JEE MAIN July 2021

CHEMISTRY

20th July 2021 [SHIFT – 1]

QUESTION WITH SOLUTION

SECTION –A

1. Compound A is converted to B on reaction with $CHCl_3$ and KOH. The compound B is toxic and can be decomposed by C. A, B and C respectively are :
(1) secondary amine, nitrile compound, conc. NaOH
(2) primary amine, isonitrile compound, conc. HCl
(3) secondary amine, isonitrile compound, conc. NaOH
(4) primary amine, nitrile compound, conc. HCl

Sol. **(2)**

$$\underset{\text{1° amine (A)}}{R-NH_2} \xrightarrow{CHCl_3} \underset{\text{Isonitrile (B)}}{R-\overset{\oplus}{N}\equiv\overset{\ominus}{C}} \xrightarrow[(HCl)]{H_3O^{\oplus}} \underset{\text{(C)}}{R-NH_2} + HCOOH$$

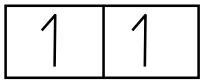
2. According to the valence bond theory the hybridization of central metal atom is dsp^2 for which one of the following compounds ?
(1) $Na_2[NiCl_4]$ (2) $NiCl_2.6H_2O$ (3) $K_2[Ni(CN)_4]$ (4) $[Ni(CO)_4]$

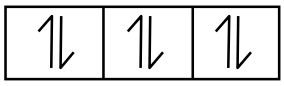
Sol. **(3)**

$NiCl_2.6H_2O$

$Ni^{+2} \rightarrow [Ar]_{18}\ 3d^8\ 4s^0$

C.N. = 6 octahedral

splitting  Hybridisation $sp^3\ d^2$



t_{2g}

(2) $K_2[Ni(CN)_4]$

$Ni^{+2} \rightarrow [Ar]_{18}\ 3d^8\ 4s^0$

C. N. = 4 Strong field ligand

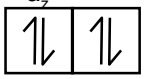
C.N. → Strong field  Hydridisation

$d_{x^2-y^2}$

Square planar 

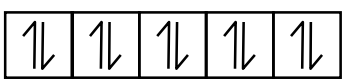
d_x

d_{z^2}

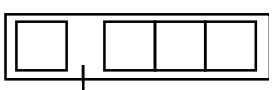


3) d_{yz} d_{xz}

CO– Strong field

Ni → 

$3d^1$



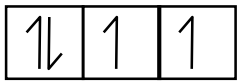
4 4

sp

Hybridisati

4) $Na_2[NiCl_4]$ $\quad Ni \rightarrow [Ar]_{18}\, 3d^8\, 4s^0$

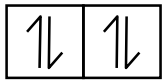
$Cl^{\ominus} \rightarrow$ weak Field ligand



t_2 Hybridisation sp^3

C. N. = 4

tetrahedral splitting



e

3. The set in which compounds have different nature is :

(1) $B(OH)_3$ and H_3PO_3 (2) $B(OH)_3$ and $Al(OH)_3$

(3) NaOH and $Ca(OH)_2$ (4) $Be(OH)_2$ and $Al(OH)_3$

Sol. **(2)**

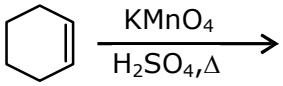
(1) $B(OH)_3$ acidic and H_3PO_3 acidic

(2) $B(OH)_3$ acidic and $Al(OH)_3$ amphoteric

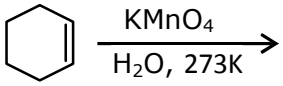
(3) NaOH basic and $Ca(OH)_2$ basic

(4) $Be(OH)_2$ amphoteric and $Al(OH)_3$ amphoteric

4.



'A' (major product)



'B' (major product)

For above chemical reactions, identify the correct statement from the following:

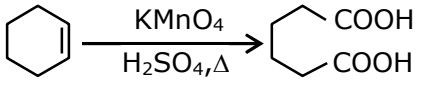
(1) Compound'A'is dicarboxylic acid and compound 'B' is diol

(2) Compound 'A' is diol and compound 'B' is dicarboxylic acid

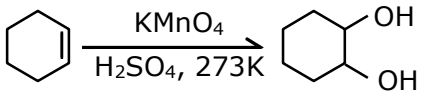
(3) Both compound 'A' and compound 'B' are diols

(4) Both compound 'A' and compound 'B' are dicarboxylic acids

Sol. **(1)**



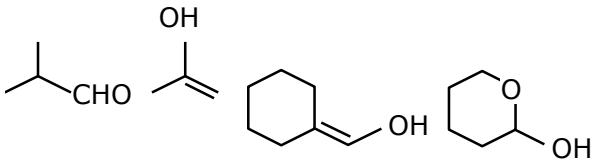
dicarboxylic acid (A)



Diol (B)

$KMnO_4/H_2SO_4/\Delta$ act as a strong oxidising agent where as $KMnO_4/H_2O/273$ K is a mild oxidising agent.

5.



(I) (II) (III) (IV)

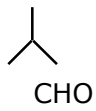
Which among the above compound/s does/do not form Silver mirror when treated with Tollen's reagent?

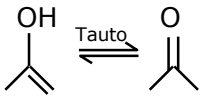
(1) Only (II) (2)(I), (III) and (IV) only

(3)(III) and (IV) only (4)Only (IV)

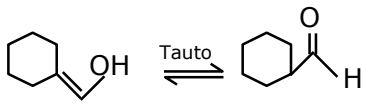
Sol. **(1)**

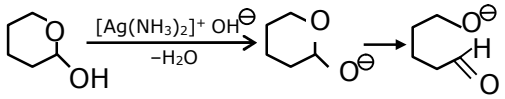
Aldehydes and hemiacetal give ⊕ ve Tollen's Test (Silver mirror test)

(I)  Tollen's test Positive

(II)  Negative

Ketone

(III)  Positive

(IV)  Positive

Hemiacetal

6. Green chemistry in day–to–day life is in the use of:

(1)Chlorine for bleaching of paper

(2)Liquified CO_2 for dry cleaning of clothes

(3)Large amount of water alone for washing clothes

(4)Tetrachloroethene for laundry

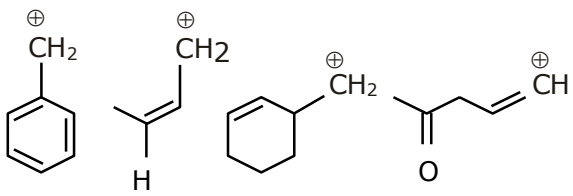
Sol. **(2)**

Chlorine gas was used earlier for bleaching paper.These days, hydrogen peroxide (H_2O_2) with suitable catalyst.

Tetra chlroroethene ($Cl_2C=CCl_2$) was earlier use as solvent for dry cleaning. The compound contaminates the ground water and is also asuspected carcinogen. Replacement of halogenatedsolvent by liquid CO_2 will result in less harm to groundwater.

Hence given statement (2) is correct.

7.



(A) (B) (C) (D)

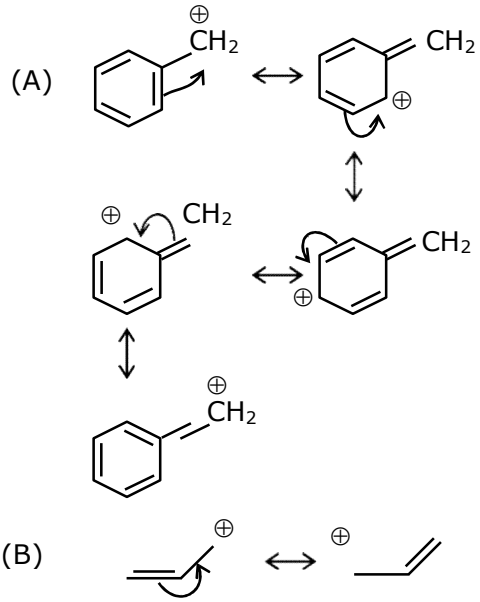
Among the given species the Resonance stabilised carbocations are:

(1)(C) and (D) only (2) (A), (B) and (C) only

(3)(A), (B) and (D) only (4)(A) and (B) only

Sol. **(4)**

(A) and (B) only in Resonance



8. The metal that can be purified economically by fractional distillation method is:

(1)Ni (2)Cu (3)Zn (4)Fe

Sol. **(3)**

Zinc can be purified economically by fractionaldistillation.

9. The conditions given below are in the context of observing Tyndall effect in colloidal solutions:

(A)The diameter of the colloidal particles is comparable to the wavelength of light used.

(B) The diameter of the colloidal particles is much smaller than the wavelength of light used.

(C)The diameter of the colloidal particles is much larger than the wavelength of light used.

(D) The refractive indices of the dispersed phase and the dispersion medium are comparable.

(E)The dispersed phase has a very different refractive index from the dispersion medium.

Choose the most appropriate conditions from the options given below:

(1) (B) and (E) only (2) (C) and (D) only

(3) (A) and (E) only (4) (A) and (D) only

Sol. **(3)**

The phenomenon of scattering of light by colloidalparticles as a result of which the path of the beambecomes visible is called a tyndall effect.smaller the diameter and similar the magnitude ofrefractive indices, lesser is the scattering and hence the tyndall effect and viced-versa. The diameter of the dispersed phase particle should not be smaller than the wavelength of light usedbecause they won't be able to scatter the light so,therefore, the diameter of the dispersed particlesshould be equal or not much smaller than the wavelength of the light used.

2. The refractive indies (i.e. the ratio of the velocity of light in vacuum to the velocity of light in any medium) of the dispersed phase and thedispersion medium should differ greatly inmagnitude than only the particles will be able to scatter the light and tyndall effect will be obersved.On the other hand, if the refractive indices of the dispersed phase and dispersion medium are almostsimilar in magnitude, then there will be noscattering of light and hence, therefore, no tyndalleffect effect is observed.

Hence answer (A) and (E) are correct.

10. Given below are two statements : One is labelled as **Assertion A** and other is labelled as **Reason R**.

Assertion A : The dihedral angles in H_2O_2 in gaseous phase is 90.2° and in solid phase is 111.5°.

Reason R : The change in dihedral angle in solid and gaseous phase is due to the difference in the intermolecular forces.

Choose the most appropriate answer from the options given below for A and R.

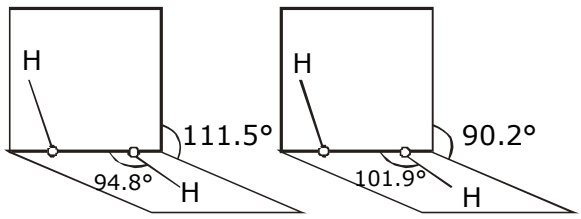
(1)Both A and R are correct but R is not the correct explanation of A.

(2)A is correct but R is not correct.

(3)Both A and R are correct and R is the correct explanation of A.

(4)A is not correct but R is correct.

Sol. **(4)**



(a) Gas phase (a) Solid phase

(a) H_2O_2 structure in gas phase, dihedral angle is 111.5°.

sssss(b) H_2O_2 structure in solid phase at 110K, dihedral angle is 90.2°

Hence given statement (A) is not correct

But statement (B) is correct.

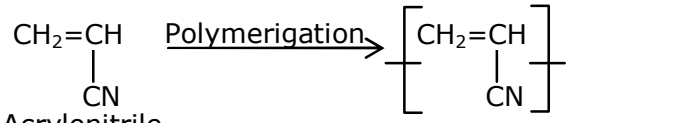
11. Orlon fibres are made up of:

(1) Polyacrylonitrile (2) Cellulose

(3) Polyamide (4) Polyesters

Sol. **(1)**

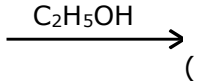
→ orlon fibers are made up of Polyacrylonitrile



Acrylonitrile

Poly acrylonitrile (PAN)

12. In the given reaction 3-Bromo-2,2-dimethyl butane



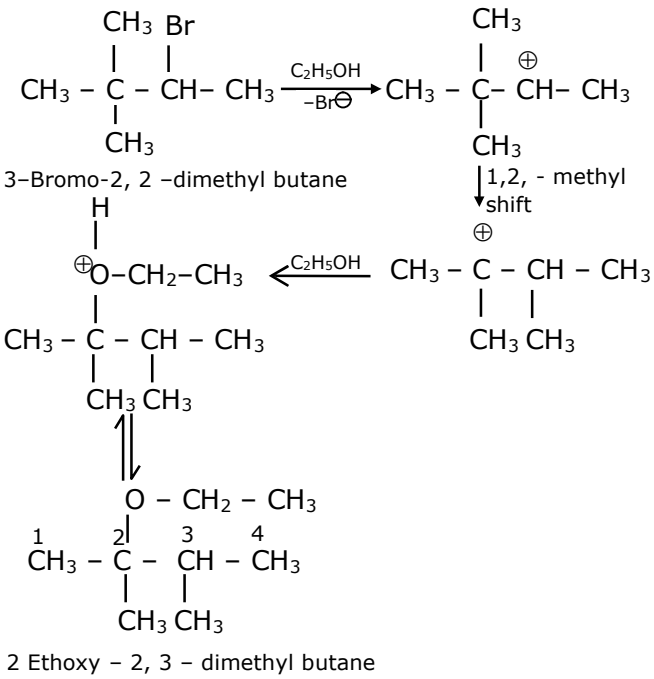
'A'
(Major product)

Product A is :

(1) 2-Hydroxy-3,3-dimethyl butane. (2) 2-Ethoxy-2,3-dimethyl butane.

(3) 2-Ethoxy-3,3-dimethyl butane. (4) 1-Ethoxy-3,3-dimethyl butane

Sol. **(2)**



13. The correct order of intensity of colors of the compounds is :

(1)$[Ni(CN)_4]^{2-} > [NiCl_4]^{2-} > [Ni(H_2O)_6]^{2+}$ (2)$[NiCl_4]^{2-} > [Ni(CN)_4]^{2-} > [Ni(H_2O)_6]^{2+}$

(3)$[NiCl_4]^{2-} > [Ni(H_2O)_6]^{2+} > [Ni(CN)_4]^{2-}$ (4)$[Ni(H_2O)_6]^{2+} > [NiCl_4]^{2-} > [Ni(CN)_4]^{2-}$

Sol. **(3)**

$[NiCl_4]^{2-} > [Ni(H_2O)_6]^{2+} > [Ni(CN)_4]^{2-}$

Splitting $\Delta_t < \Delta_0 < \Delta_{sq}$

energy order

absorbed $[NiCl_4]^{2-} < [Ni(H_2O)_6]^{2+} < [Ni(CN)_4]^{2-}$

energy order

intensity of $[NiCl_4]^{2-} > [Ni(H_2O)_6]^{2+} > [Ni(CN)_4]^{2-}$

colour of

compound

14. An inorganic Compound 'X' on treatment with concentrated H_2SO_4 produces brown fumes and gives dark brown ring with $FeSO_4$ in presence of concentrated H_2SO_4. Also Compound 'X' gives precipitate 'Y', when its solution in dilute HCI is treated with H_2S gas. The precipitate 'Y' on treatment with concentrated HNO_3 followed by excess of NH_4OH further gives deep blue coloured solution, Compound 'X' is :

(1)$Cu(NO_3)_2$ (2)$Pb(NO_3)_2$ (3)$Pb(NO_2)_2$ (4)$Co(NO_3)_2$

Sol. **(1)**

$$\underset{\text{X}}{NO_3^-} + H_2SO_4 \xrightarrow[\text{(Conc.)}]{} \underset{\text{Brown funes}}{NO_2\uparrow} + H_2O$$

(Anion)

$$FeSO_4 + H_2SO_4 + NO_3^-$$

Sol^n conc. X

$$\downarrow$$

$$[Fe(H_2O)_5(NO)]SO_4$$

(Dark brown ring)

Cu^{2+} + (dil HCl + H_2S)

X (Group – II reagent)

(cation)

$$\downarrow$$

CuS $\downarrow$

(Black ppt)

(Y)

$$\underset{(Y)}{Cus} \xrightarrow[HNO_3]{Conc^n} \overset{\text{Soluble}}{Cu(NO_3)_2} + NO_2 + S + H_2O$$

$$\downarrow \text{ Excess } NH_4(OH) \text{ Sol}^n$$

$[Cu(NH_3)_4]^{2+}$

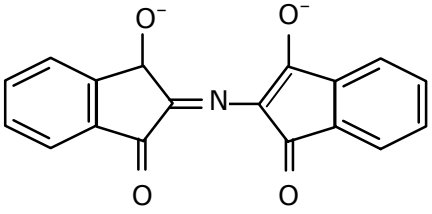
Deep blue colour solution

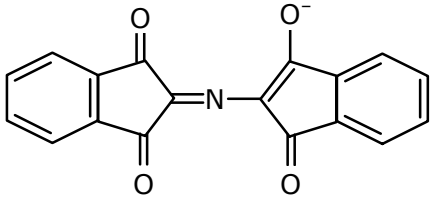
$\therefore$ X $\rightarrow Cu(NO_3)_2$

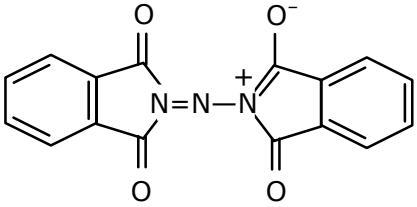
15. Identify the incorrect statement from the following :
(1) Glycogen is called as animal starch
(2) β-Glycosidic linkage makes cellulose polymer
(3) Amylose is a branched chain polymer of glucose
(4) Starch is a polymer of α-D glucose

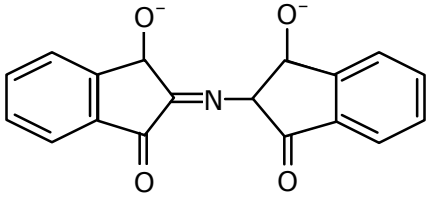
Sol. **(3)**
Amylose is a linear chain polymer of α-D-glucosewhile amylopectine is branched chain polymer of α-D-glucose.

16. The correct structure of Rhumann's Purple, the compound formed in the reaction of ninhydrin with proteins is :

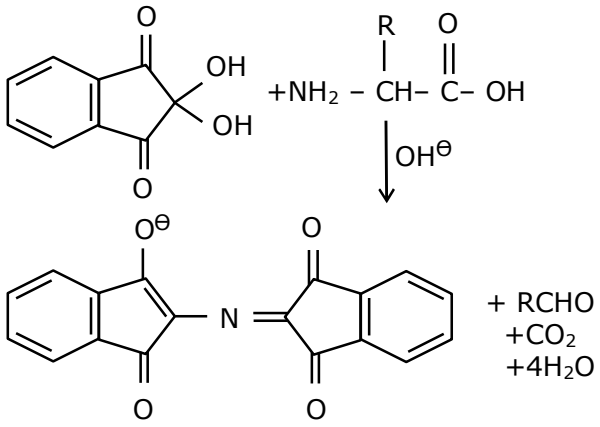
(1) 

(2) 

(3) 

(4) 

Sol. **(2)**



Ninhydrin Test

17. Given below are two statements. One is labelled as **Assertion A** and the other is labelled as **Reason R**.
Assertion A : Sharp glass edge becomes smooth on heating it upto its melting point.
Reason R : The viscosity of glass decreases on melting.
Choose the most appropriate answer from the options given below.
(1) Both **A** and **R** are true and **R** is the correct explanation of **A**
(2) **A** is true but **R** is false.
(3) **A** is false but **R** is true.
(4) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**.

Sol. **(4)**
Hence given assertion (A) is correct
reason (R) is correct
but reason is not correct explanation

18. Chemical nature of the nitrogen oxide compound obtained from a reaction of concentrated nitric acid and P_4O_{10} (in 4 : 1 ratio) is:
(1) acidic (2) amphoteric
(3) neutral (4) basic

Sol. **(1)**
$4HNO_3 + P_4O_{10}$
$\downarrow$
$2N_2O_5 + (HPO_3)_4$
Ans. N_2O_5 is acidic in nature.

19. A s-block element (M) reacts with oxygen to form an oxide of the formula MO_2. The oxide is pale yellow in colour and paramagnetic. The element (M) is :
(1) Na (2) K (3) Ca (4) Mg

Sol. **(2)**
(A) $2Mg + O_2 \rightarrow 2MgO$ (Diamagnetic)
(B) $2Na + O_2 \rightarrow Na_2O$ (Diamagnetic)
$2Na + \underset{\text{(excess)}}{O} \rightarrow Na_2O_2$ (Diamagnetic)
(C) $2\ Ca + O_2 \rightarrow CaO_2$ (Diamagnetic)
$Ca + O_2 \rightarrow CaO_2$ (Diamagnetic)
(D) $K + \underset{\text{(excess)}}{O_2} \rightarrow KO_2$ (Paramagnetic)

20. The species given below that does NOT show disproportionation reaction is :
(1) BrO_2^- (2) BrO_4^- (3) BrO^- (4) BrO_3^-

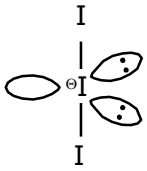
Sol. **(2)**
In $BrO_4^{\ominus}$, Br is in highest oxidation state (+7), Soit cannot oxidise further it only reduced hence it cannot show disproportionation reaction

SECTION –B

1. The number of lone pairs of electrons on the central I atom in I_3^- is _____

Sol. **3**

I_3^- :



The number of lone pairs of electron on the central atom is 3.

2. An average person needs about 10000 kJ energy per day. The amount of glucose (molar mass = 180.0 g mol^{-1}) needed to meet this energy requirement is _____ g. (Nearest integer)
(Use : $\Delta_C H$ (glucose) = −2700 kJ mol^{-1})

Sol. **667**

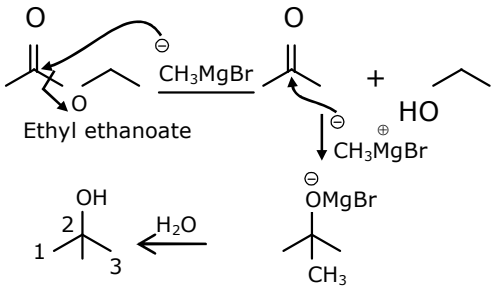
2700 kJ energy requires = 180 gm

10000 kg energy requires = $\frac{180 \times 10000}{2700}$ gm

mass of glucose = 667 gm

3. To synthesise 1.0 mole of 2-methylpropan-2-ol from Ethylethanoate _____ equivalents of CH_3MgBr reagent will be required. (Integer value)

Sol. **2**



2 – Methylpropan – 2 ol

4. The Azimuthal quantum number for the valence electrons of Ga^+ ion is _____ .
(Atomic number of Ga =31)

Sol. **0**

Ga^+ : $Is^2\ 2s^2\ 2P^6\ 3s^2\ 3p^6\ 3d^{10}4s^2$

last orbital = s

The azimuthal quantum number for the valenceelectrons (4s-subshell) of Ga+ ion is zero(0).

5. At 20°C, the vapour pressure of benzene is 70 torr and that of methyl benzene is 20 torr. The mole fraction of benzene in the vapor phase at 20°C above an equimolar mixture of benzene and methyl benzene is _____ x 10^{-2} (Nearest integer)

Sol. **78**

$P_B^o = 70 \qquad P_T^o = 20 \qquad X_B = 0.5 = X_M$

Now. $y_B = \dfrac{X_B P_B^o}{X_B P_B^o + X_M P_M^o}$

$= \dfrac{70 \times 0.5}{70 \times 0.5 + 20 \times 0.5}$

$= 0.777 \Rightarrow 77.7 \times 10^{-2} \Rightarrow 78 \times 10^{-2}$

6. 250 mL of 0.5 M NaOH was added to 500 mL of 1 M HCl The number of unreacted HCl molecules in the solution after complete reaction is _____x 10^{21}. (Nearest integer)
(N_A= 6.022 X 10^{23})

Sol. **226**

We known that no. of moles = Vlitre × Molarity& No. of millimoles = V_{ml} × Molarity
so millimoles of NaOH = 250 × 0.5 = 125
Millimoles of HCl = 500 × 1 = 500
Now reaction is

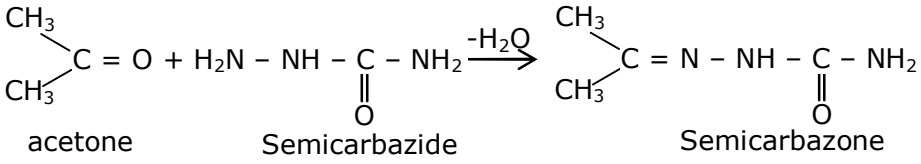
$NaOH + HCL \rightarrow NaCl + H_2O$

t = 0	125	500	0	0
t = 0	0	375	125	125

so millimoles of HCl left = 375
Moles of HCl = 375 × 10^{-3}
No. of HCl molecules = 6.022 × 10^{23} × 375 × 10^{-3}
= 225.8 × 10^{21}
≈226 × 10^{21} = 226

7. The number of nitrogen atoms in a semicarbazone molecule of acetone is ___ _

Sol. **3**



acetone Semicarbazide Semicarbazone

8. The spin-only magnetic moment value for the complex $[Co(CN_6)]^{4-}$is _____ BM
[At. no. of Co= 27]

Sol. **2**

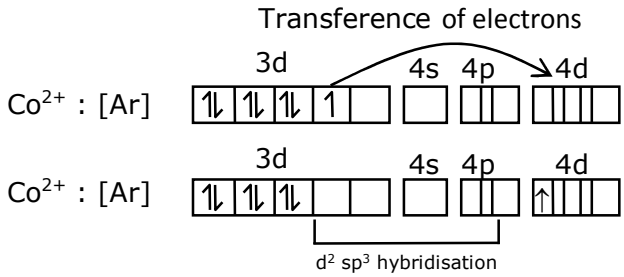
$\left[CO(CN)_6\right]^{4-}$

x + 6 × (−1)= −4

$\boxed{x = +2}$

Co^{2+} : [Ar] $3d^7$

and CN^- is a strong field ligand which can pair electron of central atom.



It has one unpaired electron (n) in 4d-subshell.So spin only magnetic moment (μ) = $\sqrt{n(n+2)}$ B.M

where n = number of unpaired electrons.

$\mu = \sqrt{3}$ B.M $\quad \boxed{\mu = 1.73\,BM}$

9. $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

In an equilibrium mixture, the partial pressures are

$P_{SO_3} = 43$ kPa ; $P_{O_2} = 530$ Pa and

$P_{SO_2} = 45$ kPa The equilibrium constant K_P = _____ $\times 10^{-2}$. (Nearest integer)

Sol. **172 (BY NTA) Motion (17228)**

$2SO_{2(g)} + O_{2(g)} = 2SO_{3(g)}$

$$K_P = \frac{\left(pSO_{3(g)}\right)^2}{pSO_{2(g)}} \times pO_{2(g)}$$

$$= \frac{43 \times 43}{45 \times 45} \times 530 \text{ Pa}^{-1} = 172.28 \times 10^{-5} \text{ Pa}^{-1}$$

$= 174.498 \text{ atm}^{-1}$

$= 17449.8 \times 10^{-2} \text{ atm}^{-1}$

Ans. is 17228

10. The inactivation rate of a viral preparation is proportional to the amount of virus. In the first minute after preparation, 10% of the virus is inactivated. The rate constant for viral inactivation is _____ x 10^{-3} min^{-1}. (Nearest integer)

[Use : ln 10 = 2.303; $\log_{10}$ 3=0.477;property of logarithm : log x^y = y log x]

Sol. **106**

As the unit of rate constant is min–1 so it must be afirst order reaction

$K \times t = 2.303 \log A_0/A_t$

in 1 min 10% is in activated so tabing

$A_0 = 100$ $A_t = 90$ in 1 min

$$\text{So } K \times 1 = 2.303 \times \log \frac{100}{90}$$

$= 2.303 \times (\log 10 - 2\log 3)$

$= 2.303 \times (1 - 2 \times 0.477) = 0.10593$

$= 105.93 \times 10^{-3}$

≈ 106