Calculate the molar concentration of hydroxide ions in a 400 mL solution containing 23 g of $Ca(OH)_2$.

Step 1:

First find the number of moles of $Ca(OH)_2$.

$$n = \frac{mass}{molar\ mass} = \frac{23\ g}{74.08\ g/mol} = 0.31\ mol\ Ca(OH)_2$$

Now we must realize that 2 moles of OH^- are dissolved in the solution for every mole of $Ca(OH)_2$ added.

$$0.31\ mol\ Ca(OH)_2 \frac{2\ mol\ OH^-}{1\ mol\ Ca(OH)_2} = 0.61\ mol\ OH^-$$

Step 2:

Now we divide the number of moles by the volume of the solution to get the molar concentration.

$$M = \frac{n}{V} = \frac{0.61\ mol}{0.400\ L} = 1.5\ M$$

How many grams of sodium hydroxide must be added to an 800 mL solution to make a solution of 2 M OH^-?

This problem must be worked backwards from what we have been doing before.

Step 1:

$$M = \frac{n}{V}$$

$$2\ mol/L = \frac{n\ mol}{0.8\ L}$$

$$n = 1.6\ mol$$

We don't need to worry about any stoichiometry changes during ionization for sodium hydroxide. Working back to get the mass to be added:

Step 2:

$$n = \frac{mass}{molar\ mass}$$

$$1.6\ mol = \frac{mass}{40\ g/mol}$$

$$mass = 64\ g$$

A 100 mL solution of 0.25 *M* formic acid is prepared. The K_a of formic acid is 1.77×10^{-4}.

a. What is the pH of this solution?

Only the acid is present, so the pH will be determined by the concentration of H_3O^+ present.

$$K_a = \frac{[H_3O^+][A^-]}{[HA]} \qquad \text{substituting with } [H_3O^+] = [A^-]$$

$$K_a = \frac{[H_3O^+]^2}{[HA]}$$

$$[H_3O^+] = \sqrt{K_a \times [HA]}$$

$$[H_3O^+] = \sqrt{1.77 \times 10^{-4} \times 0.25\ M}$$

$$[H_3O^+] = 6.65 \times 10^{-3}\ M$$

$$\text{pH} = -\log(6.65 \times 10^{-3}) = 2.18$$

You will only be asked to calculate either the K_a or K_b if you are given the initial concentrations or if the K_a or K_b is given along with the original concentration, you could be asked to calculate the hydroxide or hydronium concentration and then the pH of this solution.