

Weak Acids

$$\begin{aligned} \textcircled{1} \quad [H^+] &= 10^{-\text{pH}} \\ &= 10^{-2.78} \\ &= 0.00166 \text{ mol/L} \end{aligned}$$

$$\begin{aligned} p &= \frac{[H^+]}{[HC_3H_7O_2]} \times 100\% \\ &= \frac{0.00166}{0.05} \times 100\% \end{aligned}$$

$$p = \boxed{3.32\%}$$

$$\begin{aligned} \textcircled{2} \quad [H^+] &= 10^{-2.54} \\ &= 0.00288 \text{ mol/L} \end{aligned}$$

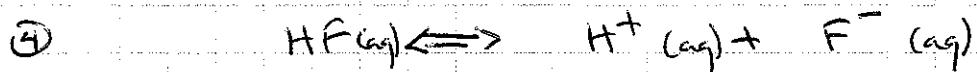
$$\begin{aligned} p &= \frac{[H^+]}{[CH_3COOH]} \times 100\% \\ &= \frac{0.00288}{0.46} \times 100\% \end{aligned}$$

$$p = \boxed{0.63\%}$$

$$\begin{aligned} \textcircled{3} \quad [H^+] &= 10^{-2} \\ &= 0.01 \text{ mol/L} \end{aligned}$$

$$\begin{aligned} p &= \frac{[H^+]}{[HF]} \times 100\% \\ &= \frac{0.01}{0.15} \times 100\% \end{aligned}$$

$$p = \boxed{6.67\%}$$



$$\text{I} \quad 0.1 \quad 0 \quad 0$$

$$\text{C} \quad -x \quad +x \quad +x$$

$$\text{E} \quad 0.1-x \quad x \quad x$$

$$x = 7.8\% \text{ of } [\text{HF}]$$

$$= (0.1)(0.078)$$

$$x = 0.0078$$

$$[\text{HF}]_{\text{eq}} = 0.1 - x$$

$$= 0.1 - 0.0078$$

$$= 0.0922 \text{ mol/L}$$

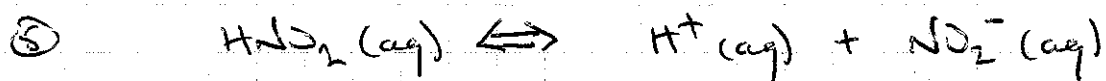
$$[\text{H}^+] = [\text{F}^-] = x$$

$$= 0.0078 \text{ mol/L}$$

$$K_a = \frac{[\text{H}^+][\text{F}^-]}{[\text{HF}]}$$

$$= \frac{(0.0078)(0.0078)}{(0.0922)}$$

$$K_a = \boxed{6.6 \times 10^{-4}}$$



$$\text{I} \quad 0.2 \quad 0 \quad 0$$

$$\text{C} \quad -x \quad +x \quad +x$$

$$\text{E} \quad 0.2-x \quad x \quad x$$

$$x = 5.8\% \text{ of } [\text{HNO}_2]$$

$$= (0.058)(0.2)$$

$$x = 0.0116$$

$$[\text{HNO}_2] = 0.2 - x$$

$$= 0.2 - 0.0116$$

$$= 0.1884 \text{ mol/L}$$

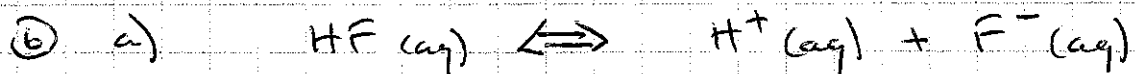
$$[\text{H}^+] = [\text{NO}_2^-] = x$$

$$= 0.0116 \text{ mol/L}$$

$$K_a = \frac{[\text{H}^+][\text{NO}_2^-]}{[\text{HNO}_2]}$$

$$= \frac{(0.0116)(0.0116)}{(0.1884)}$$

$$K_a = \boxed{7.1 \times 10^{-4}}$$



I	0.1	0	0
C	-x	+x	+x
E	0.1-x	x	x

$$K_a = \frac{[\text{H}^+][\text{F}^-]}{[\text{HF}]}$$

$$6.7 \times 10^{-4} = \frac{(x)(x)}{(0.1-x)}$$

$$6.7 \times 10^{-4} = \frac{x^2}{0.1}$$

$$x = \sqrt{(0.1)(6.7 \times 10^{-4})}$$

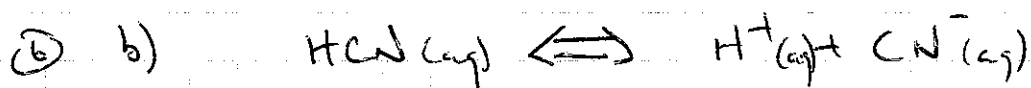
$$x = 0.00818$$

$$[\text{H}^+] = \boxed{0.00818 \text{ mol/L}}$$

Since K_a is small,
x will be small

Thus

$$0.1 - x \approx 0.1$$



I	0.1	0	0
C	-x	+x	+x
E	0.1-x	x	x

$$K_a = \frac{[\text{H}^+][\text{CN}^-]}{[\text{HCN}]}$$

$$4.9 \times 10^{-10} = \frac{(x)(x)}{(0.1-x)}$$

Since K_a is small,
x will be small.

Thus

$$0.1 - x \approx 0.1$$

$$4.9 \times 10^{-10} = \frac{x^2}{0.1}$$

$$x = \sqrt{(0.1)(4.9 \times 10^{-10})}$$

$$x = 7 \times 10^{-6}$$

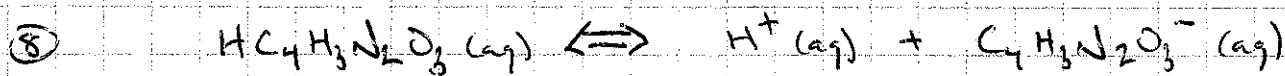
$$[\text{H}^+] = \boxed{7 \times 10^{-6} \text{ mol/L}}$$

c) HF is more acidic

$$\textcircled{7} \quad p = \frac{[H^+]}{[CH_3CH_2COOH]} \times 100\%$$

$$= \frac{1.16 \times 10^{-3}}{0.1} \times 100\%$$

$$p = \boxed{1.16\%}$$



I	0.25	0	0
C	-x	+x	+x
E	0.25 - x	x	x

$$K_a = \frac{[H^+][C_4H_9N_2O_3^-]}{[HC_4H_9N_2O_3]}$$

$$9.8 \times 10^{-5} = \frac{(x)(x)}{(0.25 - x)}$$

$$9.8 \times 10^{-5} = \frac{x^2}{0.25}$$

$$x = \sqrt{(0.25)(9.8 \times 10^{-5})}$$

$$x = 0.00495$$

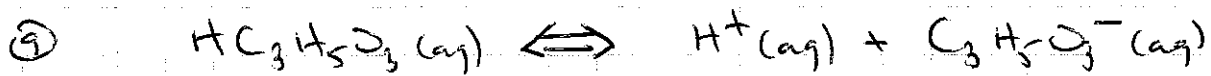
$$[H^+] = \boxed{0.00495 \text{ mol/L}}$$

Since K_a is small, x will be small. Thus,

$$0.25 - x \approx 0.25$$

$$pH = -\log(0.00495)$$

$$pH = \boxed{2.31}$$



I	0.025	0	0
C	-x	+x	+x
E	0.025 - x	x	x

$$K_a = \frac{[\text{H}^+][\text{C}_3\text{H}_5\text{O}_3^-]}{[\text{HC}_3\text{H}_5\text{O}_3]}$$

$$1.4 \times 10^{-4} = \frac{(x)(x)}{(0.025 - x)}$$

Since K_a is small,
 x will be small.

Thus

$$0.025 - x \approx 0.025$$

$$1.4 \times 10^{-4} = \frac{x^2}{0.025}$$

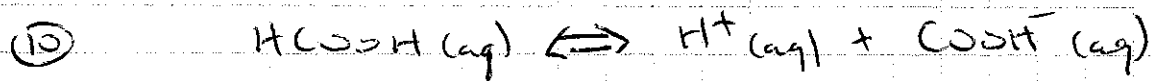
$$x = \sqrt{(0.025)(1.4 \times 10^{-4})}$$

$$x = 0.00187$$

$$[\text{H}^+] = 0.00187 \text{ mol/L}$$

$$\text{pH} = -\log(0.00187)$$

$$\text{pH} = \boxed{2.73}$$



I	0.15	0	0
C	-x	+x	+x
E	0.15-x	x	x

$$K_a = \frac{[\text{H}^+][\text{COOH}^-]}{[\text{HCOOH}]}$$

$$1.8 \times 10^{-4} = \frac{(x)(x)}{(0.15-x)}$$

$$1.8 \times 10^{-4} = \frac{x^2}{0.15}$$

$$x = \sqrt{(0.15)(1.8 \times 10^{-4})}$$

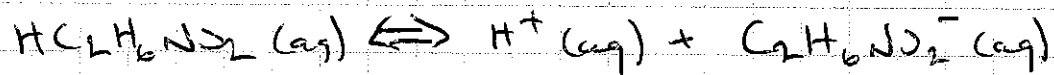
$$x = 0.0052$$

$$[\text{H}^+] = 0.0052 \text{ mol/L}$$

$$\text{pH} = -\log(0.0052)$$

$$\text{pH} = \boxed{2.28}$$

$$\begin{aligned} \textcircled{\text{ii}} \quad [H^+] &= 10^{-\text{pH}} \\ &= 10^{-3.08} \\ &= 8.31 \times 10^{-4} \text{ mol/L} \end{aligned}$$



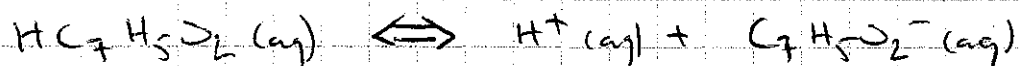
$$K_a = \frac{[H^+][C_2H_6NO_2^-]}{[HC_2H_6NO_2]} \quad [H^+] = [C_2H_6NO_2^-]$$

$$= \frac{(8.31 \times 10^{-4})(8.31 \times 10^{-4})}{(0.05)}$$

$$K_a = \boxed{1.38 \times 10^{-5}}$$

$$\textcircled{12} \quad \text{pH} = 2.40$$

$$[\text{H}^+] = 10^{-2.40} = 0.00398 \text{ mol/L}$$



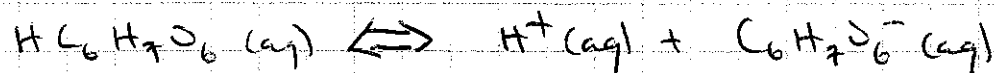
$$K_a = \frac{[\text{H}^+][\text{C}_7\text{H}_5\text{O}_2^-]}{[\text{HC}_7\text{H}_5\text{O}_2]}$$

$$[\text{H}^+] = [\text{C}_7\text{H}_5\text{O}_2^-]$$

$$= \frac{(0.00398)(0.00398)}{(0.25)}$$

$$K_a = \boxed{6.34 \times 10^{-5}}$$

$$\textcircled{13} \quad [\text{H}^+] = 10^{-2.40} = 0.00398 \text{ mol/L}$$



$$K_a = \frac{[\text{H}^+][\text{C}_6\text{H}_7\text{O}_6^-]}{[\text{HC}_6\text{H}_7\text{O}_6]}$$

$$[\text{H}^+] = [\text{C}_6\text{H}_7\text{O}_6^-]$$

$$= \frac{(0.00398)(0.00398)}{(0.2)}$$

$$K_a = \boxed{7.92 \times 10^{-5}}$$