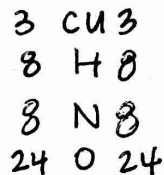
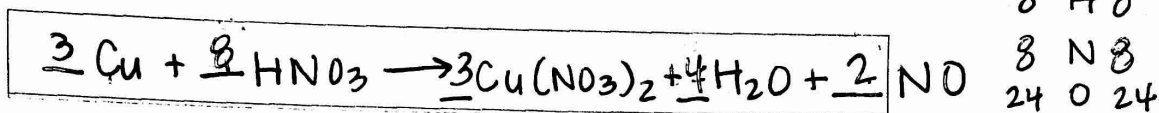


- PROBLEM OF THE UNIT -

Reactions and Stoichiometry HP

(1) Copper metal reacts with nitric acid to form copper (II) nitrate, water, and nitrogen monoxide.

(a) Give the *balanced* chemical equation for this reaction.



(b) A small piece of copper (density 8.95 g/cm^3) with a volume of 2.00 cm^3 is placed in the reaction container. What is the mass of the copper?

$$2.00 \text{ cm}^3 \times \frac{8.95 \text{ g}}{1 \text{ cm}^3} = 17.9 \text{ g Cu} \quad \underline{17.9 \text{ g Cu}}$$

(c) Calculate the number of moles of copper.

$$17.9 \text{ g Cu} \times \frac{1 \text{ mol}}{63.55 \text{ g Cu}} = 0.282 \text{ mol Cu} \quad \underline{0.282 \text{ mol Cu}}$$

(d) There are 5.00×10^{23} molecules of nitric acid present in the reaction vessel. How many moles of nitric acid are present?

$$5.00 \times 10^{23} \text{ molecules HNO}_3 \times \frac{1 \text{ mol HNO}_3}{6.02 \times 10^{23} \text{ molecules}} = \underline{0.831 \text{ mol HNO}_3}$$

(e) (i) What mass of copper (II) nitrate would theoretically be produced in the reaction?

$$0.282 \text{ mol Cu} \times \frac{3 \text{ mol Cu}(\text{NO}_3)_2}{3 \text{ mol Cu}} \times \frac{187.57 \text{ g Cu}(\text{NO}_3)_2}{1 \text{ mol Cu}(\text{NO}_3)_2} = \underline{52.9 \text{ g Cu}(\text{NO}_3)_2}$$

$$0.831 \text{ mol HNO}_3 \times \frac{3 \text{ mol Cu}(\text{NO}_3)_2}{8 \text{ mol HNO}_3} \times \frac{187.57 \text{ g Cu}(\text{NO}_3)_2}{1 \text{ mol Cu}(\text{NO}_3)_2} =$$

(ii) The reaction actually produced 40.0 g of copper (II) nitrate. Calculate the percent yield for the reaction.

$$\frac{40.0 \text{ g}}{52.9 \text{ g}} \times 100 = \underline{75.6\%}$$

(f) What volume of water would be produced by the reaction? (note: water has a density of 1.00 g/mL)

$$40.0 \text{ g Cu}(\text{NO}_3)_2 \times \frac{1 \text{ mol Cu}(\text{NO}_3)_2}{187.57 \text{ g Cu}(\text{NO}_3)_2} \times \frac{4 \text{ mol H}_2\text{O}}{3 \text{ mol Cu}(\text{NO}_3)_2} \times \frac{18.02 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} \times \frac{1 \text{ mL}}{1.00 \text{ g}} = \underline{5.12 \text{ mL}}$$

(g) How many molecules of nitrogen monoxide would be produced in the reaction?

$$40.0 \text{ g Cu}(\text{NO}_3)_2 \times \frac{1 \text{ mol Cu}(\text{NO}_3)_2}{187.57 \text{ g Cu}(\text{NO}_3)_2} \times \frac{2 \text{ mol NO}}{3 \text{ mol Cu}(\text{NO}_3)_2} \times \frac{6.02 \times 10^{23}}{1 \text{ mol NO}} = \underline{8.56 \times 10^{22} \text{ molecules}}$$