

## CHEMISTRY

### SECTION- I

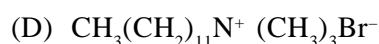
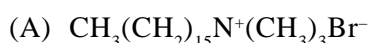
#### STRAIGHT OBJECTIVE TYPE

This section contains 9 multiple choice questions numbered 45 to 53. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY-ONE is correct

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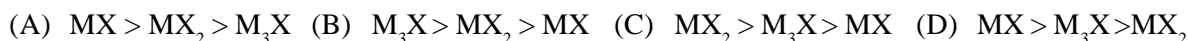
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45. Among the following, the surfactant that will form micelles in aqueous solution at the lowest molar concentration at ambient conditions is



Sol: Ans [A]

46. Solubility product constants ( $K_{\text{sp}}$ ) of salts of types MX,  $\text{MX}_2$  and  $\text{M}_3\text{X}$  at temperature "T" are  $4.0 \times 10^{-8}$ ,  $3.2 \times 10^{-14}$  and  $2.7 \times 10^{-15}$ , respectively. Solubilities ( $\text{mol dm}^{-3}$ ) of the salts at temperature "T" are in the order



Sol: Ans [D]  $K_{\text{sp}}(\text{MX}) = x^2$ ,  $x = 2 \times 10^{-4}$

$$K_{\text{sp}}(\text{MX}_2) = 4x^3, \quad x = 2 \times 10^{-5}$$

$$K_{\text{sp}}(\text{M}_3\text{X}) = 27x^4, \quad x = 10^{-4}$$

47. Electrolysis of dilute aqueous NaCl solution was carried out by passing 10 milli ampere current. The time required to liberate 0.01 mol of  $\text{H}_2$  gas at the cathode is (1 Faraday =  $96500 \text{ C mol}^{-1}$ )



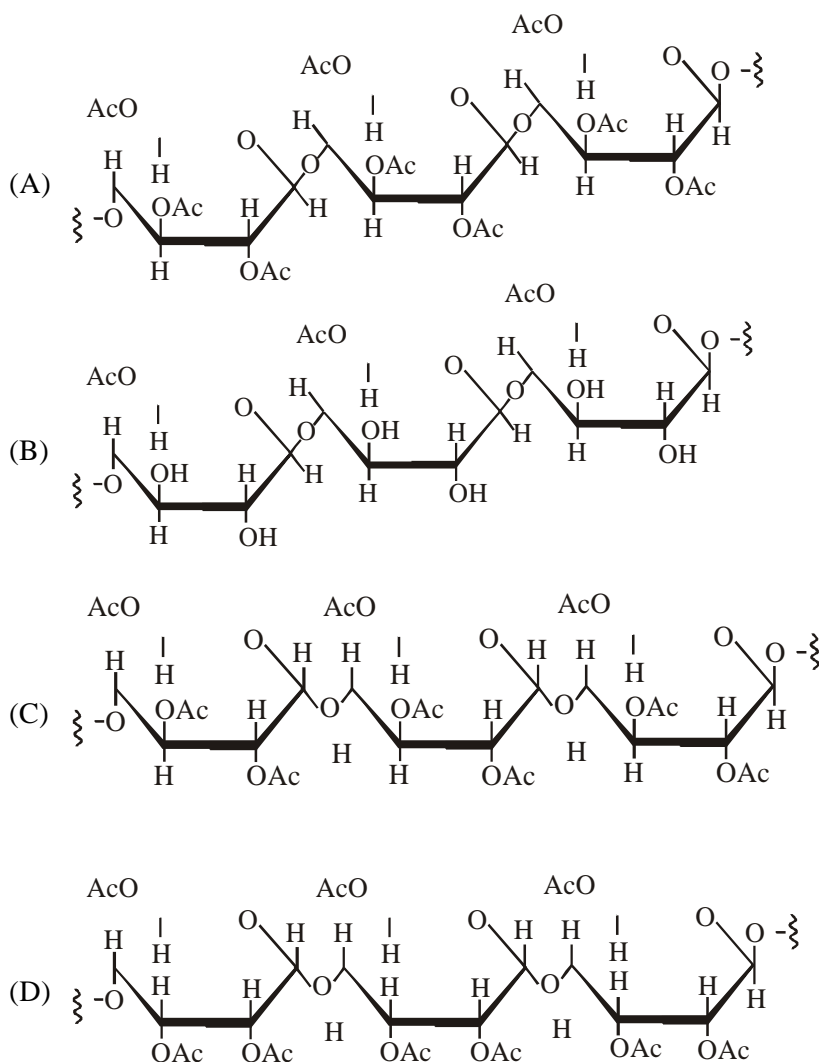
Sol: Ans [B]  $w = \frac{E}{F} It$

$$\frac{w}{M} = \frac{1}{nF} It$$

$$0.01 = \frac{1}{2 \times F} \times 10 \times 10^{-3} \times t$$

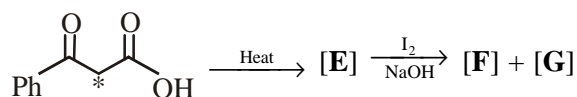
$$t = 19.3 \times 10^4 \text{ sec.}$$

48. Cellulose upon acetylation with excess acetic anhydride/ $H_2SO_4$  (catalytic) gives cellulose triacetate whose structure is

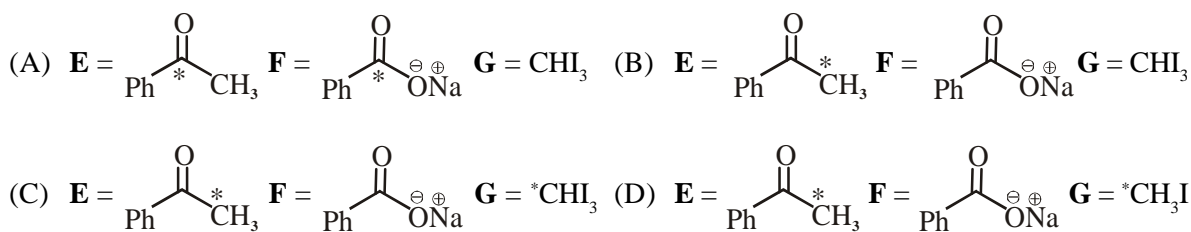


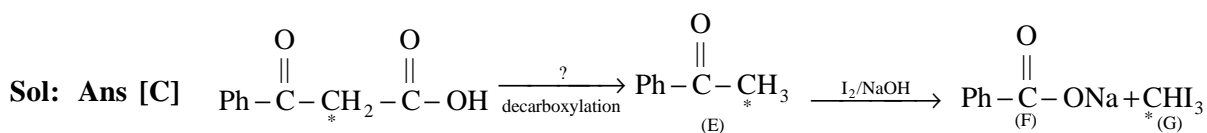
Sol: Ans [C]

49. In the following reaction sequence, the correct structures of **E**, **F** and **G** are

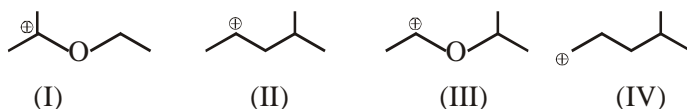


(\* implies  $^{13}\text{C}$  labelled carbon)





50. The correct stability order for the following species is



(A) (II) > (IV) > (I) > (III)

(B) (I) > (II) > (III) > (IV)

(C) (II) > (I) > (IV) > (III)

(D) (I) > (III) > (II) > (IV)

**Sol: Ans [D]** (I) and (III) have resonance but I has more number of hyperconjugation structures.

51. Among the following, the coloured compound is

(A) CuCl

(B)  $\text{K}_3[\text{Cu}(\text{CN})_4]$

(C)  $\text{CuF}_2$

(D)  $[\text{Cu}(\text{CH}_3\text{CN})_4]\text{BF}_4$

**Sol: Ans [C]**  $\text{Cu}^{2+}$  has one unpaired electron.

52. The IUPAC name of  $[\text{Ni}(\text{NH}_3)_4][\text{NiCl}_4]$  is

(A) Tetrachloronickel (II) - tetraamminenickel (II)

(B) Tetraamminenickel (II) - tetrachloronickel(II)

(C) Tetraamminenickel(II) - tetrachloronickelate (II)

(D) Tetrachloronickel(II) - tetraamminenickelate (0)

**Sol: Ans [C]**

53. Both  $[\text{Ni}(\text{CO})_4]$  and  $[\text{Ni}(\text{CN})_4]^{2-}$  are diamagnetic. The hybridisations of nickel in these complexes, respectively, are

(A)  $sp^3, sp^3$

(B)  $sp^3, dsp^2$

(C)  $dsp^2, sp^3$

(D)  $dsp^2, dsp^2$

**Sol: Ans [B]** CO and  $\text{CN}^-$  are strong field ligand and cause pairing of d-electrons.

## SECTION- II

### ASSERTION-REASON TYPE

This section contains 4 multiple choice questions. Each question 4 choices (A), (B), (C) and (D) out of which ONLY ONE is correct.

54. **STATEMENT-1:** Aniline on reaction with  $\text{NaNO}_2/\text{HCl}$  at  $0^\circ\text{C}$  followed by coupling with  $\beta$ -naphthol gives a dark blue coloured precipitate.

and

**STATEMENT-2:** The colour of the compound formed in the reaction of aniline with  $\text{NaNO}_2/\text{HCl}$  at  $0^\circ\text{C}$  followed by coupling with  $\beta$ -naphthol is due to the extended conjugation.

- (A) STATEMENT-1 is True, STATEMENT-2 is True; STATEMENT-2 is a correct explanation for STATEMENT-1
- (B) STATEMENT-1 is True, STATEMENT-2 is True; STATEMENT-2 is NOT a correct explanation for STATEMENT-1
- (C) STATEMENT-1 is True, STATEMENT-2 is False
- (D) STATEMENT-1 is False, STATEMENT-2 is True

**Sol: Ans [A]**

**55. STATEMENT-1:** The geometrical isomers of the complex  $[M(NH_3)_4Cl_2]$  are optically inactive.  
**and**

**STATEMENT-2:** Both geometrical isomers of the complex  $[M(NH_3)_4Cl_2]$  possess axis of symmetry.

- (A) STATEMENT-1 is True, STATEMENT-2 is True; STATEMENT-2 is a correct explanation for STATEMENT-1
- (B) STATEMENT-1 is True, STATEMENT-2 is True; STATEMENT-2 is NOT a correct explanation for STATEMENT-1
- (C) STATEMENT-1 is True, STATEMENT-2 is False
- (D) STATEMENT-1 is False, STATEMENT-2 is True

**Sol: Ans [A]**

**56. STATEMENT-1:** There is a natural asymmetry between converting work to heat and converting heat to work.

**and**

**STATEMENT-2:** No process is possible in which the sole result is the absorption of heat from a reservoir and its complete conversion into work.

- (A) STATEMENT-1 is True, STATEMENT-2 is True; STATEMENT-2 is a correct explanation for STATEMENT-1
- (B) STATEMENT-1 is True, STATEMENT-2 is True; STATEMENT-2 is NOT a correct explanation for STATEMENT-1
- (C) STATEMENT-1 is True, STATEMENT-2 is False
- (D) STATEMENT-1 is False, STATEMENT-2 is True

**Sol: Ans [A]**

**57. STATEMENT-1:**  $[Fe(H_2O)_5NO] SO_4$  is paramagnetic.

**and**

**STATEMENT-2:** The Fe in  $[Fe(H_2O)_5NO]SO_4$  has three unpaired electrons.

- (A) STATEMENT-1 is True, STATEMENT-2 is True; STATEMENT-2 is a correct explanation for STATEMENT-1
- (B) STATEMENT-1 is True, STATEMENT-2 is True; STATEMENT-2 is NOT a correct explanation for STATEMENT-1
- (C) STATEMENT-1 is True, STATEMENT-2 is False
- (D) STATEMENT-1 is False, STATEMENT-2 is True

**Sol: Ans [A]** Fe is in +1 state and complex contain three unpaired electron.

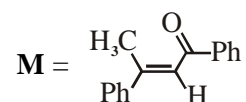
## SECTION- III

LINKED COMPREHENSION TYPE

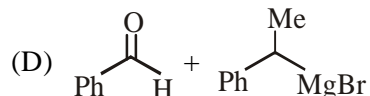
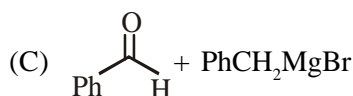
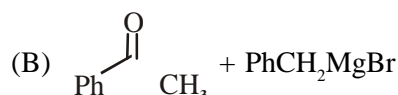
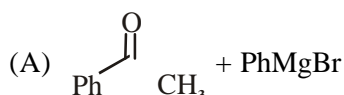
This section contains 2 Paragraphs. Based upon each paragraph, 3 multiple choice questions have to be answered. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE is correct.

## Paragraph for Question Nos. 58 to 60

A tertiary alcohol **H** upon acid catalysed dehydration gives a product **I**. Ozonolysis of **I** leads to compounds **J** and **K**. Compound **J** upon reaction with KOH gives benzyl alcohol and a compound **L**, whereas **K** on reaction with KOH gives only **M**.

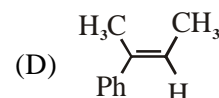
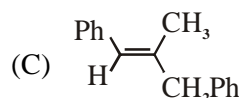
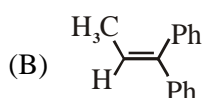
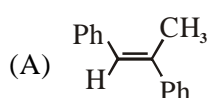


58. Compound **H** is formed by the reaction of



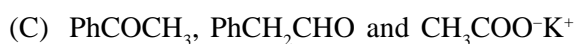
Sol: Ans [B]  $\text{H} = \text{Ph}-\text{CH}_2-\overset{\text{OH}}{\underset{\text{CH}_3}{\text{C}}}-\text{Ph}$  which is formed by  $\text{Ph}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$  and  $\text{PhCH}_2\text{MgBr}$ .

59. The structure of compound **I** is



Sol: Ans [A]  $\begin{array}{c} \text{Ph} \quad \text{CH}_3 \\ \diagdown \quad \diagup \\ \text{C}=\text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \text{Ph} \end{array} \xrightarrow{\text{O}_3} \begin{array}{c} \text{Ph} \\ \diagdown \\ \text{C}=\text{O} \\ \diagup \\ \text{H} \end{array} \text{(J)} + \text{O}=\begin{array}{c} \text{CH}_3 \\ \diagup \\ \text{C} \\ \diagdown \\ \text{Ph} \end{array} \text{(K)}$

60. The structures of compounds **J**, **K** and **L**, respectively, are



Sol: Ans [D]

**Paragraph for Question Nos. 61 to 63**

In hexagonal systems of crystals, a frequently encountered arrangement of atoms is described as a hexagonal prism. Here, the top and bottom of the cell are regular hexagons and three atoms are sandwiched in between them. A space-filling model of this structure, called hexagonal close-packed (HCP), is constituted of a sphere on a flat surface surrounded in the same plane by six identical spheres as closely as possible. Three spheres are then placed over the first layer so that they touch each other and represent the second layer. Each one of these three spheres touches three spheres of the bottom layer. Finally, the second layer is covered with a third layer that is identical to the bottom layer in relative position. Assume radius of every sphere to be 'r'.

61. The number of atoms in this HCP unit cell is

- (A) 4                                      (B) 6                                      (C) 12                                      (D) 17

Sol: Ans [A]  $12 \times \frac{1}{6} + 2 \times \frac{1}{2} + 3 = 6$

62. The volume of this HCP unit cell is

- (A)  $24\sqrt{2} r^3$                               (B)  $16\sqrt{2} r^3$                               (C)  $12\sqrt{2} r^3$                               (D)  $\frac{64}{3\sqrt{3}} r^3$

Sol: Ans [A] height of hexagonal unit cell  $4r \sqrt{\frac{2}{3}}$   
 volume of HCP unit cell =  $6 \times$  volume of equilateral triangle  $\times h$   
 $= 6 \times \frac{\sqrt{3}}{4} a^2 \times h$   
 $= 6 \times \frac{\sqrt{3}}{4} \times (2r)^2 \times 4r \times \sqrt{\frac{2}{3}} = 24\sqrt{2} r^3.$

63. The empty space in this HCP unit cell is

- (A) 74%                                      (B) 47.6%                                      (C) 32%                                      (D) 26%

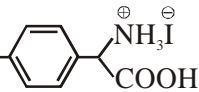
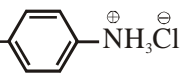
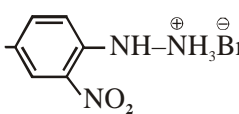
Sol: Ans [D]

**SECTION- IV****MATRIX-MATCH TYPE**

This section contains 3 questions. Each question contains statements given in two columns, which have to be matched. Statements in Column I are labelled as A, B, C and D whereas statements in Column II are labelled as p, q, r, and s. The answers to these questions have to be appropriately bubbled as illustrated in the following example.

If the correct matches are A-

64. Match the compounds in Column I with their characteristic test(s)/reaction(s) given in Column II. Indicate your answer by darkening the appropriate bubbles of the  $4 \times 4$  matrix given in the ORS.

Column I	Column II
(A) $\text{H}_2\text{N} - \text{NH}_3^+\text{Cl}^-$	(p) Sodium fusion extract of the compound gives Prussian blue colour with $\text{FeSO}_4$ .
(B) 	(q) gives positive $\text{FeCl}_3$ test.
(C) 	(r) gives white precipitate with $\text{AgNO}_3$ .
(D) 	(s) reacts with aldehydes to form the corresponding hydrazone derivative

**Sol:** Ans A-[r], [s]: It does not give laisaigen's test as it does not contain carbon.

**B-[p], [q]; C-[p], [q], [r]; D-[p], [s]**

65. Match the entries in Column I with the correctly related quantum number(s) in column II. Indicate your answer by darkening the appropriate bubbles of the  $4 \times 4$  matrix given in the ORS.

Column I	Column II
(A) Orbital angular momentum of the electron in a hydrogen-like atomic orbital	(p) Principal quantum number
(B) A hydrogen-like one-electron wave function obeying Pauli principle	(q) Azimuthal quantum number
(C) Shape, size and orientation of hydrogen-like atomic orbitals	(r) Magnetic quantum number
(D) Probability density of electron at the nucleus in hydrogen-like atom	(s) Electron spin quantum number

**Sol:** Ans A- [q]; B-[p], [q], [r], [s]; C-[p], [q], [r]; D-[p], [q], [r]

66. Match the entries in Column I with the correctly related quantum number(s) in column II. Indicate your answer by darkening the appropriate bubbles of the  $4 \times 4$  matrix given in the ORS.

Column I	Column II
(A) $\text{PbS} \rightarrow \text{PbO}$	(p) roasting
(B) $\text{CaCO}_3 \rightarrow \text{CaO}$	(q) calcination
(C) $\text{ZnS} \rightarrow \text{Zn}$	(r) carbon reduction
(D) $\text{Cu}_2\text{S} \rightarrow \text{Cu}$	(s) self reduction

**Sol:** Ans A- [p]; B-[q]; C-[p], [r]; D-[p], [s]



