2 + O_2$ is $3.0 \times 10^{-5} s^{-1}$ if the rate is 2.40×10^{-3} mol $L^{-1} s^{-1}$, then what is the concentration of N_2O_5?
a. 1.4 mol L^{-1}
b. 1.2 mol L^{-1}
c. 0.8 mol L^{-1}
d. 0.4 mol L^{-1}
e. **c**

43. At 400 K, the rate constant of a reaction is 10 times more than the rate constant at 200 K. What is the activation energy of the reaction?
a. 230.3R
b. 9212R
c. 92.12R
d. 921.2R
e. **d**

44. In a reaction, the order with respect to OH^- ion is –1. the species acts as a/an
a. Catalyst
b. Neutralizing agent
c. Promoter
d. Inhibitor
e. **d**

45. The rates of reaction starting with initial concentrations 4×10^{-3} M and 2×10^{-3} M are 2.8×10^{-4} M s^{-1} and 0.7×10^{-4} Ms^{-1} respectively. What is the order of the reaction with respect to reactant?
a. 2
b. 1
c. 0
d. Nothing can be said from the given data
e. **a**

46. Which one of the following shows maximum osmotic pressure in water?
a. 1 M NaCl
b. 1 M $MgCl_2$
c. 1 M $(NH_4)_3PO_4$
d. 1M Na_2SO_4
e. **c**

47. For a second-order reaction with single reactant having the rate equal to $k[A]^2$ the plot of $1/[A]$ versus t is linear with
a. Negative slope with zero intercept
b. Positive slope with non-zero intercept
c. Positive slope with zero intercept
d. Negative slope with non-zero intercept
e. **c**

48. In the following sequence of reactions, the energy-poor molecule A* in the ensuing collision is robbed off enough energy to be deactivated as

$$A + A \underset{k_1}{\overset{k_2}{\rightleftharpoons}} A + A^*$$

$$A^* \xrightarrow{k} B + C$$

What is the steady-state concentration $[A^*]$ equal to?
a. $\dfrac{k_2[A]}{k_2[A]+k_1}$
b. $\dfrac{k_2[A]^2}{k_{-1}[A]+k_1}$
c. $\dfrac{k_2[A]+k_1}{k_2[A]^2}$
d. None of the above
e. **b**

49. A monochromatic radiation is incident on a solution of 0.05 molar concentration of an absorbing substance. If the intensity of radiation is reduced to one-tenth of the initial value after passing through 10 cm length of the solution, then what is the molar extinction coefficient of the substance?
a. 0.005 dm^3 mol^{-1} cm^{-1}
b. 0.5 dm^3 mol^{-1} cm^{-1}
c. 2.0 dm^3 mol^{-1} cm^{-1}
d. None of the above

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e. c

50. Fluorescence emission is normally observed from
a. The first excited singlet state
b. The higher excited singlet state
c. The triplet state above the singlet state
d. The triplet state below the singlet state
e. a

51. Aqueous solution of sodium thiosulphate on chlorination gives which one of the following?
a. $Na_2S_4O_6$
b. Na_2S
c. NaCl
d. $NaHSO_4$
e. a

52. What would be the quantum yield of fluorescence, if a molecule surviving in an excited state for $3 \cdot 10^{-10} s$ fluoresces at the rate $10^9 s^{-1}$?
a. 0.3
b. 0.15
c. 0.03
d. 0.003
e. a

53. Which of the following statements are correct about the characteristics of catalysts?
1. Presence of catalyst does not affect the position of equilibrium in a reversible reaction.
2. A catalyst can initiate a reaction.
3. The efficiency of a catalyst is uniform at all ranges of temperature.
4. The action of a catalyst is specific.

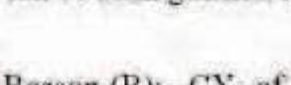
Select the correct answer using the code given below:
Code:
a. 1 and 2
b. 2 and 3
c. 3 and 4
d. 1 and 4
e. d

54. In the coagulation of negatively charged sol, the coagulating power of Na^+, Ba^{2+}, Al^{3+} and Th^{4+} is in the order of
a. $Th^{4+} < Al^{3} < Ba^{2+} < Na^{+}$
b. $Na^{+} < Ba^{2+} < Al^{3+} < Th^{4+}$
c. $Al^{3+} < Na^{+} < Th^{4+} < Ba^{2+}$
d. $Na^{+} < Al^{3+} < Ba^{2+} < Th^{4+}$
e. b

55. Micelles will normally like to remain away from each other, since
a. One will dissolve the other
b. The surfaces are hydrophilic
c. The surfaces are hydrophobic
d. They are zwitterionic in nature
e. d

56. Assertion (A): In BF_3 the B – F bonds are considerably shorter than typical B – F single bonds.
Reason (R): The hybridization of B is sp^2.
a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true
e. b

57. Assertion (A): 3-penten-2-one and 4-penten-2- one can be distinguished by UV spectroscopy.
Reason (R): λmax of the compound does not depend on the length of conjugation.
a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true
e. c

58. Assertion (A): 1-propanol and 2-propanol can be distinguished by I_2|NaoH.
Reason (R): $-CX_3$ of  is good leaving group for nucleophilic substitution reaction.
a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true
e. b

59. Assertion (A): Cis-1,3 dimethyl-cyclohexane is 1.8 kcal mol–1 less stable than its trans-isomer.
Reason (R): Cis- 1 ,3-dimethyl-cyclohexane exists in di-equatorial form whereas trans-isomner exists in axial equatorial conformation.
a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false

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d. A is false but R is true
e. **a**

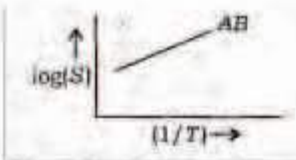
60. Assertion (A): Na_3VO_4 is a colourless compound.
Reason (R): V does not contain any unpaired electron in its 3d-orbital.
a. Both A and R are individually true and R is the correct explanation of A
b. Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true
e. **a**

61. For the equilibrium
$Fe(s)+H_2O(g)\rightleftharpoons FeO(s)+H_2(g)$
What are the number of components, phases and degrees of freedom respectively?
a. 3, 2, 3
b. 2, 3, 3
c. 3, 3, 2
d. 2, 2, 3
e. **c**

62. n simple molecules of solute A, associate in solution as $nA\rightleftharpoons(A)_n$. The degree of association is x. What is the number of particles at equilibrium?
a. $1+x+(x/n)$
b. $1-x+(x/n)$
c. $1+(2x/n)$
d. None of the above
e. **b**

63. 4.0×10^{-3} kg of acetic acid when dissolved in 100 cm^3 distilled water of density 1g cm^{-3} is found to dissociate up to 33%. What is the depression in freezing point of water approximately? (Given, K_f of water 1.86 K kg mol^{-1})
a. 0.01
b. 0.03
c. 0.001
d. 0.008
e. **b**

64.



The plot given above shows the relation between (1/T) and log(s), where S is the solubility of an electrolyte AB and T is the temperature in Kelvin. What conclusion can be drawn from the plot?
a. Dissolution of AB is exothermic
b. Dissolution of AB is endothermic
c. Solubility of AB increases with temperature
d. Nothing can be predicted
e. **a**

65. What is the molar concentration of solute particles in human blood, if the osmotic pressure is 7.3899 atm at body temperature of 27 °C?
$\left(R=8.206\times10^{-2}\ L\ atm\ K^{-1}\ mol^{-1}\right)$
a. 0.003 M
b. 0.03 M
c. 0.3 M
d. 0.6 M
e. **c**

66. In an acid-base titration using a pH meter, the dissociation constant of a weak acid can be obtained by extracting which one of the following information from the study?
a. The time required for neutralization
b. The volume of base required for neutralization
c. The pH at the neutralization point
d. The number of protons in the weak acid
e. **c**

67. What is the pH of a buffer solution containing 0.1 M acetic acid (pK_a = 4.745) and 0.01M sodium acetate?
a. 5.745
b. 4.745
c. 3.745
d. 2.745
e. **c**

68. If ΔG° is zero for a reaction, then which one of the following is correct?
a. $\Delta H=0$
b. $\Delta S=0$
c. Equilibrium constant is 1
d. Rate constant is 1
e. **c**

69. It is desired to yield 2.3 g of sodium by the electrolysis of molten sodium chloride. If the current efficiency is 50% and the potential drop across the cell is 2.5 V how much energy will be consumed in this process?
a. 482.5kJ
b. 120.6kJ
c. 12.1 kJ

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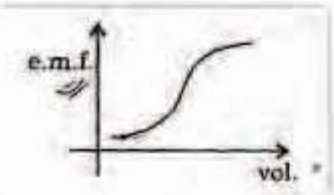
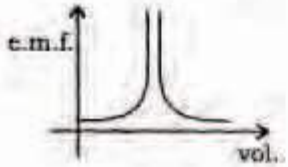
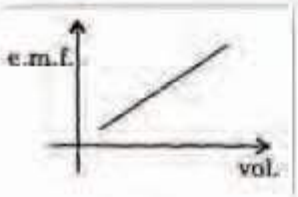
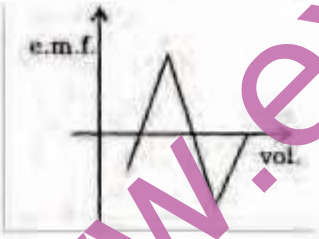
d. 48.2 kJ
e. **b**

70. Saturated calomel electrode is given by which one of the following?
a. $KCl(sat)|Hg_2Cl_2(s)|Hg(l)$
b. $Ag(s)|AgCl(s)|HCl(aq), NaCl(aq)$
c. $Hg_2Cl_2(s)|Hg(l)|KCl(sat)$
d. None of the above
e. **a**

71. Which one of the following represents the shape of potentiometric titration curve for redox reaction?
a.


b.


c.


d.


e. **a**

72. The complex $[Ru(H_2O)_6]^{2-}$ and $[RuCl_6]^{-}$ have nearly same Δ_0 values, because
a. Both the complexes contain the same metal atom
b. Both the complexes have a symmetrical octahedral structure
c. The presence of a weaker field ligand in one is compensated by the presence of the metal in a higher oxidation state
d. The H_2O and Cl^- occupy adjacent positions in the spectrochemical series
e. **c**

73. To satisfy the 18-electron rule in the complex [cycloheptatriene] $Mo(CO)_3$], the hapticity of the coordinated cycloheptatriene ligand must be
a. 6
b. 5
c. 4
d. 2
e. **b**

74. The molecule $N(SiMe_3)_3$ has a
a. Pyramidal shape and is a Lewis base
b. Pyramidal shape and is a Lewis acid
c. T-shaped geometry and is a Lewis acid
d. Trigonal planar geometry and has no Lewis base character
e. **d**

75. An example of a closo-carborane is
a. $CB_4H_5^-$
b. $CB_4H_5^-$
c. $CB_4H_5^-$
d. $CB_4H_5^-$
e. **c**

76. Wilkinson's catalyst
a. Is coordinatively saturated
b. Does not obey the 18-electron rule
c. Is used for oxidation of alcohols
d. Is an Ir complex used in the preparation of important pharmaceutical products
e. **a**

77. What results in when concentrated H_2SO_4 is added to a beaker containing sugar, $C_{12}H_{22}O_{11}$?
a. A spongy mass of elemental carbon
b. $C_6H_{12}O_6$
c. $C_{24}H_{44}O_{22}$
d. Another crystalline form of sugar
e. **b**

78. What is the product obtained on reaction between ethylene and Al_2Me_6?
a. Al_2Me_4 (n-pr)$_2$
b. Al_2 (ethylene)$_6$
c. Al_2 (ethylene)$_3$
d. Al_2H_6
e. **d**

79. Which one of the following statement is correct?
a. $CH_3CH_2\overset{\ominus}{S}$ is a stronger base and more nuclephilic than $CH_3CH_2\overset{\ominus}{O}$

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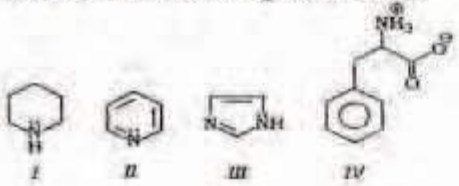
b. $CH_3CH_2\overset{\ominus}{S}$ is a stronger base and less nucleophilic than $CH_3CH_2\overset{\ominus}{O}$

c. $CH_3CH_2\overset{\ominus}{S}$ is a weaker base and less nucleophilic than $CH_3CH_2\overset{\ominus}{O}$

d. $CH_3CH_2\overset{\ominus}{S}$ is a weaker base and more nucleophilic than $CH_3CH_2\overset{\ominus}{O}$

e. **d**

80. Consider the following molecules:



What is the correct order of their basicity?

a. I > III > II > IV
b. IV > II > III > I
c. I > III > IV > II
d. IV > II > I > III
e. **a**

81. Consider the following bases:

OH^- NH_2^- $HC\equiv C^-$ $CH_3CH_2^-$

I II III IV

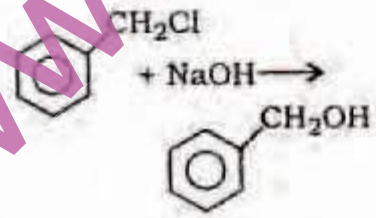
What is the correct order of their strength?

a. IV > II > III > I
b. I > III > II > I
c. IV > III > II > I
d. I > II > III > IV
e. **a**

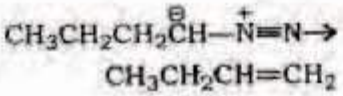
82. Match List –I with List – II and select the correct answer using the code given below the lists:

List – I (Reaction)

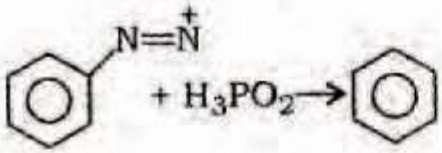
A.



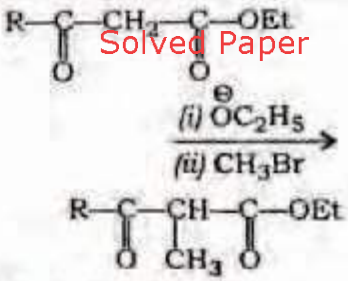
B.



C.



D.



List – II (Intermediate)

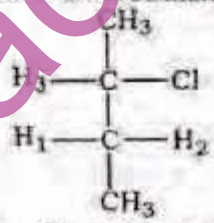
1. Benzyne
2. Carbanion
3. Carbene
4. Free radical
5. Carbocation

Codes:

	A	B	C	D
a.	5	4	3	2
b.	1	4	3	5
c.	1	3	4	5
d.	3	3	4	2

e. **d**

83. In 2-chlorobutane



a. H_1 and H_2 are homotopic
b. H_1 and H_2 are diastereotopic
c. H_1 and H_3 are homotopic
d. H_2 and H_3 are enantiotopic
e. **b**

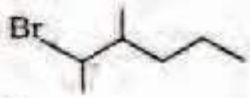
84. Which one of the following undergoes nucleophilic substitution with NaCN at the fastest rate?

a.

b.

c.

d.



e. **c**

85. In the reaction

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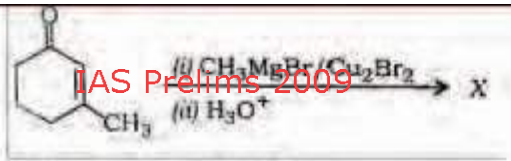
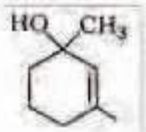
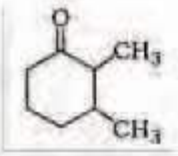
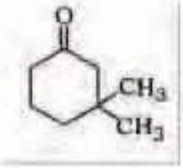
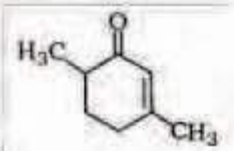


What is the product X?

a. 

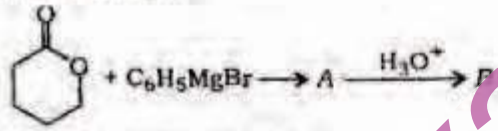
b. 

c. 

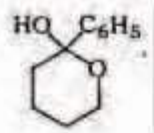
d. 

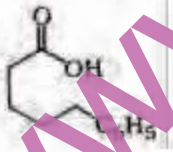
e. **a**

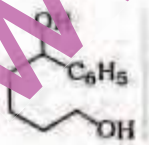
86. In the reaction

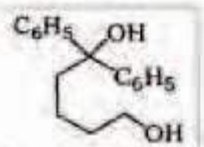


what is the product B?

a. 

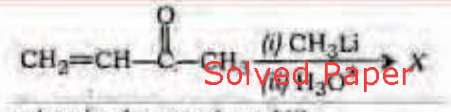
b. 

c. 

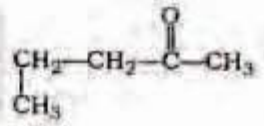
d. 

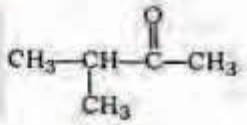
e. **d**

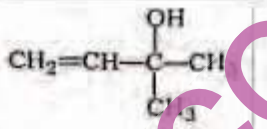
87. In the reaction

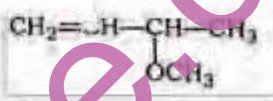


what is the product X?

a. 

b. 

c. 

d. 

e. **c**

88. Consider the following statements:
Malonic ester may be used for the synthesis of
1. substituted acetic acids
2. dicarboxylic acids
3. α-amino acids
Which of the above statements are correct?
a. 1 and 2 only
b. 1 and 3 only
c. 2 and 3 only
d. 1, 2 and 3
e. **d**

89. Consider the following statements:
Acetoacetic ester may be used for the synthesis of
1. α, β-unsaturated acids
2. β-keto acids
3. methyl ketones
4. 3-pentanone
Which of the above statements are correct?
a. 1, 2 and 3 only
b. 1, 2 and 4 only
c. 3 and 4 only
d. 1, 2, 3 and 4
e. **a**

90. By the attack of an electrophile, which one of the following will form the most stable carbocation?
a. Aniline
b. Acetanilide
c. Anisole
d. Dimethylaniline

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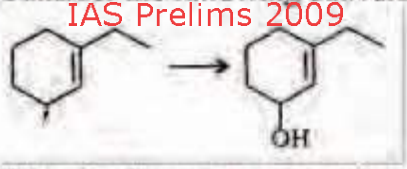
e. **d**

91. Consider the following conversion:

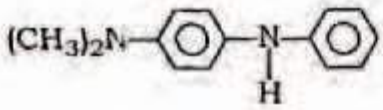


What is the most appropriate reagent for the above conversion?

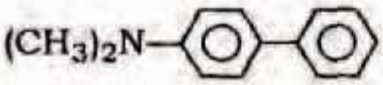
a. $KMnO_4$
b. $Pb(OAc)_4$
c. SeO_2
d. $NaIO_4$
e. **c**

92. Which one of the following is obtained by diazotization of aniline in cold followed by treatment with dimethylaniline?

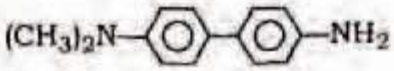
a.



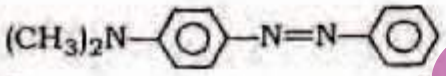
b.



c.



d.



e. **d**

93. N-acetylation on sodium salt of sulphanilic acid is much easier than on its free acid form, because

a. acetylation is hindered by steric effect exerted by large $-SO_3H$ group
b. quick desulphonation occurs prior to acetylation
c. lone pair of electrons on nitrogen is not available in salt form
d. lone pair of electrons on nitrogen is not available as free acid exists in dipolar ion form
e. **d**

94. Which one of the following has maximum resonance energy?

a.

b.

c.

d. $CH_2=CH-CH=CH_2$
e. **c**

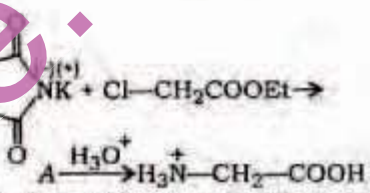
95. For converting a pentose into a hexose, what is the required reagent?

a. Phenylhydrazine/ HCl
b. Phenylhydrazine/ $NaBH_4$ /H_2O
c. $NaCN / H_3O^+ / \Delta$ / Na-Hg
d. Br_2 / H_2O, $Ca(OH)_2$, Fe^{+++} /H_2O_2
e. **c**

96. Consider the following reactions for the synthesis of α-amino acids:

1. $ClCH_2COOH \xrightarrow{\text{(i) NH}_3\text{ (ii) dil. HCl}} H_2N-CH_2-COOH$

2.



Which of the above reactions is/are correct?

a. 1 only
b. 2 only
c. Both 1 and 2
d. Neither 1 nor 2
e. **c**

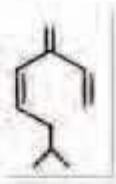
97. Lysine has $pKa_1 = 2.18$ and $pKa_2 = 8.95$. the pK_a for ionizations of the side chain is 10.53. What is the isoelectric point of lysine?

a. 5.56
b. 6.35
c. 9.74
d. 10.83
e. **c**

98. λ_{max} of an organic compound is 219 nm. What is the most likely structure of the compound?

a.

b.



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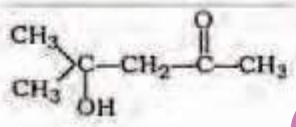
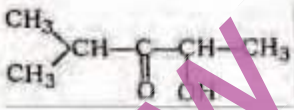
c.

d.

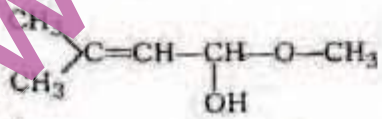
e. **a**

99. How many NMR signals will you expect for 1,2 ,3-tribromopropane?
a. Two signals, one a triplet and other a doublet
b. Three signals, two doublets and a quintet
c. Five signals, four doublets and a quintet
d. Two signals, one a doublet and other a quintet
e. **a**

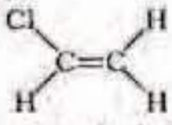
100. An organic compound $C_6H_{12}O_2$ (M 116) gave four signals in its proton-NMR spectrum at δ1.3(6H, s), δ2.2(3H, s), δ2.9(2H, s) and δ3.8(1H, s, exchangeable in D_2O). Its mass spectrum has base peak at m/z 58. What is the most likely structure of the compound?
a.


b.


c.

d.


e. **a**

101. What are the number of peaks and their multiplicity in the proton- NMR spectrum of

respectively?
a. 3 peaks, all quartets (double doublets)
b. 2 peaks, one doublet and one triplet
c. 3 peaks, two doublets and one triplet
d. 2 peaks, both doublets
e. **c**

102. Optically pure form of 2(R)-butanol is reacted under dry conditions with Na metal and then with butyl iodide. Which one of the following statements is correct for the outcome of the reaction?
a. The reaction results in destruction of chirality
b. The reaction proceeds with retention of
c. The reaction proceeds with racemization
d. The reaction proceeds with total inversion of configuration complete configuration
e. **b**

103. At ordinary temperatures, beryllium hydride occurs as a polymeric chain. The geometry around each beryllium atom is
a. trigonal planar
b. tetrahedral
c. square planar
d. linear
e. **a**

104. $[NiL_5]$ (where L is neutral) types of compounds can have trigonal bipyramidal (tbp) and square pyramidal (sp) geometries. Which one of the following is correct about magnetic properties of these types of geometries?
a. $[NiL_5]$ with sp geometry is paramagnetic only
b. $[NiL_5]$ with tbp geometry is paramagnetic only
c. $[NiL_5]$ with tbp and sp geometries is diamagnetic
d. $[NiL_5]$ with tbp and sp geometries is paramagnetic
e. **c**

105. Which one of the following salts (high spin for paramagnetic samples) will have the strongest attraction to a magnetic field?
a. $MnSO_4$
b. $CoSO_4$
c. CuO_4
d. $ZnSO_4$
e. **a**

106. The complex CuX_4^{2-} has magnetic moment 1.72 BM. The complex ion can have which of the following geometries?
1. O_h (HS)

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2. T_d (HS)
3. Square planar (HS)
4. Square planar (LS)

Select the correct answer using the code given below:
Code:
a. 1, 2, 3 and 4
b. 1, 2 and 3 only
c. 2, 3 and 4 only
d. 1 and 4 only
e. **a**

107. In metal carbonyl complexes, as more electron density moves from the metal d-orbitals to the $CO\pi^*$ orbitals, the CO stretching frequency
a. increases
b. decreases
c. remains same
d. disappears
e. **a**

108. Inverse spinel structure is observed in which one of the following?
a. Mn_3O_4
b. V_2O_5
c. Fe_2O_3
d. Fe_3O_4
e. **d**

109. Which one of the following techniques is used in the manufacture of aluminium from bauxite?
a. Reduction with magnesium
b. Reduction with coke
c. Electrolytic reduction
d. Reduction with iron
e. **c**

110. The reaction between metallic silver and aqueous NaCN forming a soluble complex occurs in the presence of
a. nitrogen
b. helium
c. argon
d. oxygen
e. **d**

111. What is the IUPAC name of $[Ni(NH_3)_4]^{2+}$ $[NiCl_4]^{2-}$?
a. Tetrachloronickel(II) tetraaminenickel(II)
b. Tetraaminenickel(II) tetrachloronickel(II)
c. Tetraaminenickel(II) tetrachloronickelate(II)
d. Tetrachloronickel(II) tetraaminenickelate(II)
e. **d**

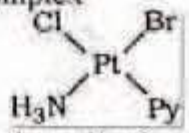
112. What is the number of isomeric forms possible for $[Co(en)_2(NH_3)_2Cl_2]^+$ complex?
a. 2
b. 3
c. 4
d. 5
e.

113. Consider the following statements in respect of $[CoCl_6]^{4-}$ complex ion:
1. It is paramagnetic.
2. It is a low-spin complex.
3. Oxidation number of Co is +4.
4. The coordination number of Co is 6.

Which of the statements given above are correct?
a. 1, 2, 3 and 4
b. 3 and 4 only
c. 1 and 4 only
d. 1 and 2 only
e. **c**

114. What type of isomerism is present in the pair of complexes $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$?
a. Linkage isomerism
b. Ligand isomerism
c. Ionization isomerism
d. Coordination isomerism
e. **c**

115. The complex



can be formally formed from $K_2[PtCl_4]$ by which one of the following sequences of substitutions of the chloride ions?
a. Py, Br^-, NH_3
b. Br^-, Py, NH_3
c. Br^-, NH_3, Py
d. NH_3, Br^-, Py
e. **d**

116. The complexes $[Co(NH_3)_5(NO_2)]^{2+}$ and $[Co(NH_3)_5(ONO)]^{2+}$ are called
a. ionization isomers
b. linkage isomers
c. coordination isomers
d. geometrical isomers
e. **b**

117. If Δ_o and Δ_t represent crystal field splitting energies for d-orbitals for octahedral and tetrahedral geometries respectively, then for d^6 (high spin in both the cases), what are the CFSE (ignoring the pairing energy) respectively?
a. $0.6\Delta_o$ and $0.6\Delta_t$

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b. $0.4\Delta_0$ and $0.4\Delta_t$
c. $0.4\Delta_0$ and $0.6\Delta_t$
d. $0.6\Delta_0$ and $0.4\Delta_t$
e. **c**

118. Which one of the following complexes is expected to have lowest Δ_0 value?
a. $[Co(NH_3)_6]^{3+}$
b. $[CoF_6]^{3-}$
c. $[Rh(NH_3)_5]^{3+}$
d. $[Ir(NH_3)_6]^{3+}$
e. **b**

119. Sulphur dioxide levels in the atmosphere can be reduced by using
a. catalytic converters in industry
b. static electricity to attract it in factory chimneys
c. more efficient car engines
d. low-sulphur fuels
e. **d**

120. What does Green Chemistry in terms environment mean?
a. Greenhouse effect
b. Reactions related to the depletion of ozone layer
c. Photosynthetic reactions in plants
d. Reduction in the use and production of hazardous chemicals
e. **b**

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