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. Which of the following is the strongest oxidising agent?
   (1) Eu^{2+}
   (2) Ce^{2+}
   (3) Ce^{4+}
   (4) Eu^{3+}

Answer (3)

Sol. $Ce^{4+}/Ce^{3+} \Rightarrow 1.74$ V, Ce^{4+} is strong oxidising agent where as Eu^{2+} is strong reducing agent as it converts to Eu^{3+}.

Since oxidising agent itself gets reduced, Ce^{4+} is most easily reduced among these.

2. The difference in melting point and boiling point of oxygen and sulphur can be explained by
   (1) Electronegativity
   (2) Electron gain enthalpy
   (3) Atomicity
   (4) Ionisation energy

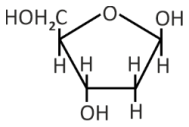
Answer (3)

Sol. It can be explained on basis of Atomicity as oxygen exists as O_2 while sulphur as S_8.

3. Ribose present in DNA is
   (A) A pentose sugar
   (B) Present in pyranose form
   (C) α anomeric carbon is present
   (D) Present in D configuration
   (E) A reducing sugar in free form
   Choose the correct statement :
   (1) A, C & E only
   (2) A, D & E only
   (3) A, B, C, D & E
   (4) A & E only

Answer (2)

Sol. Structure of Ribose is



β-D-2 deoxyribose

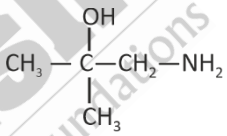
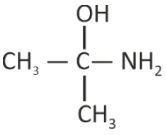
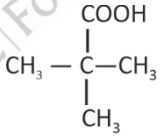
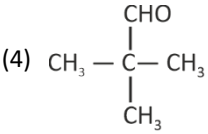
Statement A, D & E are correct

It is present in furanose form & β-anomeric C is present

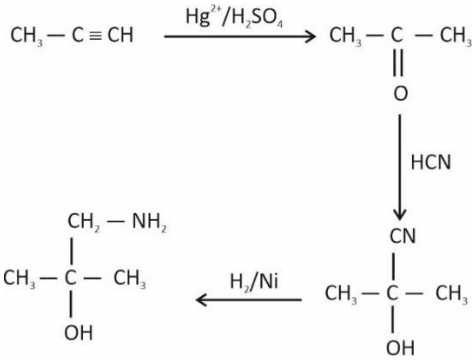
4. Consider the following reaction

$$CH_3-C\equiv CH \xrightarrow[(ii)\,HCN]{(i)\,Hg^{2+}/H_2SO_4} \xrightarrow[(iii)\,H_2/Ni]{} P$$

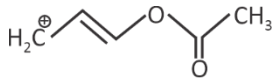
Product P is

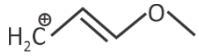
(1) 
(2) 
(3) 
(4) 

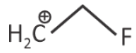
Answer (1)

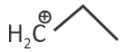
Sol. 

5. The most stable carbocation among the following is.

(1) 

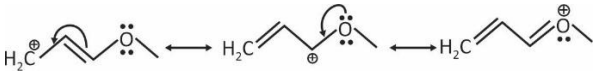
(2) 

(3) 

(4) 

Answer (2)

Sol. Among the given carbocations, the following carbocation is most stable due to extended conjugation and there is no destabilising factor.



6. Which of the following is most reactive towards nucleophilic addition reaction.

(1) Para-nitro benzaldehyde

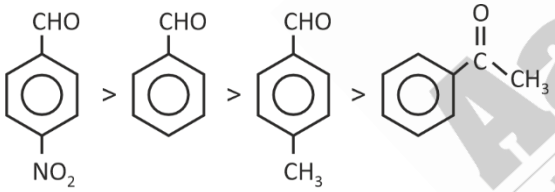
(2) Para-methyl benzaldehyde

(3) Benzaldehyde

(4) Acetophenone

Answer (1)

Sol. The order of reactivity will be dependent on hinderance and e^- deficiency (δ^+) on carbonyl carbon.



7. Consider the following statements about H_2O, NH_3 and CH_4

(A) All central atoms are sp^3 hybridised

(B) Order of dipole moment is $CH_4 < NH_3 < H_2O$

(C) NH_3 in H_2O is basic in nature, NH_3 and H_2O are Bronsted-Lowry acid and base respectively

(D) Bond angle of H_2O, NH_3 and CH_4 respectively are 104.5°, 107° and 109.5°

Which of the above statements are correct

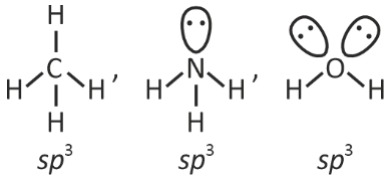
(1) A and B only

(2) A, B and C only

(3) A, B, C and D

(4) A, B and D only

Answer (4)

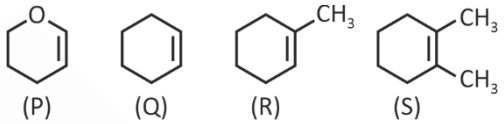
Sol. 

sp^3 sp^3 sp^3

Dipole moment of $H_2O > NH_3 > CH_4$

Bond angle of $CH_4 > NH_3 > H_2O \rightarrow 109.5 > 107° > 104.5°$

8. Which of the following is most reactive towards aq. HBr?



(P) (Q) (R) (S)

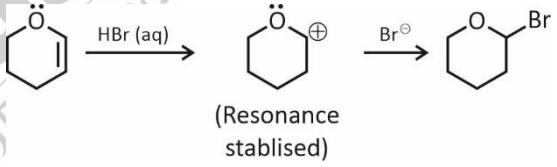
(1) (P)

(2) (Q)

(3) (R)

(4) (S)

Answer (1)

Sol. 

(Resonance stablised)

9. At the freezing point of water, process is non spontaneous, it becomes spontaneous at boiling point (Temperature varies linearly with pressure). The correct option is

(1) ΔH = +ve
ΔS = +ve

(2) ΔH = –ve
ΔH = –ve

(3) ΔH = +ve
ΔS = –ve

(4) ΔH = –ve
ΔS = +ve

Answer (1)

Sol. $\Delta G = \Delta H - T\Delta S$

For process to be spontaneous $\Delta G < 0$

The given process becomes spontaneous on increasing temperature

So $\Delta H > 0$ and $\Delta S > 0$

10. In the preparation of potassium permanganate from pyrolusite ore (MnO_2), the fusion of pyrolusite ore is done with an alkali metal hydroxide like KOH in the presence of air or an oxidising agent like KNO_3, which first produces.

(1) K_2MnO_6

(2) K_2MnO_4

(3) $KMnO_4$

(4) K_2MnO

Answer (2)

Sol. $2MnO_2 + 4KOH + O_2 \xrightarrow{\Delta} \underset{\left(\text{Potassium Manganate}\right)}{2K_2MnO_4} + 2H_2O$

Potassium Manganate (k_2MnO_4) is produced.

11. S-I : Duma's method is used for estimation of nitrogen

S-II : In Duma's method N present in compound is converted to $(NH_4)_2SO_4$

(1) S-I is correct statement.
S-II is incorrect statement

(2) S-I is incorrect statement
S-II is also incorrect statement

(3) S-I is correct statement
S-II is also correct statement

(4) S-I is incorrect statement
S-II is correct statement

Answer (1)

Sol. Estimation of N is done by Dumas and Kjeldahl method. In Dumas method N is organic compound is converted to free N_2 when compound is heated with CuO in atmosphere of CO_2. Released N_2 is collected over an aqueous solution of KOH.

12. An electron jumps from A $\rightarrow$ C by emitting a wavelength of 2000 Å and also jumps from B $\rightarrow$ C by emitting a wavelength of 6000 Å, then wavelength of that electron; if it jumps from A $\rightarrow$ B

(1) 4000 Å

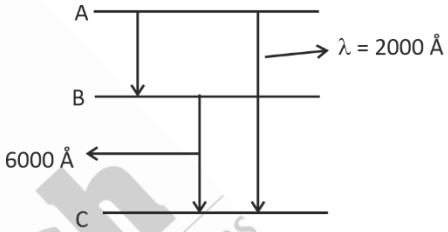
(2) 3000 Å

(3) 8000 Å

(4) 5000 Å

Answer (2)

Sol.



$$\left(\frac{hc}{\lambda}\right)_{AC} = \left(\frac{hc}{\lambda}\right)_{AB} + \left(\frac{hc}{\lambda}\right)_{BC}$$

$$\left(\frac{1}{\lambda}\right)_{AC} = \left(\frac{1}{\lambda}\right)_{AB} + \left(\frac{1}{\lambda}\right)_{BC}$$

$$\frac{1}{2000} = \frac{1}{\lambda_{AB}} + \frac{1}{6000}$$

$$\frac{1}{\lambda_{AB}} = \frac{1}{2000} - \frac{1}{6000}$$

$$\frac{1}{\lambda_{AB}} = \frac{6000 - 2000}{6000 \times 2000}$$

$$\frac{1}{\lambda_{AB}} = \frac{4000}{12 \times 10^6}$$

$$\frac{1}{\lambda_{AB}} = \frac{1}{3000}$$

$$\lambda_{AB} = 3000\,\text{Å}$$

13. Calculate the value of E°_{cell} for given cell based on given information

$Fe^{2+} + Ag^{+} \rightarrow Fe^{3+} + Ag$;

$Ag^{+} + e^{-} \rightarrow Ag$; $E^{\circ} = xV$

$Fe^{2+} + 2e^{-} \rightarrow Fe$; $E^{\circ} = yV$

$Fe^{3+} + 3e^{-} \rightarrow Fe$; $E^{\circ} = zV$

(1) $x + y - z$

(2) $x + 3y - 2z$

(3) $y - 2x$

(4) $x - 3z + 2y$

Answer (4)

Sol. $Fe^{2+} + 2e \rightarrow Fe \quad E^{\circ} = y$

$Fe \rightarrow Fe^{3+} + 3e^{-} \quad E^{\circ} = -z$

$Fe^{2+} \rightarrow Fe^{3+} + e^{-} \quad E^{\circ} = w$ (say)

$1 \times w = 2 \times y - 3z$

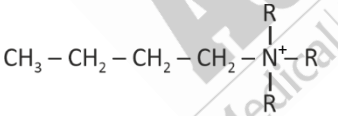
$w = 2y - 3z$

$Fe^{2+} + Ag^{+} \rightarrow Fe^{3+} + Ag$

$E^{\circ}_{Cell} = E^{\circ}_{Fe^{2+}/Fe^{3+}} + E^{\circ}_{Ag^{+}/Ag} = 2y - 3z + x$

14. Consider the given reactions and choose proper solvent.

Reaction-I: $CH_3 - CH_2 - CH_2 - CH_2 - Cl \xrightarrow{OH^-} CH_3 - CH_2 - CH_2 - CH_2 - OH$

Reaction -II: $CH_3 - CH_2 - CH_2 - CH_2 - Cl \xrightarrow{R_3N}$ 

(1) Reaction-I : polar protic, Reaction-II : polar aprotic

(2) Reaction-I : polar aprotic, Reaction-II : polar protic

(3) Reaction-I : polar aprotic, Reaction-II : polar aprotic

(4) Reaction-I : polar protic, Reaction-II : polar protic

Answer (3)

Sol. Both reactions proceeds through S_N2 mechanism and most suitable solvent would be polar aprotic solvent.

15. 2.32×10^3 kg of Fe_3O_4 reacts with 2.8×10^3 kg of CO according to the following reaction :

$Fe_3O_4 + CO \rightarrow CO_2 + Fe$

If x kg of Fe is formed. Find the value of x?

(1) 2000 kg

(2) 1680 kg

(3) 2780 kg

(4) 1500 kg

Answer (2)

Sol. Balanced reaction

$Fe_3O_4 + 4CO \rightarrow 4CO_2 + 3Fe$

Given mass of $Fe_3O_4 = 2.32 \times 10^3$ kg

Mol. Mass of $Fe_3O_4 = 232$ gm $= 0.232$ kg

Moles of $Fe_3O_4 = \frac{2.32 \times 10^3}{0.232} = 10^4$ mol

Given mass of CO $= 2.8 \times 10^3$ kg

Mol. Mass of CO $= 28$ gm $= 0.028$ kg

Moles of CO $= 10^5$ mol

According to balanced reaction

1 mol Fe_3O_4 requires 4 mol CO

$\therefore$ 10^4 mol Fe_3O_4 requires 4×10^4 mol CO

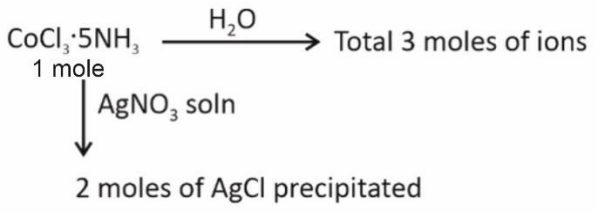
$\therefore$ CO is in excess

1 mol Fe_3O_4 gives 3 mol Fe

10^4 mol Fe_3O_4 will gives 3×10^4 mol Fe

$\therefore$ Mass of Fe formed $= 3 \times 10^4 \times \frac{56}{1000} = 1680$ kg

16. Consider the following reaction of a complex compound



The formula of complex is

(1) $[Co(NH_3)_5Cl]\ Cl_2$

(2) $[Co(NH_3)_6]\ Cl_3$

(3) $[Co(NH_3)_3Cl_3]\cdot 3NH_3$

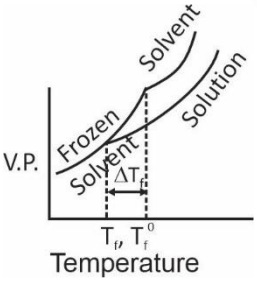
(4) $[Co(NH_3)_4Cl_2]\ Cl$

Answer (1)

Sol. $\underset{\text{1 mole}}{\left[Co(NH_3)_5Cl\right]}Cl_2 \xrightarrow{H_2O} \underbrace{\left[Co(NH_3)_5Cl\right]^{2+} + 2Cl^-}_{\text{3 mole ions}}$

$\left[Co(NH_3)_5Cl\right]Cl_2 \xrightarrow[\text{soln}]{AgNO_3} \left[CO(NH_3)_5Cl\right](NO_3)_2 + 2AgCl\downarrow$

17. Consider the following plots of vapour pressure of a solution containing non-volatile solute versus temperature (in K) and choose the correct graph which represents depression in freezing of solvent.

(1)


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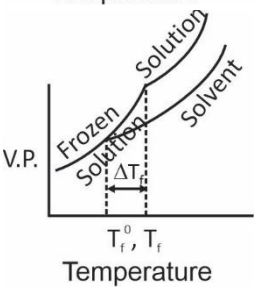

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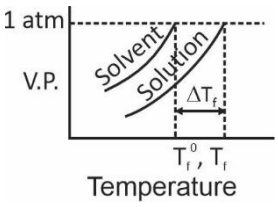

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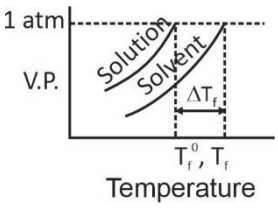
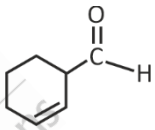


Answer (1)

Sol. Freezing point of a solvent is the temperature when vapour pressure of solid phase becomes equal to vapour pressure of liquid phase. The solute never freezes and always remains in solution. Graph (1) represents the correct plot for depression in freezing point.

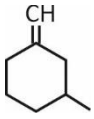
18. A student synthesised the compound given below



By using one of the following compounds available in the lab and using following reagents.

$\text{Reactant} \xrightarrow{NBS} \xrightarrow[Me_3COH]{Me_3CO^-K^+} \xrightarrow[(ii)\,H_2O_2/OH^-]{(i)\,B_2H_6/THF} \xrightarrow{PCC}$

Choose the suitable compound which can be used as reactant

(1)


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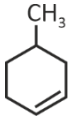

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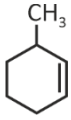

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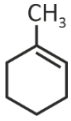
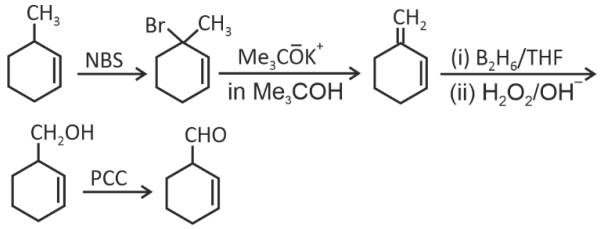


Answer (3)

Sol. 3-methylcyclohexene is likely to be the most appropriate reactant for the synthesis of the given compound.



19. Select the incorrect statements about the modern periodic table.

(1) The Physical and chemical properties of elements are periodic function of their atomic weight

(2) The Physical and chemical properties of elements are periodic function of their atomic numbers

(3) Non-metallic elements are lesser in number than metallic elements

(4) In periodic table, 18 groups are present

Answer (1)

Sol. According to modern periodic law, the physical and chemical properties of elements are periodic function of their atomic numbers.

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. If the K_{sp} of $Cr(OH)_3$ is 1.6×10^{-30} M^4. The molar solubility of salt in water is 1.56×10^{-x}, then value of x is

Answer (8)

Sol. $Cr(OH)_3(s) \rightleftharpoons \underset{s}{Cr^{3+}}(aq) + \underset{3s}{3OH^-}(aq)$

$K_{sp} = s^1(3s)^3$

$K_{sp} = 27s^4$

$s^4 = \frac{1.6}{27} \times 10^{-30}\ M^4$

$s^4 = \frac{160}{27} \times 10^{-32} = 5.92 \times 10^{-32}$

$s = 1.56 \times 10^{-8}$

$\boxed{x = 8}$

22. When x g of Benzoic acid reacts with $NaHCO_3$, 11.2 L of CO_2 is released at 273 K and 1 atm pressure, calculate mass of benzoic acid in gram?

Answer (61)

Sol. $Ph-\overset{\overset{O}{||}}{C}-OH + NaHCO_3 \rightarrow Ph-\overset{\overset{O}{||}}{C}-ONa + H_2O + CO_2$

Moles of $CO_2 = \frac{11.2}{22.4} = 0.5\,mol$

Moles of Benzoic acid = 0.5 mol

Mass of benzoic acid = 0.5 × 122 g

= 61 g

23. How many of the following cation shows characteristic coloured ppt. with $K_4[Fe(CN)_6]$?

Cu^{2+}, Ca^{2+}, Ba^{2+}, Fe^{3+}, Zn^{2+}, Mg^{2+}, Mn^{2+}

Answer (3)

Sol. $Fe^{3+} + K_4[Fe(CN)_6] \rightarrow \underset{\text{(Prussian blue)}}{Fe_4[Fe(CN)_6]_3}$

$Cu^{2+} + K_4[Fe(CN)_6] \rightarrow \underset{\text{(Chocolate brown ppt.)}}{Cu_2[Fe(CN)_6]}$

$Zn^{2+} + K_4[Fe(CN)_6] \rightarrow \underset{\text{(White ppt.)}}{Zn_2[Fe(CN)_6]}$

$Mg^{2+} + K_4[Fe(CN)_6] \rightarrow$ No visible colour change

$Ca^{2+} + K_4[Fe(CN)_6] \rightarrow \underset{\text{(White ppt.)}}{Ca_2[Fe(CN)_6]}$

$Mn^{2+} + K_4[Fe(CN)_6] \rightarrow \underset{\text{(Pale pink coloured ppt.)}}{Mn_2[Fe(CN)_6]}$

$Ba^{2+} + K_4[Fe(CN)_6] \rightarrow$ No visible colour change

24.

25.