Solutions to JEE(MAIN)-2013

CHEMISTRY

1. Sol. **(1)**

Reaction proceeds through carbocation formation as 3° carbocation is highly stable, hence reaction proceeds through S_N1 with 3° alcohol.

2. Sol. **(1)**

$\mathrm{Na} \underset{\Delta H = -5.1ev}{\overset{\Delta H = +5.1ev}{\rightleftharpoons}} \mathrm{Na}^+ + e^-$, here the backward reaction releases same amount of energy and known as Electron gain enthalpy.

3. Sol. **(1)**

$$\mathrm{Li}_2(6) = \sigma 1s^2 \overset{*}{\sigma} 1s^2 \sigma 2s^2$$

$$B.O. = \frac{4-2}{2} = 1$$

$$\mathrm{Li}_2^+(5) = \sigma 1s^2 \overset{*}{\sigma} 1s^2 \sigma 2s^1$$

$$B.O. = \frac{3-2}{2} = 0.5$$

$$\mathrm{Li}_2^-(7) = \sigma 1s^2 \overset{*}{\sigma} 1s^2 \sigma 2s^2 \overset{*}{\sigma} 2s^1$$

$$B.O. = \frac{4-3}{2} = 0.5$$

4. Sol. **(4)**

$$M_1V_1 + M_2V_2 = MV$$

$$M = \frac{M_1V_1 + M_2V_2}{V} = \frac{0.5 \times 750 + 2 \times 250}{1000}$$

$$M = 0.875$$

5. Sol. **(All the options are correct statements)**

(1) Correct, as  is bent.

(2) Correct, as ozone is violet-black solid.

(3) Correct, as ozone is diamagnetic.

(4) Correct, as $ONCl = 32$ electrons and $ONO^- = 24$ electron hence are not isoelectronic.

All options are correct statements.

6. Sol. **(3)**

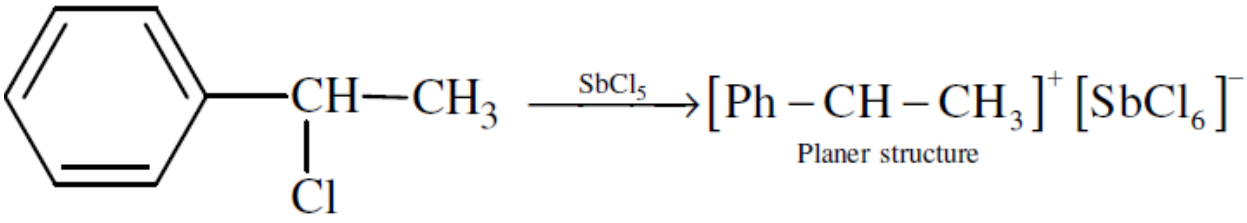
$E^0_{Mn^{+3}/Mn^{+2}} = 1.57\,V$

$E^0_{Fe^{+3}/Fe^{+2}} = 0.77\,V$

$E^0_{Co^{+3}/Co^{+2}} = 1.97\,V$

$E^0_{Cr^{+3}/Cr^{+2}} = -0.41\,V$

7. Sol. ***(2)***



8. Sol. **(1)**

As_2S_3 is an anionic sol (negative sol) hence coagulation will depend upon coagulating power of cation, which is directly proportional to the valency of cation (Hardy-Schulze rule).

9. Sol. **(3)**

Initial $pH = 1, i.e\left[H^+\right] = 0.1 mole/litre$

New $pH = 2, i.e\left[H^+\right] = 0.01 mole/litre$

In case of dilution: $M_1V_1 = M_2V_2$

$0.1 \times 1 = 0.01 \times V_2$

$V_2 = 10 litre.$

Volume of water added $= 9 litre.$

10. Sol. **(1) & (4) both are correct answers.**

$N_2 \rightarrow$ Diamagnetic
$O_2 \rightarrow$ Paramagnetic
$S_2 \rightarrow$ Paramagnetic
$C_2 \rightarrow$ Diamagnetic

11. Sol. **(2)** & **(4) both are correct answers)**

The exothermic hydration enthalpies of the given trivalent cations are:

$Sc^{+3} = 3960 kJ/mole$
$Fe^{+3} = 4429 kJ/mole$
$Co^{+3} = 4653 kJ/mole$
$Cr^{+3} = 4563 kJ/mole$

Hence Sc^{+3} is least hydrated; so least stable (not most stable)

Fe^{+2} contains 4 unpaired electrons where as Mn^{+2} contains 5 unpaired electrons hence (4) is incorrect.

12. Sol. ***(1)***

Metal oxide $= M_{0.98}O$

If 'x' ions of M are in $+3$ state, then

$3x + (0.98 - x) \times 2 = 2$

$x = 0.04$

So the percentage of metal in $+3$ state would be $\frac{0.04}{0.98} \times 100 = 4.08\%$

13. Sol. **(1)**

$$R - NH_2 + CH_3 - \overset{\overset{O}{\|}}{C} - Cl \longrightarrow R - NH - \overset{\overset{O}{\|}}{C} - CH_3 + HCl$$

Each $CH_3 - \overset{\overset{O}{\|}}{C}$ addition increases the molecular wt. by 42.

Total increase in m. wt. $= 390 - 180 = 210$

Then number of NH_2 groups $= \frac{210}{42} = 5$

14. Sol. **(3)**

As per data mentioned

MnO_4^- is strongest oxidizing agent as it has maximum SRP value.

15. Sol. **(2)**

Correct order of acidic strength is $III > I > II > IV$

16. Sol. **(4)**

As per Arrhenius equation:

$$\text{In}\ \frac{k_2}{k_1} = -\frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

$$2.303 \log 2 = -\frac{E_a}{8.314}\left(\frac{1}{310} - \frac{1}{300}\right)$$

$$\Rightarrow E_a = 53.6 \text{ kJ/mole}$$

17. Sol. **(4)**

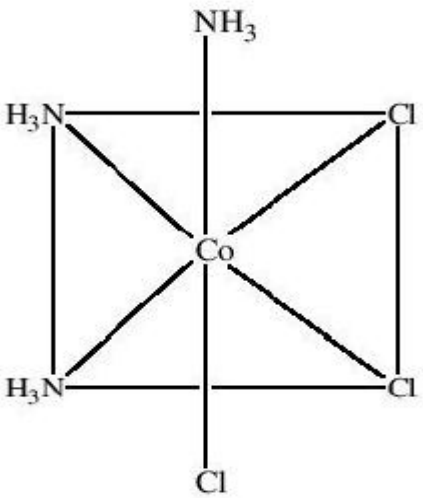
$$12H_2O + 12NADP + 18ADP \xrightarrow{\text{Light reaction}} 6O_2 + 18ATP + 12NADPH$$

$$6CO_2 + 12NADPH + 18ATP \xrightarrow{\text{Dark reaction}} C_6H_{12}O_6 + 12NADP + 18ADP + 6H_2O$$

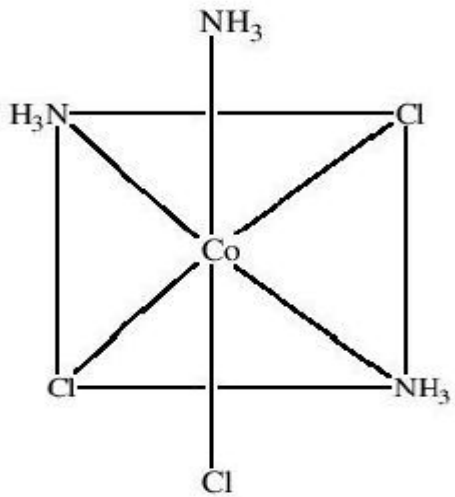
Net reaction: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

18. Sol. **(2)**

$\left[Co(NH_3)_3Cl_3\right]$ exists in two forms (facial and meridional)



facial



meridonial

Both of these forms are achiral. Hence, $\left[Co(NH_3)_3Cl_3\right]$ does not show optical isomerism.

19. Sol. **(4)**

Process is isothermal reversible expansion, hence $\Delta U = 0$.

$\therefore q = -W$

As $q = +208\,J$

Hence $W = -208\,J$

20. Sol. (3)

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

Weight(g)	3.08g	0.75g
moles	0.07	0.04

$$\frac{x}{y/2} = \frac{0.07}{0.04}$$

$$\therefore \frac{x}{y} = \frac{7}{8}$$

21. Sol. **(3)**

Order of stability is $III > I > II$

(Stability $\propto$ extent of delocalization).

22. Sol. **(2)**

Increasing order of first ionization enthalpy is Ba < Ca < Se < S < Ar

23. Sol. **(2)**

$$C^* = \sqrt{\frac{2RT}{M}}, \overline{C} = \sqrt{\frac{8RT}{\pi M}}, C = \sqrt{\frac{3RT}{M}}$$

24. Sol. **(4)**

It was methyl isocyanate (CH_3NCO)

25. Sol. **(2)**

$$2MnO_4^- + 5C_2O_4^- + 16H^+ \rightarrow 2Mn^{+2} + 10CO_2 + 8H_2O$$
$$x = 2, y = 5, z = 16$$

26. Sol. **(1)**

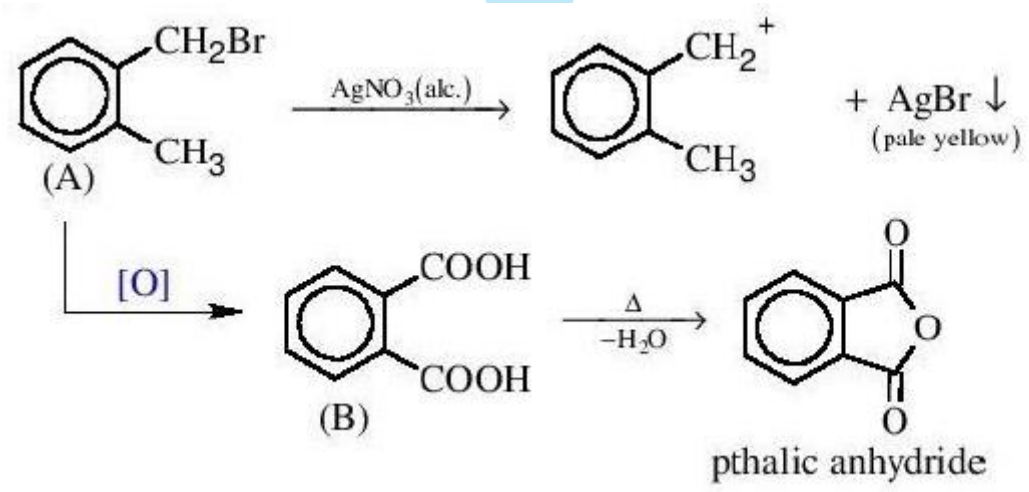
Silicon (Si) – covalent solid

Sulphur (S_8) – molecular solid

Phosphorous (P_4) – Molecular solid

Iodine (I_2) – Molecular solid

27. Sol. **(3)**

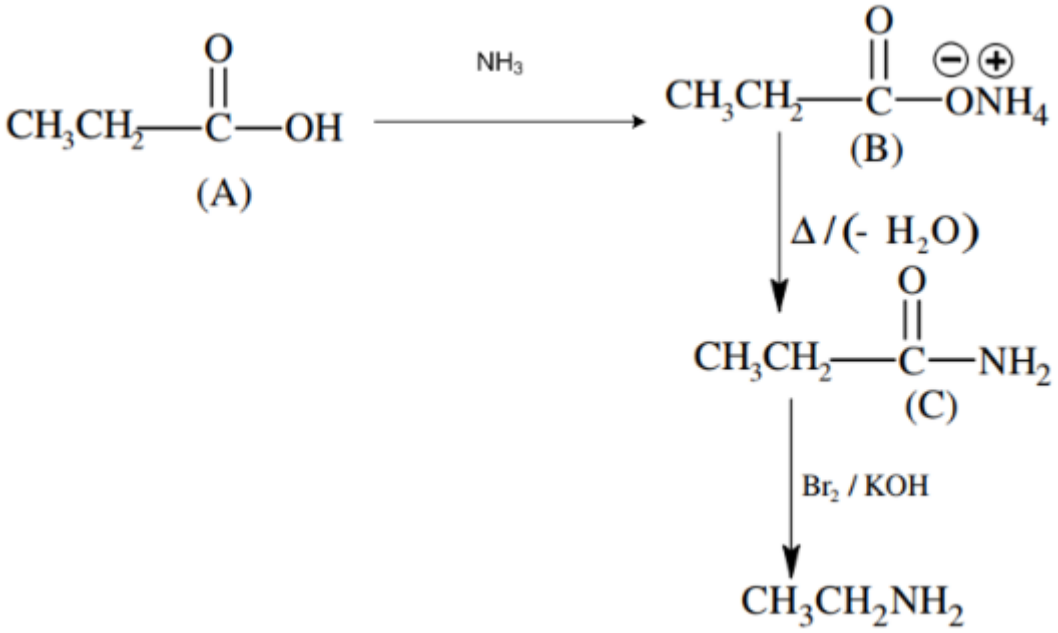


28. Sol. (4)

$$E = \frac{hc}{\lambda} = 2.178 \times 10^{-18} \times Z^2 \left[\frac{1}{1^2} - \frac{1}{2^2}\right]$$

$$\Rightarrow \lambda = 1.214 \times 10^{-7}\,\text{m}$$

***29. Sol.* (3)**



***30. Sol.* (2)**

Bond order of H_2^{2+} and He_2 is zero, thus their existence is not possible.