

FINAL JEE-MAIN EXAMINATION – JANUARY, 2023

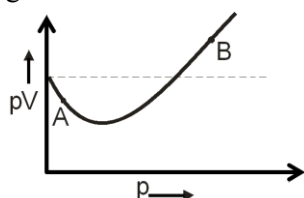
(Held On Sunday 29th January, 2023)

TIME : 9 : 00 AM to 12 : 00 NOON

CHEMISTRY

SECTION-A

31. For 1 mol of gas, the plot of pV vs p is shown below. p is the pressure and V is the volume of the gas.



What is the value of compressibility factor at point A?

- (1) $1 - \frac{a}{RTV}$ (2) $1 + \frac{b}{V}$
(3) $1 - \frac{b}{V}$ (4) $1 + \frac{a}{RTV}$

Official Ans. by NTA (1)

Allen Ans. (1)

- Sol. For 1 mole of real gas

$$PV = ZRT$$

from graph PV for real gas is less than PV for ideal gas at point A

$$Z < 1$$

$$Z = 1 - \frac{a}{V_m RT}$$

32. The shortest wavelength of hydrogen atom in Lyman series is λ . The longest wavelength in Balmer series of He^+ is

- (1) $\frac{5}{9\lambda}$ (2) $\frac{9\lambda}{5}$
(3) $\frac{36\lambda}{5}$ (4) $\frac{5\lambda}{9}$

Official Ans. by NTA (2)

Allen Ans. (2)

- Sol. For H: $\frac{1}{\lambda} = R_H \times 1^2 \left(\frac{1}{1^2} - \frac{1}{\infty^2} \right) \dots (1)$

$$\frac{1}{\lambda_{\text{He}^+}} = R_H \times 2^2 \times \left(\frac{1}{4} - \frac{1}{9} \right) \dots (2)$$

$$\text{From (1) \& (2) } \frac{\lambda_{\text{He}^+}}{\lambda} = \frac{9}{5}$$

$$\lambda_{\text{He}^+} = \lambda \times \frac{9}{5}$$

$$\lambda_{\text{He}^+} = \frac{9\lambda}{5}$$

TEST PAPER WITH SOLUTION

33. Which of the following salt solutions would coagulate the colloid solution formed when FeCl_3 is added to NaOH solution, at the fastest rate?

- (1) 10 mL of $0.2 \text{ mol dm}^{-3} \text{ AlCl}_3$
(2) 10 mL of $0.1 \text{ mol dm}^{-3} \text{ Na}_2\text{SO}_4$
(3) 10 mL of $0.1 \text{ mol dm}^{-3} \text{ Ca}_3(\text{PO}_4)_2$
(4) 10 mL of $0.15 \text{ mol dm}^{-3} \text{ CaCl}_2$

Official Ans. by NTA (1)

Allen Ans. (1)

- Sol. Sol. Formed is negatively charged solution, therefore Al^{3+} has highest coagulating power

34. The bond dissociation energy is highest for

- (1) Cl_2
(2) I_2
(3) Br_2
(4) F_2

Official Ans. by NTA (1)

Allen Ans. (1)

- Sol. Bond energy of F_2 less than Cl_2 due to lone pair – lone pair repulsions.

$$\text{Bond energy order } \text{Cl}_2 > \text{Br}_2 > \text{F}_2 > \text{I}_2$$

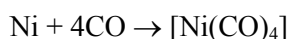
35. The reaction representing the Mond process for metal refining is _____

- (1) $\text{Ni} + 4\text{CO} \xrightarrow{\Delta} \text{Ni}(\text{CO})_4$
(2) $2\text{K} [\text{Au}(\text{CN})_2] + \text{Zn} \xrightarrow{\Delta} \text{K}_2 [\text{Zn}(\text{CN})_4] + 2\text{Au}$
(3) $\text{Zr} + 2\text{I}_2 \xrightarrow{\Delta} \text{ZrI}_4$
(4) $\text{ZnO} + \text{C} \xrightarrow{\Delta} \text{Zn} + \text{CO}$

Official Ans. by NTA (1)

Allen Ans. (1)

- Sol. Mond's process uses:



36. Which of the given compounds can enhance the efficiency of hydrogen storage tank?

- (1) Li/P_4
(2) SiH_4
(3) NaNi_5
(4) Di-isobutylaluminium hydride

Official Ans. by NTA (3)

Allen Ans. (3)

- Sol. Refer NCERT

37. The correct order of hydration enthalpies is

- (A) K^+
 (B) Rb^+
 (C) Mg^{2+}
 (D) Cs^+
 (E) Ca^{2+}

Choose the correct answer from the options given below:

- (1) $C > A > E > B > D$
 (2) $E > C > A > B > D$
 (3) $C > E > A > D > B$
 (4) $C > E > A > B > D$

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. Hydration enthalpies:

- (i) $K^+ > Rb^+ > Cs^+$: (A) > (B) > (D)
 (ii) $Mg^{+2} > Ca^{+2}$: (C) > (E)

Option (D)

(C) > (E) > (A) > (B) > (D)

38. The magnetic behaviour of Li_2O , Na_2O_2 and KO_2 , respectively, are

- (1) diamagnetic, paramagnetic and diamagnetic
 (2) paramagnetic, paramagnetic and diamagnetic
 (3) paramagnetic, diamagnetic and paramagnetic
 (4) diamagnetic, diamagnetic and paramagnetic

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. $Li_2O \rightarrow O^{2-} \rightarrow$ diamagnetic

$Na_2O_2 \rightarrow O_2^{2-} \rightarrow$ diamagnetic

$KO_2 \rightarrow O_2^- \rightarrow$ paramagnetic

39. "A" obtained by Ostwald's method involving air oxidation of NH_3 , upon further air oxidation produces "B". "B" on hydration forms an oxoacid of Nitrogen along with evolution of "A". The oxoacid also produces "A" and gives positive brown ring test

- (1) NO_2 , N_2O_5
 (2) NO_2 , N_2O_4
 (3) NO , NO_2
 (4) N_2O_3 , NO_2

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. $4NH_3 + 5O_2 \xrightarrow{\Delta} 4NO + 6H_2O$

(A)

$2NO + O_2 \longrightarrow 2NO_2$

(B)

40. The standard electrode potential (M^{3+}/M^{2+}) for V, Cr, Mn & Co are -0.26 V, -0.41 V, +1.57 V and +1.97 V, respectively. The metal ions which can liberate H_2 from a dilute acid are

- (1) V^{2+} and Mn^{2+}
 (2) Cr^{2+} and Co^{2+}
 (3) V^{2+} and Cr^{2+}
 (4) Mn^{2+} and Co^{2+}

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. Metal cation with (-) value of reduction potential (M^{3+}/M^{2+}) or with (+) value of oxidation potential (M^{2+}/M^{3+}) will liberate H_2 . Therefore they will reduce H^+ i.e. V^{2+} and Cr^{2+}

41. Correct statement about smog is

- (1) NO_2 is present in classical smog
 (2) Both NO_2 and SO_2 are present in classical smog
 (3) Photochemical smog has high concentration of oxidizing agents
 (4) Classical smog also has high concentration of oxidizing agents

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. Photochemical smog has high concentration of oxidising agents

NO_2 is produced from NO and O_3 in the presence of sunlight

Classical smog contain smoke, fog and SO_2 and it is known as reducing smog, as chemically it is reducing mixture

42. Chiral complex from the following is :

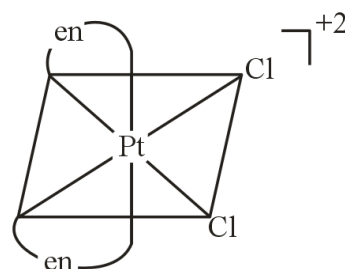
Here en = ethylene diamine

- (1) cis - $[PtCl_2(en)_2]^{2+}$
 (2) trans - $[PtCl_2(en)_2]^{2+}$
 (3) cis - $[PtCl_2(NH_3)_2]$
 (4) trans - $[Co(NH_3)_4Cl_2]^+$

Official Ans. by NTA (1)

Allen Ans. (1)

Sol.



this is chiral complex form

43. Identify the correct order for the given property for following compounds

(A) Boiling Point: $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl} < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl} < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$

(B) Density: $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br} < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl} < \text{CH}_3\text{CH}_2\text{CH}_2\text{I}$

(C) Boiling Point: $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br} < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br} < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$

(D) Density: $\text{CH}_3\text{CH}_2\text{CH}_2\text{I} < \text{CH}_3\text{CH}_2\text{CH}_2\text{Br} < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$

(E) Boiling Point: $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl} > \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl} > \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$

Choose the correct answer from the option given below :-

(1) (B), (C) and (D) only

(2) (A), (C) and (E) only

(3) (A), (C) and (D) only

(4) (A), (B) and (E) only

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. Boiling point of alkyl halide increases with increase in size, mass of halogen atom and size of alkyl group

Boiling point of isomeric alkyl halide decreases with increase in branching

Density increases with increase in atomic mass of halogen atom

44. The increasing order of pK_a for the following phenols is

(1) 2, 4-Dinitrophenol

(2) 4 - Nitrophenol

(3) 2, 4, 5- Trimethylphenol

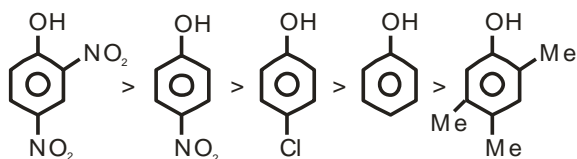
(4) Phenol

(5) 3-Chlorophenol

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. Order of acidity for following phenol is



- M and - I increases acidity

+ M and + I decreases acidity

45. Match List I with List II.

List-I	List-II
Reaction	Reagents
(A) Hoffmann Degradation	(I) Conc.KOH, Δ
(B) Clemenson reduction	(II) CHCl_3 , $\text{NaOH}/\text{H}_3\text{O}^+$
(C) Cannizaro reaction	(III) Br_2 , NaOH
(D) Reimer-Tiemann reaction	(IV) $\text{Zn-Hg}/\text{HCl}$

(1) (A) – III, (B) – IV, (C) – II, (D) – I

(2) (A) – II, (B) – IV, (C) – I, (D) – III

(3) (A) – III, (B) – IV, (C) – I, (D) – II

(4) (A) – II, (B) – I, (C) – III, (D) – IV

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. Reactions Reagent used

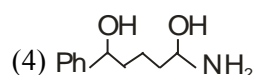
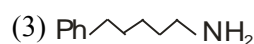
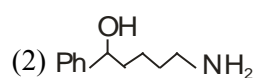
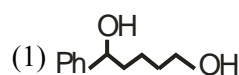
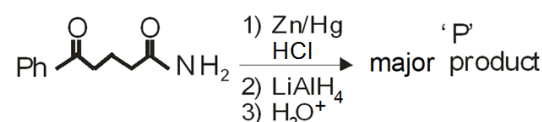
(A) Hoffmann degradation Br_2/NaOH

(B) Clemenson reduction $\text{Zn-Hg}/\text{HCl}$

(C) Cannizaro reaction $\text{conc.KOH}/\Delta$

(D) Reimer-Tiemann reaction CHCl_3 , $\text{NaOH}/\text{H}_3\text{O}^+$

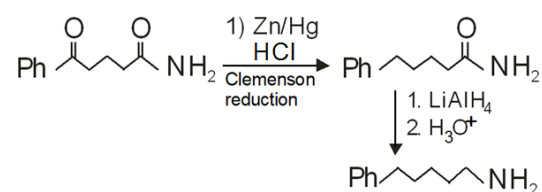
46. The major product 'P' for the following sequence of reactions is:



Official Ans. by NTA (3)

Allen Ans. (3)

Sol.



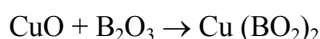
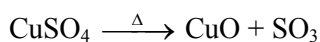
47. During the borax bead test with CuSO_4 , a blue green colour of the bead was observed in oxidising flame due to the formation of

- (1) Cu_3B_2 (2) Cu
 (3) $\text{Cu}(\text{BO}_2)_2$ (4) CuO

Official Ans. by NTA (3)

Allen Ans. (3)

- Sol.** Blue green colour is due to formation of $\text{Cu}(\text{BO}_2)_2$



48. Match List I with List II

List I	List II
Antimicrobials	Names
(A) Narrow Spectrum Antibiotic	(I) Furacin
(B) Antiseptic	(II) Sulphur dioxide
(C) Disinfectants	(III) Penicillin-G
(D) Broad spectrum antibiotic	(IV) Chloramphenicol

- (1) (A) – III, (B) – I, (C) – II, (D) – IV
 (2) (A) – I, (B) – II, (C) – IV, (D) – III
 (3) (A) – II, (B) – I, (C) – IV, (D) – III
 (4) (A) – III, (B) – I, (C) – IV, (D) – II

Official Ans. by NTA (1)

Allen Ans. (1)

- Sol.** (A) Narrow spectrum antibiotic – penicillin-G
 (B) Antiseptic – Furacin
 (C) Disinfectants – sulphur dioxide
 (D) Broad spectrum antibiotics – chloramphenicol

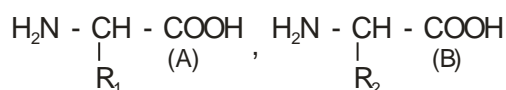
49. Number of cyclic tripeptides formed with 2 amino acids A and B is:

- (1) 2 (2) 3
 (3) 5 (4) 4

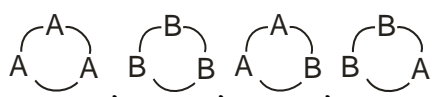
Official Ans. by NTA (4)

Allen Ans. (4)

- Sol.** Two amino acid are



Tripeptide are formed from three amino acids



50. Compound that will give positive Lassaigne's test for both nitrogen and halogen is

- (1) $\text{N}_2\text{H}_4 \cdot \text{HCl}$
 (2) $\text{CH}_3\text{NH}_2 \cdot \text{HCl}$
 (3) NH_4Cl
 (4) $\text{NH}_2\text{OH} \cdot \text{HCl}$

Official Ans. by NTA (2)

Allen Ans. (2)

- Sol.** $\text{CH}_3\text{NH}_2 \cdot \text{HCl} \xrightarrow[\text{fusion}]{\text{Na}} \text{NaCN} \text{ and } \text{NaCl}$

NaCN gives +ve test for nitrogen and

NaCl gives +ve test for halogen

SECTION-B

51. Millimoles of calcium hydroxide required to produce 100 mL of the aqueous solution of pH 12 is $x \times 10^{-1}$. The value of x is _____ (Nearest integer).

Assume complete dissociation.

Official Ans. by NTA (5)

Allen Ans. (5)

- Sol.** $\therefore \text{pH} = 12$

$$\therefore [\text{H}^+] = 10^{-12} \text{ M}$$

$$\therefore [\text{OH}^-] = 10^{-2} \text{ M}$$

$$\therefore [\text{Ca}(\text{OH})_2] = 5 \times 10^{-3} \text{ M}$$

$$5 \times 10^{-3} = \frac{\text{milli moles of Ca}(\text{OH})_2}{100 \text{ mL}}$$

$$\text{milli moles of Ca}(\text{OH})_2 = 5 \times 10^{-1}$$

Ans. = 5

52. The number of molecules or ions from the following, which do not have odd number of electrons are _____.

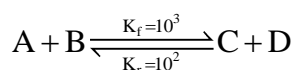
- (A) NO_2
 (B) ICl_4^-
 (C) BrF_3
 (D) ClO_2
 (E) NO_2^+
 (F) NO

Official Ans. by NTA (3)

Allen Ans. (3)

- Sol.** ICl_4^- , BrF_3 and NO_2^+ do not have odd number of e^-

53. Consider the following reaction approaching equilibrium at 27°C and 1 atm pressure



The standard Gibb's energy change ($\Delta_r G^\circ$) at 27°C is (–) _____ kJ mol^{–1}

(Nearest integer).

(Given : R = 8.3 J K^{–1} mol^{–1} and ln 10 = 2.3)

Official Ans. by NTA (6)

Allen Ans. (6)

Sol. $\therefore \Delta G^\circ = -RT \ln K_{eq}$

$$\text{and } K_{eq} = \frac{K_f}{K_b}$$

$$\therefore K_{eq} = \frac{10^3}{10^2} = 10$$

$$\therefore \Delta G = -RT \ln 10$$

$$\Rightarrow -(8.3 \times 300 \times 2.3) = -5.7 \text{ kJ mole}^{-1} \approx 6 \text{ kJ mole}^{-1} \text{ (nearest integer)}$$

Ans = 6

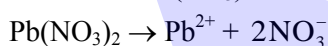
54. Solid Lead nitrate is dissolved in 1 litre of water. The solution was found to boil at 100.15°C. When 0.2 mol of NaCl is added to the resulting solution, it was observed that the solution froze at –0.8°C. The solubility product of PbCl₂ formed is _____ × 10^{–6} at 298 K. (Nearest integer)

Given : $K_b = 0.5 \text{ K kg mol}^{-1}$ and $K_f = 1.8 \text{ kg mol}^{-1}$. Assume molality to be equal to molarity in all cases.

Official Ans. by NTA (13)

Allen Ans. (13)

Sol. Let a mole Pb(NO₃)₂ be added



a a 2a

$$\Delta T_b = 0.15 = 0.5 [3a] \Rightarrow a = 0.1$$



t = 0 0.1 0.2

t = ∞ (0.1 – x) (0.2 – 2x)

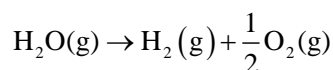
In final solution

$$\Delta T_f = 0.8 = 1.8 \left[\frac{0.3 - 3x + 0.2 + 0.2}{1} \right]$$

$$\Rightarrow x = \frac{2.3}{27}$$

$$\Rightarrow K_{sp} = \left(0.1 - \frac{2.3}{27} \right) \left(0.2 - \frac{4.6}{27} \right)^2 = 13 \times 10^{-6}$$

55. Water decomposes at 2300 K

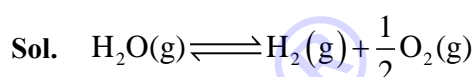


The percent of water decomposing at 2300 K and 1 bar is _____ (Nearest integer).

Equilibrium constant for the reaction is 2×10^{-3} at 2300 K

Official Ans. by NTA (2)

Allen Ans. (2)



$$P_0[1-\alpha] \quad P_0\alpha \quad \frac{P_0\alpha}{2} \quad \text{partial pr. at eq.}$$

$$P_0 \left[1 + \frac{\alpha}{2} \right] = 1 \quad \dots(i)$$

$$K_p = \frac{(P_{H_2})(P_{O_2})^{1/2}}{P_{H_2O}}$$

$$\frac{(P_0\alpha) \left(\frac{P_0\alpha}{2} \right)^{1/2}}{P_0[1-\alpha]} = 2 \times 10^{-3}$$

since α is negligible w.r.t 1 so $P_0 = 1$ and $1 - \alpha \approx 1$

$$\frac{\alpha\sqrt{\alpha}}{\sqrt{2}} = 2 \times 10^{-3}$$

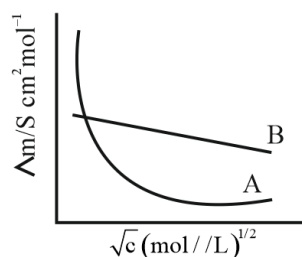
$$\alpha^{3/2} = 2^{3/2} \times 10^{-3}$$

$$\alpha = 2^{3/2 \times 2/3} \times 10^{-3 \times 2/3}$$

$$\alpha = 2 \times 10^{-2} \quad \% \alpha = 2\%$$

56. Following figure shows dependence of molar conductance of two electrolytes on concentration.

Λ_m° is the limiting molar conductivity.



The number of **Incorrect** statement(s) from the following is _____

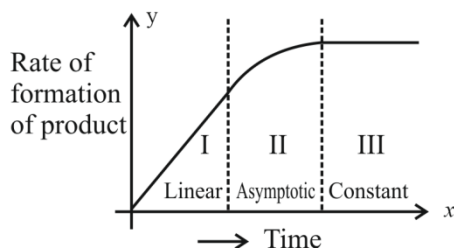
- (A) Λ_m^0 for electrolyte A is obtained by extrapolation
- (B) For electrolyte B, Λ_m vs \sqrt{c} graph is a straight line with intercept equal to Λ_m^0
- (C) At infinite dilution, the value of degree of dissociation approach zero for electrolyte B.
- (D) Λ_m^0 for any electrolyte A or B can be calculated using λ° for individual ions.

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. Statement (A) and Statement (C) are incorrect

57. For certain chemical reaction $X \rightarrow Y$, the rate of formation of product is plotted against the time as shown in the figure. The number of **Correct** statement/s from the following is _____



- (A) Over all order of this reaction is one
- (B) Order of this reaction can't be determined
- (C) In region-I and III, the reaction is of first and zero order respectively
- (D) In region-II, the reaction is of first order
- (E) In region-II, the order of reaction is in the range of 0.1 to 0.9.

Official Ans. by NTA (2)

Allen Ans. (1)

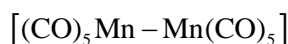
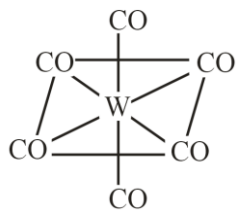
Sol. Only option (B) is correct as order cannot be determined

58. The sum of bridging carbonyls in $W(CO)_6$ and $Mn_2(CO)_{10}$ is _____.

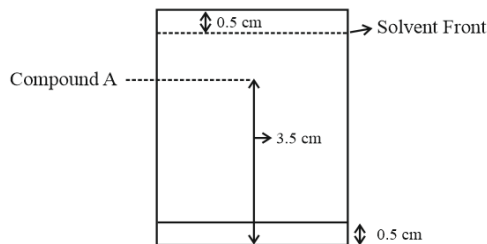
Official Ans. by NTA (0)

Allen Ans. (0)

Sol.



59. Following chromatogram was developed by adsorption of compound 'A' on a 6 cm TLC glass plate. Retardation factor of the compound 'A' is _____ $\times 10^{-1}$.



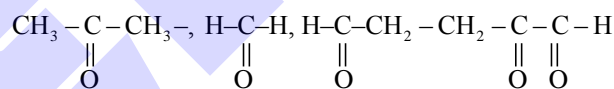
Official Ans. by NTA (6)

Allen Ans. (6)

Sol. $R_f = \frac{\text{Distance moved by the substance from base line}}{\text{Distance moved by the solvent from base line}}$

$$= \frac{3.0 \text{ cm}}{5.0 \text{ cm}} = 0.6 \text{ or } 6 \times 10^{-1}$$

60. 17 mg of a hydrocarbon (M.F. $C_{10}H_{16}$) takes up 8.40 mL of the H_2 gas measured at $0^\circ C$ and 760 mm of Hg. Ozonolysis of the same hydrocarbon yields



The number of double bond/s present in the hydrocarbon is _____.

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. Moles of hydrocarbon = $\frac{17 \times 10^{-3}}{136} = 1.25 \times 10^{-4}$

Mole of H_2 gas

$$\Rightarrow 1 \times \frac{8.40}{1000} = n \times 0.0821 \times 273$$

$$\Rightarrow n = 3.75 \times 10^{-4}$$

Hydrogen molecule used for 1 molecule of hydrocarbon is 3

$$= \frac{3.75 \times 10^{-4}}{1.25 \times 10^{-4}} = 3$$