1. Enough water is added to 0.35 g of benzoic acid ($K_a = 6.5 \times 10^{-5}$, molar mass = 122 g/mol) to make 1000 mL of solution. What is the pH of the solution? You must write out the correct chemical equation to receive credit.

$$HBz + H_2O \rightleftharpoons H_3O^+ + Bz^-$$

I. 2.87×10^{-3} NA   0   0

C. $-x$ $+x$ $+x$

E. $2.87 \times 10^{-3} - x$ x x
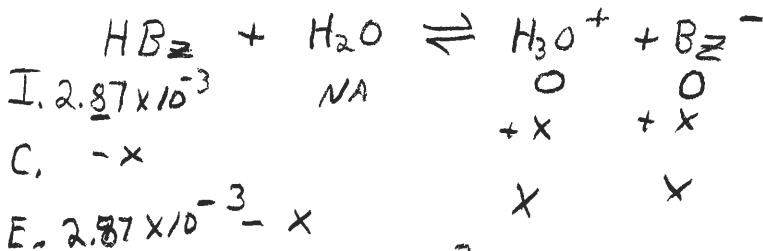
$$\frac{0.35g\, HBz}{} \cdot \frac{mol}{122g} \cdot \frac{1}{1.0L} = 2.87 \times 10^{-3} M$$

$$K_a = \frac{x^2}{2.87 \times 10^{-3} - x}$$

$$6.5 \times 10^{-5} = \frac{x^2}{2.87 \times 10^{-3} - x} \leftarrow drop?$$

If worked as quadr. eq.
$$x^2 + 6.5 \times 10^{-5} x - 1.87 \times 10^{-7} = 0$$
$$x = 4.06 \times 10^{-4}$$
$$\boxed{pH = 3.39}$$

$$x = [H_3O^+] = 4.32 \times 10^{-4} \qquad \boxed{pH = 3.36}$$
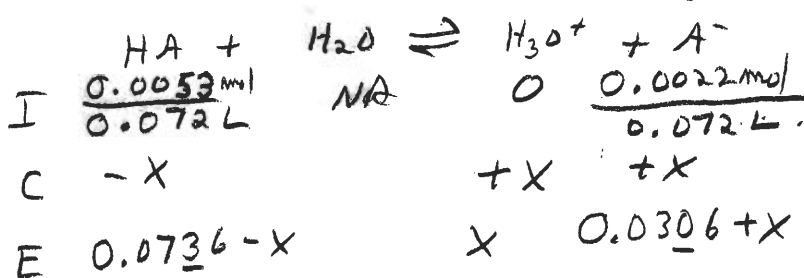
2. A 50.0 mL volume of 0.15 M $HC_2H_3O_2$ is reacted with 22.0 mL of 0.10 M NaOH. What is the pH of the resulting solution? (The K_a of acetic acid is 1.85×10^{-5}). You must write out the correct chemical equations to receive credit.

$$HC_2H_3O_2 + NaOH \rightarrow H_2O + NaC_2H_3O_2 + xs?$$
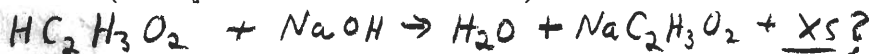
1. moles acid $\frac{50.0\,mL}{} \cdot \frac{0.15\,mol}{1000\,mL} = 0.0075\,moles\ HA$

2. moles base $\frac{22.0\,mL}{} \cdot \frac{0.10\,mol}{1000\,mL} = 0.0022\,mol\ OH^-$

$$0.0053\,mol\ xs\ HA$$

$$HA + H_2O \rightleftharpoons H_3O^+ + A^-$$

I $\frac{0.0053\,mol}{0.072\,L}$ NA   0 $\frac{0.0022\,mol}{0.072\,L}$

C $-x$ $+x$ $+x$

E $0.0736 - x$ x $0.0306 + x$

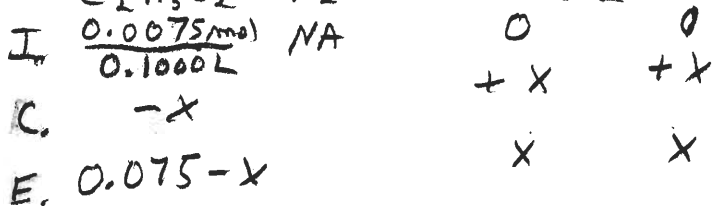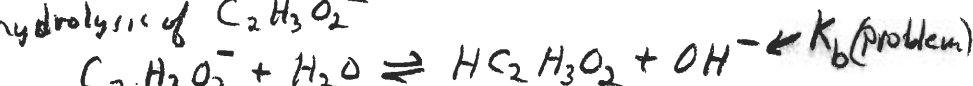$$K_a = \frac{x(0.0306 + x)}{(0.0736 - x)}$$

$$x = 4.45 \times 10^{-5} = [H_3O^+]$$

$$\boxed{pH = 4.35}$$

3. A 50.0 mL volume of 0.15 M $HC_2H_3O_2$ is reacted with 50.0 mL of 0.15 M NaOH. What is the pH of the resulting solution? (The K_a of acetic acid is 1.85×10^{-5}) You must write out the correct chemical equations to receive credit.

$$H_2C_2H_3O_2 + NaOH \rightarrow H_2O + NaC_2H_3O_2$$

moles HA = moles OH^- = 0.0075 moles

hydrolysis of $C_2H_3O_2^-$

$$C_2H_3O_2^- + H_2O \rightleftharpoons HC_2H_3O_2 + OH^- \leftarrow K_b(problem)$$

I $\frac{0.0075\,mol}{0.1000\,L}$ NA   0   0

C. $-x$ $+x$ $+x$

E. $0.075 - x$ x x

$$K_b = \frac{10^{-14}}{K_a} = 5.4 \times 10^{-10}$$

$$K_b = \frac{x^2}{0.075 - x}$$

$$x = [OH^-] = 6.37 \times 10^{-6}$$

$$pOH = 5.20$$

$$\boxed{pH = 8.80}$$