JEE Main July 2021

Question Paper With Text Solution

25 July. | Shift-1

CHEMISTRY

MATRIX

JEE Main & Advanced | XI-XII Foundation| VI-X Pre-Foundation

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JEE MAIN JULY 2021 | 25TH JULY SHIFT-1

SECTION – A

1. The ionic radii of K^+ , Na^+, Al^{3+} and Mg^{2+} are in the order :

(1) $Na^+ < K^+ < Mg^{2+} < A1^{3+}$

(2) $Al^{3+} < Mg^{2+} < Na^+ < K^+$

(3) $K^+ < Al^{3+} < Mg^{2+} < Na^+$

(4) $Al^{3+} < Mg^{2+} < K^+ < Na^+$

Ans. Official Answer NTA (2)

Sol. Size increases down the group

$K^+ > Na^+$

Size decreases with increase in charge for isoelectronic species

$Na^+ > Mg^{2+} > Al^{3+}$

2. Which one of the following chemical agent is not being used for dry-cleaning of clothes ?

(1) $Cl_2C = CCl_2$

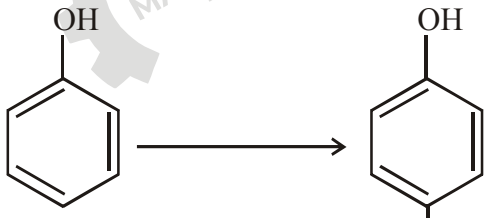
(2) Liquid CO_2

(3) H_2O_2

(4) $CC1_4$

Ans. Official Answer NTA (4)

Sol. CCl_4 is not used as solvent in dry cleaning.

3. 

(Major Product)

The given reaction can occur in the presence of :

(a) Bromine water

(b) Br_2 in CS_2, 273 K

(c) $Br_2/FeBr_3$

(d) Br_2 in $CHCl_3$, 273 K

Choose the correct answer from the options given below :

(1) (b) and (d) only

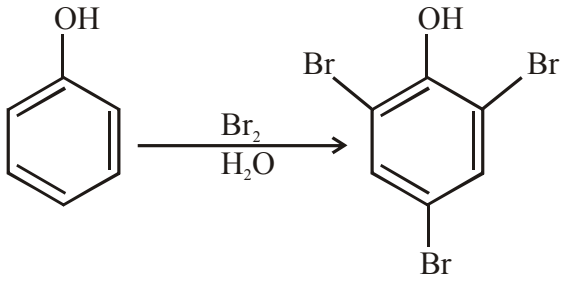
(2) (a), (b) and (d) only

(3) (b), (c) and (d) only

(4) (a) and (c) only

Ans. Official Answer NTA (3)

Sol.



Br_2 in H_2O produces tribromoderivative as product.

4. An Organic compound 'A' C_4H_8 on treatment with $KMnO_4/H^+$ yields compound 'B' C_3H_6O. Compound 'A' also yields compound 'B' an ozonolysis. Compound 'A' is :

(1) But-2-ene

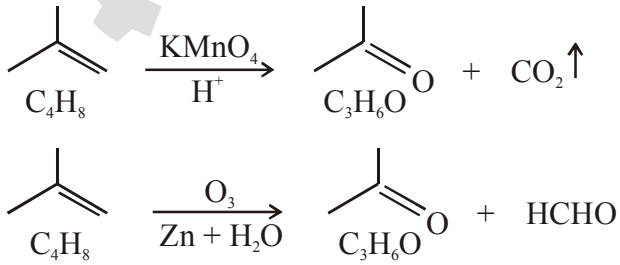
(2) 2-Methylpropene

(3) 1-Methylcyclopropane

(4) Cyclobutane

Ans. Official Answer NTA (2)

Sol.



5. Given below are two statements :

Statement I : None of the alkaline earth metal hydroxides dissolve in alkali.

Statement II : Solubility of alkaline earth metal hydroxides in water increases down the group.

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

(1) Statement I and Statement II both are correct.

(2) Statement I is incorrect but Statement II is correct

(3) Statement I is correct but Statement II is incorrect.

(4) Statement I and Statement II both are incorrect.

Ans. Official Answer NTA (2)

Sol. $Be(OH)_2$ dissolve in alkali.

Solubility of group 2 metal hydroxide increases down the group due to increment in basic behaviaur.

6. Which one of the following compounds will liberate CO_2, when treated with $NaHCO_3$?

(1) $CH_3-\overset{\overset{O}{\|}}{C}-NH_2$

(2) $(CH_3)_3\overset{\oplus}{N}H\overset{\ominus}{Cl}$

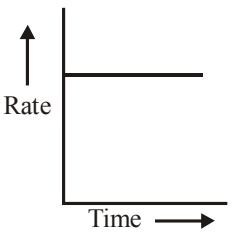
(3) CH_3NH_2

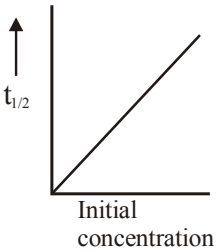
(4) $(CH_3)_4\overset{\oplus}{N}\overset{\ominus}{O}H$

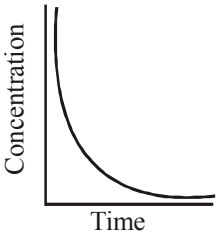
Ans. Official Answer NTA (2)

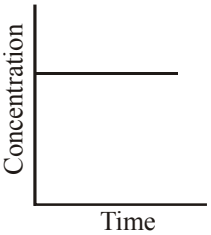
Sol. Conjugate acids of 3° amines are good acid and more acidic than $NaHCO_3$ so they will liberate CO_2 with $NaHCO_3$.

7. For the following graphs,

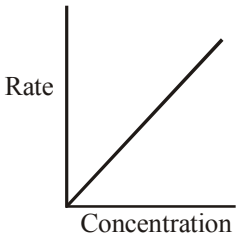
(a) 

(b) 

(c) 

(d) 

(e)



Choose from the options given below, the correct one regarding order of reaction is :

(1) (b) and (d) Zero order (e) First order

(2) (a) and (b) Zero order (e) First order

(3) (b) Zero order (c) and (e) First order

(4) (a) and (b) Zero order (c) and (e) First order

Ans. Official Answer NTA (3)

Sol. For zero order reaction

Rate = K = constant

$t_{\frac{1}{2}} = \frac{C_O}{2K}$ (Straight line curve)

for first order reaction

$C_t = C_O\, e^{-Kt}$ (exponential curve)

Rate = $K(C_t)$ (Straight line curve)

8. The correct order of following 3d metal oxides, according to their oxidation numbers is :

(a) CrO_3 (b) Fe_2O_3 (c) MnO_2 (d) V_2O_5

(e) Cu_2O

(1) (a) > (d) > (c) > (b) > (e)

(2) (c) > (a) > (d) > (e) > (b)

(3) (d) > (a) > (b) > (c) > (e)

(4) (a) > (c) > (d) > (b) > (e)

Ans. Official Answer NTA (2)

Sol.

	Oxidation Number
CrO_3	+ 6
Fe_2O_3	+ 3
MnO_2	+ 4
V_2O_5	+ 5
Cv_2O	+ 1

9. Which one of the following compounds of Group-14 elements is not known ?

(1) $[SiF_6]^{2-}$

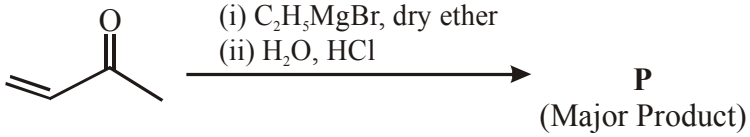
(2) $[Sn(OH)_6]^{-2}$

(3) $[GeCl_6]^{2-}$

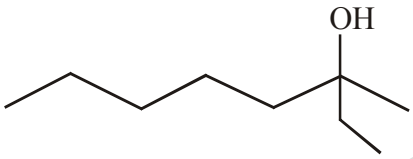
(4) $[SiCl_6]^{2-}$

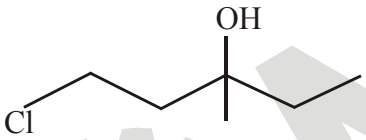
Ans. Official Answer NTA (4)

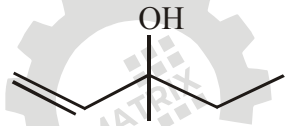
Sol. Silicon cannot accomodate 6 Cl^- ions due to steric repulsion.

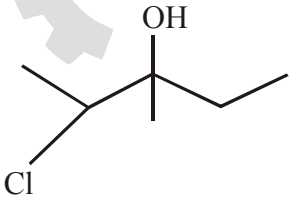
10. 

Consider the above reaction, the major product 'P' is :

(1) 

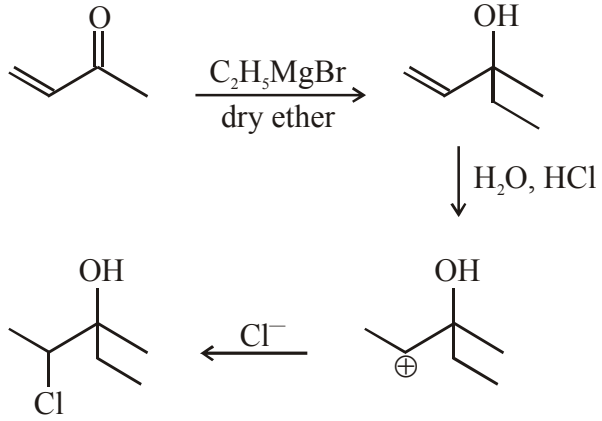
(2) 

(3) 

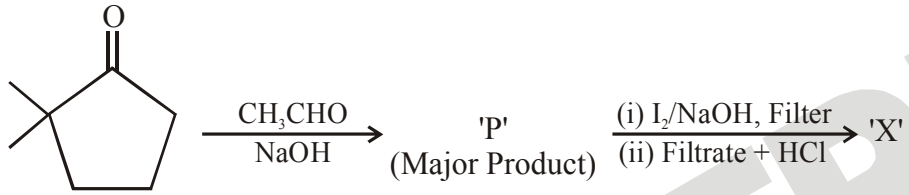
(4) 

Ans. Official Answer NTA (4)

Sol.

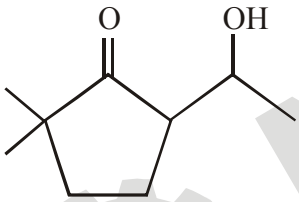


11.

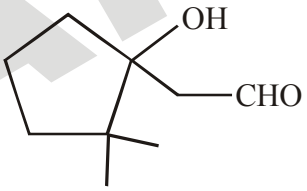


Consider the given reaction, the product 'X' is :

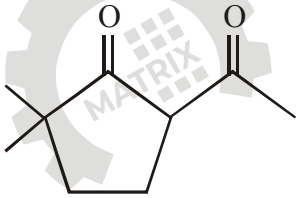
(1)



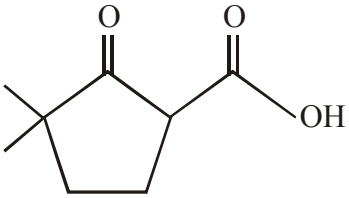
(2)



(3)

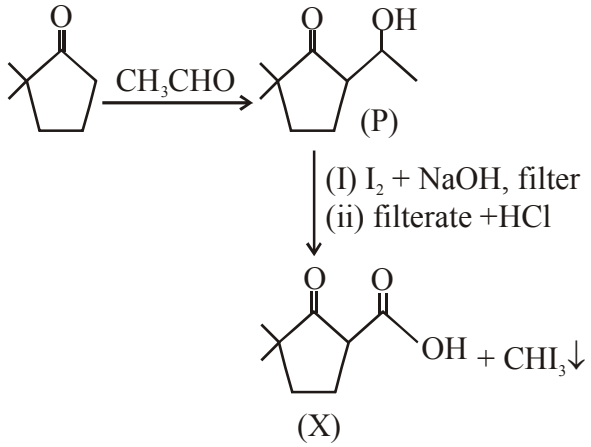


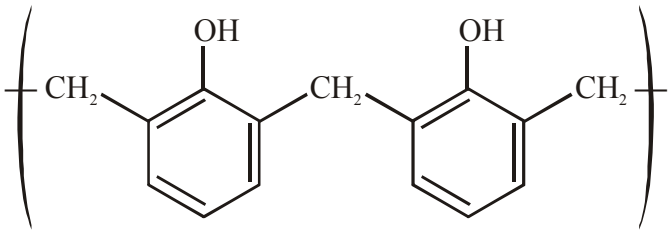
(4)



Ans. Official Answer NTA (4)

Sol.



12.  is a repeating unit for :

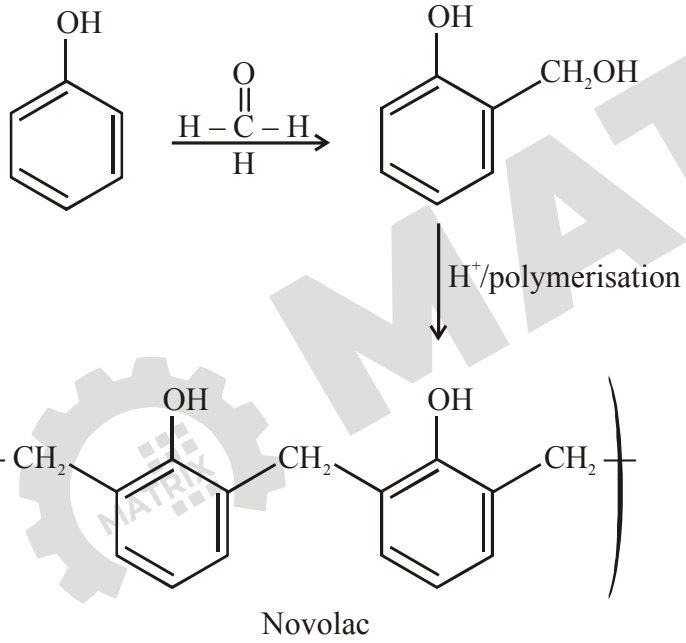
(1) Acrilan

(2) Buna-N

(3) Novolac

(4) Neoprene

Ans. Official Answer NTA (3)

Sol. 

Novolac

13. Sodium stearate $CH_3(CH_2)_{16}COO^- Na^+$ is an anionic surfactant which forms micelles in oil. Choose the correct statement for it from the following :

(1) It forms spherical micelles with $CH_3(CH_2)_{16}^-$ group pointing towards the centre of sphere.

(2) It forms non-spherical micelles with $CH_3(CH_2)_{16}^-$ group pointing towards the centre.

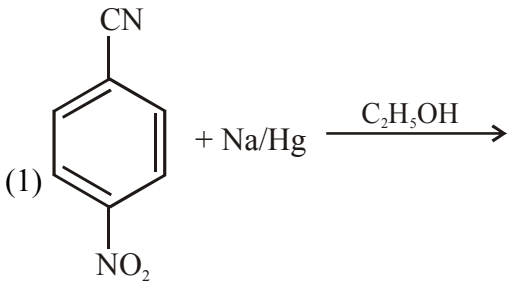
(3) It forms spherical micelles with $CH_3(CH_2)_{16}^-$ group pointing outwards on the surface of sphere.

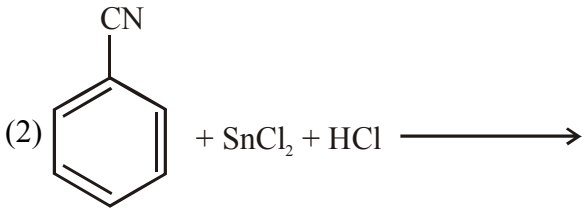
(4) It forms non-spherical micelles with $-COO^-$ group pointing outwards on the surface.

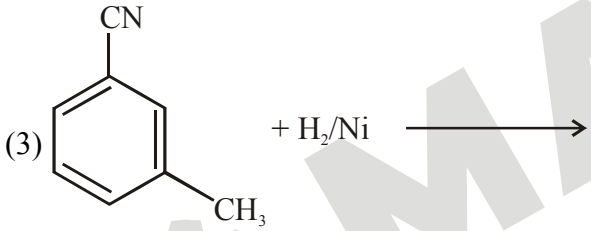
Ans. Official Answer NTA (1)

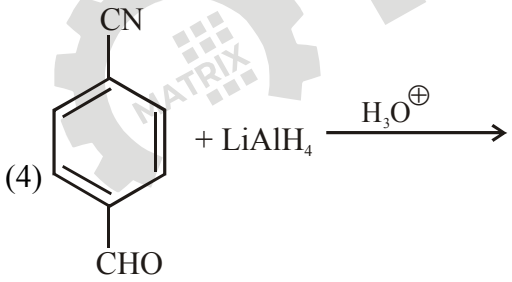
Sol. Micelles have hydrophobic and hydrophilic part where hydrophobic (alkyl) group point towards centre and hydrophilic (anionic) group point outwards and micelles are spherical.

14. Which one of the products of the following reactions does not react with Hinsberg reagent to form sulphonamide ?

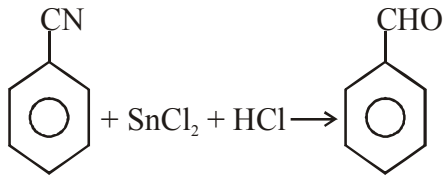
(1) 

(2) 

(3) 

(4) 

Ans. Official Answer NTA (2)

Sol. 

aldehyde does not react with hinsberg reagent.

All other will form amines which react with hinsberg reagent.

15. In the leaching of alumina from bauxite, the ore expected to leach out in the process by reacting with NaOH is :

(1) TiO_2

(2) Fe_2O_3

(3) SiO_2

(4) ZnO

Ans. Official Answer NTA (3)

Sol. SiO_2 is acidic oxide present as impurity in bauxite hence it leaches out

$SiO_2 + 2NaOH \longrightarrow Na_2SiO_3 + H_2O$

Fe_2O_3 and TiO_2 are basic oxide so they will not react with base.

16. Given below are two statements, one is labelled as Assertion (A) and other is labelled as Reason (R).

Assertion (A) : Gabriel phthalimide synthesis cannot be used to prepare aromatic primary amines.

Reason (R) : Aryl halides do not undergo nucleophilic substitution reaction.

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

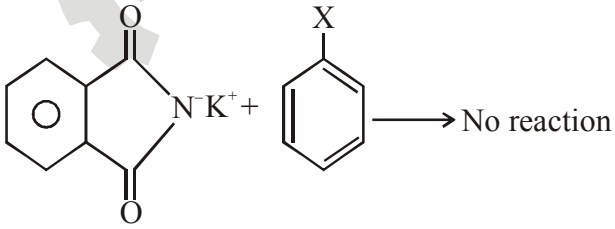
(1) Both (A) and (R) are true and (R) is correct explanation of (A).

(2) (A) is true but (R) is false.

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

(4) (A) is false but (R) is true.

Ans. Official Answer NTA (1)

Sol. 

X is attached to sp^2 hybridised carbon which does not undergo SN^1/SN^2 reaction.

17. The water soluble protein is :

(1) Fibrin

(2) Myosin

(3) Collagen

(4) Alburnin

Ans. Official Answer NTA (4)

Sol. Albumin is globular protcin which is water soluble.

18. Which one of the following species responds to an external magnetic field ?

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

(2) $[Ni(CO)_4]$

(3) $[Co(CN)_6]^{3-}$

(4) $[Fe(H_2O)_6]^{3+}$

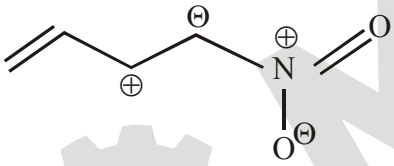
Ans. Official Answer NTA (4)

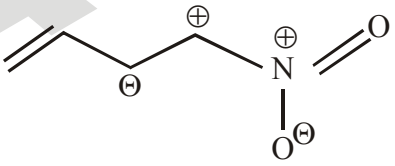
Sol. $\left[Fe(H_2O)_6\right]^{3+}$ $3d^5\ 4s^0$

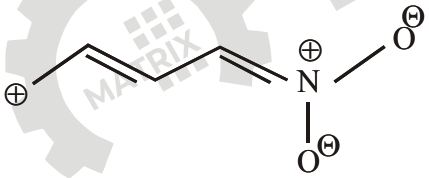
Sp^3d^2 hybridisation

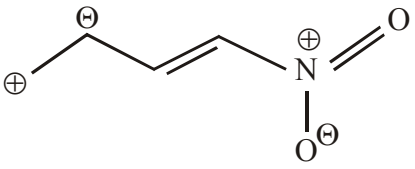
since it is paramagnetic so it will respond to external magnetic field. Rest all are diamagnetic.

19. Which one among the following resonating structures is not correct ?

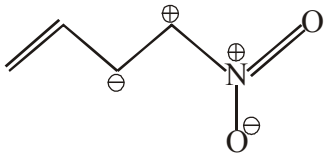
(1) 

(2) 

(3) 

(4) 

Ans. Official Answer NTA (2)

Sol. 

In this structure like charges are close so it is most unstable.

20. At 298.2 K the relationship between enthalpy of bond dissociation (in kJ mol^{-1}) for hydrogen (E_H) and its isotope, deuterium (E_D), is best described by :

(1) $E_H = E_D$

(2) $E_H \cong E_D - 7.5$

(3) $E_H = \frac{1}{2}E_D$

(4) $E_H = 2E_D$

Ans. Official Answer NTA (2)

Sol.

	Bond enthalpy
H_2	435.88 KJ/mol
D_2	443.35 KJ/mol

SECTION - B

1. Consider the cell at 25°C

$Zn \mid Zn^{2+}(aq), (1\ M) \parallel Fe^{3+}(aq), Fe^{2+}(aq) \mid Pt(s)$

The fraction of total iron present as Fe^{3+} ion at the cell potential of 1.500 V is $x \times 10^{-2}$ The value of x is _____. (Nearest integer)

(Given : $E^0_{Fe^{3+}/Fe^{2+}} = 0.77V, E^0_{Zn^{2+}/Zn} = -0.76V$)

Ans. Official Answer NTA (24)

Sol. $$E_{cell} = E°_{Cell} - \frac{0.06}{2}\log\frac{[Zn^{2+}][Fe^{2+}]^2}{[Fe^{3+}]^2}$$

$$1.50 = 1.53 - \frac{0.06}{2}\log\left[\frac{[Fe^{2+}]}{[Fe^{3+}]}\right]^2$$

$$-0.03 = -\frac{0.06}{2}\log\left(\frac{[Fe^{2+}]}{[Fe^{3+}]}\right)^2$$

$$1 = \log\left(\frac{[Fe^{2+}]}{[Fe^{3+}]}\right)^2$$

$$0.5 = \log\frac{Fe^{2+}}{Fe^{3+}}$$

$\frac{Fe^{2+}}{Fe^{3+}} = 3.16$

fraction $Fe^{3+} = \frac{1}{4.16} = 0.24 = 24 \times 10^{-2}$

x = 24

2. Three moles of AgCl get precipitated when one mole of an octahedral co-ordination compound with empirical formula $CrCl_3.3NH_3.3H_2O$ reacts with excess of silver nitrate. The number of chloride ions satisfying the secondary valency of the metal ion is_____.

Ans. Official Answer NTA (0)

Sol. $\left[Cr(H_2O)_3(NH_3)_3\right]Cl_3 + 3AgNO_3 \longrightarrow 3AgCl\downarrow + [Cr(H_2O)_3(NH_3)_3]^{3+} + 3NO_3^-$

Since all Cl^- ion precipitate so it will have all Cl^- ions as primary valency.

3. A home owner uses 4.00×10^3 m^3 of methane (CH_4) gas, (assume CH_4 is an ideal gas) in a year to heat his home. Under the pressure of 1.0 atm and 300 K, mass of gas used is $x \times 10^5$ g. The value of x is_____. (Nearest integer) (Given R = 0.083 L atm K^{-1} mol^{-1})

Ans. Official Answer NTA (26)

Sol. $V = 4 \times 10^3$ m^3

P = 1 atm T = 300 K

M mass = 16 g/mol

PV = nRT

$1 \times 4 \times 10^3 \times 10^3 = \frac{w}{16} \times 0.083 \times 300$

$w = 2.57 \times 10^6$

$w = 25.7 \times 10^5$ g

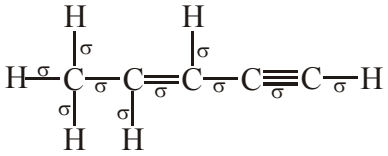
$x \cong 26$

4. The number of sigma bonds in

$H_3C-\underset{\underset{H}{|}}{C}=CH-C\equiv C-H$ is _____ .

Ans. Official Answer NTA (10)

Sol.



10 σ bond

5. A source of monochromatic radiation of wavelength 400 run provides 1000 J of energy in 10 seconds. When this radiation falls on the surface of sodium, $x \times 10^{20}$ electrons are ejected per second. Assume that wavelength 400 ran is sufficient for ejection of electron horn the surface of sodium metal. The value of x is_____. (Nearest integer) ($h = 6.626 \times 10^{-34}$ Js)

Ans. Official Answer NTA (2)

Sol. Energy provided = Energy absorbed by electrons

$$\frac{1000}{10} = n \times \frac{hc}{\lambda}$$

$$\frac{1000}{10} = x \times 10^{20} \times \frac{6.626 \times 10^{-34} \times 3 \times 10^{8}}{400 \times 10^{-9}}$$

$$\frac{1000}{10} = x \times \frac{6.626 \times 3}{4} \times \frac{10^{20} \times 10^{-34} \times 10^{8}}{10^{2} \times 10^{-5}}$$

$100 = x \times 4.96 \times 10$

$$x = \frac{10}{4.96} \cong 2$$

6. When 10 mL of an aqueous solution of Fe^{2+} ions was titrated in the presence of dil H_2SO_4 using diphenylamine indicator, 15 mL of 0.02 M solution of $K_2Cr_2O_7$ was required to get the end point. The molarity of the solution containing Fe^{2+} ions is $x \times 10^{-2}$ M. The value of x is _____. (Nearest integer)

Ans. Official Answer NTA (18)

Sol. $e_{Fe^{2+}} = e_{K_2Cr_2O_7}$

$N \times V = N \times V$

$M \times n_f \times V = M \times n_f \times V$

$M \times 1 \times \frac{10}{1000} = 0.02 \times 6 \times \frac{15}{1000}$

$M = 0.18$

$M = 18 \times 10^{-2}$

$x = 18$

7. Consider the complete combustion of butane, the amount of butane utilized to produce 72.0 g of water is_____ $\times 10^{-1}$ g. (in nearest integer)

Ans. Official Answer NTA (464)

Sol. $C_4H_{10} + \frac{13}{2}O_2 \longrightarrow 4CO_2 + 5H_2O$

72g H_2O is produced by 58 g of butane

72g H_2O is produced by $\frac{58 \times 72}{5 \times 18} = 46.4g$

$= 464 \times 10^{-1}g$

$x = 464.$

8. At 298 K, the enthalpy of fusion of a solid (X) is 2.8 kj mol^{-1} and the enthalpy of vaporisation of the liquid (X) is 98.2 kJ mol^{-1}, The enthalpy of sublimation of the substance (X) in kJ mol^{-1} is_____. (in nearest integer)

Ans. Official Answer NTA (101)

Sol. $X_{(S)} \xrightarrow{\text{fusion}} X_{(l)} \xrightarrow{\text{vaporisation}} X_{(g)}$

$X_{(S)} \xrightarrow{\text{sublimation}} X_{(g)}$

$\Delta H_{sub.} = \Delta H_{fus.} + \Delta H_{vap.}$

$= 2.8 + 98.2$

$= 101$ KJ/mol.

9. CO_2 gas is bubbled through water during a soft drink manufacturing process at 298 K. If CO_2 exerts a partial pressure of 0.835 bar then x m mol of CO_2 would dissolve in 0.9 L of water. The value of x is_____. (Nearest integer) (Henry's law constant for CO_2 at 298 K is 1.67×10^3 bar)

Ans. Official Answer NTA (25)

Sol. $P = K_n x$

$$0.835 = 1.67 \times 10^3 \times \frac{n_{CO_2}}{n_{CO_2} + n_{H_2O}}$$

$$n_{H_2O} = \frac{mass}{18}$$

$mass = 0.9 \times 10^3 \times 1 = 900\ g$

$n_{H_2O} = 50$

$n_{CO_2} + n_{H_2O} \approx n_{H_2O}$

$$n_{CO_2} = \frac{0.835 \times n_{H_2O}}{1.67 \times 10^3}$$

$= 25 \times 10^{-3}$

$n_{CO_2}\,(m\,mol) = 25$

10. For the reaction $A + B \rightleftharpoons 2C$

the value of equilibrium constant is 100 at 298 K. If the initial concentration of all the three species is 1 M each, then the equilibrium concentration of C is $x \times 10^{-1}$ M. The value of x is _____. (Nearest integer)

Ans. Official Answer NTA (25)

Sol. $A + B \rightleftharpoons 2C$

$K_{eq} = 100$

1	1	1
1 – x	1 × x	1 + 2x

$$K_{eq} = 100 = \frac{(1+2x)^2}{(1-x)(1-x)}$$

$$(10)^2 = \left(\frac{1+2x}{1-x}\right)^2$$

$$10 = \frac{1+2x}{1-x}$$

$10 - 10x = 1 + 2x$

$$x = \frac{3}{4}$$

$[C] = 1 + 2x$

$$= 1 + 2 \times \frac{3}{4}$$

$= 1 + 1.5 = 2.5$

$= 25 \times 10^{-1}$

$x = 25$