CHEMISTRY

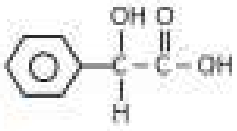
SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

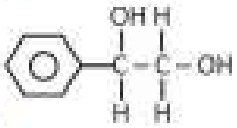
Choose the correct answer :

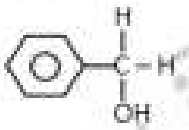
1. Consider the following reaction.

What is the product 'A'?

(1) 

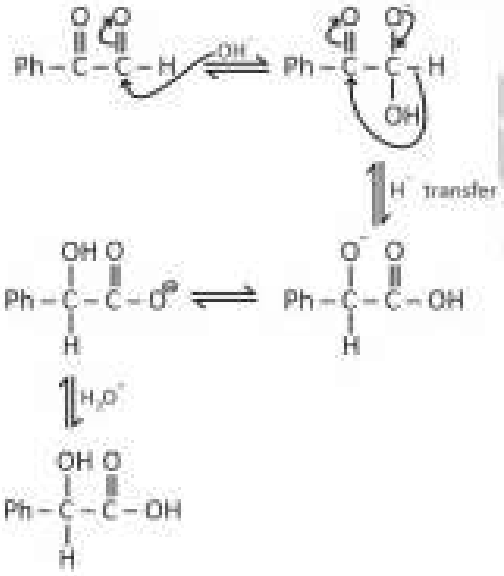
(2) 

(3) 

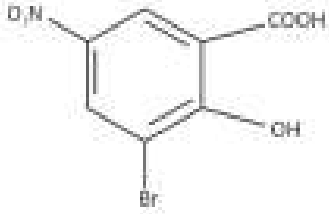
(4) 

Answer (1)

Sol.



2. The correct IUPAC name of the given compound is:



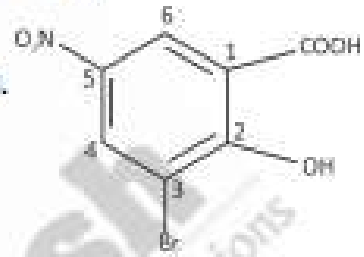
(1) 2-Hydroxy-3-bromo-5-nitrobenzoic acid

(2) 3-Bromo-2-hydroxy-5-nitrobenzoic acid

(3) 5-Bromo-6-hydroxy-3-nitrobenzoic acid

(4) 3-Nitro-6-hydroxy-6-bromobenzoic acid

Answer (2)

Sol. 

→ 3-Bromo-2-hydroxy-5-nitrobenzoic acid.

Naming will be done according to alphabetical order of substituents.

3. At 715 mm Hg pressure, 300 K, volume of N_2 (g) evolved was 80 mL by a 0.4 g sample of organic compound. Find % of N in organic compound

Aq. tension at 300 K = 15 mm Hg

(1) 20.95 (2) 25.85

(3) 30.25 (4) 15.83

Answer (1)

Sol. V_{N_2} at STP $= \frac{273 \times (715-15) \times 80}{300 \times 760}$

$= 67.05$ mL

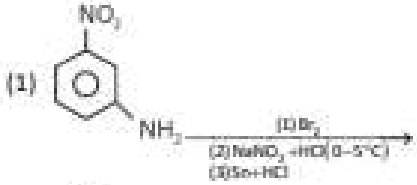
22400 mL weighs 28 g

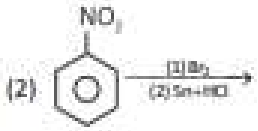
67.05 mL weighs $\frac{28}{22400} \times 67.05$

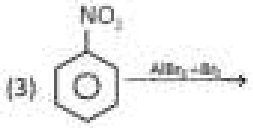
0.0838 g

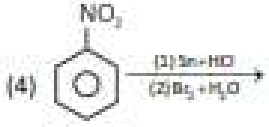
$\%\text{ of N} = \frac{0.0838}{0.4} \times 100 = 20.95$

4. Which of the following reagent is used to prepare tribromoaniline?

(1) 

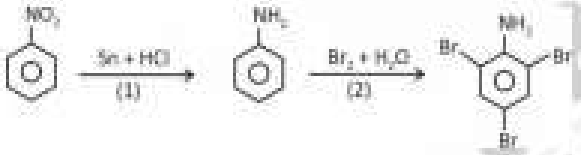
(2) 

(3) 

(4) 

Answer (4)

Sol.



Step (1) involves reduction of nitrobenzene to aniline and step (2) involves bromination of aniline to give 2, 4, 6-tribromoaniline

5. Match the following list-I with list-II :

List-I (Groups)	List-II (Elements)
(A) Pnictogens	(I) Rn
(B) Chalcogens	(II) At
(C) Halogens	(III) Te
(D) Noble gases	(IV) Bi

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

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

Answer (2)

Sol. Pnictogens → group-15 ⇒ N, P, As, Sb, Bi

Chalcogens → group-16 ⇒ O, S, Se, Te, Po

Halogens → group-17 ⇒ F, Cl, Br, I, At

Noble gases → group-18 ⇒ He, Ne, Ar, Kr, Xe, Rn

6. Find orbital angular momentum for 2s and 2p energy levels

(1) $0, \frac{h}{(\sqrt{2})\pi}$ (2) $0, \frac{h}{\sqrt{2}\pi}$

(3) $\frac{h}{\pi}, \frac{h}{\pi}$ (4) $0, \frac{h}{2\pi}$

Answer (1)

Sol. Orbital angular momentum = $\frac{h}{2\pi}\sqrt{l(l+1)}$

For 2s $l = 0$

Orbital angular momentum = 0

For 2p $l = 1 \Rightarrow \frac{h}{2\pi}\sqrt{l(l+1)}$

$\frac{h}{(\sqrt{2})\pi}$

7. Which of the following order is correct?

(A) Electronegativity : B > Tl > In > Ga > Al

(B) First Ionisation energy : B > Tl > Ga > Al > In

(C) Density : Tl > In > Ga > Al > B

(D) Size : B > Al > Ga > In > Al

(1) (A, B, C) only

(2) (B, C, D) only

(3) (A, B, D) only

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

Answer (1)

Sol. EN : B > Tl > In > Ga > Al

(2.0) (1.8) (1.7) (1.6) (1.5)

IE_1 : B > Tl > Ga > Al > In

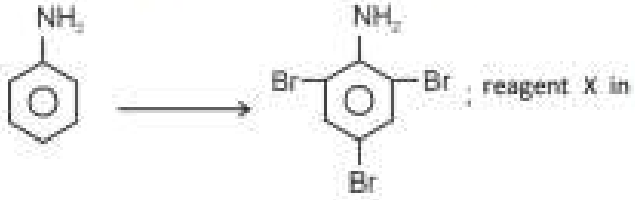
(801) (589) (579) (577) (558) (in kJ/mol)

Density : Tl > In > Ga > Al > B

(11.85) (7.31) (5.9) (2.7) (2.35) (in g/ml)

Size : B < Ga < Al < In < Tl

(85) (135) (143) (167) (170) (in pm)

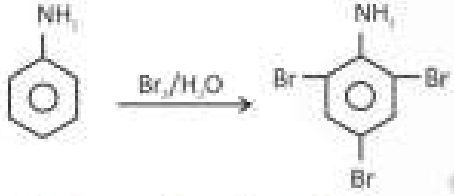
8.  ; reagent X in this reaction is

(1) Br_2/CCl_4 (2) Br_2/H_2O

(3) HBr/H_2SO_4 (4) Br_2/acetone

Answer (2)

Sol. Br_2 in water causes tribromination



H_2O Promotes formation of Br^+ in excess

9. Which of the following vitamins are fat-soluble?

B_{12}, C, D, B, E

(1) B and C

(2) D and E

(3) B and E

(4) C, D and E

Answer (2)

Sol. Fat soluble vitamins are (A, D, E and K)

10. Statement-I : CrO_3 is a strong oxidising agent

Statement-II : Cr^{+6} is more stable than Mo^{+6}

considering the above statements, choose the correct option.

(1) Both statement-I and Statement-II are correct

(2) Both statement-I and Statement-II are incorrect

(3) Statement-I is correct but Statement-II is incorrect

(4) Statement-I is incorrect but Statement-II is correct

Answer (3)

Sol. CrO_3 is a strong oxidising agent and itself is reduced to Cr^{3+} which is more stable than Cr^{6+} because Cr^{3+} has stable electronic configuration.

$Cr^{+6} + 3e \rightarrow Cr^{+3}$

Cr^{+3} : $3d^3$ or $t_{2g}^3 e_g^0$

∴ Statement-I is correct.

Stability of +6 state in group-6 increases down the group. Therefore, Mo^{+6} is more stable than Cr^{+6}. So, statement-II is incorrect.

11. Which of the following compound or complex ions is/are diamagnetic in nature

(a) CrO_3 (b) $[Fe(CN)_6]^{4-}$

(c) $[Co(H_2O)_2F_4]$ (d) $[Cr(NH_3)_6]^{3+}$

(1) a and b only

(2) a, b and c only

(3) a, b, c and d

(4) c and d only

Answer (2)

Sol. Species having unpaired electron are paramagnetic in nature

$CrO_3 \Rightarrow Cr^{+6} \Rightarrow$ 0 unpaired electron hence diamagnetic

$[Fe(CN)_6]^{4-}$

$Fe^{2+} \Rightarrow$ with CN^- (SFL)

$\Rightarrow t_{2g}^6 e_g^0$

Number of unpaired electron = 0

$\Rightarrow$ diamagnetic

$[Cr(NH_3)_6]^{3+}$

Cr^{3+} $3d^3$

$t_{2g}^3 e_g^0$

Number of unpaired electrons = 3

$\Rightarrow$ Paramagnetic

12. 20 mL 1M NaOH is mixed with 10 mL 2M HCl which is further diluted to 100 mL. Find concentration of final solution?

(1) 2×10^{-3} M

(2) 0.2 M

(3) 2×10^{-2} M

(4) 0.1 M

Answer (2)

Sol. $NaOH + HCl \rightarrow NaCl + H_2O$

20×1	10×2	
20mmol	20mmol	
0	0	20mmol

So, concentration of NaCl = $\frac{20 \text{ m mol}}{100 \text{ mL}}$

= 0.2 M

13. Which of the following statement is correct w.r.t. Arrhenius equation?

(1) Dimensions of k and A are same

(2) k decreases with increase in temperature generally

(3) A decreases with increase in temperature always

(4) k increases as value of E_a increase

Answer (1)

Sol. $k = Ae^{-\frac{E_a}{RT}}$

$E_a \uparrow \quad k \downarrow$

14. Match the column-I with column-II and choose the correct option

Column I	Column II
(P) Finkelstein reaction	(1) 
(Q) Lucas Test	(2) $R - X \xrightarrow[\text{Dry ether}]{Na}$
(3) Wurtz reaction	(3) 
(4) Gatterman Koch Reaction	(4) $CH_3CH_2Cl \xrightarrow[\text{Acetone}]{NaI}$

(1) P → (4), Q → (3), R → (2), S → (1)

(2) P → (1), Q → (2), R → (3), S → (4)

(3) P → (1), Q → (3), R → (2), S → (4)

(4) P → (3), Q → (2), R → (1), S → (4)

Answer (1)

Sol. P → (4), Q → (3), R → (2), S → (1)

15. **Statement-I :** When ice and water are at equilibrium, heat is absorbed by system, yet there is no increase in temperature until ice melts completely.

Statement-II : System absorbs the heat to break inter molecular H-bond and there is no increase in kinetic energy.

(1) Both statement-I and Statement-II are correct

(2) Statement-I is correct. Statement-II is incorrect

(3) Statement-I is incorrect. Statement-II is correct

(4) Both statements-I and II are incorrect

Answer (1)

Sol. Heat absorbed is consumed in conversion of solid ice to liquid water. So no temperature change. Even kinetic energy is same is the trasition.

16. **Statement-I :** Wet cotton clothes made up of cellulose based carbohydrates take a comparatively longer time to get dried than wet nylon based clothes.

Statement-II : Both form intermolecular H-bonds with water molecules

(1) Both statement-I and statement-II are correct

(2) Both statement-I and statement-II are incorrect

(3) Statement-I is correct but statement-II is incorrect

(4) Statement-I is incorrect but statement-II is correct

Answer (1)

Sol. Wet cellulose-based cotton clothes take longer time to dry than wet nylon-based clothes due to more number of H-bonds between cellulose and water molecules. So statement-I is correct. Statement-II is also correct as both the cellulose and nylon form intermolecular H-bonds with water molecules.

17.

18.

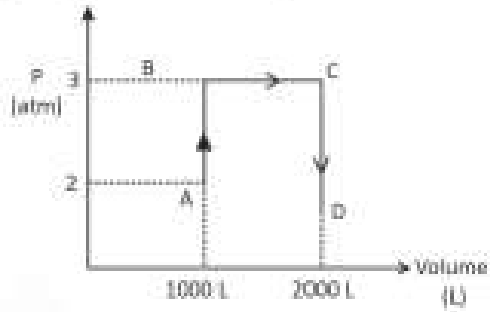
19.

20.

SECTION - B

Numerical Value Type Questions: This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. Find out magnitude of work done in the process ABCD (in kJ) (1 Latm = 101.3 J)



Answer (304)

Sol. (W) = 3 × 1000

= 3000 atm L

(W) = 303900 Joule

= 303.9 kJ

= 304 kJ

22. Amount of magnesium (Mg) (in mg) required to liberate 224 mL of H_2 gas at STP, when reacted with HCl.

Answer (240)

Sol. $Mg + 2HCl \rightarrow MgCl_2 + H_2$

Moles of H_2 gas at STP $= \frac{224}{22400}$ mol

= 0.01 mol

1 mol H_2 formed by 1 mol of Mg.

mol of Mg required = 0.01 mol

mass of Mg required = 0.01 × 24

= 0.24 g

= 240 mg

23. Among Sc, Ti, Mn and Co, calculate the spin only magnetic moment in +2 oxidation state of metal having highest heat of atomisation

Answer (3)

Sol. Enthalpy of atomisation

Sc – 326 kJ mol^{-1}

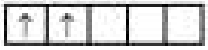
Ti – 473 kJ mol^{-1}

Mn – 281 kJ mol^{-1}

Co – 425 kJ mol^{-1}

Ti has highest heat of atomisation

$Ti^{2+} \Rightarrow 3d^2$



$\mu_{spin\,only} = \sqrt{n(n+2)}$ BM

n = number of unpaired electrons

= 2

$\mu = \sqrt{2(2+2)}$

$= \sqrt{8}$ BM

= 2.82 BM

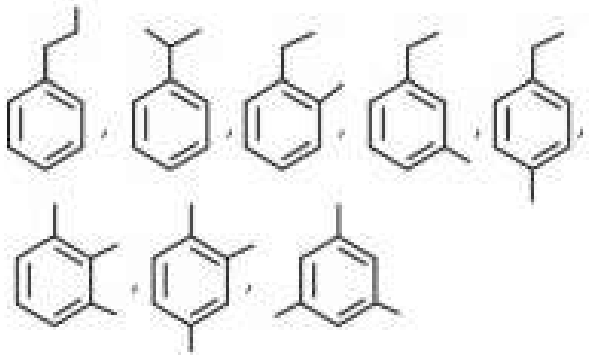
≈ 3 BM

24. C_9H_{12} is a derivative of benzene, how many total structural isomers of molecular formula C_9H_{12} are possible.

Answer (8)

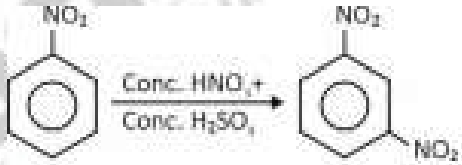
Sol. Degree of unsaturation =

$$\frac{2\times 9+2-12}{2}=4$$



25. 'x' g of nitrobenzene gives 4.2 g 1, 3-dinitrobenzene with 100% yield. Find the value of 'x'.

Answer (3)



Sol. 'x' g 4.2 g

Molar mass of $C_6H_5NO_2$ = 123 g mol^{-1}

Molar mass of $C_6H_4(NO_2)_2$ = 168 g mol^{-1}

No. of moles of $C_6H_5NO_2$ = No of moles $C_6H_4(NO_2)_2$

$$\frac{x}{123}=\frac{4.2}{168}$$

x = 3.075 g ≈ 3 g