Solutions to the Titrations Practice Worksheet

For questions 1 and 2, the units for your final answer should be "M", or "molar", because you're trying to find the molarity of the acid or base solution. To solve these problems, use $M_1V_1 = M_2V_2$.

For problem 3, you need to divide your final answer by two, because H_2SO_4 is a diprotic acid, meaning that there are two acidic hydrogen's that need to be neutralized during the titration. As a result, it takes twice as much base to neutralize it, making the concentration of the acid appear twice as large as it really is.

You cannot do a titration without knowing the molarity of at least one of the substances, because you'd then be solving one equation with two unknowns (the unknowns being M_1 and M_2).

Endpoint: When you actually stop doing the titration (usually, this is determined by a color change in an indicator or an indication of pH = 7.0 on an electronic pH probe). **Equivalence point**: When the solution is exactly neutralized. It's important to keep in mind that the equivalence point and the endpoint are not exactly the same because indicators don't change color at exactly 7.0000 pH and pH probes aren't infinitely accurate. Generally, you can measure the effectiveness of a titration by the closeness of the endpoint to the equivalence point.

1. If it takes 54.0 mL of 0.10 M NaOH to neutralize 125 mL of an HCl solution, what is the concentration of the HCl?

2. If it takes 25 mL of 0.050 M HCl to neutralize 345 mL of NaOH solution, what is the concentration of the NaOH solution?

3. If it takes 50 mL of 0.50 M KOH solution to completely neutralize 125 mL of sulfuric acid solution (H_2SO_4), what is the concentration of the H_2SO_4 solution?

4. What is the concentration of a hydrochloric acid solution if 35.00 mL of it are exactly neutralized by 14.8 mL of a 0.500 M sodium hydroxide solution?

5. What volume of 0.500 M hydrochloric acid is required to exactly neutralize 40.00 mL 0.150 M NaOH?

6. What volume of 2.500 M NaOH solution is required to neutralize 25.5 mL of a 1.200 M HNO_3 solution?

7. What is the concentration of a sodium hydroxide solution if 14.5 mL of it are exactly neutralized by 30.0 mL of a 0.500 M hydrochloric acid solution?

8. Phosphoric acid is neutralized by potassium hydroxide according to the following reaction:

$$KOH(aq) + H_3PO_4(aq) \rightarrow K_3PO_4(aq) + H_2O(l)$$
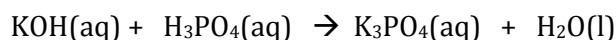
What is the concentration of a phosphoric acid solution if 25.0 mL are exactly neutralized by 20.0 mL of 2.000 M KOH solution?

9. Hydrochloric acid is neutralized by calcium hydroxide according to the following reaction:

$$Ca(OH)_2(aq) + 2\,HCl\,(aq) \rightarrow CaCl_2(aq) + 2\,H_2O(l)$$
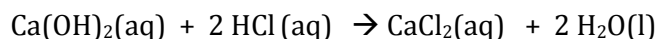
What is the concentration of a calcium hydroxide solution if 15.0 mL are exactly neutralized by 10.00 mL of 0.250 M HCl solution?
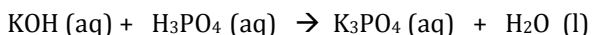
10.   Acid spills are often neutralized with sodium carbonate. For example

$$Na_2CO_3(s) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + CO_2\,(g) + H_2O(l)$$

An instructor dropped a 2.50 L bottle of 18.0 M H_2SO_4 on a cement floor. How much (mass) sodium carbonate would be required to neutralize it?

Neutralization Worksheet #1

1. If it takes 54 mL of 0.10 M NaOH to neutralize 125 mL of an HCl solution, what is the concentration of the HCl? [HCl] = 0.043 M

2. If it takes 25 mL of 0.05 0M HCl to neutralize 345 mL of NaOH solution, what is the concentration of the NaOH solution? [NaOH] = 0.0036 M

3. If it takes 50 mL of 0.50 M KOH solution to completely neutralize 125 mL of sulfuric acid solution (H_2SO_4), what is the concentration of the H_2SO_4 solution? [HCl] = 0.10 M

4. What is the concentration of a hydrochloric acid solution if 35.00 mL of it are exactly neutralized by 14.8 mL of a 0.500 M sodium hydroxide solution? 0.211 M HCl

5. What volume of 0.500 M hydrochloric acid is required to exactly neutralize 40.00 mL 0.150 M NaOH? 12 mL HCl

6. What volume of 2.500 M NaOH solution is required to neutralize 25.5 mL of a 1.200 M HNO_3 solution? 12.2 mL NaOH

7. What is the concentration of a sodium hydroxide solution if 14.5 mL of it are exactly neutralized by 30.0 mL of a 0.500 M hydrochloric acid solution? 1.03 M NaOH

8. Phosphoric acid is neutralized by potassium hydroxide according to the following reaction:

    KOH (aq) + H_3PO_4 (aq) → K_3PO_4 (aq) + H_2O (l)

    What is the concentration of a phosphoric acid solution if 25.0 mL are exactly neutralized by 20.0 mL of 2.000 M KOH solution? 0.533 M [H_3PO_4]

9. Hydrochloric acid is neutralized by calcium hydroxide according to the following reaction:

    $Ca(OH)_2$ (aq) + 2 HCl (aq) → $CaCl_2$(aq) + 2 H_2O (l)
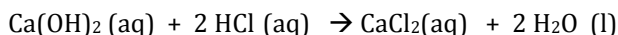
    What is the concentration of a calcium hydroxide solution if 15.0 mL are exactly neutralized by 10.00 mL of 0.250 M HCl solution? 0.083 M [$Ca(OH)_2$]

10. Acid spills are often neutralized with sodium carbonate. For example
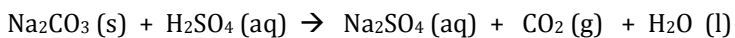
    Na_2CO_3 (s) + H_2SO_4 (aq) → Na_2SO_4 (aq) + CO_2 (g) + H_2O (l)

    An instructor dropped a 2.50 L bottle of 18.0 M H_2SO_4 on a cement floor. How much (mass) sodium carbonate would be required to neutralize it? 4.77 kg Na_2CO_3