If K_1 & K_2 be first and second ionization constant of H_3PO_4 and $K_1 >> K_2$ which is incorrect

(A) $[H^+] = [H_2PO_4^-]$ (B) $[H^+] = \sqrt{K_1[H_3PO_4]}$

(C) $K_2 = [HPO_4^{2-}]$ (D) $[H^+] = 3[PO_4^{3-}]$

Sol D

$H_3PO_4 \overset{K_1}{\rightleftharpoons} H_2PO_4^- + H^+$

C — — x

$C - x$ — — x

$H_2PO_4^- \overset{K_2}{\rightleftharpoons} HPO_4^{2-} + H^+$

$x - y$ — y — $x + y + z$

$\downarrow x$ — y — (x)

$HPO_4^- \overset{K_3}{\rightleftharpoons} PO_4^{3-} + H^+$

$y - z$ — z — $x + y + z$

x — (x) same (x)

As we know,

$K_1 >> K_2 >> K_3$ → implies: $x >> y >> z$

$$K_1 = \frac{[H_2PO_4^-][H^+]}{[H_3PO_4]} = \frac{x \times x}{[H_3PO_4]}$$

$$\therefore x = \sqrt{K_1[H_3PO_4]} = [H^+]$$

$$K_2 = \frac{[HPO_4^{2-}][H^+]}{[H_2PO_4^-]} = \frac{y \times x}{x} = y$$

$$\therefore K_2 = y = [HPO_4^{2-}]$$

NOTE:) $x \neq 3z$. ∴ D) incorrect option

The first and second dissociation constants of an acid H_2A are 1.0×10^{-5} and 5.0×10^{-10} respectively. The overall dissociation constant of the acid will be:

(A) 5.0×10^{-5} (B) 5.0×10^{15}

(C) 5.0×10^{-15} (D) 0.2×10^{5}

Sol C

R_1 $H_2A \xrightleftharpoons{K_1} HA^- + H^+$

R_2 $HA^- \xrightleftharpoons{K_2} A^{2-} + H^+$

R_3 $H_2A \xrightleftharpoons{K_3} 2H^+ + A^{2-}$

$R_3 = R_1 + R_2$

$K_3 = K_1 \times K_2$

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

$K_3 = 5 \times 10^{-15}$

K_3 Overall dissociation constant.

If equilibrium constant of

$CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$

Is 1.8×10^{-5}, equilibrium constant for

$CH_3COOH + OH^- \rightleftharpoons CH_3COO^- + H_2O$ is

(A) 1.8×10^{-9} (B) 1.8×10^{9}

(C) 5.55×10^{-9} (D) 5.55×10^{10}

Sol B

$$CH_3COOH + H_2O \overset{K_1}{\rightleftharpoons} CH_3COO^- + H_3O^+$$

$$K_1 = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]}$$

$$CH_3COOH + OH^- \overset{K_2}{\rightleftharpoons} CH_3COO^- + H_2O$$

$$K_2 = \frac{[CH_3COO^-]}{[CH_3COOH][OH^-]}$$

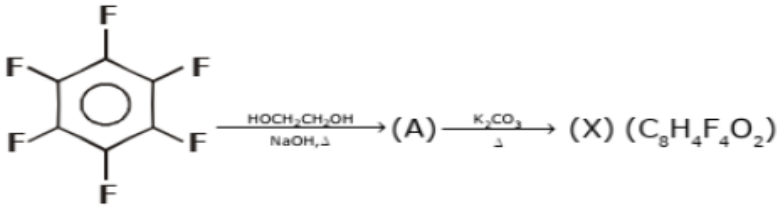
Multiply & divide by $[H^+]$ in K_2

$$K_2 = \frac{[CH_3COO^-] \times [H^+]}{[CH_3COOH][OH^-][H^+]}$$

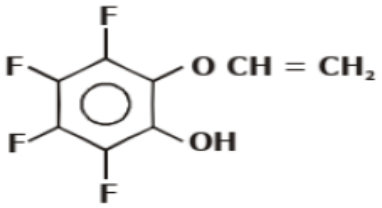
$[CH_3COOH][OH^-][H^+]$ in the denominator: $[CH_3COOH][OH^-]$ is K_1, $[H^+][OH^-]$ is K_w

$$K_2 = \frac{K_1}{K_w} = \frac{1.8 \times 10^{-5}}{10^{-14}} = 1.8 \times 10^{9}$$

The cumulative effect of their fluorine activate the rings of penta and hexa fluorobenzene toward nucleophilic aromatic substituiton. What is compound X in the following synthesis ?



Sol C

(A)


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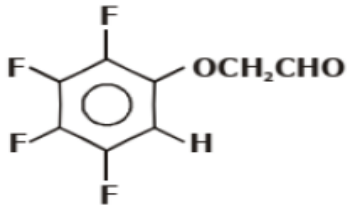

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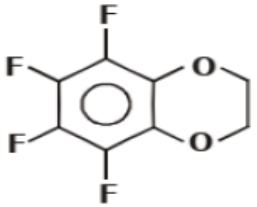
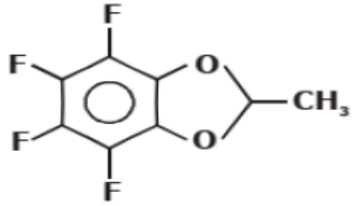
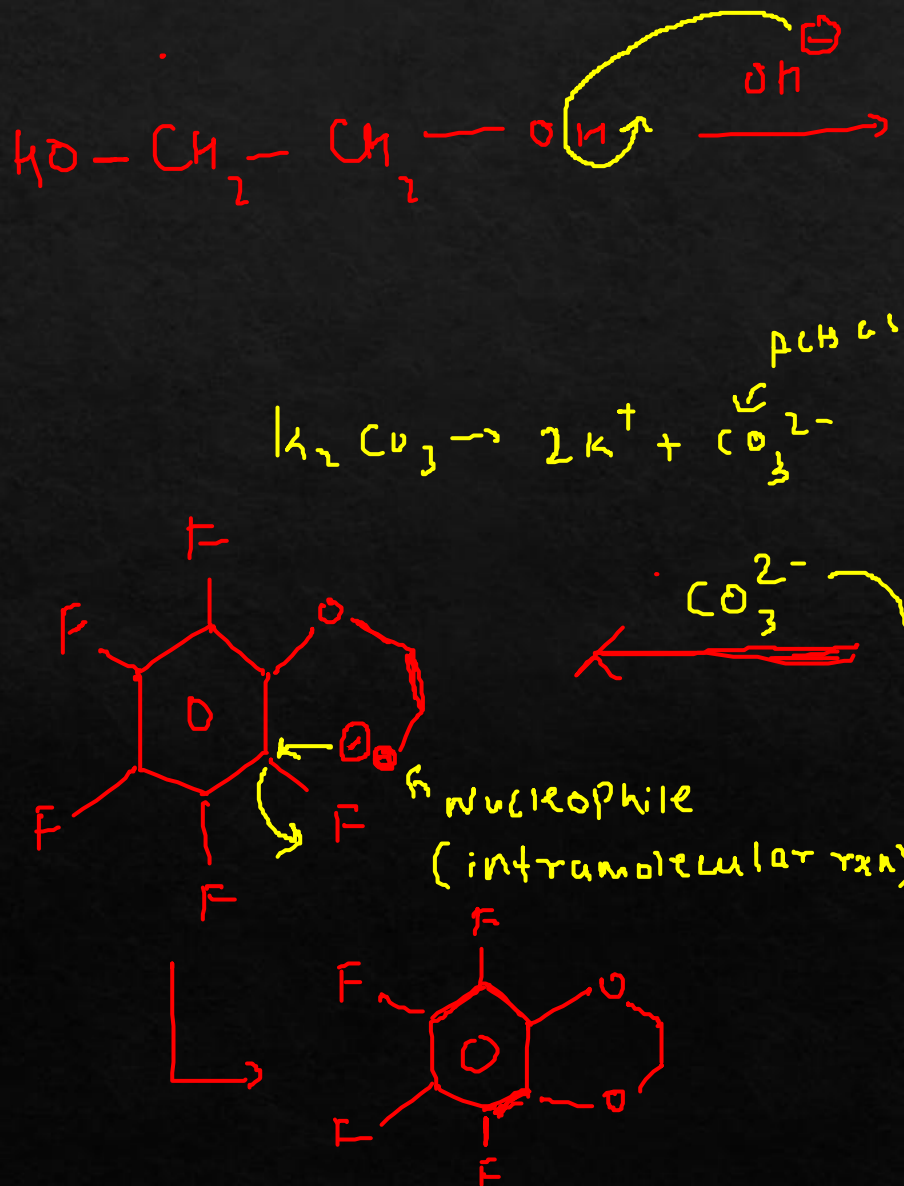
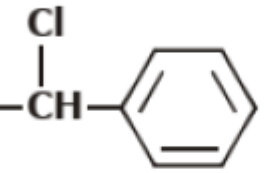
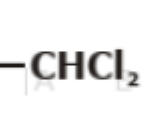


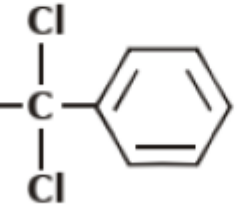
(D)


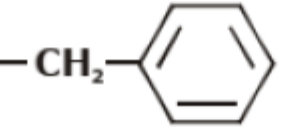


WHich of the following structures correspond to the product expected, when excess of C_6H_6 reacts with CH_2Cl_2 in presence of anhydrous $AlCl_3$?

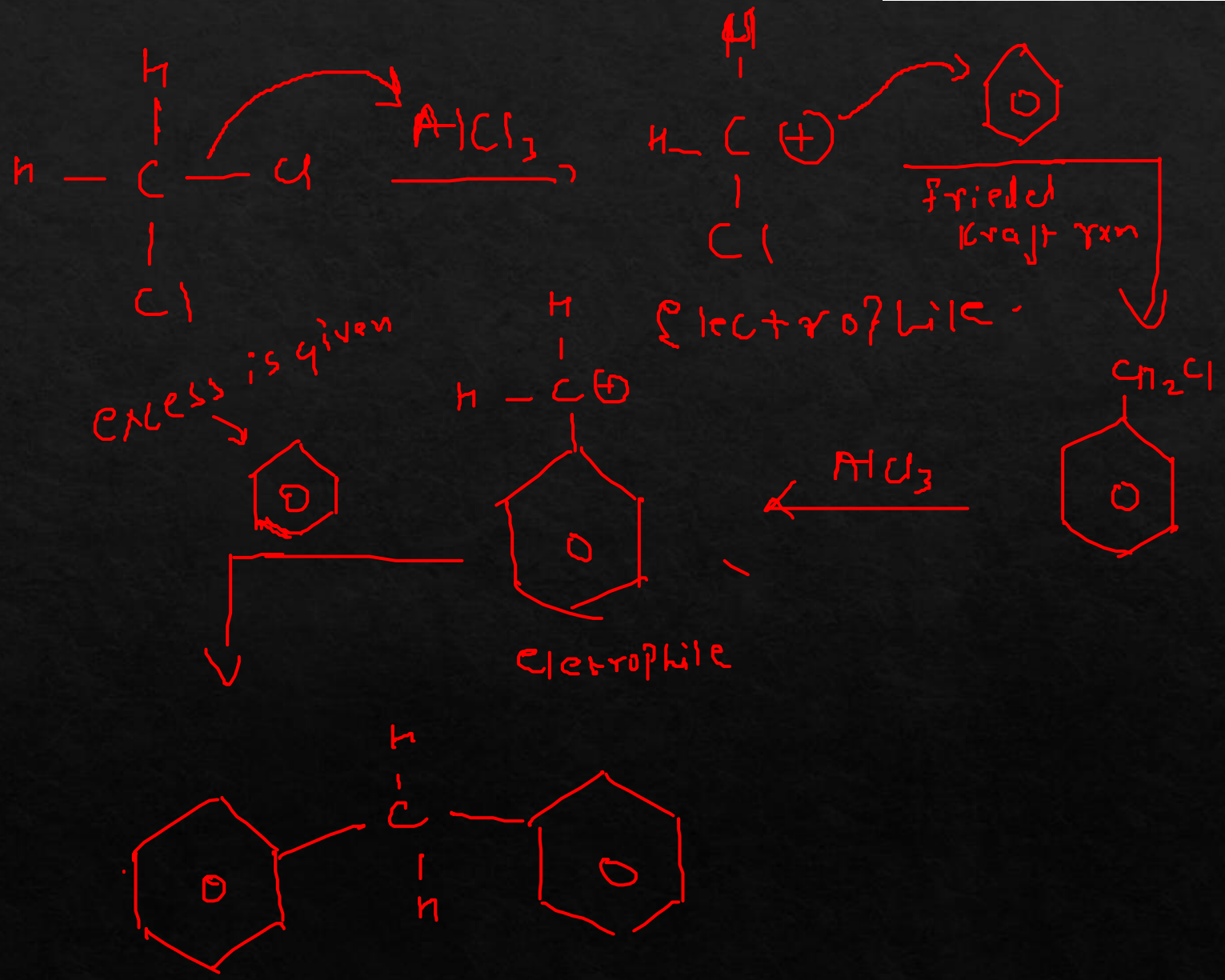
(A) 

(B) 

(C) 

(D) 

Sol D



pH of saturated solution of silver salt of monobasic acid HA is found to be 9.

Find the K_{sp} of sparingly soluble salt Ag A(s).

Given : $K_a(HA) = 10^{-10}$

(A) 1.1×10^{-11} (B) 1.1×10^{-10}

(C) 10^{-12} (D) None of these

Sol A

$AgA \longrightarrow Ag^+ + A^-$

$S \quad S$

$A^- + H-O-H \underset{K_h = \frac{K_w}{K_a}}{\overset{\text{salt hydrolysis}}{\rightleftharpoons}} HA + OH^-$

$S - x \quad x \quad x$

As $pH = 9 \Rightarrow pOH = 5$

$\therefore [OH^-] = x = 10^{-5}$

$K_h = \frac{K_w}{K_a} = \frac{[HA][OH^-]}{[A^-]} = \frac{x^2}{(S-x)}$

$\therefore \frac{10^{-14}}{10^{-10}} = \frac{10^{-10}}{(S - 10^{-5})}$

$\Rightarrow$ Solve & get S

$K_{sp} = S^2$

If 40 ml of 0.2 M KOH is added to 160 ml of 0.1 M HCOOH [Ka = 2×10^{-4}]. The pOH of the resulting solution is

(A) 3.4 (B) 3.7 (C) 7 (D) 10.3

Sol D

$$HCOOH + KOH \longrightarrow HCOOK + H_2O$$

mmoles 16 8

8 0 8

$$\therefore \frac{1}{10} < \frac{[salt]}{[Acid]} < 10$$

w.A dissociation — Buffer soln — salt hydrolysis

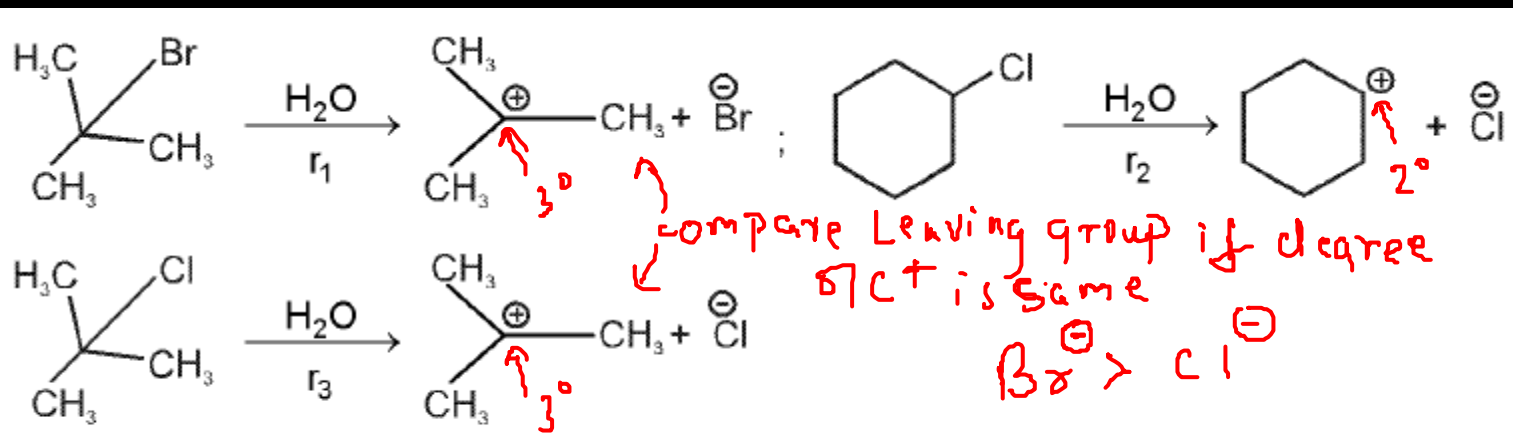
$$\therefore pH = pK_a + \log \frac{[salt]}{[Acid]}$$

$$= \log[2\times10^{-4}] + \log 1$$

$$= 4 - \log 2 + 0$$

$$pH = 3.7$$

$$pOH = 14 - 3.7 = 10.3$$



The rates r_1 , r_2 and r_3 are in the order :

(A) $r_1 > r_2 > r_3$ (B) $r_3 > r_1 > r_2$ (C) $r_1 > r_3 > r_2$ (D) $r_2 > r_1 > r_3$

S_N1 Note Rate $\propto$ Stability of Carbocation (C^+)

↳ i.e $3^\circ > 2^\circ > 1^\circ$

$\propto$ Leaving group.

If pK_b for fluoride ion at 25°C is 10.83, the ionisation constant of hydrofluoric acid in water at this temperature is :

(A) 1.74×10^{-5} (B) 3.52×10^{-3}

(C) 6.75×10^{-4} (D) 5.38×10^{-2}

Sol C

$\therefore \quad pK_a + pK_b = pK_w$

$pK_a + 10.83 = 14$

$pK_a = 4.83$

NOTE :- for Conjugate acid - base pairs,

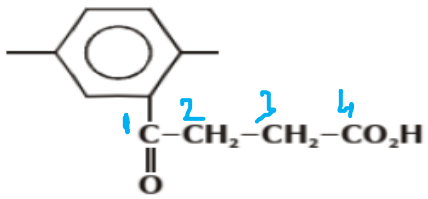
$K_a \times K_b = K_w$

$HF \rightleftharpoons H^+ + F^-$

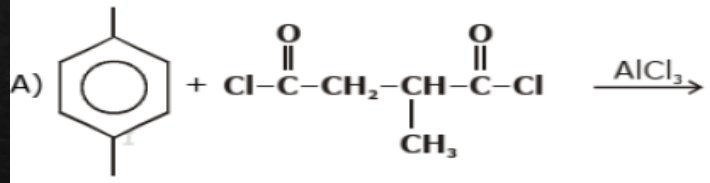
HF: Acid

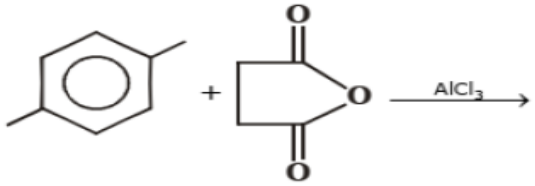
F^-: Conjugate base

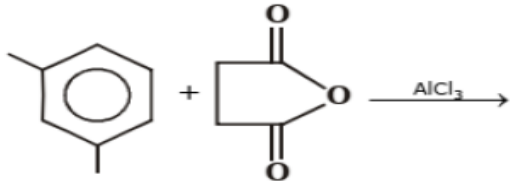
What combiantion of acid chloride or anhydride and arene would you choose to prepare given compound ?

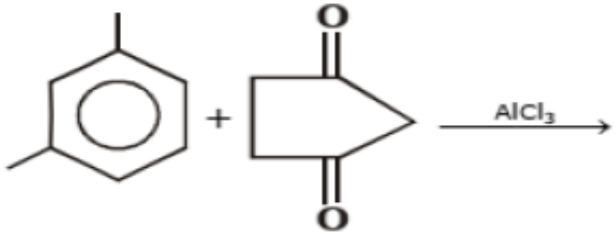


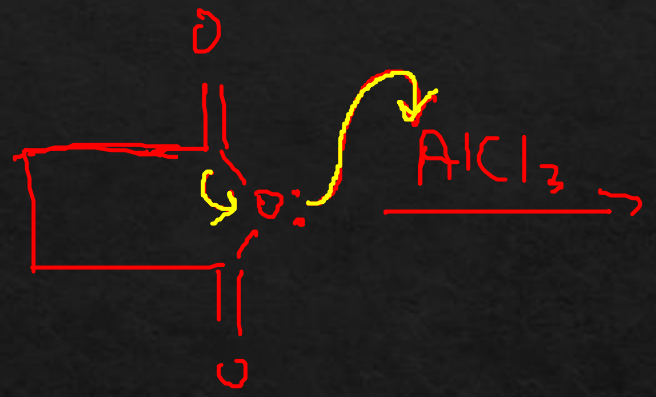
Sol B

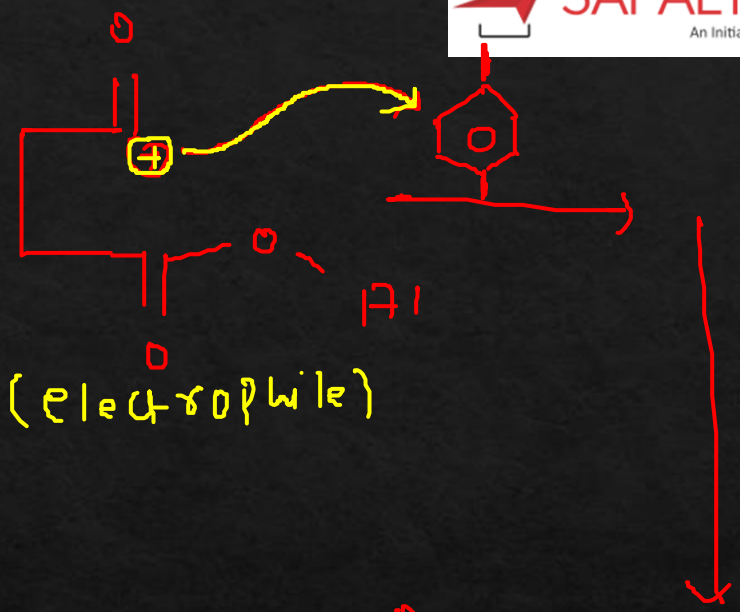
A) 

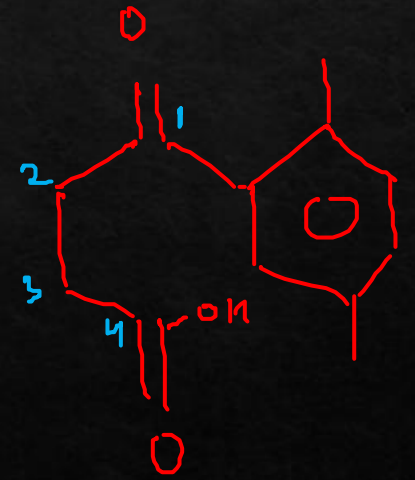
(B) 

(C) 

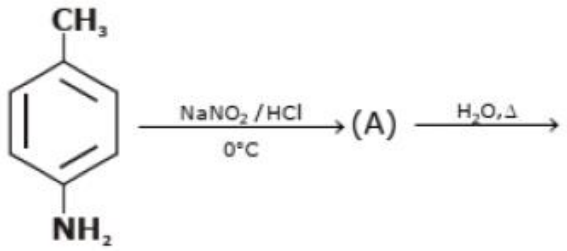
(D) 

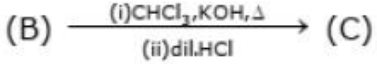


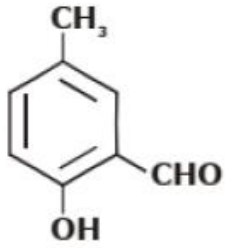


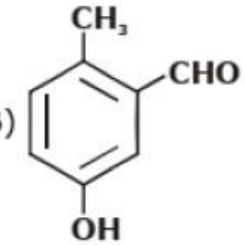


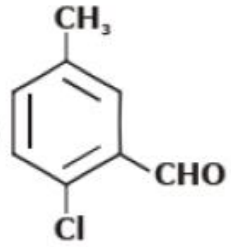
Identify (C) in the reaction(s)



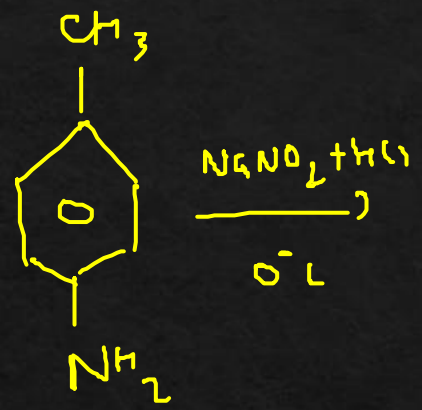


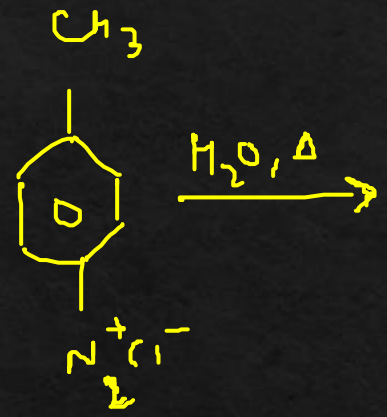
(A) 

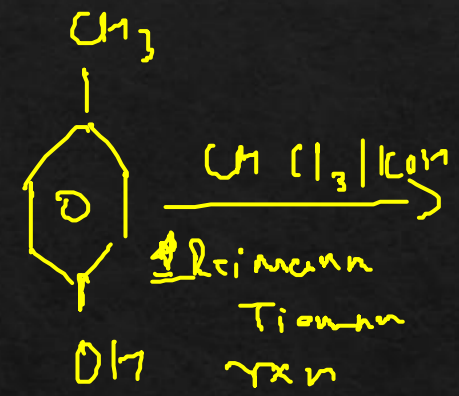
(B) 

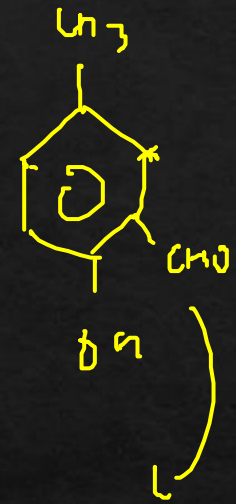
(C) 

(D) None of these









NOTE:- :C(Cl)Cl is electrophile

Sol A