FINAL JEE-MAIN EXAMINATION - SEPTEMBER, 2020

Held On Friday, 4 September 2020

TIME : 3: 00 PM to 6 : 00 PM

1. If the equilibrium constant for $A \rightleftharpoons B+C$ is $K_{eq}^{(1)}$ and that of $B+C \rightleftharpoons P$ is $K_{eq}^{(2)}$, the equilibrium constant for $A \rightleftharpoons P$ is :-

(1) $K_{eq}^{(2)} - K_{eq}^{(1)}$ (2) $K_{eq}^{(1)} K_{eq}^{(2)}$

(3) $K_{eq}^{(1)} / K_{eq}^{(2)}$ (4) $K_{eq}^{(1)} + K_{eq}^{(2)}$

Official Ans. by NTA (2)

Sol. $A \rightleftharpoons B+C \quad K_{eq}^{(1)} = \frac{[B][C]}{[A]}$ .....(1)

$B+C \rightleftharpoons P \quad K_{eq}^{(2)} = \frac{[P]}{[B][C]}$ .....(2)

For

$A \rightleftharpoons P \quad K_{eq} = \frac{[P]}{[A]}$

Multiplying equation (1) & (2)

$K_{eq}^{(1)} \times K_{eq}^{(2)} = \frac{[P]}{[A]} = K_{eq}$

2. Five moles of an ideal gas at 1 bar and 298 K is expanded into vacuum to double the volume. The work done is :-

(1) $C_V(T_2 - T_1)$ (2) $-RT \ln V_2/V_1$

(3) $-RT(V_2 - V_1)$ (4) zero

Official Ans. by NTA (4)

Sol. As the expansion is done in vaccum that is in absence of p_{ext} so

W = zero

3. The process that is NOT endothermic in nature is :-

(1) $Ar_{(g)} + e^- \rightarrow Ar^-_{(g)}$ (2) $H_{(g)} + e^- \rightarrow H^-_{(g)}$

(3) $Na_{(g)} \rightarrow Na^+_{(g)} + e^-$ (4) $O^-_{(g)} + e^- \rightarrow O^{2-}_{(g)}$

Official Ans. by NTA (2)

Sol. $H_{(g)} + e^- \rightarrow H^-$ is exothermic

rest of all endothermic process.

4. The crystal Field stabilization Energy (CFSE) of $[CoF_3(H_2O)_3](\Delta_0 < P)$ is :-

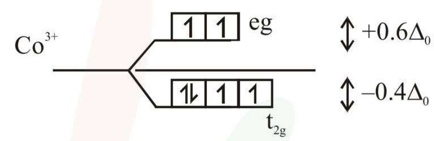
(1) $-0.8\ \Delta_0$ (2) $-0.4\ \Delta_0 + P$

(3) $-0.8\ \Delta_0 + 2P$ (4) $-0.4\ \Delta_0$

Official Ans. by NTA (4)

Sol. $[CoF_3(H_2O)_3]$ $\Delta_0 < P$

Means all ligands behaves as weak field ligands



$= [-0.4 \times 4 + 0.6 \times 2]\Delta_0$

$= [-1.6 + 1.2]\Delta_0$

$= [-0.4\Delta_0]$

5. The mechanism of action of "Terfenadine" (Seldane) is :-

(1) Activates the histamine receptor

(2) Inhibits the secretion of histamine

(3) Inhibits the action of histamine receptor

(4) Helps in the secretion of histamine

Official Ans. by NTA (3)

Sol. Seldane is an antihistamine drugs it inhibits the action of histamine receptor.

6. An alkaline earth metal 'M' readily forms water soluble sulphate and water insoluble hydroxide. Its oxide MO is very stable to heat and does not have rock-salt structure. M is :-

(1) Ca (2) Be (3) Mg (4) Sr

Official Ans. by NTA (2)

Sol. [Be]

$BeSO_4$ is water soluble

$Be(OH)_2$ is water insoluble

BeO is stable to heat

7. The reaction in which the hybridisation of the underlined atom is affected is :-

(1) $\underline{N}H_3 \xrightarrow{H^+}$

(2) $\underline{Xe}F_4 + SbF_5 \rightarrow$

(3) $H_2\underline{S}O_4 + NaCl \xrightarrow{420\ K}$

(4) $H_3\underline{P}O_2 \xrightarrow{\text{Disproportionation}}$

Official Ans. by NTA (2)

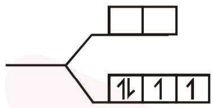
Sol. $XeF_4 + SbF_5 \rightarrow [XeF_3]^+ [SbF_6]^-$

sp^3d^2 sp^3d sp^3d sp^3d^2

8. The one that can exhibit highest paramagnetic behaviour among the following is :-
gly = glycinato; bpy = 2, 2'-bipyridine
(1) $[Pd(gly)_2]$
(2) $[Ti(NH_3)_6]^{3+}$
(3) $[Co(OX)_2(OH)_2]^-$ $(\Delta_0 > P)$
(4) $[Fe(en)(bpy)(NH_3)_2]^{2+}$
Official Ans. by NTA (3)

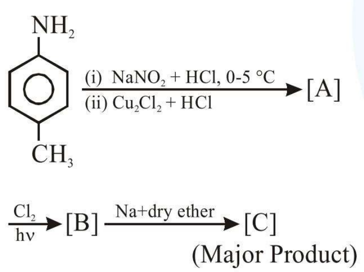
Sol. $[Co(OX)_2(OH)_2]^-$ $\Delta_0 > P$ [S.F.L]

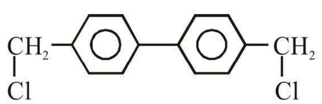
$Co = 3d^7\,4s^2$
$Co^{+5} = 3d^4\,4s^0$

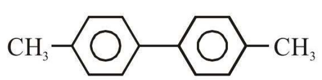


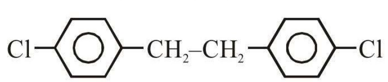
It has highest number of unpaired e⁻s. so it is most paramagnetic.

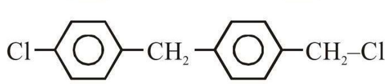
9. In the following reaction sequence, [C] is :-



(1) 

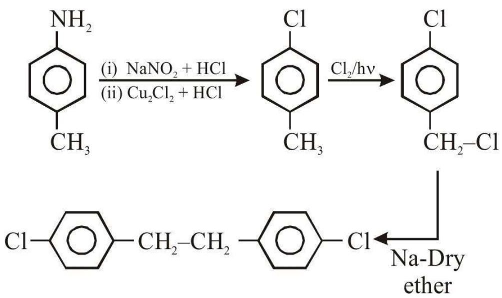
(2) 

(3) 

(4) 

Official Ans. by NTA (3)

Sol.

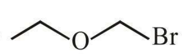


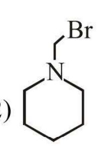
10. A sample of red ink (a colloidal suspension) is prepared by mixing eosin dye, egg white, HCHO and water. The component which ensures stability of the ink sample is :-
(1) HCHO (2) Eosin dye
(3) Egg white (4) Water
Official Ans. by NTA (3)

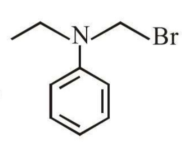
11. The processes of calcination and roasting in metallurgical industries, respectively, can lead to :-
(1) Global warming and acid rain
(2) Photochemical smog and ozone layer depletion
(3) Global warming and photochemical smog
(4) Photochemical smog and global warming
Official Ans. by NTA (1)

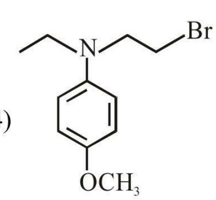
Sol. Due to industrial process SO_2 gas is released which is responsible for acid rain & global warming.

12. Which of the following compounds will form the precipitate with aq. $AgNO_3$ solution most readily ?

(1) 

(2) 

(3) 

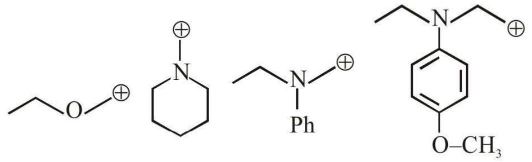
(4) 

Official Ans. by NTA (2)

Sol. $R-x+aq.AgNO_3 \xrightarrow{R.D.S} R^{\oplus} + \underset{(PPT)}{Agx}$ (1)

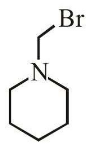
So rate of P.P.T formation of Agx depend's on stability of carbocation (R^+)

In given question formed carbocation will be



(a) (b) (c) (d)

Most stable carbocation is (b) so



give fastest P.P.T of AgBr with aq $AgNO_3$

13. The molecule in which hybrid MOs involve only one d-orbital of the central atom is :-

(1) $[Ni(CN)_4]^{2-}$ (2) $[CrF_6]^{3-}$

(3) BrF_5 (4) XeF_4

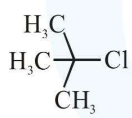
Official Ans. by NTA (1)

Sol. $[Ni(CN)_4]^{2-}$

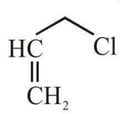
dsp^2 hybridisation.

14. Among the following compounds, which one has the shortest C—Cl bond ?

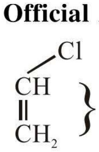
(1) H_3C-Cl

(2) 

(3) 

(4) 

Official Ans. by NTA (3)

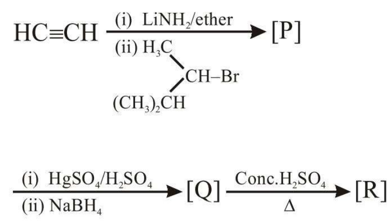
Sol. 

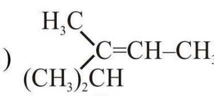
In option (3) C—Cl bond is shortest due to resonance of lone pair of –Cl.

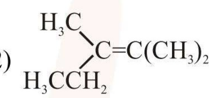
Due to resonance C—Cl bond acquire partial double bond character.

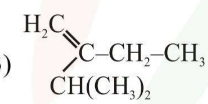
Hence C—Cl bond length is least.

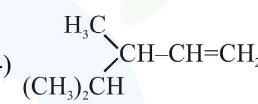
15. The major product [R] in the following sequence of reactions is :-



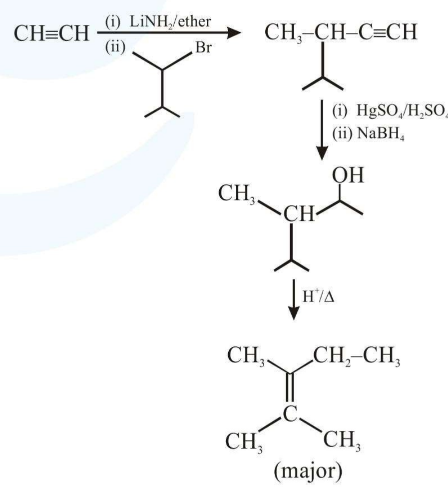
(1) 

(2) 

(3) 

(4) 

Official Ans. by NTA (2)

Sol. 

Now :- (i) $HgSO_4$/dil.H_2SO_4

(ii) $NaBH_4$

is convert triple bond into ketone and formed ketone is reduced by $NaBH_4$ and convert into Alcohol.

16. The incorrect statement(s) among (a) - (c) is (are) :-

(a) W(VI) is more stable than Cr(VI).

(b) in the presence of HCl, permanganate titrations provide satisfactory results.

(c) some lanthanoid oxides can be used as phosphors.

(1) (a) and (b) only (2) (a) only

(3) (b) and (c) only (4) (b) only

Official Ans. by NTA (4)

Sol. $KMnO_4$ will not give satisfactory result when it is titrated by HCl.

17. 250 mL of a waste solution obtained from the workshop of a goldsmith contains 0.1 M $AgNO_3$ and 0.1 M AuCl. The solution was electrolyzed at 2 V by passing a current of 1 A for 15 minutes. The metal/metals electrodeposited will be :-

$\left(E^0_{Ag^+/Ag} = 0.80V,\ E^0_{Au^+/Au} = 1.69V\right)$

(1) only silver

(2) only gold

(3) silver and gold in equal mass proportion

(4) silver and gold in proportion to their atomic weights

Official Ans. by NTA (4)

Sol. As voltage is '2V' so both Ag^+ & Au^+ will reduce and their equal gm equivalent will reduce so

gmeq Ag = gmeq of Au

$$\frac{Wt_{Ag}}{E_{qwt_{Ag}}} = \frac{Wt_{Au}}{E_{qwt_{Au}}}$$

$$\text{So } \frac{wt_{Ag}}{wt_{Au}} = \frac{E_{qwt_{Ag}}}{E_{qwt_{Au}}} = \frac{At\,wt_{Ag}}{Atwt_{Au}}$$

18. The major product [B] in the following reactions is :-

$CH_3-CH_2-CH(CH_3)-CH_2-OCH_2-CH_3 \xrightarrow[\text{Heat}]{HI} [A]\ \text{alcohol} \xrightarrow[\Delta]{H_2SO_4} [B]$

(1) $CH_3-CH_2-C(CH_3)=CH_2$

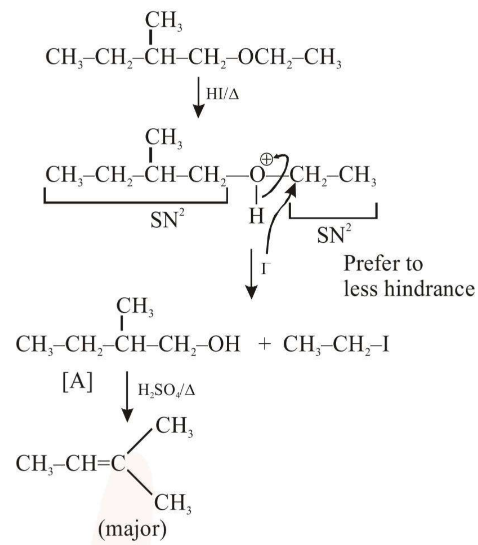
(2) $CH_3-CH_2-CH=CH-CH_3$

(3) $CH_2=CH_2$

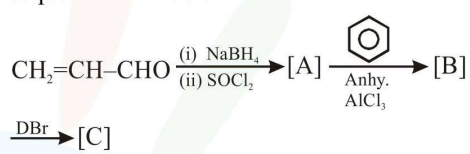
(4) $CH_3-CH=C(CH_3)-CH_3$

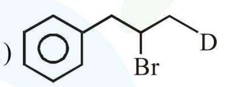
Official Ans. by NTA (4)

Sol.



19. The major product [C] of the following reaction sequence will be :-



(1)


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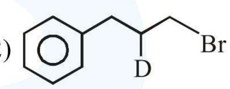

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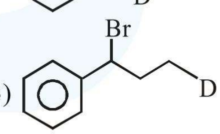

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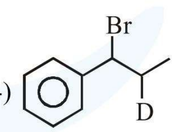
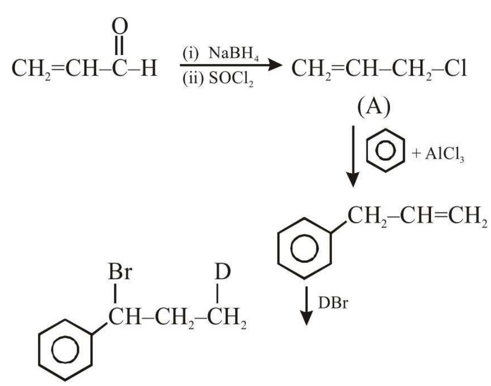


Official Ans. by NTA (3)

Sol.



20. The shortest wavelength of H atom is the Lyman series is λ_1. The longest wavelength in the Balmer series of He^+ is :-

(1) $\frac{5\lambda_1}{9}$ (2) $\frac{27\lambda_1}{5}$

(3) $\frac{9\lambda_1}{5}$ (4) $\frac{36\lambda_1}{5}$

Official Ans. by NTA (3)

Sol. As we know $\Delta E = \frac{hc}{\lambda}$

So $\lambda = \frac{hc}{\Delta E}$ for λ minimum i.e.

shortest; ΔE = maximum

for Lyman series n = 1 & for ΔE_{max}

Transition must be form n = ∞ to n = 1

So $\frac{1}{\lambda} = R_H Z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$\frac{1}{\lambda} = R_H Z^2(1-0)$

$\frac{1}{\lambda} = R \times (1)^2 \Rightarrow \lambda_1 = \frac{1}{R}$

For longest wavelength ΔE = minimum for Balmer series n = 3 to n = 2 will have ΔE minimum

for He^+ Z = 2

So $\frac{1}{\lambda_2} = R_H \times Z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$\frac{1}{\lambda_2} = R_H \times 4\left(\frac{1}{4} - \frac{1}{9}\right)$

$\frac{1}{\lambda_2} = R_H \times \frac{5}{9}$

$\lambda_2 = \lambda_1 \times \frac{9}{5}$

21. A 100 mL solution was made by adding 1.43 g of $Na_2CO_3 \cdot xH_2O$. The normality of the solution is 0.1 N. The value of x is _______.

(The atomic mass of Na is 23g/mol) :-

Official Ans. by NTA (10)

Sol. Molar mass of $Na_2CO_3 \cdot xH_2O$

$\Rightarrow 23 \times 2 + 12 + 48 + 18x$

$\Rightarrow 46 + 12 + 48 + 18x$

$\Rightarrow (106 + 18x)$

$\text{Eqwt} = \frac{M}{2} = (53 + 9x)$

As n_{factor} in dissolution will be determined from net cationic or anionic charge; which is 2 so

$\text{Eqwt} = \frac{M}{2} = 53 + 9x$

$\text{Gmeq} = \frac{\text{wt}}{\text{Eqwt}} = \frac{1.43}{53+9x}$

$\text{Normality} = \frac{\text{Gmeq}}{V_{litre}}$

$\text{Normality} = 0.1 = \frac{\frac{1.43}{53+9x}}{0.1}$

As volume = 100 ml

= 0.1 Litre

So $10^{-2} = \frac{1.43}{53+9x}$

$53 + 9x = 143$

$9x = 90$

$x = 10.00$

22. The osmotic pressure of a solution of NaCl is 0.10 atm and that of a glucose solution is 0.20 atm. The osmotic pressure of a solution formed by mixing 1 L of the sodium chloride solution with 2 L of the glucose solution is $x \times 10^{-3}$ atm. x is _____. (nearest integer) :-

Official Ans. by NTA (167)

Sol. Osmotic pressure = $\pi = i \times C \times RT$

For NaCl i = 2 so

$\pi_{NaCl} = i \times C_{NaCl} \times RT$ $\quad C_{NaCl}$ = conc. of NaCl

$0.1 = 2 \times C_{NaCl} \times RT$

$C_{NaCl} = \dfrac{0.05}{RT}$ $\quad C_{glucose}$ = conc. of glucose

For glucose i = 1 so

$\pi_{Glucose} = i \times C_{glucose} \times RT$

$0.2 = 1 \times C_{glucose} \times RT$

$C_{Glucose} = \dfrac{0.2}{RT}$ $\quad \eta_{NaCl}$ = No. of moles NaCl

η_{NaCl} in 1 L = $C_{NaCl} \times V_{Litre}$

$= \dfrac{0.05}{RT}$ $\quad \eta_{glucose}$ = No. of moles glucose

$\eta_{glucose}$ in 2 L = $C_{glucose} \times V_{Litre}$

$= \dfrac{0.4}{RT}$

$V_{Total} = 1 + 2 = 3L$

so Final conc. NaCl = $\dfrac{0.05}{3RT}$

Final conc. glucose = $\dfrac{0.4}{3RT}$

$\pi_{Total} = \pi_{NaCl} + \pi_{glucose}$

$= \left[i \times C_{NaCl} + C_{glucose}\right] \times RT$

$= \left(\dfrac{2 \times 0.05}{3RT} + \dfrac{0.4}{3RT}\right) \times RT$

$= \dfrac{0.5}{3}$ atm

$= 0.1666$ atm

$= 166.6 \times 10^{-3}$ atm

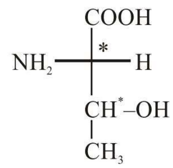
$\Rightarrow 167.00 \times 10^{-3}$ atm

so x = 167.00

23. The number of chiral centres present in threonine is _________.

Official Ans. by NTA (2)

Sol. Structure of Threonine is :



S. 2-chiral center is present

24. Consider the following equations :

$2\,Fe^{2+} + H_2O_2 \rightarrow x\,A + y\,B$

(in basic medium)

$2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow x'\,C + y'\,D + z'\,E$

(in acidic medium)

The sum of the stoichiometric coefficients x, y, x', y' and z' for products A, B, C, D and E, respectively, is ___________.

Official Ans. by NTA (19)

Sol. $\left[Fe^{2+} \rightarrow Fe^{3+} + e^-\right] \times 2$

$H_2O_2 + 2e^- \rightarrow 2HO^{\ominus}$

$2Fe^{2+} + H_2O_2 \rightarrow 2Fe^{3+} + 2HO^{\ominus}_{(q\omega)}$

x = 2 $\quad$ y = 2

$\left[8H^+ + MnO_4^- + 5e^- \rightarrow Mn^{2+} + 4H_2O\right] \times 2$

$\left[H_2O_2 \rightarrow O_{2(g)} + 2H^+ + 2e^-\right] \times 5$

$\Rightarrow 16H^+ + 2MnO_4^- + 5H_2O_2$

$\rightarrow 2Mn^{2+} + 8H_2O + 5O_{2(g)} + 10H^+$

$\Rightarrow 6H^+ + 2MnO_4^- + 5H_2O_2$

$\rightarrow 2Mn^{2+} + 8H_2O + 5O_{2(g)}$

So $\quad$ x' = 2 $\quad$ y' = 8 $\quad$ z' = 5

so $\quad$ x + y + x' + y' + z'

$\Rightarrow$ 2 + 2 + 2 + 8 + 5

$\Rightarrow$ 19

25. The number of molecules with energy greater than the threshold energy for a reaction increases five fold by a rise of temperature from 27 °C to 42 °C. Its energy of activation in J/mol is _________. (Take ln 5 = 1.6094; R = 8.314 J $mol^{-1}K^{-1}$)

Official Ans. by NTA (84297)

(84297.47 or 84297.48)

Sol. $T_1 = 300K$ $T_2 = 315K$

As per question $K_{T_2} = 5K_{T_1}$ as molecules activated are increased five times so k will increases 5 times

Now

$$\ln\left(\frac{K_{T_2}}{K_{T_1}}\right) = \frac{Ea}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\ln 5 = \frac{Ea}{R}\left(\frac{15}{300 \times 315}\right)$$

$$\text{So} \quad Ea = \frac{1.6094 \times 8.314 \times 300 \times 315}{15}$$

Ea = 84297.47 Joules/mole