**Problem 1**

A comic book villain is holding you at gun point and is making you drink a sample of acid. She gives you a beaker with 100ml of a strong acid with pH=5. She also gives you a beaker of a strong base with a pH=10. You can add as much of the strong base to the strong acid as you want, and you must then drink the solution. How much of the base should you add?

*Answer = 10 mL*

**Problem 2**

I want to make a solution that will have $[HCOO^-] = 3[HCOOH]$. I start with 100ml of a 0.1M HCOOH solution. How many ml of a 1M KOH solution should I add?

*Answer = 75 mL*

**Problem 3**

You have two solutions, both with a concentration of 0.1M. Solution A contains a weak acid with a pKa of 5. The pH of solution A is 3. Solution B contains a weak acid with a pKa of 9. What is the pH of solution B?

*Answer = pH is 5*

**Problem 4**

You have a powder that dissolves in water to form a strong acid. You dissolve 2g of the powder in 100ml of water, and measure the pH to be 4. You would like to form 100ml of a solution with pH 5. How many grams of the powder do you dissolve in 100ml of water?

*Answer = 0.2 g*

**Problem 5**

Consider an exceptionally weak acid, HA, with a $K_a = 1 \times 10^{-20}$ . You make a 0.1M solution of the salt NaA. What is the pH?

*Answer = pH is 3.5*

**Problem 6**

Vinegar is a dilute water solution of acetic acid with small amounts of other components. Calculate the pH of bottled vinegar that is 0.667 M $HC_2H_3O_2$, assuming that none of the other components affect the acidity of the solution.

*Answer = pH is 2.46*