

Solution Composition Calculations (NO CALCULATORS)

1. A 200 mL solution is made by dissolving 3 moles of solute in water. What is the molarity of the resulting solution?

$$M = \frac{\text{moles solute}}{\text{L soln}}$$

$$M = \frac{3 \text{ mol}}{0.2 \text{ L}}$$

$$M = \frac{3 \text{ mol}}{2/10} = 3 \times \frac{10}{2} = \frac{30}{2} = 15 \text{ M}$$

2. How many moles of solute is needed to make 500 mL of a 6 M solution?

$$6 \text{ M} = \frac{x \text{ mol}}{0.5 \text{ L}}$$

$$x = 3 \text{ mol}$$

$$\begin{array}{r} 6 \\ \times 0.5 \\ \hline 30 \end{array} = 3$$

3. You need to make 300 mL of a 4 M KCl solution? The molar mass of KCl is 75 g/mol.

a. How many grams of KCl are needed to make the solution?

b. Describe how you would make the KCl solution in lab.

$$a) \quad 4 \text{ M} = \frac{x \text{ mol}}{0.3 \text{ L}}$$

$$x = 1.2 \text{ mol}$$

$$\frac{1.2 \text{ mol KCl}}{1 \text{ mol}} \times 75 \text{ g} = 90 \text{ g}$$

$$1 \times 75 = 75$$

$$0.2 \times 75 = +15.0$$

$$90$$

$$\begin{array}{r} 75 \\ \times 1.2 \\ \hline 150 \\ + 750 \\ \hline 900 \end{array} = 90$$

b) ① Measure 90 g of KCl.

② Add 90 g KCl to a 300 mL volumetric flask.

③ Add distilled water and swirl.

④ Once all solid is dissolved, add distilled water until the volume is 300 mL (calibration line)

⑤ Put a rubber stopper on top and Invert.

4. You wish to prepare a 0.3 M HCl solution with a volume of 250 mL.

a. How many milliliters of a concentrated 12 M HCl solution will you need?

b. Describe how you would make the diluted solution in lab.

$$M_1 V_1 = M_2 V_2 \text{ (Dilution Formula)}$$

$$(12 \text{ M})(V_1) = (0.3 \text{ M})(250 \text{ mL})$$

$$(12 \text{ M})(V_1) = 750$$

$$V_1 = \frac{75}{12} = \frac{25}{4} = 6\frac{1}{4} = 6.25 \text{ mL}$$

b) ① Measure and add 6.25 mL of 12 M HCl
to a 250 mL volumetric flask that
contains a small amount of H₂O.

② Swirl

③ Add H₂O until final volume is 250 mL
(calibration line)

④ Stopper

⑤ Invert

5. A salt water solution is made by dissolving 20 grams of NaCl in water. The total mass of solution is 160 grams. Which of the following is the approximate mass percent of salt in the solution?

mass percent = $\frac{\text{g solute}}{\text{g soln}} \times 100$

a. 10%
b. 12%
c. 20%
d. 25%

$$\frac{20 \text{ g}}{160 \text{ g}} = \frac{1}{8} = .125$$
$$\frac{1}{4} = .25$$

6. A solution of antifreeze is made by mixing equal volumes of ethylene glycol (d = 1.1 g/mL) and water (d = 1.0 g/mL). Which of the following is the approximate mass percent of ethylene glycol in the solution?

- ~~a. 48%~~
~~b. 50%~~
c. 52%
d. 60%

$$\frac{\text{g glycol}}{\text{g soln}} = \frac{1.1 \text{ g}}{2.1 \text{ g}} = \frac{11}{21}$$

$$\frac{1}{2} \text{ of } 21 = 10.5$$