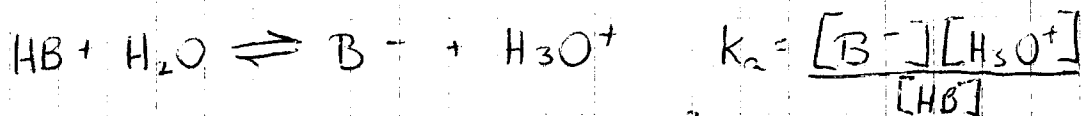


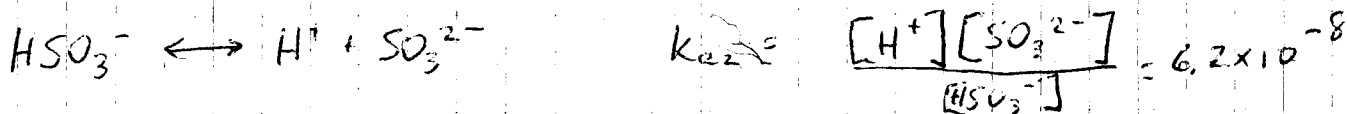
Acid # 1  
Acid HB



$$[\text{H}_3\text{O}^+] = [\text{B}^-] \quad K_a = \frac{[\text{H}_3\text{O}^+]^2}{[\text{HB}]}$$

$$K_a [\text{HB}] = [\text{H}_3\text{O}^+]^2$$

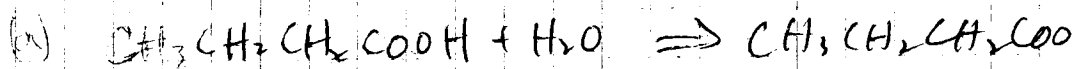
$$[\text{H}_3\text{O}^+] = \sqrt{K_a [\text{HB}]}$$



$$K_a = K_{a1} \times K_{a2}$$

$$\frac{[\text{H}^+][\text{HSO}_3^-]}{[\text{H}_2\text{SO}_3]} \times \frac{[\text{H}^+][\text{SO}_3^{2-}]}{[\text{HSO}_3^-]} = \frac{[\text{H}^+]^2 [\text{SO}_3^{2-}]}{[\text{H}_2\text{SO}_3]} = K_a$$

$$K_a = 1.7 \times 10^{-2} \times 6.2 \times 10^{-8} = 1.1 \times 10^{-9}$$



$$(b) \quad K_a = 1.54 \times 10^{-5} = \frac{[\text{H}_3\text{O}^+][\text{CH}_3\text{CH}_2\text{CH}_2\text{COO}^-]}{[\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}]}$$

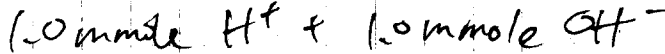
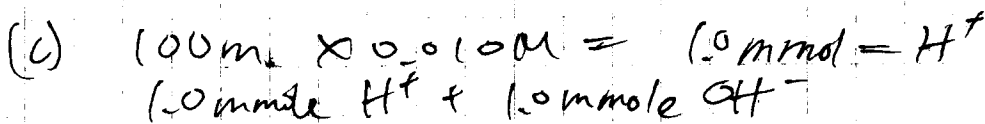
$$\text{let } x = [\text{H}_3\text{O}^+] = [\text{CH}_3\text{CH}_2\text{CH}_2\text{COO}^-]$$

$$\text{then } [\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}] = 0.010 \text{ M} - x$$

$$1.54 \times 10^{-5} = \frac{x^2}{0.010}$$

$$\therefore x = [\text{H}_3\text{O}^+] = 3.92 \times 10^{-4}$$

$$\text{pH} = 3.41$$



$$\text{Vol NaOH} = \frac{1.0 \text{ mmol}}{0.35 \text{ M}} = 2.86 \text{ mL} = 2.9 \text{ mL}$$

(d)  $H_2O$  water

$NaCH_3CH_2CH_2COO$  sodium butanoate

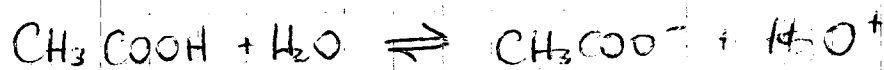
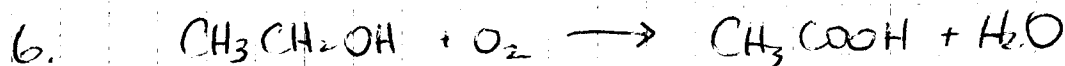
4. # of moles  $(50\text{ mL} \times 0.50\text{ M}) + (100\text{ mL} \times 0.25\text{ M}) = 50\text{ mmoles}$

$$[H_2SO_4] = \frac{50\text{ mmoles}}{50\text{ mL} + 100\text{ mL}} = 0.33\text{ M}$$

5. Fumaric Acid  $\rightarrow$  HFum.



as sodium hydroxide reacts with  $H^+$  to produce water  $[H^+]$  decreases and equilibrium shifts to products causing more fumaric acid to dissolve as the titration proceeds.



$$K_a = 1.8 \times 10^{-5} = \frac{[CH_3COO^-][H_3O^+]}{[CH_3COOH]}$$

$$[H_3O^+] = [CH_3COO^-] = \text{antilog } -2.80 = 1.58 \times 10^{-3}\text{ M}$$

$$[CH_3COOH] = X - 1.58 \times 10^{-3}\text{ M}$$

$$1.8 \times 10^{-5} = \frac{(1.58 \times 10^{-3})^2}{X - 1.58 \times 10^{-3}}$$

$$X = 1.40 \times 10^{-1}\text{ M}$$

amount of ethanoic acid in 1 litre = 0.140 moles

0.140 moles of ethanoic

0.140 moles  $\times$  46 g/mols = 6.4 grams