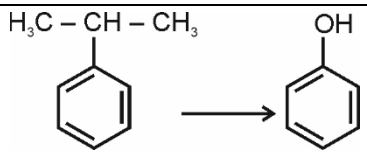
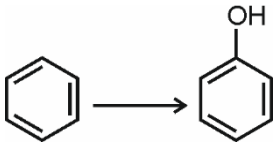
# CHEMISTRY

46. Match List I with List II:

| | List I | | List II |
|---|---|---|---|
| A. |  | (I) | (i) Oleum;<br>(ii) NaOH, Δ;<br>(iii) $H^+$ |
| B. | $CH_3COOH \longrightarrow CH_3CH_2OH$ | (II) | (i) $O_2$;<br>(ii) $H_2O/H^+$ |
| C. | $CH_3CH_2CH_2OH \longrightarrow CH_3-\underset{\displaystyle OH}{\underset{\displaystyle |}{CH}}-CH_3$ | (III) | (i) $CH_3OH$, $H^+$;<br>(ii) $H_2$, catalyst |
| D |  | (IV) | (i) conc. $H_2SO_4$, Δ;<br>(ii) $H^+/H_2O$ |

Choose the **correct** answer from the options given below :

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

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

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

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

**Answer (4)**

47. The major product Z formed in the following sequence of reactions is

$$C_2H_6 \xrightarrow[\text{UV light}]{Cl_2} \underset{\text{(monochlorinated product)}}{X} \xrightarrow{NH_3} Y \xrightarrow[(ii)\,H_2O]{(i)\,NaNO_2,\ HCl} Z$$

(1) $C_2H_5 - N = N - OH$

(2) $C_2H_5OH$

(3) $C_2H_5NO_2$

(4) $C_2H_5NH_2$

**Answer (2)**

48. In a qualitative analysis, $Bi^{3+}$ is detected by appearance of precipitate of BiO(OH)(s). Calculate pH when the following equilibrium exists at 298 K.

$BiO(OH)(s) \rightleftharpoons BiO^+(aq) + OH^-(aq)$, $K = 4 \times 10^{-10}$

(Given : log2 = 0.3010)

(1) 4.699

(2) 8.714

(3) 9.301

(4) 5.286

**Answer (3)**

49. When 1 $dm^3$ of $CO_2$ gas is passed over hot coke, the volume of gaseous mixture after complete reaction at STP becomes 1.4 $dm^3$. The composition of the gaseous mixture at STP is:

(1) 0.6 $dm^3$ of CO, 0.8 $dm^3$ of $CO_2$

(2) 0.8 $dm^3$ of CO, 0.8 $dm^3$ of $CO_2$

(3) 0.8 $dm^3$ of CO, 0.6 $dm^3$ of $CO_2$

(4) 0.6 $dm^3$ of CO, 0.4 $dm^3$ of $CO_2$

**Answer (3)**

50. Match List I with List II :

| | **List I (Quantum Numbers)** | | | **List II (Orbital)** |
|---|---|---|---|---|
| | 'n' | 'l' | | |
| A. | 2 | 1 | I. | 3d |
| B. | 4 | 0 | II. | 2p |
| C. | 5 | 3 | III. | 4s |
| D. | 3 | 2 | IV. | 5f |

Choose the **correct** answer from the options given below.

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

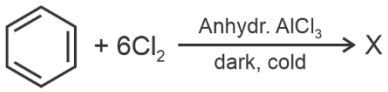
(2) A-I, B-II, C-III, D-IV

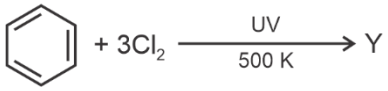
(3) A-IV, B-II, C-III, D-I

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

**Answer (1)**

51. The number of chlorine atoms present in the organic products X and Y of the following reactions, respectively, are :




(1) 3 and 6

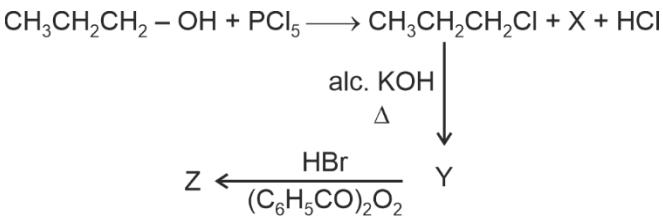
(2) 6 and 6

(3) 6 and 3

(4) 3 and 3

**Answer (2)**

52. In the following reaction sequence, X and Z respectively are :




(1) $X = POCl_3$; $Z = CH_3 - \underset{\underset{Br}{|}}{CH} - CH_3$

(2) $X = H_3PO_3$; $Z = CH_3CH_2CH_2 - Br$

(3) $X = H_3PO_3$; $Z = CH_3 - \underset{\underset{Br}{|}}{CH} - CH_3$

(4) $X = POCl_3$; $Z = CH_3CH_2CH_2 - Br$

**Answer (4)**

53. Match List I with List II :

| | **List I (Transition metal/compound complex)** | | **List II (Catalytic Role)** |
|---|---|---|---|
| A. | $V_2O_5$ | I. | Preparation of ammonia from $N_2/H_2$ mixture |
| B. | Fe | II. | Polymerisation of alkynes |
| C. | $PdCl_2$ | III. | Preparation of $H_2SO_4$ and $SO_2$ |
| D. | Ni complex | IV. | Oxidation of ethyne to ethanal |

Choose the **correct** answer from the options given below.

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

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

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

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

**Answer (4)**

54. Identify the correct statement about $ClF_3$ from the following options :

(1) It has a trigonal pyramidal geometry with two lone pairs on Cl atom.

(2) It has T-shaped geometry with two lone pairs on Cl atom.

(3) It has a planar trigonal geometry with two lone pairs on Cl atom.

(4) It has T-shaped geometry with three lone pairs on Cl atom.

**Answer (2)**

55. Calculate emf of the half cell given below :
Pt (s) | $H_2$(g, 2 atm) | HCl (aq, 0.02 M)

$E^{\circ}_{H_2/H^+} = 0$ V

(Given: $\frac{2.303\,RT}{F} = 0.059,\ \log 2 = 0.3010$)

(1) 0.109 V

(2) 0.035 V

(3) –0.035 V

(4) –0.109 V

**Answer (1)**

56. Match List I with List II :

| | **List-I (Order of reaction)** | | **List-II (Unit of rate constant)** |
|---|---|---|---|
| A. | Zero order | I. | $mol^{-1}\ L\ s^{-1}$ |
| B. | First order | II. | $mol^{-2}\ L^2\ s^{-1}$ |
| C. | Second order | III. | $s^{-1}$ |
| D. | Third order | IV. | $mol\ L^{-1}\ s^{-1}$ |

Choose the **correct** answer from the options given below :

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

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

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

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

**Answer (3)**

57. The calculated 'spin-only' magnetic moment of $Ti^{2+}$ ($3d^2$) is :

(1) 2.84 BM

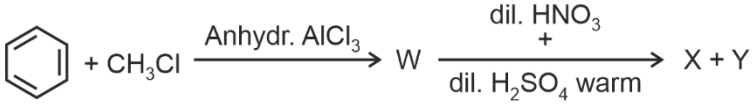
(2) 5.92 BM

(3) 4.90 BM

(4) 3.87 BM

**Answer (1)**

58. Two products X and Y are formed in the following reaction sequence.




The suitable method that can be used for the separation of products X and Y is :

(1) Continuous extraction

(2) Differential extraction

(3) Fractional distillation

(4) Sublimation

**Answer (3)**

59. A bulb is rated at 150 watt, converting 8% energy into light. If energy of one photon is $4.42 \times 10^{-19}$ J, how many photons are emitted by the bulb per second?

(1) $1.35 \times 10^{19}$

(2) $4.06 \times 10^{19}$

(3) $2.71 \times 10^{19}$

(4) $27.2 \times 10^{19}$

**Answer (3)**

60. In a test tube containing a salt, a few drops of dilute $H_2SO_4$ was added, which gave colourless vapours having the smell of vinegar. The vapours turned the blue litmus paper red.
Identify the **correct** anion from the following :

(1) Acetate, $CH_3COO^-$

(2) Carbonate, $CO_3^{2-}$

(3) Sulphate, $SO_4^{2-}$

(4) Sulphide, $S^{2-}$

**Answer (1)**

61. Select the reagents that reduce nitriles to primary amines.

A. (i) $LiAlH_4$; (ii) $H_2O$

B. Sn + HCl

C. $H_2$/Ni

D. Na(Hg)/$C_2H_5OH$

E. $Br_2$/aq. NaOH

Choose the **correct** answer from the options given below.

(1) A, B and C only

(2) A, C and D only

(3) A, D and E only

(4) B, D and E only

**Answer (2)**

62. Identify the **incorrect** statement from the following:

(1) Carbon has the ability to form $p\pi$-$p\pi$ multiple bond with itself.

(2) $ECl_3$ (E = B and Al) is a monomer when E = B and a dimer when E = Al.

(3) Oxygen exhibits only –2 oxidation state.

(4) The order of catenation property of Group 14 elements is C >> Si > Ge $\approx$ Sn.

**Answer (3)**

63. Although +3 oxidation state is most common in lanthanoids, cerium still shows +4 oxidation state because:

(1) Its nearest inert gas is Radon.

(2) After losing one more electron, it acquires $4f^{14}$ electronic configuration.

(3) Its atomic number is 61.

(4) After losing one more electron, it acquires $4f^0$ electronic configuration.

**Answer (4)**

64. During Lassaigne's test, the elements present in an organic compound are converted from :

(1) Covalent form to covalent form

(2) Ionic form to ionic form

(3) Covalent form to ionic form

(4) Ionic form to covalent form

**Answer (3)**

65. The number of hydrogen atoms present in 5.4 g of urea is:

(Given: Molar mass of urea : 60 g $mol^{-1}$,

$N_A$ : $6.022 \times 10^{23}$ particles $mol^{-1}$)

(1) $2.168 \times 10^{23}$

(2) $2.168 \times 10^{22}$

(3) $1.084 \times 10^{22}$

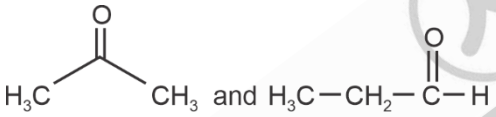
(4) $1.084 \times 10^{23}$

**Answer (1)**

66. The pair of molecules that are metamers among the following is :

(1) $CH_3CH_2CH_2OH$ and $CH_3 - CH(OH) - CH_3$

(2) $CH_3OCH_2CH_2CH_3$ and $CH_3CH_2OCH_2CH_3$

(3)  and 

(4) $CH_3CH_2CH_2CH_2CH_3$ and $(CH_3)_2CHCH_2CH_3$

**Answer (2)**

67. Identify the ***incorrect*** statement from the following:

(1) $P(C_2H_5)_3$ and $As(C_6H_5)_3$ form $d\pi$-$d\pi$ bond with transition metals.

(2) Nitrogen can form $d\pi$-$p\pi$ bond with oxygen.

(3) Nitrogen can form $p\pi$-$p\pi$ multiple bonds with itself.

(4) Phosphorus, arsenic and antimony show catenation property.

**Answer (2)**

68. Phenolphthalein is used as an indicator for the titration of sodium hydroxide solution against a standard solution of oxalic acid. The colour change that is observed at an alkaline pH close to the equivalence point during this titration is:

(1) pinkish red to yellow

(2) yellow to pinkish red

(3) colourless to pink

(4) pink to colourless

**Answer (3)**

69. Match List I with List II :

| | List I | | List II |
|---|---|---|---|
| A. | $C_2H_4$ | I. | 3 $\sigma$ bonds, 2 $\pi$ bonds |
| B. | $C_2H_2$ | II. | 3 $\sigma$ bonds, one lone pair |
| C. | $CH_4$ | III. | 4 $\sigma$ bonds |
| D. | $NH_3$ | IV. | 5 $\sigma$ bonds, 1 $\pi$ bond |

Choose the **correct** answer from the options given below :

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

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

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

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

**Answer (1)**

70. At a certain temperature, T (K), during a process, 500 J is absorbed by the system and work of 200 J is done by the system. Then change in internal energy of the system is :

(1) 700 J

(2) 300 J

(3) 400 J

(4) 500 J

**Answer (2)**

71. Methane reacts with steam at 1273 K in the presence of nickel catalyst to form :

(1) CO and $H_2$

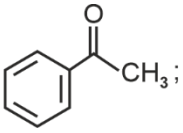
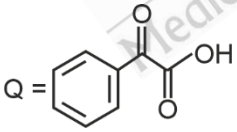
(2) CO and $H_2O$

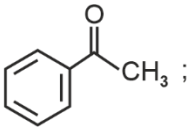
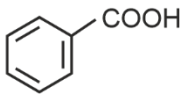
(3) $CO_2$ and $H_2O$

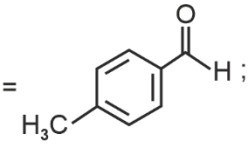
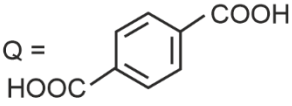
(4) $CO_2$ and $H_2$

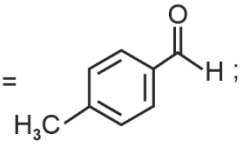
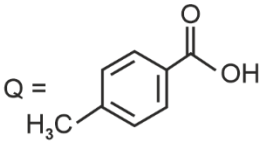
**Answer (1)**

72. Compound P($C_8H_8O$) gives a red orange precipitate with 2,4-DNP reagent and it does not reduce Fehling's reagent. On drastic oxidation with chromic acid, P gives an aromatic product Q that produces effervescence on treating with aq. $NaHCO_3$. Compounds P and Q, respectively, are :

(1) P =  ; Q = 

(2) P =  ; Q = 

(3) P =  ; Q = 

(4) P =  ; Q = 

**Answer (2 or 3)**

73. A solution of copper sulphate is electrolysed for 10 minutes with a current of 1.5 amperes. The mass of copper deposited at cathode is :
(Given : Molar mass of Cu = 63 g $mol^{-1}$;
1 F = 96487 C $mol^{-1}$)

(1) 2.4036 g

(2) 1.7018 g

(3) 0.5876 g

(4) 0.2938 g

**Answer (4)**

74. The functional group that can be identified through phthalein dye test is :

(1) Phenolic

(2) Alcohol

(3) Aldehyde

(4) Carboxylic acid

**Answer (1)**

75. The correct statement with regard to the secondary structure of DNA/RNA is

(1) DNA possesses a single strand helix structure and contains uracil as one of the four bases

(2) RNA possesses a single strand helix structure and contains thymine as one of the four bases

(3) DNA possesses a double strand helix structure and contains thymine as one of the four bases

(4) RNA possesses a double strand helix structure and contains uracil as one of the four bases

**Answer (3)**

76. Identify the correct statements :

(A) The molality of 2.5 g of ethanoic acid (Molar mass : 60 g $mol^{-1}$) in 75 g of benzene solution is 0.556 m.

(B) The molarity of a solution containing 5 g of NaOH (molar mass : 40 g $mol^{-1}$) in 450 mL of solution is 0.278 M at 298 K.

(C) Aquatic species are more comfortable in cold water.

(D) The solubility of gas increases with decrease in pressure.

(E) For a binary mixture of A and B, the number of moles of A and B are $n_A$ and $n_B$ respectively. The mole fraction of B will be $x_B = \frac{n_A}{n_A + n_B}$.

Choose the **correct** answer from the options given below :

(1) A and C only

(2) A, B and C only

(3) A, D and E only

(4) A and B only

**Answer (2)**

77. Mixture of chloroform and acetone forms a solution with negative deviation from Raoult's law due to :

(1) Formation of hydrogen bonding between acetone and chloroform

(2) Increase in escaping tendency of molecules of each component.

(3) Stronger intermolecular forces between chloroform molecules than those between chloroform and acetone molecules.

(4) Repulsive forces.

**Answer (1)**

78. At 298 K, a certain buffer solution contains equal concentrations of $X^-$ and HX, $K_b$ for $X^-$ is $10^{-10}$. What is the pH of this buffer solution?

(1) 2
(2) 10
(3) 4
(4) 6

**Answer (3)**

79. Identify the **incorrect** statement from the following :

(1) The IUPAC name of the element with atomic number 107 is Unnilseptium.
(2) The largest and the smallest species among Mg, $Mg^{2+}$, Al and $Al^{3+}$ are Al and $Mg^{2+}$ respectively.
(3) The similarity in behaviour of Li with Mg is referred to as 'diagonal relationship'
(4) The oxidation state and covalency of Al in $[AlCl(H_2O)_5]^{2+}$ are 3 and 6, respectively.

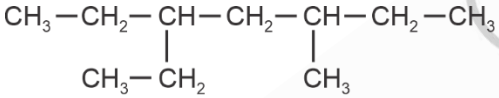
**Answer (2)**

80. The correct order of increasing metallic character of Na, Be, P, Mg and Si is

(1) P < Si < Be < Mg < Na
(2) Be < Si < P < Mg < Na
(3) P < Si < Na < Mg < Be
(4) P < Mg < Be < Si < Na

**Answer (1)**

81. The correct IUPAC name of the following compound is :



(1) 2,4-diethylhexane
(2) 3,5-diethylhexane
(3) 3-ethyl-5-methylheptane
(4) 3-methyl-5-ethylheptane

**Answer (3)**

82. Match **List I** with **List II** :

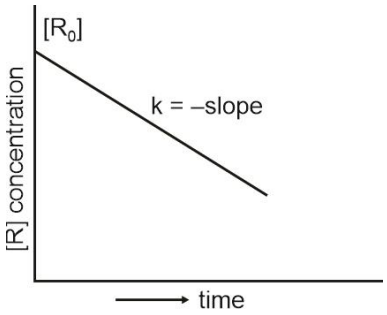
| | **List I (Complex/ion)** | | **List II (Shape/geometry)** |
|---|---|---|---|
| A. | $[Pt(Cl_2)(NH_3)_2]$ | (I) | Octahedral |
| B. | $[Co(NH_3)_6]Cl_3$ | (II) | Trigonal bipyramidal |
| C. | $[NiCl_4]^{2-}$ | (III) | Square planar |
| D | $[Fe(CO)_5]$ | (IV) | Tetrahedral |

Choose the **correct** answer from the options given below :

(1) A-I, B-III, C-IV, D-II
(2) A-III, B-IV, C-I, D-II
(3) A-IV, B-I, C-III, D-II
(4) A-III, B-I, C-IV, D-II

**Answer (4)**

83. For a certain reaction R → Product, the plot of concentration [R] vs time has a negative slope as shown. The order of reaction is :




(1) 0
(2) 1
(3) 2
(4) 2.5

**Answer (1)**

84. Which one of the following is an ambidentate ligand?

(1) Ethylenediaminetetraacetate ion
(2) Oxalate
(3) Ethane-1,2-diamine
(4) Thiocyanate

**Answer (4)**

85. Consider the following reaction :

$2A(g) + B(g) \rightarrow 2D(g)$

$\Delta U^{\ominus} = -10\ kJ\ mol^{-1}$ and $\Delta S^{\ominus} = -44\ JK^{-1}$ at 298 K.

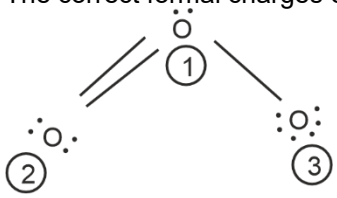
Identify the **correct** option with $\Delta G^{\ominus}$ for the reaction and spontaneity of the reaction at 298 K.

(Given : R = 8.31 J $mol^{-1}$ $K^{-1}$)

(1) –1.635 kJ $mol^{-1}$, spontaneous
(2) +0.63568 kJ $mol^{-1}$, non-spontaneous
(3) –0.63568 kJ $mol^{-1}$, spontaneous
(4) +1.635 kJ $mol^{-1}$, non-spontaneous

**Answer (2)**

86. The correct formal charges on oxygen atoms numbered 2, 1 and 3 respectively are :




(1) –1, 0, +1
(2) 0, +1, –1
(3) 0, 0, 0
(4) +1, 0, –1

**Answer (2)**

87. Given below are certain reactions. Identify the reaction for which $K_P \neq K_C$.

(1) $H_2(g)+I_2(g) \rightleftharpoons 2HI(g)$

(2) $N_2(g)+O_2(g) \rightleftharpoons 2NO(g)$

(3) $N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$

(4) $H_2O(g)+CO(g) \rightleftharpoons H_2(g)+CO_2(g)$

**Answer (3)**

88. Given below is an expression for the rate constant of a first-order reaction occurring at a certain temperature, T (K).

$$\ln k = 14.34 - \frac{1.25 \times 10^4}{T}$$

The energy of activation in kcal $mol^{-1}$ for the reaction is :
(Given: k in $s^{-1}$, R = 1.987 cal $mol^{-1}$ $K^{-1}$)

(1) 12.42

(2) 14.34

(3) 18.63

(4) 24.84

**Answer (4)**

89. The following two reactions give the same foul smelling product Z.

$$C_2H_5Cl \xrightarrow{X} Z$$

$$C_2H_5\overset{\overset{O}{\|}}{C}NH_2 \xrightarrow{Br_2,\ NaOH} Y \xrightarrow[\Delta]{CHCl_3/\text{ethanolic KOH}} Z$$

X and Z, respectively, are :

(1) X = AgCN; Z = $C_2H_5CN$

(2) X = KCN; Z = $C_2H_5CN$

(3) X = KCN; Z = $C_2H_5NC$

(4) X = AgCN; Z = $C_2H_5NC$

**Answer (4)**

90. Match List I with List II :

| | **List-I (Complex)** | | **List-II (Type of isomerism)** |
|---|---|---|---|
| A. | $[Pt(NH_3)_2Cl_2]$ | I. | Optical |
| B. | $[Co(en)_3]^{3+}$ | II. | Solvate |
| C. | $[Co(NH_3)_5NO_2]Cl_2$ | III. | Geometrical |
| D. | $[Cr(H_2O)_6]Cl_3$ | IV. | Linkage |

Choose the **correct** answer from the options given below :

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

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

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

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

**Answer (3)**