JEE Main 2023 (Memory based)

31 January 2023 - Shift 2
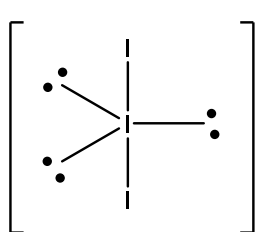
Answer & Solutions

CHEMISTRY

1. Which one of the following species is linear in shape?

 A. I_3^-

 B. I_3^+
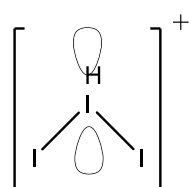
 C. ICl_3

 D. ICl_2^+

Answer (A)

Solution:
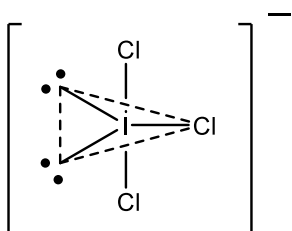
The shapes of the given species are
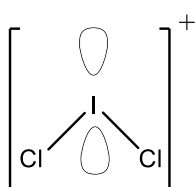

I_3^- - Linear I_3^+- Angular (or) bent

ICl_3 - T - Shaped ICl_2^+ - Angular (or) bent

2. For a given hydrocarbon, 11 moles of O_2 is used and produces 4 moles of H_2O. Then, the formula for hydrocarbon is:

 A. $C_{11}H_8$

 B. C_9H_8

 C. $C_{11}H_{16}$

 D. C_6H_{14}

Answer (B)

Solution:

$$C_xH_y + \left(x + \frac{y}{4}\right)O_2 = xCO_2 + \frac{y}{2} \times (H_2O)$$
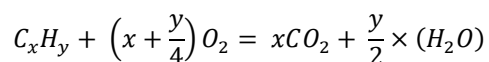
$$\frac{y}{2} = 4$$

$$y = 8$$

$$x + \frac{8}{4} = 11$$

$$x = 9$$

Hence, hydrocarbon will be C_9H_8.

3. Which of the following plays an important role in neuromuscular functions.

    A. Ca
    B. Mg
    C. Be
    D. Li

Answer (A)

Solution:

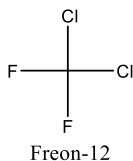Calcium plays an important role in neuromuscular functions.

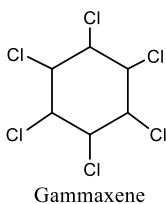**4.** Which of the following compound contain maximum number of chlorine atoms?

    A. Chloropicrin
    B. Chloral
    C. Gammaxene
    D. Freon-12

Answer (C)

Solution:

Compounds	Number of chlorine atoms
A. Chloropicrin	3
B. Chloral	3
C. Gammaxene	6
D. Freon-12	2

Chloropicrin   Chloral

Gammaxene   Freon-12
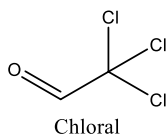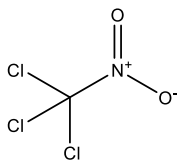
5. Decreasing order of Lewis acid character is:

    A. $BF_3 > BCl_3 > BBr_3 > BI_3$
    B. $BI_3 > BBr_3 > BCl_3 > BF_3$
    C. $BF_3 > BCl_3 > BI_3 > BBr_3$
    D. $BI_3 > BCl_3 > BF_3 > BBr_3$

Answer (B)

Solution:

Lewis acid charecter α Tendency to accept electrons

And due to backbonding the peripheral atom donates electron to the central atom there by the tendency of the central atom to accept electron decreases.

Thus lewis acid character is inversely proportional to extent of back bonding.

Extent of back bonding

$$\frac{BF_3}{2p-2p} > \frac{BCl_3}{2p-3p} > \frac{BBr_3}{2p-4p} > \frac{BI_3}{2p-5p}$$

Hence the correct answer is option B.

6. pH of acid rain is 5.6 Which of the following reaction is involved in acid rain.

   A. $H_2O + SO_2 + O_2 \rightarrow H_2SO_4$
   B. $N_2 + O_2 + H_2O \rightarrow HNO_3$
   C. $N_2O + O_2 + H_2O \rightarrow HNO_3$
   D. None of these

Answer (A)

Solution:

The correct answer to this question is option (A).

7. Which of the following metals of f-block have half-filled f-subshell?
   1. Samarium (Sm)
   2. Gadolinium (Gd)
   3. Europium (Eu)
   4. Terbium (Tb)
   [Atomic numbers : Sm = 62, Eu = 63, Gd = 64, Tb = 65]

   A. 1 and 2
   B. 2 and 3
   C. 3 and 4
   D. 1 and 3

Answer (B)

Solution:

The valence shell electronic configuration of the given f-block metals are
   1. Sm: $4f^6 6s^2$
   2. Gd: $4f^7 5d^1 6s^2$
   3. Eu: $4f^7 6s^2$
   4. Tb: $4f^9 6s^2$

Therefore, Gd and Eu have half-filled f-subshell.

8. If ionisation energy of H-atom is 13.6 eV. Find out ionisation energy of Li^{2+} ions.

   A. 54.4 eV
   B. 122.4 eV
   C. 13.6 eV
   D. 3.4 eV

Answer (B)

Solution:

$$I.E = 13.6 \times z^2$$
$$= 13.6 \times (3)^2$$
$$= 13.6 \times 9$$
$$= 122.4 \ eV$$

9. Which of the following compound is not a disinfectant?

   A. Chloroxylenol
   B. Bithionol
   C. Terpineol
   D. Peracetic acid

Answer (D)

Solution:

   Chloroxylenol, bithionol, and terpineol are the disinfectants.

10. A reaction follows 1st order kinetics with rate constant (k) = 20 min^{-1}. Calculate the time required to reach the concentration to 1/32 times of initial concentration.

   A. $0.17325 \ min$
   B. $1.7325 \ min$
   C. $17.325 min$
   D. $173.25 \ min$

Answer (A)

Solution:

   $$K = 20 \ min^-$$
   $$t_{\frac{1}{2}} = \frac{0.693}{K} = \frac{0.693}{20} min$$
   $$C = \frac{C_o}{(C)^n} = \frac{C_o}{32}$$
   C = Concentration at time t
   C_o = Initial concentration
   n = no of half life's
   n = 5
   $$t = 5 \times t_{\frac{1}{2}}$$
   $$= 5 \times \frac{0.693}{20} = 0.17325 \ min$$

11. If solubility of AgCl in aqueous solution is 1.434 x 10^{-3} M than find the value of [-logK$_{sp}$] where K$_{sp}$ is the solubility product of AgCl

   A. 3.7
   B. 5.7
   C. 6.7
   D. 7.7

Answer (B)

Solution:

Solubility of AgCl in water = $1.434 \times 10^{-3} M$

Solubility product (K_{sp}) of $AgCl = (1.434 \times 10^{-3})^2$

Therefore $K_{sp} = 2 \times 10^{-6}$

$-\log K_{sp} = -log2 + 6 = 5.7$

12. Consider the following combination of n, l, and m values.
    (i) n=3; l=0; m=0
    (ii) n=4; l=0; m=0
    (iii) n=3; l=1; m=0
    (iv) n=3; l=2; m=0
    The correct order of energy of the corresponding orbitals for multielectron species

    A. (ii) > (i)> (iv)> (iii)
    B. (iv) > (ii) > (iii) > (i)
    C. (i) > (iii) > (iv) > (ii)
    D. (iv) > (iii) > (i) > (ii)

Answer (B)

Solution:

In case of multielectron species energy of electron corresponding to an orbital is α (n + l).

If the value of n + l comes out to be same then the one having higher value if n has more energy.
(i) n=3; l=0; m=0
Here, n + l = 3 + 0 = 3

(ii) n=4; l=0; m=0
Here, n + l = 4 + 0 = 4

(iii) n=3; l=1; m=0
Here, n + l = 3 + 1 = 4

(iv) n=3; l=2; m=0
Here, n + l = 3 + 2 = 5

From above we can say that (iv) has maximum energy and (i) has minimum energy.
Among (ii) and (iii) since the value of (n + l) is same and (ii) has higher value of n therefore (ii) has more energy than (iii).

13. Two metals are given:
    Metal – 1: Work function = 4.8 eV
    Metal – 2: Work function = 2.8 eV
    Photons of wavelength 350 nm are incident on both metals separately. Which metal will eject electrons at this wavelength?

    A. Metal-1 only
    B. Metal-2 only
    C. Both metal -1 and metal -2
    D. None of metal -1 and metal -2

Answer (B)

Solution:

$$E_{photon} = \frac{12400}{3500} = 3.54 \text{ eV}$$

$$W_{metal-1} > E_{photon} > W_{metal-2}$$

Only metal 2 will emit photons

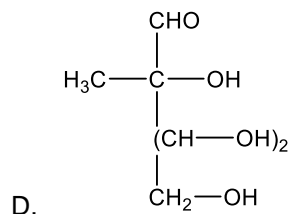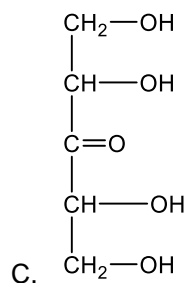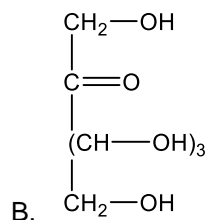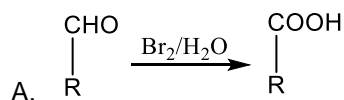**14.** A biomolecule gives the following observations
(i) with Br₂/H₂O, it gives monocarboxylic acid
(ii) with acetate, it gives tetraacetate
(iii) with HI/Red P, it gives isopentane
The correct structure of biomolecule is:

A.
$$\underset{\text{R}}{\overset{\text{CHO}}{|}} \xrightarrow{Br_2/H_2O} \underset{\text{R}}{\overset{\text{COOH}}{|}}$$

B.
```
CH₂—OH
  |
  C=O
  |
(CH—OH)₃
  |
CH₂—OH
```

C.
```
CH₂—OH
  |
 CH—OH
  |
  C=O
  |
 CH—OH
  |
CH₂—OH
```

D.
```
        CHO
         |
H₃C—C—OH
         |
     (CH—OH)₂
         |
      CH₂—OH
```

Answer (D)

Solution:

Br_2/H_2O Is a mild oxidising agent, it converts the carbonyl group present as aldehyde to carboxylic acid group. This confirms the presence of -CHO group in the reactant.

$$\underset{\text{R}}{\overset{\text{CHO}}{|}} \xrightarrow{Br_2/H_2O} \underset{\text{R}}{\overset{\text{COOH}}{|}}$$
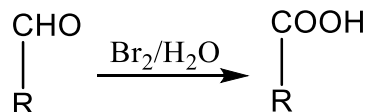
Acetylation of reactant with acetate is giving us tetraacetate this confirms the presence of 4 -OH groups in the

reactant.

Red P/HI behave as a strong reducing agent and is converting the reactant into isopentane which confirms the presence of 5 – carbons in the reactant with one methyl chain.

Thus, from the above options the correct answer is option (D).

15. Which of the following has more relative lowering in vapour pressure at the same temperature

   A. 0.1 M urea

   B. 0.1 M NaCl

   C. 0.1 M sucrose

   D. 0.1 M $CaCl_2$

Answer (D)

Solution:

Relative lowering of vapor pressure is a colligative property and colligative property depends only on the amount of solute.

$$\frac{\Delta P}{p^O_{solvent}} = i\chi_{solute}$$

$\Delta P =$ Lowering of vapor pressure

$p^O_{solvent} =$ Pure state pressure of solvent

$\chi_{solute} =$ Molefraction of solute

$i =$ Van't hoff factor

From above we can say that $\frac{\Delta P}{p^O_{solvent}} \, \alpha \, i$

   A. Urea → non electrolyte, therefore, i = 1

   B. NaCl → electrolyte, therefore, i = 2

   C. Sucrose → non electrolyte, therefore, i = 1

   D. CaCl₂ → electrolyte, therefore, i = 3

Hence the $CaCl_2$ solution will show maximum relative lowering in vapor pressure.

16. Assertion: First ionization energy of 4d series element is always greater than those of 3d series element.
Reason: 4d series element has much more nuclear charge than those of 3d series element.

   A. Assertion is correct, but reason is incorrect.

   B. Assertion is incorrect, but reason is correct

   C. Assertion is correct and reason are correct.

   D. Assertion is incorrect and reason are incorrect.
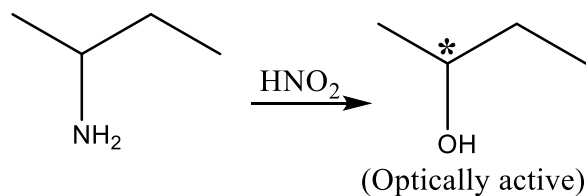
Answer (B)

Solution:

The first ionization energy of 4d series elements is not always greater than those of 3d series elements. So assertion is incorrect. The reason is a correct statement because 4d series elements have much more nuclear charge than those of 3d series elements.

17. What is the structural formula of compound $C_4H_{11}N$, which reacts with HNO_2 and is optically active?

A.

$$CH_2\!-\!CH_3$$
$$H_3C\!-\!\underset{\underset{H}{|}}{\overset{|}{C}}\!-\!NH_2$$

B. $H_3C\!-\!CH_2\!-\!CH_2\!-\!CH_2\!-\!NH_2$

C.

$$H_3C\diagdown_{\!N}\diagup^{CH_2\!-\!CH_3}$$
$$\underset{CH_3}{|}$$

D.

$$H\diagdown_{\!N}\diagup^{CH_3}$$
$$\underset{CH_2\!-\!CH_2\!-\!CH_3}{|}$$

Answer (A)

Solution:

(Optically active)

18. Energy of a radiation given by $E = \dfrac{hc}{\lambda_{absorb}}$. If $E = 96\,\dfrac{KJ}{mole}$. Then find λ_{absorb} $(in\ A^o)$

A. $12471\ A^o$
B. $124.71\ A^o$
C. $1247.1\ A^o$
D. $1.2471\ A^o$

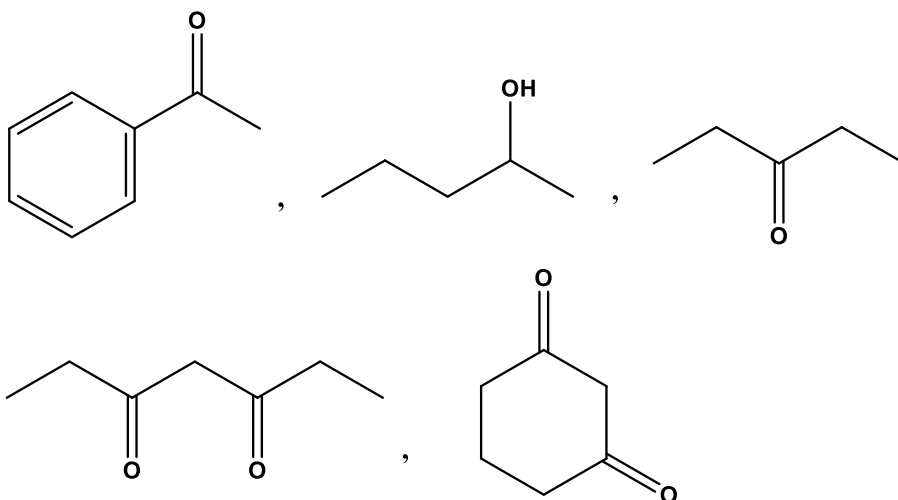**Answer (A)**

Solution:

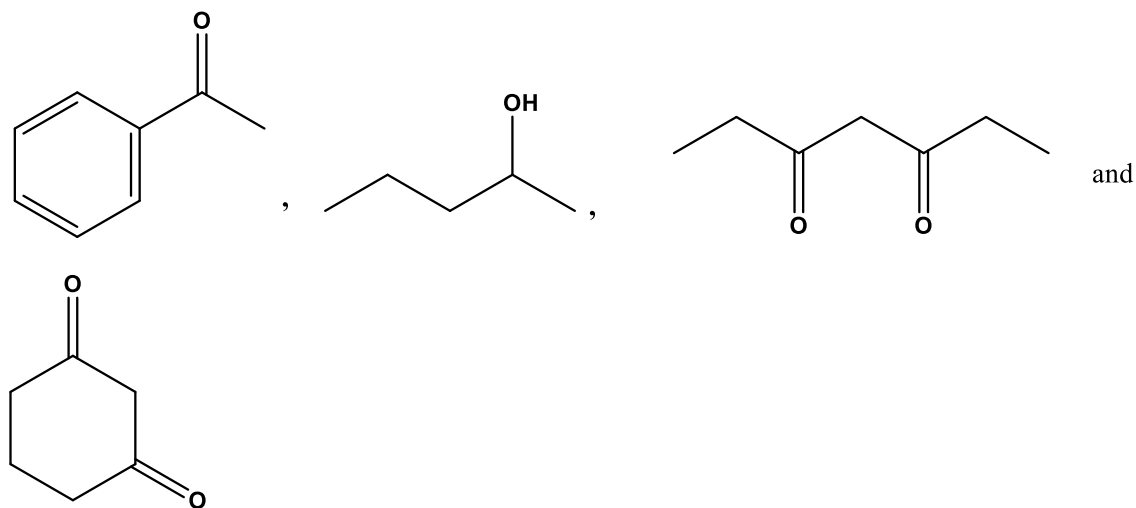$$\frac{6.626\times10^{-34}\times3\times10^{8}\times6.023\times10^{23}}{96\times10^{3}} = \lambda$$

$$\lambda = 1.2471\times10^{6}m = 12471\ A^o$$

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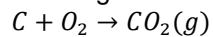**19.** How many of the following compounds can give iodoform test?

Answer (4)

Solution:

and

will give Iodoform Test.

20. For the given reaction

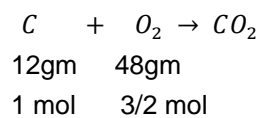$C + O_2 \rightarrow CO_2(g)$

12 gm of C is reacted with 48 gm of O_2 to give CO_2. If volume of CO_2 gas produced at STP is t litres. Find out 2t

Given: Molar volume at STP = 22.4 Lit/mol

Answer (45)

Solution:

$C \quad + \quad O_2 \rightarrow CO_2$

12gm   48gm

1 mol   3/2 mol

Volume = t = 22.4 Lit

2t = 44.8 Lit ~ 45 Lit

21. In non-stoichiometry compound $M_{0.83}O$, M exists in 2 states +2 and +3 calculate the percentage of M^{2+} ion in the compound

Answer (59)

Solution:

Let M^{2+} is x

Let M^{3+} will be y

Therefore, x + y = 0.83 → Eq -1

Using charge balancing, $2x + 3y = 2$ → Eq -2

From Eq – 1 and Eq – 2

$x = 0.49$

$\%M^{2+} = \dfrac{0.49}{0.83} X100 = 59\%$

22. The resistivity of 0.8 M solution of an electrolyte is $5X10^{-3} \, \Omega \, cm$. If λ_m is $2.5 \, X10^x$. Find x

Answer (5)

Solution:

$\kappa = \dfrac{10^3}{5} S \, cm^{-1}$

$\lambda_m = \kappa X \dfrac{1000}{m} = \dfrac{\dfrac{10^3}{5} X1000}{0.8} = \dfrac{200X \, 10^3}{0.8}$

$= \dfrac{2X10^5}{0.8} = 2.5 \, X10^5$

$x = 5$