

FINAL JEE–MAIN EXAMINATION – MARCH, 2021

(Held On Tuesday 16th March, 2021) TIME : 3 : 00 PM to 6 : 00 PM

CHEMISTRY

TEST PAPER WITH ANSWER & SOLUTION

SECTION-A

1. The green house gas/es is (are) :

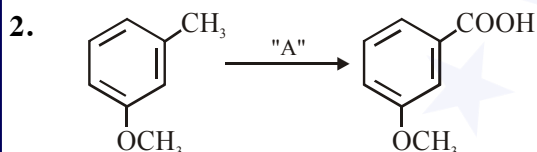
- (A) Carbon dioxide
- (B) Oxygen
- (C) Water vapour
- (D) Methane

Choose the most appropriate answer from the options given below :

- (1) (A) and (C) only
- (2) (A) only
- (3) (A), (C) and (D) only
- (4) (A) and (B) only

Official Ans. by NTA (3)

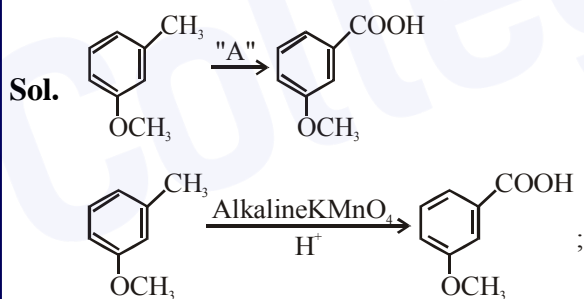
Sol. The green house gases are CO_2 , H_2O (vapour) & CH_4 .



In the above reaction, the reagent "A" is :

- (1) NaBH_4 , H_3O^+
- (2) LiAlH_4
- (3) Alkaline KMnO_4 , H^+
- (4) HCl , Zn-Hg

Official Ans. by NTA (3)



3. Which of the following reduction reaction CANNOT be carried out with coke ?

- (1) $\text{Al}_2\text{O}_3 \rightarrow \text{Al}$
- (2) $\text{ZnO} \rightarrow \text{Zn}$
- (3) $\text{Fe}_2\text{O}_3 \rightarrow \text{Fe}$
- (4) $\text{Cu}_2\text{O} \rightarrow \text{Cu}$

Official Ans. by NTA (1)

Sol. Reduction of $\text{Al}_2\text{O}_3 \rightarrow \text{Al}$ is carried out by

4. Identify the elements X and Y using the ionisation energy values given below :

	Ionization energy (kJ/mol)	
	1 st	2 nd
X	495	4563
Y	731	1450

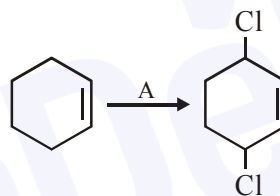
- (1) X = Na ; Y = Mg
- (2) X = Mg ; Y = F
- (3) X = Mg ; Y = Na
- (4) X = F ; Y = Mg

Official Ans. by NTA (1)

Sol. $\text{Na} \rightarrow [\text{Ne}] 3s^1$ IE₁ is very low but IE₂ is very high due to stable noble gas configuration of Na^+ .

$\text{Mg} \rightarrow [\text{Ne}] 3s^2$ IE₁ & IE₂ → Low
IE₃ is very high.

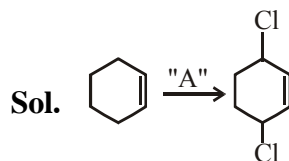
5.



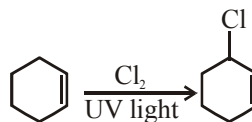
Identify the reagent(s) 'A' and condition(s) for the reaction :

- (1) A = HCl ; Anhydrous AlCl_3
- (2) A = HCl , ZnCl_2
- (3) A = Cl_2 ; UV light
- (4) A = Cl_2 ; dark, Anhydrous AlCl_3

Official Ans. by NTA (3)



For substitution at allylic position in the given compound, the reagent used is $\text{Cl}_2/\text{uv light}$.
The reaction is free radical halogenation.



6. The secondary structure of protein is stabilised by:
 (1) Peptide bond
 (2) glycosidic bond
 (3) Hydrogen bonding
 (4) van der Waals forces

Official Ans. by NTA (3)

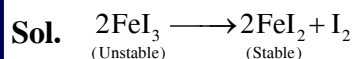
Sol. The secondary structure of protein includes two type :

- (a) α -Helix (b) β -pleated sheet

In α -Helix structure, the poly peptide chain is coil around due to presence of Intramolecular H-Bonding.

7. Fex_2 and Fey_3 are known when x and y are :
 (1) x = F, Cl, Br, I and y = F, Cl, Br
 (2) x = F, Cl, Br and y = F, Cl, Br, I
 (3) x = Cl, Br, I and y = F, Cl, Br, I
 (4) x = F, Cl, Br, I and y = F, Cl, Br, I

Official Ans. by NTA (1)



Due to strong reducing nature of I^-



remaining halides of Fe^{2+} & Fe^{3+} are stable.

8. Which of the following polymer is used in the manufacture of wood laminates ?
 (1) *cis*-poly isoprene
 (2) Melamine formaldehyde resin
 (3) Urea formaldehyde resin
 (4) Phenol and formaldehyde resin

Official Ans. by NTA (3)

Sol. Urea -HCHO resin is used in manufacture of wood laminates.

9. **Statement I :** Sodium hydride can be used as an oxidising agent.


Statement II : The lone pair of electrons on nitrogen in pyridine makes it basic.

Choose the CORRECT answer from the options given below :

- (1) Both statement I and statement II are false
 (2) Statement I is true but statement II is false
 (3) Statement I is false but statement II is true
 (4) Both statement I and statement II are true

Official Ans. by NTA (3)

Sol. (1) NaH (sodium Hydride) is used as a reducing reagent.

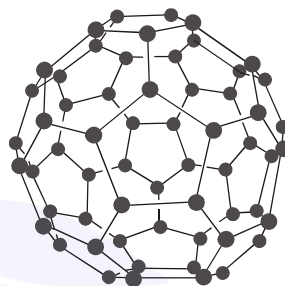
- (2)  In pyridine, due to free electron on


10. The INCORRECT statement regarding the structure of C_{60} is :

- (1) The six-membered rings are fused to both six and five-membered rings.
 (2) Each carbon atom forms three sigma bonds.
 (3) The five-membered rings are fused only to six-membered rings.
 (4) It contains 12 six-membered rings and 24 five-membered rings.

Official Ans. by NTA (4)

Sol. Structure of C_{60}



It contain 20 hexagons  and 12 pentagons

 so option 4 is incorrect.

11. The correct statements about H_2O_2 are :

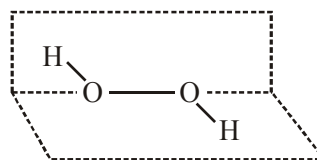
- (A) used in the treatment of effluents.
 (B) used as both oxidising and reducing agents.
 (C) the two hydroxyl groups lie in the same plane.
 (D) miscible with water.

Choose the correct answer from the options given below :

- (1) (A), (B), (C) and (D)
 (2) (A), (B) and (D) only
 (3) (B), (C) and (D) only
 (4) (A), (C) and (D) only

Official Ans. by NTA (2)

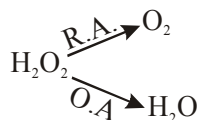
Sol.



Structure of H_2O_2

(Open book type) \rightarrow Non planar

H_2O_2 is used in the treatment of effluents.

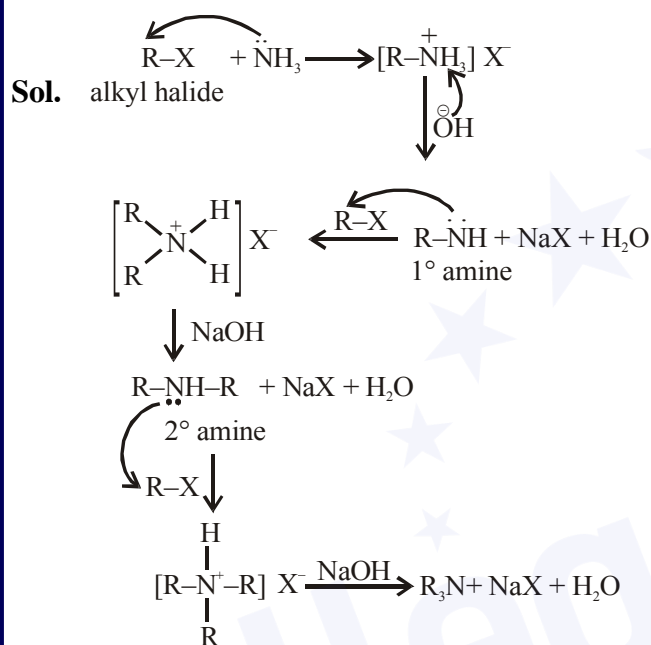


act as both O.A & R.A.

12. Ammonolysis of Alkyl halides followed by the treatment with NaOH solution can be used to prepare primary, secondary and tertiary amines. The purpose of NaOH in the reaction is :

- (1) to remove basic impurities
- (2) to activate NH_3 used in the reaction
- (3) to remove acidic impurities
- (4) to increase the reactivity of alkyl halide

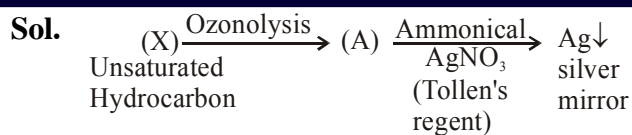
Official Ans. by NTA (3)



So the purpose of NaOH in the above reactions is to remove acidic impurities.

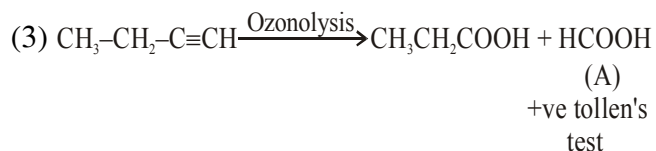
13. An unsaturated hydrocarbon X on ozonolysis gives A. Compound A when warmed with ammoniacal silver nitrate forms a bright silver mirror along the sides of the test tube. The unsaturated hydrocarbon X is :

- (1) $\text{CH}_3-\text{C}=\text{C}-\text{CH}_3$
 $\text{CH}_3 \quad \text{CH}_3$
- (2) $\text{CH}_3-\overset{\text{CH}_3}{\text{C}}=\triangle$
- (3) $\text{HC}\equiv\text{C}-\text{CH}_2-\text{CH}_3$
- (4) $\text{CH}_3-\text{C}\equiv\text{C}-\text{CH}_3$

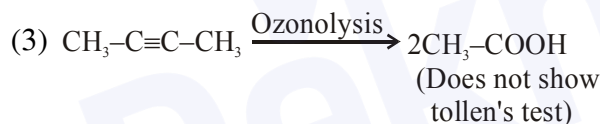
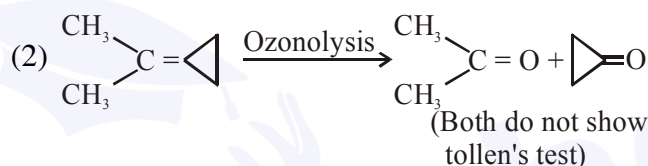
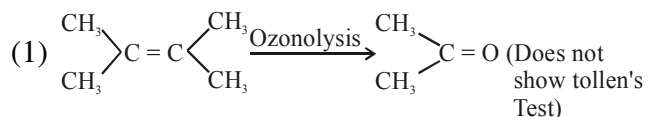


As (A) compound gives positive Tollen's test hence it may consist $-\text{CHO}$ (aldehyde group) or it can be HCOOH

So for the given option :



and for other compounds (options):

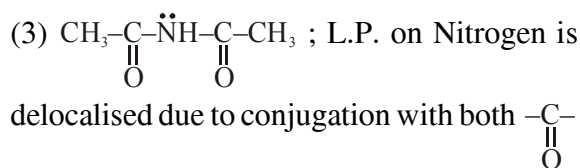
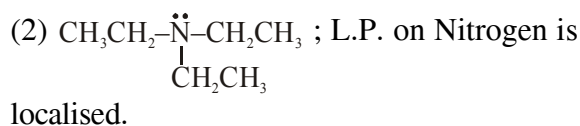
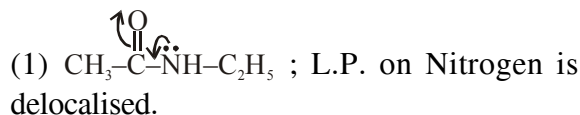


14. Which of the following is least basic ?

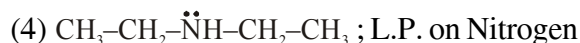
- (1) $(\text{CH}_3\text{CO})\ddot{\text{N}}\text{HC}_2\text{H}_5$
- (2) $(\text{C}_2\text{H}_5)_3\ddot{\text{N}}$
- (3) $(\text{CH}_3\text{CO})_2\ddot{\text{N}}\text{H}$
- (4) $(\text{C}_2\text{H}_5)_2\ddot{\text{N}}\text{H}$

Official Ans. by NTA (3)

Sol. For the given compounds :



(Hence least basic)



15. The characteristics of elements X, Y and Z with atomic numbers, respectively, 33, 53 and 83 are :

- (1) X and Y are metalloids and Z is a metal.
- (2) X is a metalloid, Y is a non-metal and Z is a metal.
- (3) X, Y and Z are metals.
- (4) X and Z are non-metals and Y is a metalloid

Official Ans. by NTA (2)

Sol. $X = {}_{33}\text{As} \rightarrow \text{Metalloid}$

$Y = {}_{53}\text{I} \rightarrow \text{Nonmetal}$

$Z = {}_{83}\text{Bi} \rightarrow \text{Metal}$

16. Match List-I with List-II

List-I Test/Reagents/Observation(s)	List-II Species detected
(a) Lassaigne's Test	(i) Carbon
(b) Cu(II) oxide	(ii) Sulphur
(c) Silver nitrate	(iii) N, S, P, and halogen
(d) The sodium fusion extract gives black precipitate with acetic acid and lead acetate	(iv) Halogen Specifically

The correct match is :

- (1) (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)
- (2) (a)-(i), (b)-(iv), (c)-(iii), (d)-(ii)
- (3) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)
- (4) (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)

Official Ans. by NTA (3)

Sol. Match list :-

(a) Lassaigne's Test	(iii) N, S, P and Halogen
(b) Cu(II) Oxide	(i) Carbon
(c) AgNO_3	(iv) Halogen specifically.
(d) Sodium fusion extract given black precipitate with acetic acid and lead acetate ($\text{CH}_3\text{COOH}/(\text{CH}_3\text{COO})_2\text{Pb}$)	(ii) Sulphur

17. The INCORRECT statements below regarding colloidal solutions is :

- (1) A colloidal solution shows colligative properties.
- (2) An ordinary filter paper can stop the flow of colloidal particles.
- (3) The flocculating power of Al^{3+} is more than that of Na^+ .
- (4) A colloidal solution shows Brownian motion of colloidal particles.

Official Ans. by NTA (2)

Sol. * Colloidal solution exhibits colligative properties

* An ordinary filter can not stop the flow of colloidal particles.

* Flocculating power increases with increase the opposite charge of electrolyte.

* Colloidal particles show brownian motion.

18. Arrange the following metal complex/compounds in the increasing order of spin only magnetic moment. Presume all the three, high spin system.

(Atomic numbers Ce = 58, Gd = 64 and Eu = 63.)

- (a) $(\text{NH}_4)_2[\text{Ce}(\text{NO}_3)_6]$ (b) $\text{Gd}(\text{NO}_3)_3$ and
(c) $\text{Eu}(\text{NO}_3)_3$

Answer is :

- (1) (b) < (a) < (c)
- (2) (c) < (a) < (b)
- (3) (a) < (b) < (c)
- (4) (a) < (c) < (b)

Official Ans. by NTA (4)

Sol. (a) ${}_{58}\text{Ce} \rightarrow [\text{Xe}]4f^2 5d^0 6s^2$
In complex $\text{Ce}^{4+} \rightarrow [\text{Xe}] 4f^0 5d^0 6s^0$
there is no unpaired electron so $\mu_m = 0$

(b) ${}_{64}\text{Gd}^{3+} \rightarrow [\text{Xe}]4f^7 5d^0 6s^0$
contain seven unpaired electrons so,

$$\mu_m = \sqrt{7(7+2)} = \sqrt{63} \text{ B.M.}$$

(c) ${}_{63}\text{Eu}^{3+} \rightarrow [{}_{54}\text{Xe}]4f^6 5d^0 6s^0$
contain six unpaired electron

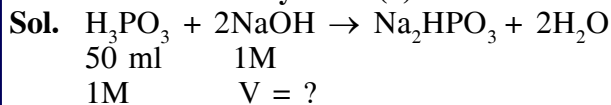
$$\text{so, } \mu_m = \sqrt{6(6+2)} = \sqrt{48} \text{ B.M.}$$

Hence, order of spin only magnetic movement

19. The exact volumes of 1 M NaOH solution required to neutralise 50 mL of 1 M H_3PO_3 solution and 100 mL of 2 M H_3PO_2 solution, respectively, are :

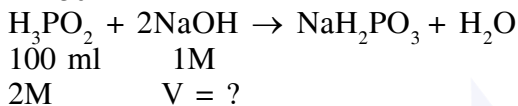
- (1) 100 mL and 100 mL
- (2) 100 mL and 50 mL
- (3) 100 mL and 200 mL
- (4) 50 mL and 50 mL

Official Ans. by NTA (3)

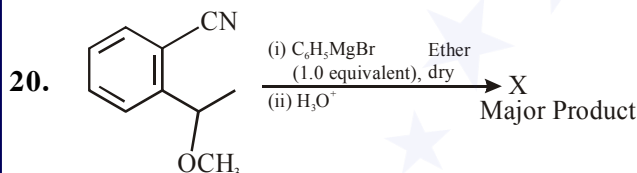


$$\Rightarrow \frac{n_{NaOH}}{n_{H_3PO_3}} = \frac{2}{1}$$

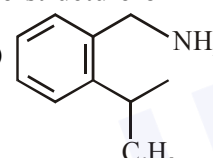
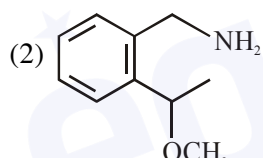
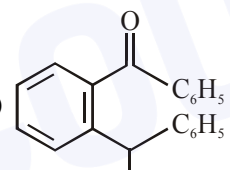
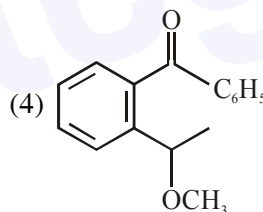
$$\Rightarrow \frac{1 \times V}{50 \times 1} = \frac{2}{1} \Rightarrow \boxed{V_{NaOH} = 100 \text{ ml}}$$



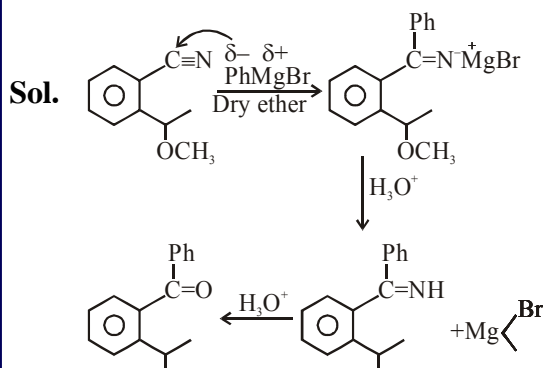
$$\Rightarrow \frac{n_{NaOH}}{n_{H_3PO_2}} = \frac{1}{1} \Rightarrow \frac{1 \times V}{2 \times 100} = \frac{1}{1} \Rightarrow \boxed{V_{NaOH} = 200 \text{ ml}}$$



The structure of X is :

- (1) 
- (2) 
- (3) 
- (4) 

Official Ans. by NTA (4)



SECTION-B

1. Ga (atomic mass 70 u) crystallizes in a hexagonal close packed structure. The total number of voids in 0.581 g of Ga is _____ $\times 10^{21}$. (Round off to the Nearest Integer).

Official Ans. by NTA (15)

- Sol.** HCP structure : Per atom, there will be one octahedral void (OV) and two tetrahedral voids (TV).

Therefore total three voids per atom are present in HCP structure.

→ therefore total no of atoms of Ga will be-

$$= \frac{\text{Mass}}{\text{Molar Mass}} \times N_A = \frac{0.581 \text{ g}}{70 \text{ g/mol}} \times 6.023 \times 10^{23}$$

→ Now, total Number of voids = 3 \times total no. of atoms

$$= 3 \times \frac{0.581}{70} \times 6.023 \times 10^{23} = 14.99 \times 10^{21} \approx 15 \times 10^{21}$$

2. A 5.0 m mol dm^{-3} aqueous solution of KCl has a conductance of 0.55 mS when measured in a cell constant 1.3 cm^{-1} . The molar conductivity of this solution is _____ $\text{mSm}^2 \text{ mol}^{-1}$. (Round off to the Nearest Integer)

Official Ans. by NTA (14)

- Sol.** Given concⁿ of KCl = $\frac{\text{m.mol}}{\text{L}}$

: Conductance (G) = 0.55 mS

: Cell constant $\left(\frac{\ell}{A}\right) = 1.3 \text{ cm}^{-1}$

To Calculate : Molar conductivity (λ_m) of sol.

$$\rightarrow \text{Since } \lambda_m = \frac{1}{1000} \times \frac{k}{m} \dots\dots(1)$$

$$\rightarrow \text{Molarity} = 5 \times 10^{-3} \frac{\text{mol}}{\text{L}}$$

$$\rightarrow \text{Conductivity} = G \times \left(\frac{\ell}{A}\right) = 0.55 \text{ mS} \times \frac{1.3}{1} \text{ m}^{-1} = 55 \times 1.3 \text{ mSm}^{-1}$$

$$\text{eq}^n (1) \quad \lambda_m = \frac{1}{1000} \times \frac{55 \times 1.3 \text{ mSm}^2}{\left(\frac{5}{1000}\right) \text{ mol}} = \underline{\underline{14.99 \text{ mSm}^2}}$$

7. Sulphurous acid (H_2SO_3) has $K_{a1} = 1.7 \times 10^{-2}$ and $K_{a2} = 6.4 \times 10^{-8}$. The pH of 0.588 M H_2SO_3 is _____. (Round off to the Nearest Integer)

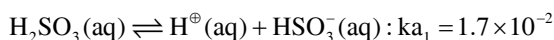
Official Ans. by NTA (1)

Sol. H_2SO_3 [Dibasic acid]

$$c = 0.588 \text{ M}$$

\Rightarrow pH of solution is due to First dissociation only since $K_{a1} \gg K_{a2}$

\Rightarrow First dissociation of H_2SO_3



t = 0 C

t C-x x x

$$\Rightarrow K_{a1} = \frac{1.7}{100} = \frac{[\text{H}^+][\text{HSO}_3^-]}{[\text{H}_2\text{SO}_3]}$$

$$\Rightarrow \frac{1.7}{100} = \frac{x^2}{(0.588 - x)}$$

$$\Rightarrow 1.7 \times 0.588 - 1.7x = 100x^2$$

$$\Rightarrow 100x^2 + 1.7x - 1 = 0$$

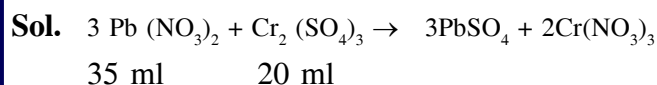
$$\Rightarrow [\text{H}^+] = x = \frac{-1.7 + \sqrt{(1.7)^2 + 4 \times 100 \times 1}}{2 \times 100} = 0.09186$$

Therefore pH of sol. is : $\text{pH} = -\log [\text{H}^+]$

$$\Rightarrow \text{pH} = -\log (0.09186) = 1.036 \approx 1$$

8. When 35 mL of 0.15 M lead nitrate solution is mixed with 20 mL of 0.12 M chromic sulphate solution, _____ $\times 10^{-5}$ moles of lead sulphate precipitate out. (Round off to the Nearest Integer).

Official Ans. by NTA (525)



35 ml 20 ml

0.15 M 0.12 M

$$= 5.25 \text{ m.mol} = 2.4 \text{ m.mol} \quad 5.25 \text{ m.mol}$$

$$= 5.25 \times 10^{-3} \text{ mol}$$

therefore moles of PbSO_4 formed = 5.25×10^{-3}

$$= 525 \times 10^{-5}$$

9. At 25°C , 50 g of iron reacts with HCl to form FeCl_2 . The evolved hydrogen gas expands against a constant pressure of 1 bar. The work done by the gas during this expansion is _____ J.

(Round off to the Nearest Integer)

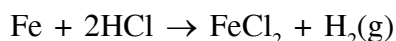
[Given : $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$. Assume, hydrogen is an ideal gas]

[Atomic mass of Fe is 55.85 u]

Official Ans. by NTA (2218)

$$\text{Sol. } T = 298 \text{ K}, R = 8.314 \frac{\text{J}}{\text{mol K}}$$

\rightarrow Chemical reaction is



50g P = 1 bar

$$= \frac{50}{55.85} \text{ mol}$$

$$\frac{50}{55.85} \text{ mol}$$

\rightarrow Work done for 1 mol gas

$$= -P_{\text{ext}} \times \Delta V$$

$$= \Delta n g RT$$

$$= -1 \times 8.314 \times 298 \text{ J}$$

\rightarrow Work done for $\frac{50}{55.85}$ mol of gas

$$= -1.8314 \times 298 \times \frac{50}{55.85} \text{ J}$$

$$= -2218.059 \text{ J}$$

$$\approx -2218 \text{ J}$$

10. $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ absorbs light of wavelength 498 nm during a d - d transition. The octahedral splitting energy for the above complex is _____ $\times 10^{-19}$ J. (Round off to the Nearest Integer). $h = 6.626 \times 10^{-34} \text{ Js}$; $c = 3 \times 10^8 \text{ ms}^{-1}$.

Official Ans. by NTA (4)

Sol. $\lambda_{\text{absorbed}} = 498 \text{ nm}$ (given)

The octahedral splitting energy

$$\Delta_0 \text{ or } E = \frac{hc}{\lambda} = \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{498 \times 10^{-9}}$$

$$= 0.0399 \times 10^{-17} \text{ J}$$