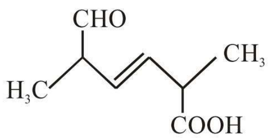
FINAL JEE-MAIN EXAMINATION - SEPTEMBER, 2020

Held On Wednesday, 2 September 2020

TIME : 9 : 00 AM to 12 : 00 PM

1. The IUPAC name for the following compound is:



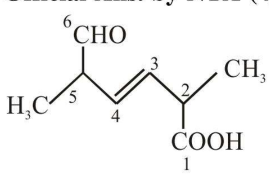
(1) 2, 5-dimethyl-6-carboxy-hex-3-enal

(2) 6-formyl-2-methyl-hex-3-enoic acid

(3) 2, 5-dimethyl-5-carboxy-hex-3-enal

(4) 2, 5-dimethyl-6-oxo-hex-3-enoic acid

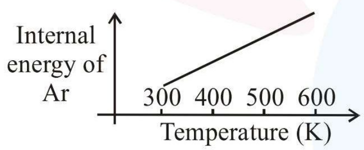
Official Ans. by NTA (4)

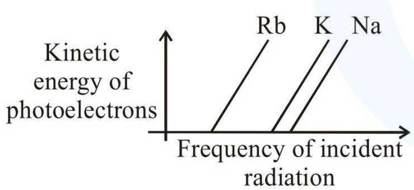
Soll. 

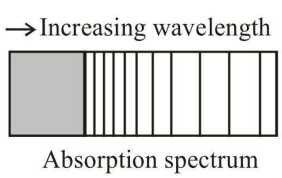
IUPAC name

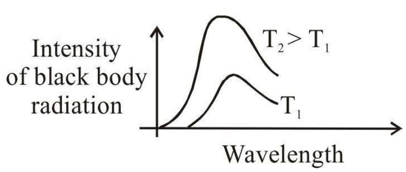
2, 5-dimethyl-6-oxo-hex-3-enoic acid

2. The figure that is not a direct manifestation of the quantum nature of atoms is :

(1) 

(2) 

(3) 

(4) 

Official Ans. by NTA (1)

Sol. Photoelectric effect (option 2), atomic spectrum (option 3) and Black body radiations (option 4) may be explained by quantum theory.

As on increasing temperature, all the values of internal energy becomes possible, it is not directly explained from quantum theory.

3. For the following Assertion and Reason, the correct option is

Assertion (A) : When Cu (II) and sulphide ions are mixed, they react together extremely quickly to give a solid.

Reason (R) : The equilibrium constant of $Cu^{2+}(aq) + S^{2-}(aq) \rightleftharpoons CuS(s)$ is high because the solubility product is low.

(1) Both (A) and (R) are true and (R) is the explanation for (A)

(2) Both (A) and (R) are false

(3) (A) is false and (R) is true

(4) Both (A) and (R) are true but (R) is not the explanation for (A)

Official Ans. by NTA (4)

Sol. Slow or fast process is kinetic parameter but extent less or more is thermodynamic parameter.

4. If AB_4 molecule is a polar molecule, a possible geometry of AB_4 is :

(1) Square pyramidal

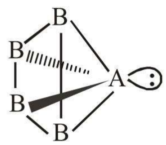
(2) Tetrahedral

(3) Square planar

(4) Rectangular planar

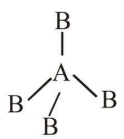
Official Ans. by NTA (1)

Sol. (1) If AB_4 molecule is a square pyramidal then it has one lone pair and their structure should be



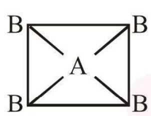
and it should be polar because dipole moment of lone pair of 'A' never be cancelled by others.

(2) If AB_4 molecule is a tetrahedral then it has no lone pair and their structure should be



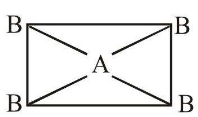
and it should be non polar due to perfect symmetry.

(3) If AB_4 molecule is a square planar then



it should be non polar because vector sum of dipole moment is zero.

(4) If AB_4 molecule is a rectangular planar then



it should be non polar because vector sum of dipole moment is zero.

5. On heating compound (A) gives a gas (B) which is constituent of air. This gas when treated with H_2 in the presence of a catalyst gives another gas (C) which is basic in nature. (A) should not be:

(1) $(NH_4)_2Cr_2O_7$

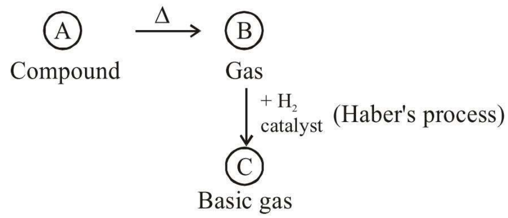
(2) $Pb(NO_3)_2$

(3) NaN_3

(4) NH_4NO_2

Official Ans. by NTA (2)

Sol.



Basic gas (C) must be ammonia (NH_3).
It means (B) gas should be N_2 which is formed by heating of compound (A).

(1) $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2\uparrow + Cr_2O_3 + 4H_2O\uparrow$

(2) $Pb(NO_3)_2 \xrightarrow{\Delta} PbO + 2NO_2\uparrow + \frac{1}{2}O_2\uparrow$

(3) $2NaN_3 \xrightarrow{\Delta} 2Na + 3N_2\uparrow$

(4) $NH_4NO_2 \xrightarrow{\Delta} N_2\uparrow + 2H_2O\uparrow$

So, (A) should not be $Pb(NO_3)_2$

6. In general, the property (magnitudes only) that shows an opposite trend in comparison to other properties across a period is

(1) Electronegativity

(2) Electron gain enthalpy

(3) Ionization enthalpy

(4) Atomic radius

Official Ans. by NTA (4)

Sol. In general across a period atomic radius decreases while ionisation enthalpy, electron gain enthalpy and electronegativity increases because effective nuclear charge (Z_{eff}) increases.

7. The statement that is not true about ozone is :

(1) in the stratosphere, it forms a protective shield against UV radiation.

(2) it is a toxic gas and its reaction with NO gives NO_2.

(3) in the atmosphere, it is depleted by CFCs.

(4) in the stratophere, CFCs release chlorine free radicals ($\dot{Cl}$) which reacts with O_3 to give chlorine dioxide radicals.

Official Ans. by NTA (4)

Sol. In the stratosphere, CFCs release chlorine free radical $(\dot{Cl})$

$$CF_2Cl_2(g) \xrightarrow{UV} \dot{Cl}(g) + \dot{C}F_2Cl(g)$$

which react with O_3 to give chlorine oxide $(Cl\dot{O})$ radical not chlorine dioxide $(\dot{Cl}O_2)$ radical.

$$\dot{Cl}(g) + O_3(g) \rightarrow Cl\dot{O}(g) + O_2(g)$$

8. The metal mainly used in devising photoelectric cells is:

(1) Na (2) Rb

(3) Li (4) Cs

Official Ans. by NTA (4)

Sol. Cs used in photoelectric cell as it has least ionisation energy.

9. For octahedral Mn(II) and tetrahedral Ni(II) complexes, consider the following statements :

(I) both the complexes can be high spin

(II) Ni(II) complex can very rarely be low spin.

(III) with strong field ligands, Mn(II) complexes can be low spin.

(IV) aqueous solution of Mn(II) ions is yellow in color.

The **correct** statements are :

(1) (I), (III) and (IV) only

(2) (II), (III) and (IV) only

(3) (I), (II) and (III) only

(4) (I) and (II) only

Official Ans. by NTA (3)

Sol. (I) Under weak field ligand, octahedral Mn(II) and tetrahedral Ni(II) both the complexes are high spin complex.

(II) Tetrahedral Ni(II) complex can very rarely be low spin because square planar (under strong ligand) complexes of Ni(II) are low spin complexes.

(III) With strong field ligands Mn (II) complexes can be low spin because they have less number of unpaired electron (unpaired electron = 1)

While with weak field ligands Mn(II) complexes can be high spin because they have more number of unpaired electron (unpaired electron = 5)

(IV) Aqueous solution of Mn(II) ions is pink in colour.

10. Consider that a d^6 metal ion (M^{2+}) forms a complex with aqua ligands, and the spin only magnetic moment of the complex is 4.90 BM. The geometry and the crystal field stabilization energy of the complex is :

(1) tetrahedral and $-1.6\ \Delta_t + 1P$

(2) tetrahedral and $-0.6\ \Delta_t$

(3) octahedral and $-1.6\ \Delta_0$

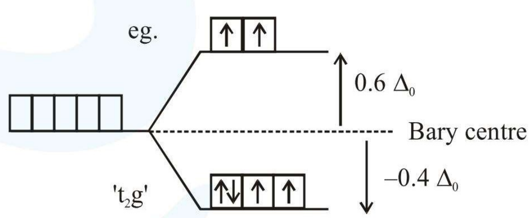
(4) octahedral and $-2.4\ \Delta_0 + 2P$

Official Ans. by NTA (2)

Sol. If spin only magnetic moment of the complex is 4.90 BM, it means number of unpaired electrons should be 4.

(A) In octahedral complex : $[M(H_2O)_6]^{2+}$

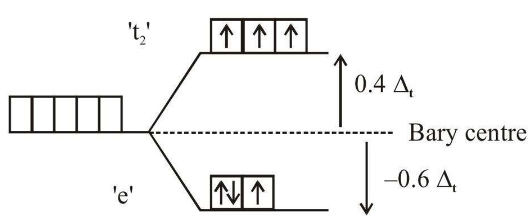
d^6



C.F.S.E. $= (-0.4\ \Delta_0) \times 4 + (+0.6\ \Delta_0) \times 2 + 0 \times P$
$= -0.4\ \Delta_0$

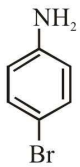
(B) In tetrahedral complex : $[M(H_2O)_4]^{2+}$

d^6

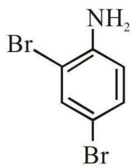


C.F.S.E. $= (-0.6\ \Delta_t) \times 3 + (+0.4\ \Delta_t) \times 3 + 0 \times P$
$= -0.6\ \Delta_t$

11. In Carius method of estimation of halogen, 0.172g of an organic compound showed presence of 0.08g of bromine. Which of these is the **correct** structure of the compound :

(1) 

(2) $H_3C–CH_2–Br$

(3) 

(4) $H_3C–Br$

Official Ans. by NTA (1)

Sol. In Carius method

mass of organic compound = 0.172 gm

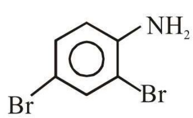
mass of Bromine = 0.08 gm

Hence % of Bromine $= \frac{0.08}{0.172} \times 100$

$= 46.51\%$

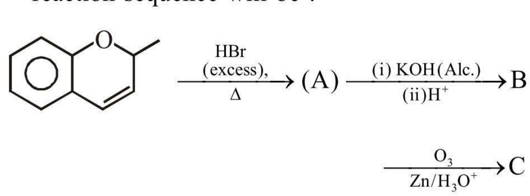
(1)  C_6H_6NBr $\left[\%Br = \frac{80}{172} \times 100\right] = 46.51\%$

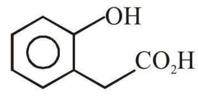
(2) CH_3CH_2Br C_2H_5Br $\%Br = \frac{80}{109} \times 100 = 73.33\%$

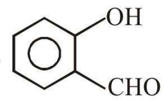
(3)  $C_6H_5NBr_2$

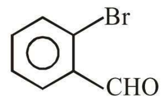
(4) CH_3Br

12. The major aromatic product C in the following reaction sequence will be :



(1) 

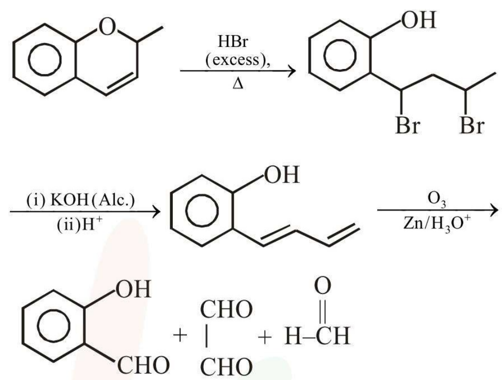
(2) 

(3) 

(4) 

Official Ans. by NTA (2)

Sol.



13. An open beaker of water in equilibrium with water vapour is in a sealed container. When a few grams of glucose are added to the beaker of water, the rate at which water molecules :

(1) leaves the vapour increases

(2) leaves the solution increases

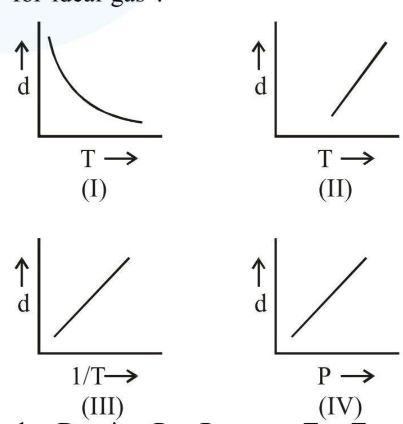
(3) leaves the solution decreases

(4) leaves the vapour decreases

Official Ans. by NTA (1)

Sol. With addition of solute in solvent, surface area for vapourisation decreases causes lowering in vapour pressure

14. Which one of the following graphs is **not correct** for ideal gas ?



d = Density, P = Pressure, T = Temperature

(1) II (2) III

(3) I (4) IV

Official Ans. by NTA (1)

Sol. $PM = dRT \Rightarrow d \propto \frac{1}{T}$

15. Which of the following compounds will show retention in configuration on nucleophic substitution by OH^- ion ?

(1) $CH_3-CH(C_2H_5)-CH_2Br$ (2) $CH_3-CH(C_6H_5)-Br$

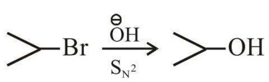
(3) $CH_3-CH(CH_3)-Br$ (4) $CH_3-C(Br)(H)-C_6H_{13}$

Official Ans. by NTA (1)

Sol. (1) $CH_3-\overset{*}{C}H(Et)-CH_2-Br \xrightarrow[S_N2]{\overset{\ominus}{O}H} CH_3-\overset{*}{C}H(Et)-CH_2OH$

* (NCERT)

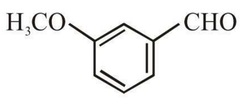
(2) $CH_3-CH(Ph)-Br \xrightarrow[S_N2]{\overset{\ominus}{O}H} Ph-CH(CH_3)-OH$

(3) 

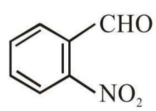
(4) $CH_3-CH(C_6H_{13})-Br \xrightarrow[S_N2]{\overset{\ominus}{O}H} CH_3-CH(C_6H_{13})-OH$

As language given, we have to go with option (1) as stereochemistry of chiral centre is not distortet.

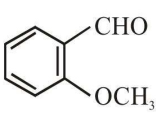
16. The increasing order of the following compounds towards HCN addition is :



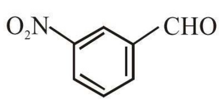
(i)



(ii)



(iii)



(iv)

(1) (iii) < (iv) < (ii) < (i)

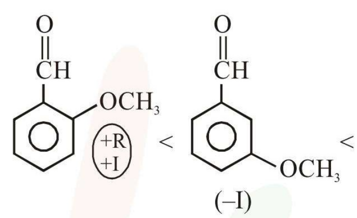
(2) (iii) < (iv) < (i) < (ii)

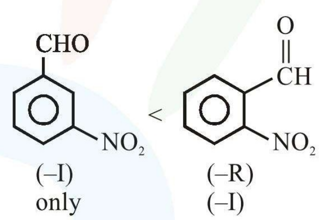
(3) (iii) < (i) < (iv) < (ii)

(4) (i) < (iii) < (iv) < (ii)

Sol. Increasing order of reactivity towards HCN addition

Greater the electrophilicity on $-\overset{O}{\overset{\|}{C}}-$ group greater the reactivity in nucleophilic addition.





(iii) < (i) < (iv) < (ii)

17. While titrating dilute HCl solution with aqueous NaOH, which of the following will **not** be required?

(1) Clamp and phenolphthalein

(2) Pipette and distilled water

(3) Burette and porcelain tile

(4) Bunsen burner and measuring cylinder

Official Ans. by NTA (4)

Sol. Lab manual

18. Consider the following reactions :

(i) Glucose + ROH $\xrightarrow{\text{dry HCl}}$ Acetal $\xrightarrow[(CH_3CO)_2O]{\text{x eq. of}}$ acetyl derivative

(ii) Glucose $\xrightarrow{Ni/H_2} A \xrightarrow[(CH_3CO)_2O]{y\ eq.\ of}$ acetyl derivative

(iii) Glucose $\xrightarrow[(CH_3CO)_2O]{z\ eq.\ of}$ acetyl derivative

'x', 'y' and 'z' in these reactions are respectively.

(1) 5, 6, & 5 (2) 4, 5 & 5

(3) 5, 4 & 5 (4) 4, 6 & 5

Official Ans. by NTA (4)

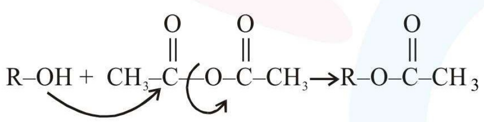
Sol.

(i) Glucose + dry HCl $\xrightarrow{ROH}$ Acetal $\xrightarrow[(CH_3CO)_2O]{x\ Eq}$ acetyl derivative

(ii) Glucose $\xrightarrow{Ni/H_2} A \xrightarrow[(CH_3CO)_2O]{y\ Eq}$ Acetyl derivative

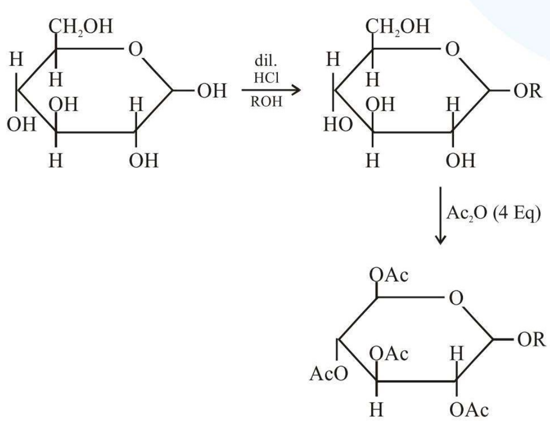
(iii) Glucose $\xrightarrow[(CH_3CO)_2O]{z\ Eq}$ Acetyl derivative

due to presence of –OH group in Glucose the reaction is



Acetyl derivative

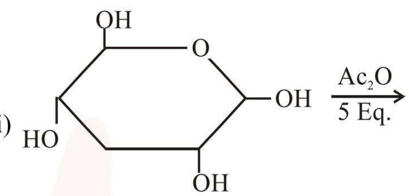
so for (i)



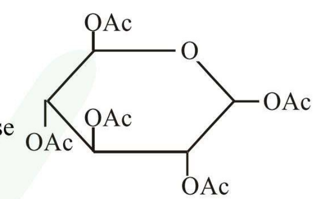
(ii)
$CH{=}O$ | $(CH{-}OH)_4$ | $CH_2{-}OH$ $\xrightarrow[H_2]{Ni}$ $CH_2{-}OH$ | $(CH{-}OH)_4$ | $CH_2{-}OH$ $\xrightarrow[Ac_2O]{6\ Eq.}$

$CH_2{-}OAc$ | $(CH_2{-}OAc)_4$ | $CH_2{-}OAc$

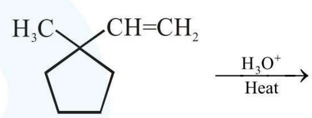
(iii)

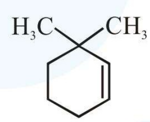


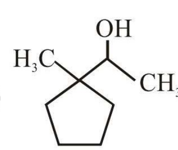
Glucose pentacetase

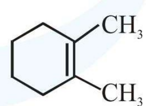


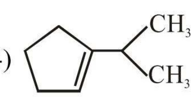
19. The major product in the following reaction is :



(1) 

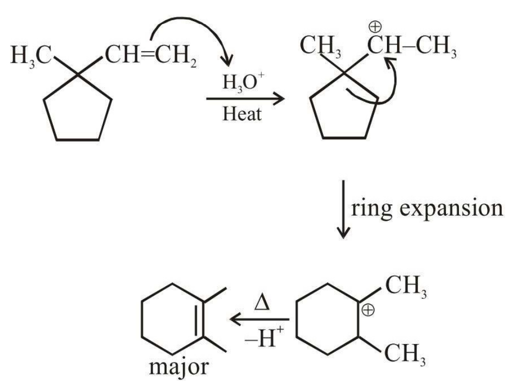
(2) 

(3) 

(4) 

Official Ans. by NTA (3)

Sol.



20. Which of the following is used for the preparation of colloids ?

(1) Ostwald Process (2) Van Arkel Method
(3) Bredig's Arc Method (4) Mond Process

Official Ans. by NTA (3)

Sol. Bredig's Arc method is used to from metal colloids.

21. The Gibbs energy change (in J) for the given reaction at $[Cu^{2+}] = [Sn^{2+}] = 1$ M and 298K is:
$Cu(s) + Sn^{2+}(aq.) \rightarrow Cu^{2+}(aq.) + Sn(s)$;

$(E^0_{Sn^{2+}|Sn} = -0.16V, E^0_{Cu^{2+}|Cu} = 0.34V,$

Take F = 96500 C mol^{-1})

Official Ans. by NTA (96500.00)

Sol. $\Delta G = \Delta G^o + RT \ln \left[\frac{Sn^{+2}}{Cu^{+2}}\right]$

$= -2 \times 96500 [(-0.16) - 0.34] + RT \ln \left(\frac{1}{1}\right)$

= 96500 J

22. The mass of gas adsorbed, x, per unit mass of adsorbate, m, was measured at various pressures, p. A graph between $\log \frac{x}{m}$ and log p gives a straight line with slope equal to 2 and the intercept equal to 0.4771. The value of $\frac{x}{m}$ at a pressure of 4 atm is : (Given log 3 = 0.4771)

Official Ans. by NTA (6.00)

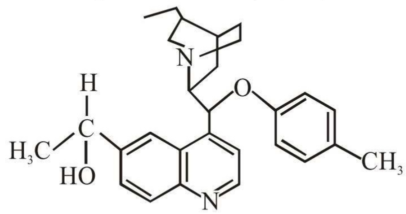
Sol. $\frac{x}{m} = k p^x$ ...(1)

$\Rightarrow \underbrace{\log \frac{x}{m}}_{y} = \underbrace{\log k}_{c} + \underbrace{x}_{m} \underbrace{\log p}_{x}$

Given c = log k = 0.4771 or k = 3
slope x = 2

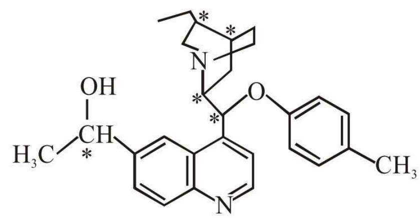
put in eq. (1) $\frac{x}{m} = 3 \times (4)^2 \Rightarrow 48$

23. The number of chiral carbons present in the molecule given below is _____ .



Official Ans. by NTA (5.00)

Sol. No. of chiral centres



24. The oxidation states of iron atoms in compounds (A), (B) and (C), respectively, are x, y and z. The sum of x,y and z is ____.

$Na_4[Fe(CN)_5NOS)]$ (A) $Na_4[FeO_4]$ (B) $[Fe_2(CO)_9]$ (C)

Official Ans. by NTA (6)

Sol. (A) $Na_4[\overset{x}{Fe}(CN)_5(NOS)]$

(+1)4 + x + (–1)5 + (–1) 1 = 0

x = +2

(B) $Na_4[\overset{y}{Fe}O_4]$

(+1)4 + y + (–2)4 = 0

y = +4

(C) $[\overset{z}{Fe_2}(CO)_9]$

2z + 0 × 9 = 0

z = 0

so (x + y + z) = +2 + 4 + 0
= 6

25. The internal energy change (in J) when 90g of water undergoes complete evaporation at 100ºC is ____ .

(Given : ΔH_{vap} for water at 373 K = 41 kJ/mol, R = 8.314 $JK^{-1} mol^{-1}$)

Official Ans. by NTA (189494.00)

Sol. $H_2O(\ell) \rightleftharpoons H_2O(g)$ 90 gm of H_2O

$\Delta H = \Delta U + \Delta n_g RT$ $\Rightarrow$ 5 moles of H_2O

$5 \times 41000 J = \Delta U + 1 \times 8.314 \times 373 \times 5$

ΔU = 189494.39 Joule