

CHM 161 – Chemistry for the Life Sciences

I will ask you “staged” questions as shown below.

An Acid/Base Problem

- a) Draw the products of the acid/base reaction between H_3PO_4 and potassium hydroxide.



- b) Balance the reaction. See above.
c) If you have 75.0 mL of 0.200 M H_3PO_4 , how many moles do you have?

Molarity x Liters = moles

$$75.0 \text{ mL} \times 1 \text{ L}/1000 \text{ mL} = \mathbf{0.0750 \text{ L}}$$

$$0.200 \text{ mol/L} \times 0.0750 \text{ L} = \mathbf{0.0150 \text{ mol H}_3\text{PO}_4}$$

- d) How many moles of potassium hydroxide do you need to neutralize that amount of phosphoric acid? $0.0150 \text{ mol H}_3\text{PO}_4 \times 3 \text{ mol KOH}/1 \text{ mol H}_3\text{PO}_4 = \mathbf{0.0450 \text{ mol KOH}}$

- e) If you have 0.500 M KOH, how many mL do you need to neutralize that amount of phosphoric acid? Molarity x L = mol

Solve for L

$$L = \text{mol}/\text{M}$$

$$= 0.0450 \text{ mol}/0.500\text{M}$$

$$= \mathbf{0.0900 \text{ L KOH}}$$
 now convert to mL

$$0.0900 \text{ L} \times 1000 \text{ mL}/1\text{L} = \mathbf{90.0 \text{ mL of 0.500 M KOH}}$$

This question could read as follows: “How many mL of 0.500 M KOH is needed to neutralize 75 mL of 0.200 M H_3PO_4 ?”

Another Acid/Base Problem

- a) Draw and balance the acid/base reaction between magnesium bicarbonate and HBr.



- b) If you spill 250 mL of 2.80 M HBr on the floor, how many moles of HBr did you spill?

Molarity x L = mol

$$0.250 \text{ L} \times 2.80 \text{ mol/L} = \mathbf{0.700 \text{ mol HBr}}$$

- c) According to your balanced equation in part a), how many moles of magnesium bicarbonate (solid) do you need to neutralize the spill (react with all the HBr)?

Your conversion factor is taken from the coefficients in the balanced equation.

$$0.700 \text{ mol HBr} \times \frac{1 \text{ mol Mg}(\text{HCO}_3)_2}{2 \text{ mol HBr}} = \mathbf{0.350 \text{ mol Mg}(\text{HCO}_3)_2}$$

- d) How many grams of magnesium bicarbonate is this this?

For this, you need the molecular weight (molar mass) of $\text{Mg}(\text{HCO}_3)_2$ as your conversion factor.

$$\text{MW} = 24.3 + 2(1.0) + 2(12.0) + 6(48.0) = \mathbf{146.3 \text{ g/mol}}$$

Mg H C O₃

$$0.350 \text{ mol Mg(HCO}_3)_2 \times \frac{146.3 \text{ g Mg(HCO}_3)_2}{1 \text{ mol Mg(HCO}_3)_2} = \mathbf{51.1 \text{ g Mg(HCO}_3)_2}$$

e) How many kilograms is this?

$$51.1 \text{ g} \times 1 \text{ kg}/1000 \text{ g} = \mathbf{0.051 \text{ kg of magnesium bicarbonate}}$$

This question could read as follows: "How many kg of magnesium bicarbonate is needed to neutralize a 250 mL spill of 2.80 M HBr?"