FINAL JEE-MAIN EXAMINATION - JULY, 2022
Held On Friday 29 July, 2022
TIME :3:00 PM TO 06:00 PM

SECTION-A

1. Consider the reaction

$4HNO_3(l) + 3KCl(s) \rightarrow Cl_2(g) + NOCl(g) + 2H_2O(g) + 3KNO_3(s)$

The amount of HNO_3 required to produce 110.0 g of KNO_3 is :

(Given : Atomic masses of H, O, N and K are 1, 16, 14 and 39, respectively.)

(A) 32.2 g (B) 69.4 g

(C) 91.5 g (D) 162.5 g

Official Ans. by NTA (C)

Ans. (C)

Sol. $4HNO_3(\ell) + 3KCl(s) \rightarrow Cl_2(g) + NOCl(g) + 2H_2O(g) + 3KNO_3(g)$

x gm **110 gm**

$\frac{x}{63}$ Mole $= \frac{110}{101}$

$4 \rightarrow 3$

$1 \rightarrow \frac{3}{4}$

$\frac{x}{63} \rightarrow \frac{3}{4} \times \frac{x}{63} = \frac{110}{101}$

$x = \frac{110 \times 63 \times 4}{101 \times 3} = 91.5\,gm$

2. Given below are the quantum numbers for 4 electrons.

A. $n = 3, l = 2, m_l = 1, m_s = +1/2$

B. $n = 4, l = 1, m_l = 0, m_s = +1/2$

C. $n = 4, l = 2, m_l = -2, m_s = -1/2$

D. $n = 3, l = 1, m_l = -1, m_s = +1/2$

The correct order of increasing energy is :

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

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

Official Ans. by NTA (B)

Ans. (B)

Sol. Energy order of subshell decided by (n+λ) rule.

$A \Rightarrow 3d \Rightarrow n + 1 = 5$

$B \Rightarrow 4p \Rightarrow n + \lambda = 5$

$C \Rightarrow 4d \Rightarrow n + \ell \Rightarrow 6$

$D \Rightarrow 3s \Rightarrow (n + \ell) = 4$

D < A < B < C

3. $C(s) + O_2(g) \rightarrow CO_2(g) + 400\ kJ$

$C(s) + \frac{1}{2}O_2(g) \rightarrow CO(g) + 100\ kJ$

When coal of purity 60% is allowed to burn in presence of insufficient oxygen, 60% of carbon is converted into 'CO' and the remaining is converted into 'CO_2'.

The heat generated when 0.6 kg of coal is burnt is _____.

(A) 1600 kJ (B) 3200 kJ

(C) 4400 kJ (D) 6600 kJ

Official Ans. by NTA (D)

Ans. (D)

Sol. $C(S) + O_2(g) \rightarrow CO_2(g) + 400\ kJ$

1 g mole

$C(s) + \frac{1}{2}O_2(g) \rightarrow CO(g) + 100kJ$ .... (II)

0.6×1000

$= 600$ gm

$600 \times \frac{60}{100}$ (Pure Carbon)

$= 360gm = \frac{360}{12} = 30mole$ (Pure Carbon)

Carbon converted into $CO_2 = \left(30 - 30 \times \frac{60}{100}\right)$

= 12 mole

and carbon converted in CO = $30 \times \frac{60}{100} = 18mole$

Energy generated during II equation

$= 18 \times 100$

$= 1800$ kJ

Energy generated during I^{st} reaction.

$= 12 \times 400$

$= 4800$

Total = 1800 + 4800 = 6600 kJ

4. 200 mL of 0.01 M HCl is mixed with 400 mL of 0.01M H_2SO_4. The pH of the mixture is ____.

(A) 1.14 (B) 1.78

(C) 2.34 (D) 3.02

Official Ans. by NTA (B)

Ans. (B)

Sol. $HCl + H_2SO_4$

$$[H^+] = \frac{(0.01\times 200)+(0.01\times 2\times 400)}{600}$$

$$= \frac{2+8}{600} = \frac{10}{600} = \frac{1}{60}$$

$$pH = -\log\left[\frac{1}{60}\right]$$

$= 1.78$

5. Given below are the critical temperatures of some of the gases :

Gas	Critical temperature (K)
He	5.2
CH_4	190
CO_2	304.2
NH_3	405.5

The gas showing least adsorption on a definite amount of charcoal is :

(A) He (B) CH_4

(C) CO_2 (D) NH_3

Official Ans. by NTA (A)

Ans. (A)

Sol. More the critical temp. of gas greater is the ease of liquefaction hence greater is the adsorption.

6. In liquation process used for tin (Sn), the metal :

(A) is reacted with acid

(B) is dissolved in water

(C) is brought to molten form which is made to flow on a slope

(D) is fused with NaOH.

Official Ans. by NTA (C)

Ans. (C)

Sol. Liquation process is used for metal having low melting point such as tin in which they are heated and brought to molten state and made to flow down the slope while impurities with higher melting point left on the top.

7. Given below are two statements.

Statement I : Stannane is an example of a molecular hydride.

Statement II : Stannane is a planar molecule.

In the light of the above statement, choose the most appropriate answer from the options given below :

(A) Both Statement I and Statement II are true.

(B) Both Statement I and Statement II are false.

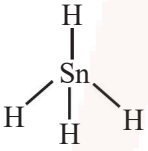
(C) Statement I is true but Statement II is false.

(D) Statement I is false but Statement II is true.

Official Ans. by NTA (C)

Ans. (C)

Sol. SnH_4 is non planar molecular hydride



Tetrahedral shape, sp^3 hybridisation

8. Portland cement contains 'X' to enhance the setting time. What is 'X'?

(A) $CaSO_4.\frac{1}{2}H_2O$ (B) $CaSO_4.2H_2O$

(C) $CaSO_4$ (D) $CaCO_3$

Official Ans. by NTA (B)

Ans. (B)

Sol. Gypsum ($CaSO_4.2H_2O$) is used to enhance setting time in portland cement.

9. When borax is heated with CoO on a platinum loop, blue coloured bead formed is largely due to :

(A) B_2O_3 (B) $Co(BO_2)_2$

(C) CoB_4O_7 (D) $Co[B_4O_5(OH)_4]$

Official Ans. by NTA (B)

Ans. (B)

Sol. $Na_2B_4O_7{\cdot}10H_2O \xrightarrow{\Delta} Na_2B_4O_7 + 10H_2O$

$Na_2B_4O_7 \xrightarrow{\Delta} 2NaBO_2$(sodium meta borate) $+ B_2O_3$

$B_2O_3 + CoO \rightarrow Co(BO_2)_2$(cobalt (II) meta borate)

Blue Bead

10. Which of the following 3d-metal ion will give the lowest enthalpy of hydration ($\Delta_{hyd}H$) when dissolved in water ?

(A) Cr^{2+} (B) Mn^{2+}

(C) Fe^{2+} (D) Co^{2+}

Official Ans. by NTA (B)

Ans. (B)

Sol.

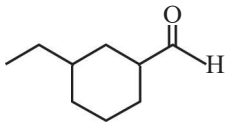
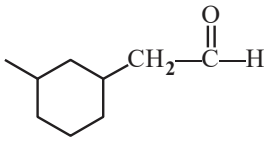
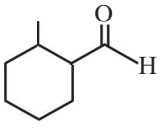
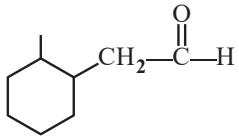
Ion	$\Delta H^{o}_{Hyd.}$ (kJ/mole)
Cr^{2+}	–1925
Mn^{2+}	–1862
Fe^{2+}	–1998
Co^{2+}	–2079

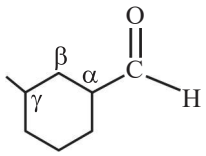
11. Octahedral complexes of copper (II) undergo structural distortion (Jahn-Teller). Which one of the given copper (II) complexes will show the maximum structural distortion ?
(en–ethylenediamine; $H_2N\text{-}CH_2\text{-}CH_2\text{-}NH_2$)
(A) $[Cu(H_2O)_6]SO_4$ (B) $[Cu(en)(H_2O)_4]SO_4$
(C) cis-$[Cu(en)_2Cl_2]$ (D) trans-$[Cu(en)_2Cl_2]$
Official Ans. by NTA (A)
Ans. (A)

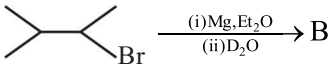
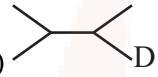
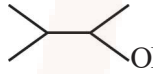
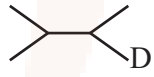
Sol. There is unsymmetric filling of e_g subset of Cu^{+2} ion, while there is symmetrical distribution in t_{2g} set, if the complex has same ligand there will be equal repulsion which leads to symmetrical bond length along t_{2g} , but due to uneven filling of electron in e_g subset, either octahedral will be elongated or compressed.

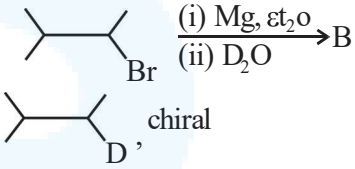
12. Dinitrogen is a robust compound, but reacts at high altitude to form oxides. The oxide of nitrogen that can damage plant leaves and retard photosynthesis is :
(A) NO (B) NO_3^-
(C) NO_2 (D) NO_2^-
Official Ans. by NTA (C)
Ans. (C)

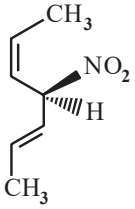
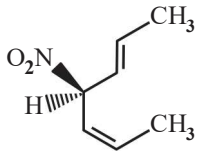
Sol. $N_2(g) + O_2(g) \rightarrow 2NO(g)$
$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$
NO_2 damage plant leaves

13. Correct structure of γ-methylcyclohexane carbaldehyde is :
(A) 
(B) 
(C) 
(D) 
Official Ans. by NTA (A)
Ans. (A)

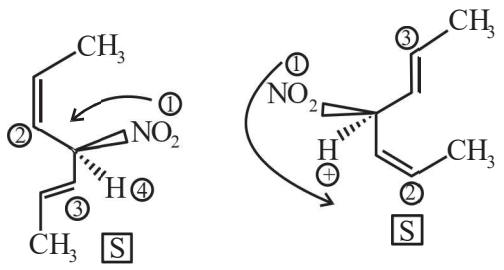
Sol. 
γ-methyl cyclohexane carbaldehyde

14. Compound 'A' undergoes following sequence of reactions to give compound 'B'. The correct structure and chirality of compound 'B' is:
[where Et is $-C_2H_5$]

Compound 'A'
(A)  , Achiral
(B)  , Chiral
(C)  , Chiral
(D)  , Achiral
Official Ans. by NTA (C)
Ans. (C)

Sol. 
chiral

15. Given below are two statements.
Statement I : The compound  is optically active.
Statement II :  is mirror image of above compound A.
In the light of the above statement, choose the **most appropriate** answer from the options given below.
(A) Both Statement I and Statement II are correct
(B) Both Statement I and Statement II are incorrect.
(C) Statement I is correct but Statement II is incorrect.
(D) Statement I is incorrect but Statement II is correct.
Official Ans. by NTA (C)
Ans. (C)

Sol.



(A) (B)

Having same configuration.

16. When enthanol is heated with conc. H_2SO_4, a gas is produced. The compound formed, when this gas is treated with cold dilute aqueous solution of Baeyer's reagent, is :

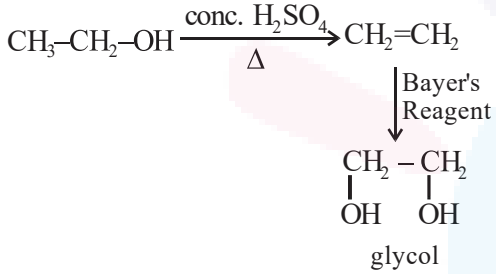
(A) Formaldehyde (B) Formic acid

(C) Glycol (D) Ethanoic acid

Official Ans. by NTA (C)

Ans. (C)

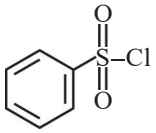
Sol.



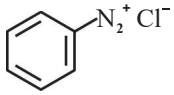
glycol

17. The Hinsberg reagent is :

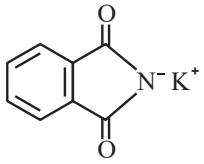
(A)



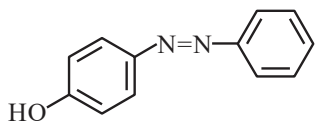
(B)



(C)



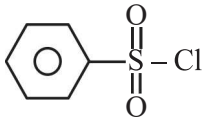
(D)



Official Ans. by NTA (A)

Ans. (A)

Sol.



B.S.C (Benzene sulphonyl chloride) is known's Hinsberg Reagent

18. Which of the following is **NOT** a natural polymer?

(A) Protein

(B) Starch

(C) Rubber

(D) Rayon

Official Ans. by NTA (D)

Ans. (D)

Sol. Rayon is semisynthetic polymer.

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

Assertion A : Amylose is insoluble in water.

Reason R : Amylose is a long linear molecule with more than 200 glucose units.

In the light of the above statements, choose the correct answer from the options given below.

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

(B) Both **A** and **R** are correct and **R** is NOT the correct explanation of A.

(C) **A** is correct but **R** is not correct.

(D) **A** is not correct but **R** is correct.

Official Ans. by NTA (D)

Ans. (D)

Sol. Amylose is water soluble.

20. A compound 'X' is a weak acid and it exhibits colour change at pH close to the equivalence point during neutralization of NaOH with CH_3COOH. Compound 'X' exists in ionized form in basic medium. The compound 'X' is :

(A) methyl orange (B) methyl red

(C) phenolphthalein (D) erichrome Black T

Official Ans. by NTA (C)

Ans. (C)

Sol. Phenolphthalein is weak acid give colour in basic medium.

SECTION-B

1. 'x' g of molecular oxygen (O_2) is mixed with 200 g of neon (Ne). The total pressure of the non-reactive mixture of O_2 and Ne in the cylinder is 25 bar. The partial pressure of Ne is 20 bar at the same temperature and volume. The value of 'x' is_____.

[Given: Molar mass of O_2 = 32 g mol^{-1}.

Molar mass of Ne = 20 g mol^{-1}]

Official Ans. by NTA (80)

Ans. (80)

Sol. **O_2 + Ne**

Xgm 200gm

P_{total} = 25 bar ; P_{Ne} = 20

$$P_{O_2} + P_{Ne} = 25$$

$$P_{O_2} = 25 - 20 = 5\,bar$$

$$5 = \frac{\frac{x}{32}}{\frac{x}{32}+\frac{200}{20}} \times 25$$

$$\frac{1}{5} = \frac{\frac{x}{32}}{\frac{x}{32}+10}$$

$$\frac{1}{5} = \frac{x \times 32}{32(x+320)}$$

$$5x = x + 320$$

$$4x = 320$$

$$x = \frac{320}{4} = 80\,gm$$

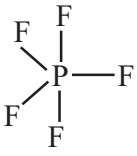
2. Consider, PF_5, BrF_5, PCl_3, SF_6, $[ICl_4]^-$, ClF_3 and IF_5.

Amongst the above molecule(s)/ion(s), the number of molecule(s)/ion(s) having sp^3d^2 hybridisation is____.

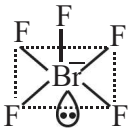
Official Ans. by NTA (4)

Ans. (4)

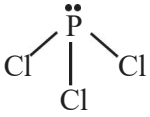
Sol.



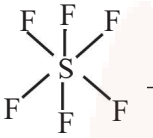
$\rightarrow sp^3d$ Hybridisation



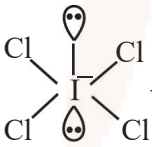
$\rightarrow sp^3d^2$ Hybridisation



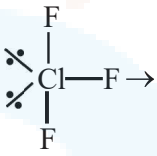
$\rightarrow sp^3$ Hybridisation



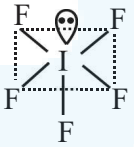
$\rightarrow sp^3d^2$ Hybridisation



$\rightarrow sp^3d^2$ Hybridisation



$\rightarrow sp^3d$ Hybridisation



$\rightarrow sp^3d^2$ Hybridisation

3. 1.80 g of solute A was dissolved in 62.5 cm^3 of ethanol and freezing point of the solution was found to be 155.1 K. The molar mass of solute A is __g mol^{-1}.

[Given: Freezing point of ethanol is 156.0 K.

Density of ethanol is 0.80 g cm^{-3}.

Freezing point depression constant of ethanol is 2.00 K kg mol^{-1}]

Official Ans. by NTA (80)

Ans. (80)

Sol. Mass of C_2H_5OH = 62.5 × 0.8 = 50 g

$$\Delta T_f = K_f \times m$$

$$0.9 = 2 \times \frac{1.8 \times 1000}{M_w \times 50}$$

$$M_w = \frac{2 \times 1.8 \times 1000}{0.9 \times 50} = 80$$

4. For a cell, Cu(s) $|Cu^{2+}(0.001M)| |Ag^{+}(0.01M)|$ Ag(s) the cell potential is found to be 0.43 V at 298 K. The magnitude of standard electrode potential for Cu^{2+}/Cu is ___ $\times 10^{-2}$ V.

$$\left[\text{Given : } E^{\Theta}_{Ag^{+}/Ag} = 0.80V \text{ and } \frac{2.303RT}{F} = 0.06V\right]$$

Official Ans. by NTA (34)

Ans. (34)

Sol. At anode

$Cu \rightarrow Cu^{2+} + 2e^{-}$

At cathode

$2Ag^{+} + 2e^{-} \rightarrow 2Ag$

Cell reaction $\rightarrow Cu + 2Ag^{+} \rightarrow Cu^{2+} + 2Ag$

$$E_{cell} = E^{0}_{cell} - \frac{0.06}{2}\log\frac{[Cu^{2+}]}{[Ag^{+}]^{2}}$$

$$0.43 = E^{0}_{cell} - \frac{0.06}{2}\log\frac{(0.001)}{(0.01)^{2}}$$

$$E^{0}_{cell} = 0.46$$

$$E^{0}_{cell} = E^{0}_{Ag^{+}/Ag} - E^{0}_{Cu^{2+}/Cu}$$

$$0.46 = 0.80 - E^{0}_{Cu^{2+}/Cu}$$

$$E^{0}_{Cu^{2+}/Cu} = 0.34 \text{ volt}$$

$$E^{0}_{Cu^{2+}/Cu} = 34 \times 10^{-2}$$

5. Assuming 1μg of trace radioactive element X with a half life of 30 years is absorbed by a growing tree. The amount of X remaining in the tree after 100 years is___$\times 10^{-1}$μg.

[Given : ln 10 = 2.303; log2 = 0.30]

Official Ans. by NTA (1)

Ans. (1)

Sol. $$t = \frac{1}{\lambda}\ell n\left(\frac{a}{a-x}\right)$$

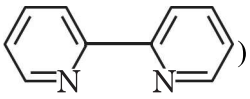
$$100 = \frac{30}{\ell n 2}\ell n\left(\frac{1}{w}\right)$$

$$\frac{1}{w} = 10$$

$W = 0.1 \times \mu g$

Ans. 1×10^{-1} μg

6. Sum of oxidation state (magnitude) and coordination number of cobalt in $Na[Co(bpy)Cl_4]$ is__.

(Given bpy = )

Official Ans. by NTA (9)

Ans. (9)

Sol. Coordination no. = 6

Oxidation state = 3

6 + 3 = 9

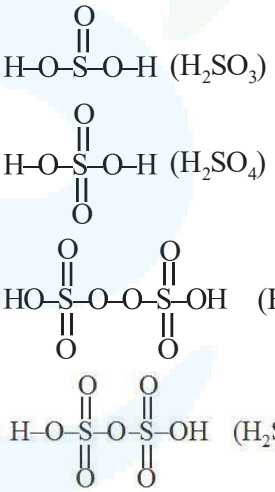
7. Consider the following sulphure based oxoacids.

H_2SO_3, H_2SO_4, $H_2S_2O_8$ and $H_2S_2O_7$.

Amongst these oxoacids, the number of those with peroxo(O-O) bond is_____.

Official Ans. by NTA (1)

Ans. (1)

Sol. 

8. A 1.84 mg sample of polyhydric alcoholic compound 'X' of molar mass 92.0 g/mol gave 1.344 mL of H_2 gas at STP. The number of alcoholic hydrogens present in compound 'X' is____.

Official Ans. by NTA (3)

Ans. (6)

Sol. $R(OH)_x \rightarrow H_2$

PoAC on H –

$$x\left(\frac{1.84\times10^{-3}}{92}\right) = \frac{1.344}{22.4}\times 2$$

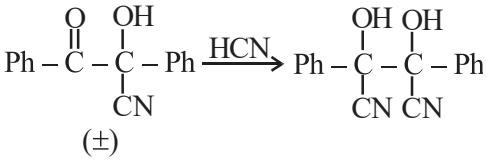
$$x = \frac{1.344\times2\times92\times1000}{1.84\times22400} = 6$$

$x = 6$

9. The number of stereoisomers formed in a reaction of (±) Ph(C=O) C(OH)(CN)Ph with HCN is_____.

Official Ans. by NTA (3)

Ans. (3)

Sol. 

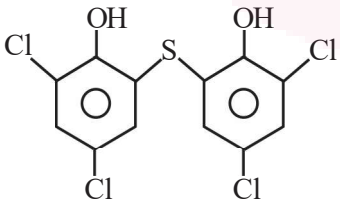
3 stereoisomers

10. The number of chlorine atoms in bithionol is____.

Official Ans. by NTA (4)

Ans. (4)

Sol. Bithinol



Chlorine atoms = 4