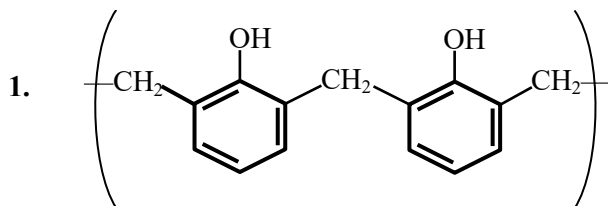


CHEMISTRY

SECTION-A

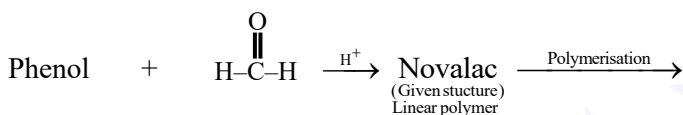


is a repeating unit for :

- (1) Novolac (2) Buna-N
(3) Acrilan (4) Neoprene

Official Ans. by NTA (1)

Sol.



Bakelite
(3D structures)

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

- (1) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ (2) $[\text{Ni}(\text{CN})_4]^{2-}$
(3) $[\text{Co}(\text{CN})_6]^{3-}$ (4) $[\text{Ni}(\text{CO})_4]$

Official Ans. by NTA (1)

Sol. 1. $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$

$\text{Fe}^{3+} : [\text{Ar}]3d^5$

Hybridisation : sp^3d^2

Magnetic nature : Paramagnetic (so this complex response to external magnetic field)

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

$\text{Ni}^{2+} : [\text{Ar}]3d^8$

Hybridisation : dsp^2

Magnetic nature : diamagnetic

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

$\text{Co}^{3+} : [\text{Ar}]3d^6$

Hybridisation : d^2sp^3

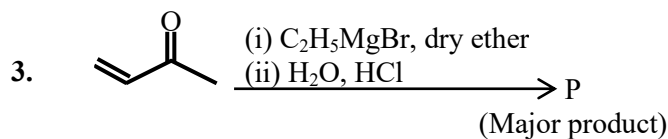
Magnetic nature : diamagnetic

4. $[\text{Ni}(\text{CO})_4]$

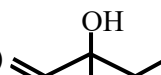
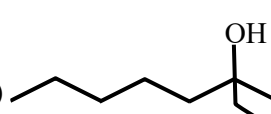
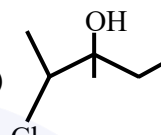
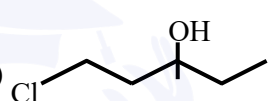
$\text{Ni} : [\text{Ar}] 3d^8 4s^2$

Hybridisation : sp^3

Magnetic nature : diamagnetic

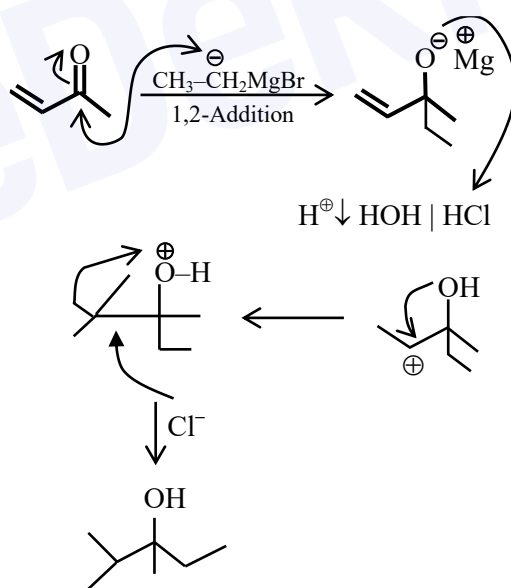


Consider the above reaction, the major product 'P' is:

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

Official Ans. by NTA (3)

Sol.



4. Sodium stearate $\text{CH}_3(\text{CH}_2)_{16}\text{COO}^-\text{Na}^+$ is an anionic surfactant which forms micelles in oil. Choose the **correct** statement for it from the following :

- (1) It forms spherical micelles with $\text{CH}_3(\text{CH}_2)_{16}$ - group pointing towards the centre of sphere.
- (2) It forms non-spherical micelles with $-\text{COO}^-$ group pointing outwards on the surface.
- (3) It forms spherical micelles with $\text{CH}_3(\text{CH}_2)_{16}$ - group pointing outwards on the surface of sphere
- (4) It forms non-spherical micelles with $\text{CH}_3(\text{CH}_2)_{16}$ -group pointing towards the centre.

Official Ans. by NTA (1)

Sol. Forms spherical micelles with $\text{CH}_3(\text{CH}_2)_{16}$ group pointing towards the centre of sphere

5. The water soluble protein is :

- (1) Fibrin
- (2) Albumin
- (3) Myosin
- (4) Collagen

Official Ans. by NTA (2)

Sol. Albumin is water soluble.

6. 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) $E_H = \frac{1}{2} E_D$
- (2) $E_H = E_D$
- (3) $E_H \approx E_D - 7.5$
- (4) $E_H = 2E_D$

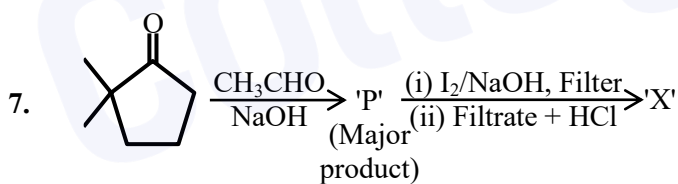
Official Ans. by NTA (3)

Sol. Enthalpy of bond dissociation (kJ/mole) at 298.2K

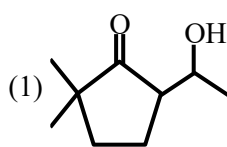
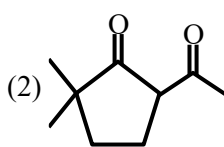
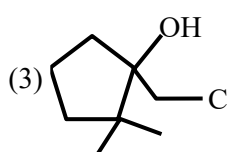
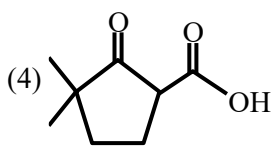
For , hydrogen = 435.88

For , Deuterium = 443.35

$$\therefore E_H \approx E_D - 7.5$$

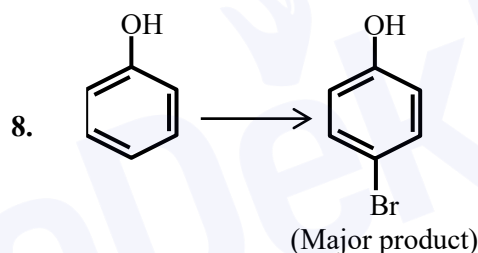
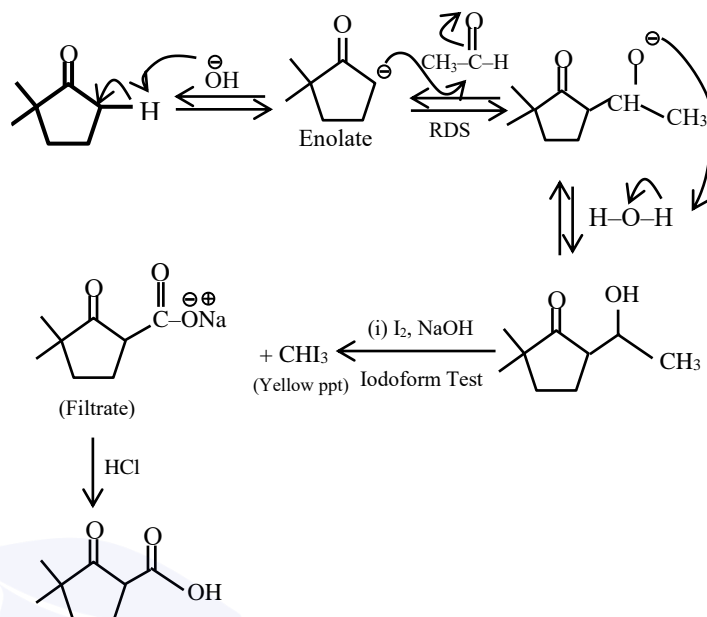


Consider the given reaction, the product 'X' is:

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

Official Ans. by NTA (4)

Sol.



The given reaction can occur in the presence of :

- (a) Bromine water
- (b) Br_2 in CS_2 , 273 K
- (c) $\text{Br}_2/\text{FeBr}_3$
- (d) Br_2 in CHCl_3 , 273 K

Choose the correct answer from the options given below :

- (1) (b) and (d) only
- (2) (a) and (c) only
- (3) (b), (c) and (d) only
- (4) (a), (b) and (d) only

Official Ans. by NTA (3)

Sol. Bromine water gives tribromo products, other gives monobromo products in which para is major product.

9. Given below are two statements, one is labelled as **Assertion (A)** and other is labelled as **Reason (R)**.
Assertion (R) : Gabriel phthalimide synthesis cannot be used to prepare aromatic primary amines.

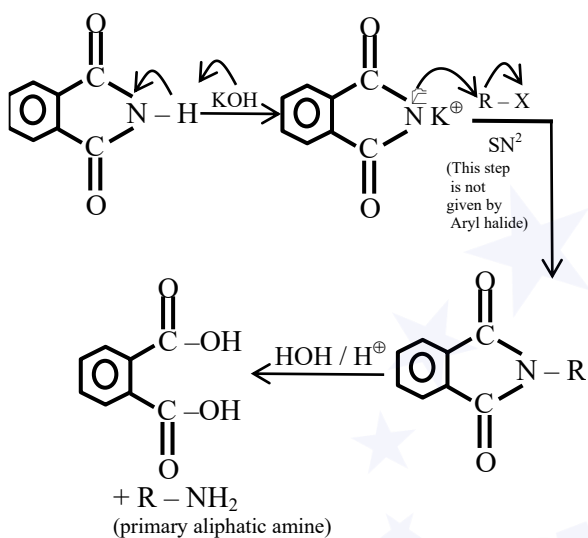
Reason : Aryl halides do not undergo nucleophilic substitution reaction.

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

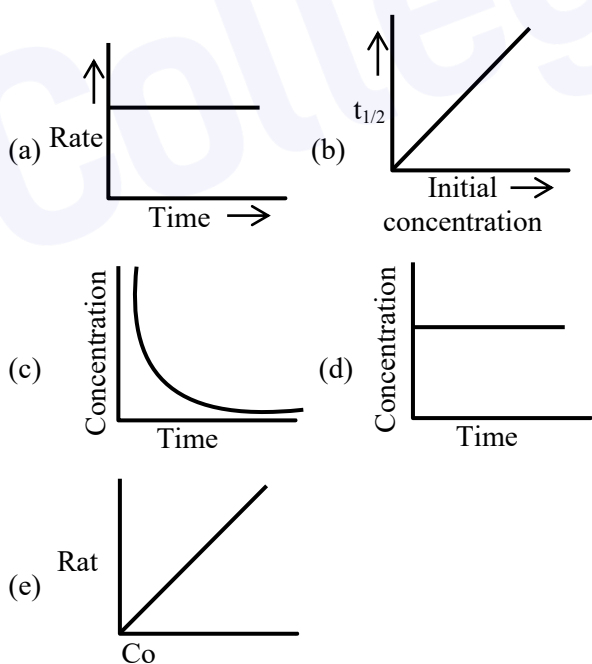
- (1) Both (A) and (R) true but (R) is not the correct explanation of (A).
- (2) (A) is false but (R) is true.
- (3) Both (A) and (R) true and (R) is correct explanation of (A).
- (4) (A) is true but (R) is false.

Official Ans. by NTA (3)

Sol. Gabriel phthalamide synthesis



10. For the following graphs,

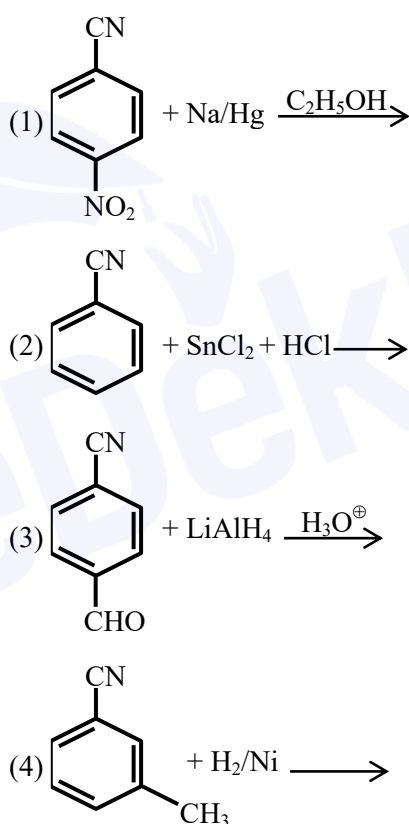


Choose from the options given below, the **correct** one regarding order of reaction is :

- (1) (b) zero order (c) and (e) First order
- (2) (a) and (b) Zero order (e) First order
- (3) (b) and (d) Zero order (e) First order
- (4) (a) and (b) Zero order (c) and (e) First order

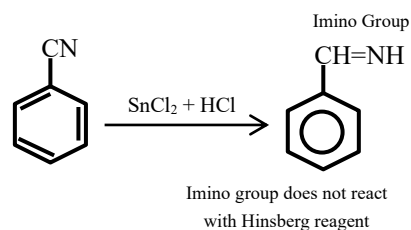
Official Ans. by NTA (4)

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



Official Ans. by NTA (2)

Sol.



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

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

Official Ans. by NTA (3)

Sol. Al^{3+} , Mg^{2+} and Na^+ are isoelectronic ionic species.

For monoatomic ionic isoelectronic species as positive charge increases ionic size decreases.

The order of size of Na^+ & K^+ is $Na^+ < K^+$,

\therefore order of ionic radii is : $Al^{3+} < Mg^{2+} < Na^+ < K^+$

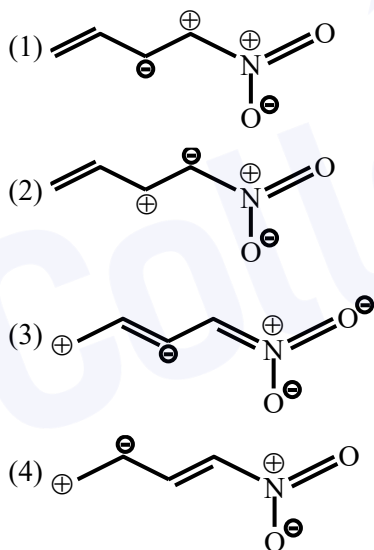
13. Which one of the following compounds of Group-14 elements is **not** known?

- (1) $[GeCl_6]^{2-}$
- (2) $[Sn(OH)_6]^{2-}$
- (3) $[SiCl_6]^{2-}$
- (4) $[SiF_6]^{2-}$

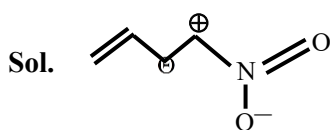
Official Ans. by NTA (3)

Sol. $[SiCl_6]^{2-}$ does not exist due to steric crowding of surrounding atoms.

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



Official Ans. by NTA (1)



It is unstable RS (due to similar charge on adjacent atom)

15. 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** is correct but **Statement II** is incorrect.
- (2) **Statement I** is incorrect but **Statement II** is correct.
- (3) **Statement I** and **Statement II** both are incorrect.
- (4) **Statement I** and **Statement II** both are correct.

Official Ans. by NTA (2)

Sol. Statement-I is incorrect

$Be(OH)_2$ dissolve in alkali due to its amphoteric nature.

Statement-II is correct

Solubility of alkaline earth metal hydroxide in water increases down the group due to rapid decreases in lattice energy as compared to hydration energy.

16. 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) $(d) > (a) > (b) > (c) > (e)$

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

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

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

Official Ans. by NTA (3)

Sol. (a) CrO_3 (d) V_2O_5

(b) Fe_2O_3 (e) Cu_2O

(c) MnO_2

So order of oxidation state

$a > d > c > b > e$

3. A source of monochromatic radiation of wavelength 400 nm 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 nm is sufficient for ejection of electron from the surface of sodium metal. The value of x is _____ . (Nearest integer)

$$(h = 6.626 \times 10^{-34} \text{ Js})$$

Official Ans. by NTA (2)

Sol. Total energy provided by

$$\text{Source per second} = \frac{1000}{10} = 100 \text{ J}$$

$$\text{Energy required to eject electron} = \frac{hc}{\lambda}$$

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

Number of electrons ejected

$$= \frac{100}{\frac{6.626 \times 10^{-34} \times 3 \times 10^8}{400 \times 10^{-9}}}$$

$$= \frac{400 \times 10^{-7} \times 10^{26}}{6.626 \times 3}$$

$$= \frac{40 \times 10^{-20}}{6.626 \times 3}$$

$$= 2.01 \times 10^{20}$$

4. 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)

Official Ans. by NTA (25)

Sol. From Henry's law

$$P_{\text{gas}} = K_H \cdot X_{\text{gas}}$$

$$0.835 = 1.67 \times 10^3 \times \frac{n(\text{CO}_2)}{0.9 \times 1000}$$

$$n(\text{CO}_2) = 0.025$$

$$\text{Millimoles of } \text{CO}_2 = 0.025 \times 1000 = 25$$

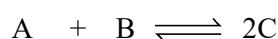
5. For the reaction, $\text{A} + \text{B} \rightleftharpoons 2\text{C}$

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)

Official Ans. by NTA (25)

5. **Sol.**



$$\begin{array}{ccc} 1 & 1 & 1 \\ -x & -x & 2x \end{array}$$

$$\frac{1-x}{1-x} \quad \frac{1-x}{1-x} \quad \frac{1+2x}{1+2x}$$

$$K = \frac{[\text{C}]_{\text{eq}}^2}{[\text{A}]_{\text{eq}}[\text{B}]_{\text{eq}}} = \frac{(1+2x)^2}{(1-x)(1-x)}$$

$$100 = \left(\frac{1+2x}{1-x} \right)^2$$

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

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

$$[\text{C}]_{\text{eq}} = 1 + 2x$$

$$= 1 + 2 \left(\frac{3}{4} \right)$$

$$= 2.5 \text{ M}$$

$$25 \times 10^{-1} \text{ M}$$

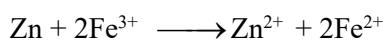
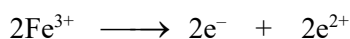
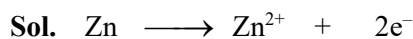
6. Consider the cell at 25°C



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 : $E_{\text{Fe}^{3+}/\text{Fe}^{2+}}^0 = 0.77\text{V}$, $E_{\text{Zn}^{2+}/\text{Zn}}^0 = -0.76\text{V}$)

Official Ans. by NTA (24)



$$E_{\text{cell}}^0 = 0.77 - (0.76)$$

$$= 1.53 \text{ V}$$

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

$$\log \left(\frac{[\text{Fe}^{2+}]}{[\text{Fe}^{3+}]} \right) = \frac{0.03}{0.06} = \frac{1}{2}$$

$$\frac{[\text{Fe}^{2+}]}{[\text{Fe}^{3+}]} = 10^{1/2} = \sqrt{10}$$

$$\frac{[\text{Fe}^{3+}]}{[\text{Fe}^{2+}]} = \frac{1}{\sqrt{10}}$$

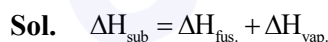
$$\frac{[\text{Fe}^{3+}]}{[\text{Fe}^{2+}] + [\text{Fe}^{3+}]} = \frac{1}{1 + \sqrt{10}} = \frac{1}{4.16}$$

$$= 0.2402$$

$$= 24 \times 10^{-2}$$

7. 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)

Official Ans. by NTA (101)



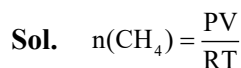
$$= 2.8 + 98.2$$

$$= 101 \text{ kJ/mol}$$

8. A home owner uses $4.00 \times 10^3 \text{ m}^3$ of methane (CH₄) gas, (assume CH₄ 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 $x \times 10^5 \text{ g}$. The value of x is _____ . (Nearest integer)

(Given R = 0.083 L atm K⁻¹ mol⁻¹)

Official Ans. by NTA (26)



$$= \frac{1 \times 4 \times 10^3 \times 1000}{0.083 \times 300}$$

Weight of CH₄

$$= \frac{40 \times 16 \times 10^5}{0.083 \times 300} \text{ gm}$$

$$= 25.7 \times 10^5 \text{ gm}$$

9. When 10 mL of an aqueous solution of Fe²⁺ ions was titrated in the presence of dil H₂SO₄ using diphenylamine indicator, 15 mL of 0.02 M solution of K₂Cr₂O₇ was required to get the end point. The molarity of the solution containing Fe²⁺ ions is $x \times 10^{-2} \text{ M}$. The value of x is _____ . (Nearest integer)

Official Ans. by NTA (18)

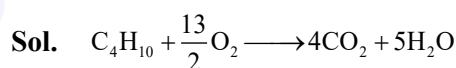
- Sol.** milli-equivalents of Fe²⁺ = milli-equivalents of K₂Cr₂O₇

$$M \times 10 \times 1 = 0.02 \times 15 \times 6$$

$$M = 0.18 = 18 \times 10^{-2} \text{ M}$$

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

Official Ans. by NTA (464)



$$\text{Moles of H}_2\text{O} = \frac{72}{18} = 4$$

$$\text{Moles of C}_4\text{H}_{10} \text{ used} = \frac{1}{5} \times 4$$

$$\text{Weight of C}_4\text{H}_{10} \text{ used} = \frac{4}{5} \times 58$$

$$= 46.4 \text{ gm}$$