

Chemistry 20 - Unit 2 - Dilution and Distillation

Name: _____

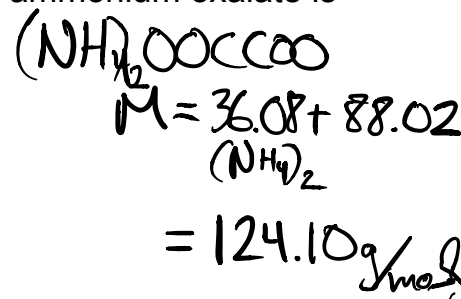
You may find the following formulas useful:

$C = \frac{n}{V}$ $m = Mn$	$d = \frac{m}{V}$ $C_1V_1 = C_2V_2$
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1. To test the hardness of water, an industrial chemist performs an analysis using 100.0 mL of a 0.250 mol/L standard solution of ammonium oxalate. What mass of ammonium oxalate is needed to make this solution?

$$\frac{0.250 \text{ mol}}{1 \text{ L}} \times 0.1000 \text{ L} = 0.0250 \text{ mol}$$

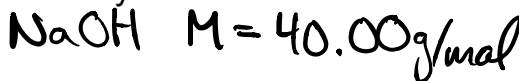
$$m = \frac{124.10 \text{ g}}{1 \text{ mol}} \times 0.0250 \text{ mol} = \boxed{3.10 \text{ g}}$$



2. Calculate the mass of solid sodium hydroxide needed to make 500 mL of a 10.0 mol/L cleaning solution.

$$n = \frac{10.0 \text{ mol}}{1 \text{ L}} \times 0.500 \text{ L} = 5.00 \text{ mol}$$

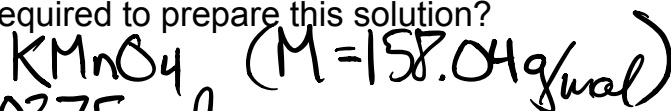
$$m = \frac{40.00 \text{ g}}{1 \text{ mol}} \times 5.00 \text{ mol} = \boxed{200 \text{ g}}$$



3. When acidified, potassium permanganate is a lethally powerful oxidizing agent. Mr. Pruden's dog, Maggie, decides to prepare 500.0 mL of a 0.0750 mol/L potassium permanganate solution. What mass of potassium permanganate is required to prepare this solution?

$$n = \frac{0.0750 \text{ mol}}{1 \text{ L}} \times 0.5000 \text{ L} = 0.0375 \text{ mol}$$

$$m = 0.0375 \text{ mol} \times \frac{158.04 \text{ g}}{1 \text{ mol}} = \boxed{5.93 \text{ g}}$$



4. Maggie realizes that her solution is too weak, but with the help of a distillation apparatus, manages to reduce 500.0 mL of the 0.0750 mol/L solution to a volume of 200.0 mL. What is the resulting concentration?

$$C_1V_1 = C_2V_2$$

$$\frac{(0.0750 \text{ mol/L}) \cdot 500.0 \text{ mL}}{200.0 \text{ mL}} = \boxed{0.188 \text{ M}}$$

5. The next step in Maggie's nefarious plan is to produce 4.00 L of a 10.0% hydrochloric acid solution, using a 36.0% stock solution. How much of the stock solution will Maggie need to use?

$$C_1 V_1 = C_2 V_2$$

$$\frac{(10.0\%)(4.00\text{L})}{36.0\%} = V_1$$

$$V_1 = 1.11\text{L}$$

6. Maggie mixes her potassium permanganate with his hydrochloric acid, but alas, the reaction does not work as desired. Undeterred, my dog decides to produce 2.00 L of 0.200 mol/L sulfuric acid solution from a 17.8 mol/L stock solution. How much of the stock solution is necessary?

$$C_1 V_1 = C_2 V_2$$

$$V_1 = \frac{0.200\text{mol/L} \times 2.00\text{L}}{17.8\text{mol/L}} = 0.0225\text{L}$$

$$22.5\text{mL}$$

7. In a rage, Mr. Pruden kicks over Maggie's doghouse and scolds his dog for getting into his chemicals again. Afterwards, Mr. Pruden takes 5.00 mL of a 0.005000 mol/L $\text{CuSO}_4(\text{aq})$ solution and dilutes it to a final volume of 100.0 mL. What is the final concentration of the diluted solution?

$$C_1 V_1 = C_2 V_2$$

$$C_2 = \frac{(5.00\text{mL})(0.005000\text{mol/L})}{100.0\text{mL}}$$

$$C_2 = 0.000250\text{M} \text{ or } 0.250\text{mmol/L}$$

8. Maggie's antics will not stop! She seizes 50.00 mL of a 1.50 mol/L nitric acid solution and adds 950.00 mL of water to it. What is the new concentration of nitric acid?

$$C_1 V_1 = C_2 V_2$$

$$\frac{(1.50\frac{\text{mol}}{\text{L}})(50.00\text{mL})}{(1000.00\text{mL})} = C_2$$

$$C_2 = 0.075\text{M}$$

9. 15.00 grams of potassium dichromate is added to water, preparing 100.00 mL of solution.
a. What is the concentration of this solution?

$$\text{K}_2\text{Cr}_2\text{O}_7$$

$$M = 294.20\text{g/mol}$$

$$n = 15.00\text{g} \times \frac{1\text{mol}}{294.20\text{g}} = 0.0510\text{mol}$$

$$C = \frac{0.0510\text{mol}}{0.10000\text{L}} = 0.510\text{M}$$

- b. If 200.00 mL of water are added to the solution, what is the resulting concentration?

$$C_1 V_1 = C_2 V_2$$

$$C_2 = \frac{(0.510\text{M})(100.00\text{mL})}{(300.00\text{mL})} = 0.170\text{M}$$