1. We dissolve 17.3 g of LiO_2 (molar mass = 29.9 g/mol) in sufficient water to 400. mL of solution. What is the molarity of the solution?

$$\mathrm{M}_{LiO_2} = \frac{n_{LiO_2}}{V_{solution}}$$

Remember the volume ***must*** be in liters!!!

$$\mathrm{M}_{LiO_2} = \frac{\left(17.3\text{ g LiO}_2 \times \frac{1\text{ mol LiO}_2}{29.9\text{ g LiO}_2}\right)}{\left(400 \times 10^{-3}\text{ L}\right)}$$

$$\mathrm{M}_{LiO_2} = \frac{0.5786\text{ mol LiO}_2}{400 \times 10^{-3}\text{ L}}$$

$$\mathrm{M}_{LiO_2} = 1.45\ \frac{\text{mol}}{\text{L}}$$

$$\mathrm{M}_{LiO_2} = 1.45\text{ M}$$

2. Calculate the mass, in grams of $Ba(OH)_2$ required to prepare exactly 500. mL of a 0.880-M solution of $Ba(OH)_2$.

$$\mathrm{M}_{BaOH_2} = \frac{\mathrm{n}_{Ba(OH)_2}}{V_{solution}}$$

To determine the mass we must first calculate the number of moles of $Ba(OH)_2$.

$$\mathrm{M}_{Ba(OH)_2} = \frac{\mathrm{n}_{Ba(OH)_2}}{V_{solution}}$$

$$n_{Ba(OH)_2} = \mathrm{M}_{Ba(OH)_2} \cdot V_{solution}$$

$$n_{Ba(OH)_2} = \mathrm{M}_{Ba(OH)_2} \cdot V_{solution}$$

$$n_{Ba(OH)_2} = (0.880\text{ M})\left(500 \times 10^{-3}\text{ L}\right)$$

$$n_{Ba(OH)_2} = \left(0.880\ \frac{\text{mol Ba(OH)}_2}{\text{L}}\right)\left(500 \times 10^{-3}\text{ L}\right)$$

$$n_{Ba(OH)_2} = 0.440\text{ mol Ba(OH)}_2$$

Now that we know the number of moles of $Ba(OH)_2$ required, we can calculate the mass required that gives us this number of moles!

$$m_{Ba(OH)_2} = 0.440\text{ mol Ba(OH)}_2 \times \frac{171.34\text{ g Ba(OH)}_2}{1\text{ mol Ba(OH)}_2}$$

$$m_{Ba(OH)_2} = 75.4\text{ g Ba(OH)}_2$$

3. A stock solution of $Na_3PO_4$is available to prepare solutions that are more dilute. Calculate the volume, in mL, of a 2.0-M solution of Na_3PO_4 required to prepare exactly 500. mL of a 0.560-M solution of Na_3PO_4.

This is a dilution question so we need to use.

$$M_1V_1 = M_2V_2$$

The key is determining which numbers corresponds to which variables. The 2.0-M solution is more concentrated than the 0.560 M solution so this tells us that M_1 is 2.0 M and M_2 is 0.560 M. Next, we see 500. mL of the 0.560-M (diluted) solution. Thus, the final volume, or $V_2$is 500. mL. Thus, V_1 is what we are solving for! We can also confirm this assignment because the question asks us what volume of our 2.0-M solution (stock/starting solution) we must dilute.
In summary:

$$M_1 = 2.0\,\text{M}$$
$$M_2 = 0.560\,\text{M}$$
$$V_1 = ?$$
$$V_2 = 500.\text{ mL}$$

Now we can solve for V_1!!

$$M_1V_1 = M_2V_2$$

$$V_1 = \frac{M_2V_2}{M_1}$$

$$V_1 = \frac{(0.560\,\text{M})(500.\text{ mL})}{(2.0\,\text{M})}$$

$$V_1 = 140\text{ mL}$$

Note, because of 2.0 M we need two significant figures!

$$V_1 = 14 \times 10^1\text{ mL}$$

4. Indicate the volume of each solute and solvent needed to make the following solutions:

(a) 280. mL of a 38% v/v of ethanol, C_2H_6O, in water:

(i) mL of C_2H_6O

(ii) mL of water

(b) 435 mL of a 1.4% v/v solution of ethyl acetate, $C_4H_8O_2$, in water:

(i) mL of $C_4H_8O_2$

(ii) mL of water

(a)
(i)

$$(\mathrm{v/v})\,\% = \frac{\text{mL solute}}{\text{mL solution}} \times 100$$

Rewriting our expression for v/v % into the form of an equation:

$$P = \frac{V_{\text{solute}}}{\mathrm{V}_{\text{solution}}} \times 100$$

$$V_{\text{solute}} = \frac{P}{100} \cdot V_{\text{solution}}$$

$$V_{\text{solute}} = \frac{38\%}{100} \cdot 280.\ \text{mL}$$

$$V_{\text{solute}} = (0.38)\,(280.\ \text{mL})$$

$$V_{\text{solute}} = 106.4\ \text{mL}$$

(ii)

$$V_{\text{solution}} = V_{\text{solute}} + V_{\text{solvent}}$$

Recall that ethanol is the solute and water is the solvent. Therefore,

$$V_{\text{solution}} = V_{\text{ethanol}} + V_{\text{water}}$$

$$V_{\text{water}} = V_{\text{solution}} - V_{\text{ethanol}}$$

$$V_{\text{water}} = 280.\ \text{mL} - 106.4\ \text{mL}$$

$$V_{\text{water}} = 173.6\ \text{mL}$$

$$V_{\text{water}} = 174\ \text{mL}$$

(b)
(i)

$$(\text{v/v})\,\% = \frac{\text{mL solute}}{\text{mL solution}} \times 100$$

Rewriting our expression for v/v % into the form of an equation:

$$P = \frac{V_{\text{solute}}}{\text{V}_{\text{solution}}} \times 100$$

$$V_{\text{solute}} = \frac{P}{100} \cdot V_{\text{solution}}$$

$$V_{\text{solute}} = \frac{1.4}{100} \cdot 435.\ \text{mL}$$

$$V_{\text{solute}} = (0.014)\,(435.\ \text{mL})$$

$$V_{\text{solute}} = 6.1\ \text{mL}$$

(ii)

$$V_{\text{solution}} = V_{\text{solute}} + V_{\text{solvent}}$$

Recall that ethyl acetate is the solute and water is the solvent. Therefore,

$$V_{\text{solution}} = V_{\text{ethyl acetate}} + V_{\text{water}}$$

$$V_{\text{water}} = V_{\text{solution}} - V_{\text{ethyl acetate}}$$

$$V_{\text{water}} = 435.\ \text{mL} - 6.1\ \text{mL}$$

$$V_{\text{water}} = 428.9\ \text{mL}$$

$$V_{\text{water}} = 429\ \text{mL}$$

5. The label on a jar of jam says it contains 17 g of sucrose, $C_{12}H_{22}O_{11}$,per tablespoon (15 mL). What is the molarity of sucrose in the jam?

$$M_{\text{sucrose}} = \frac{n_{\text{sucrose}}}{V_{\text{solution}}}$$

$$M_{\text{sucrose}} = \frac{17\text{ g sucrose} \times \frac{1\text{ mol sucrose}}{342.29\text{ g sucrose}}}{15 \times 10^{-3}\text{ L}}$$

$$M_{\text{sucrose}} = \frac{0.049665\text{ mol sucrose}}{15 \times 10^{-3}\text{ L}}$$

$$M_{\text{sucrose}} = 3.31\ \frac{\text{mol}}{\text{L}}$$

$$M_{\text{sucrose}} = 3.3\text{ M}$$