

28. Calculate the indicated quantity for each of the various chemical reactions given:
- theoretical yield = 20.0 g, actual yield = 15.0 g, percentage yield = ?
 - theoretical yield = 1.0 g, percentage yield = 90.0%, actual yield = ?
 - theoretical yield = 5.00 g, actual yield = 4.75 g, percentage yield = ?
 - theoretical yield = 3.45 g, percentage yield = 48.0%, actual yield = ?
29. The percentage yield for the reaction
- $$\text{PCl}_3 + \text{Cl}_2 \longrightarrow \text{PCl}_5$$
- is 83.2%. What mass of PCl_5 is expected from the reaction of 73.7 g PCl_3 with excess chlorine?
30. The Ostwald process for producing nitric acid from ammonia consists of the following steps:
- $$4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \longrightarrow 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{g})$$
- $$2\text{NO}(\text{g}) + \text{O}_2(\text{g}) \longrightarrow 2\text{NO}_2(\text{g})$$
- $$3\text{NO}_2(\text{g}) + \text{H}_2\text{O}(\text{g}) \longrightarrow 2\text{HNO}_3(\text{aq}) + \text{NO}(\text{g})$$
- If the yield in each step is 94.0%, how many grams of nitric acid can be produced from 5.00 kg of ammonia?
33. Coal gasification is a process that converts coal into methane gas. If this reaction has a percentage yield of 85.0%, what mass of methane can be obtained from 1250 g of carbon?
- $$2\text{C}(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \longrightarrow \text{CH}_4(\text{g}) + \text{CO}_2(\text{g})$$
34. If the percentage yield for the coal gasification process is increased to 95%, what mass of methane can be obtained from 2750 g of carbon?
35. Builders and dentists must store plaster of Paris, $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$, in airtight containers to prevent it from absorbing water vapor from the air and changing to gypsum, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. How many liters of water vapor evolve when 2.00 kg of gypsum are heated at 110°C to produce plaster of Paris? At 110°C , the density of water vapor is 0.574 g/L.
36. Gold can be recovered from sea water by reacting the water with zinc, which is refined from zinc oxide. The zinc displaces the gold in the water. What mass of gold can be recovered if 2.00 g of ZnO and an excess of sea water are available?
- $$2\text{ZnO}(\text{s}) + \text{C}(\text{s}) \longrightarrow 2\text{Zn}(\text{s}) + \text{CO}_2(\text{g})$$
- $$2\text{Au}^{3+}(\text{aq}) + 3\text{Zn}(\text{s}) \longrightarrow 3\text{Zn}^{2+}(\text{aq}) + 2\text{Au}(\text{s})$$

MIXED REVIEW

31. Magnesium is obtained from sea water. $\text{Ca}(\text{OH})_2$ is added to sea water to precipitate $\text{Mg}(\text{OH})_2$. The precipitate is filtered and reacted with HCl to produce MgCl_2 . The MgCl_2 is electrolyzed to produce Mg and Cl_2 . If 185.0 g of magnesium are recovered from 1000. g MgCl_2 , what is the percentage yield for this reaction?
32. Phosphate baking powder is a mixture of starch, sodium hydrogen carbonate, and calcium dihydrogen phosphate. When mixed with water, phosphate baking powder releases carbon dioxide gas, causing a dough or batter to bubble and rise.
- $$2\text{NaHCO}_3(\text{aq}) + \text{Ca}(\text{H}_2\text{PO}_4)_2(\text{aq}) \longrightarrow \text{Na}_2\text{HPO}_4(\text{aq}) + \text{CaHPO}_4(\text{aq}) + 2\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$$
- If 0.750 L CO_2 is needed for a cake and each kilogram of baking powder contains 168 g of NaHCO_3 , how many grams of baking powder must be used to generate this amount CO_2 ? The density of CO_2 at baking temperature is about 1.20 g/L.

CRITICAL THINKING

37. **Relating Ideas** The chemical equation is a good source of information concerning a reaction. Explain the relationship between the actual yield of a reaction product and the chemical equation of the product.
38. **Analyzing Results** Very seldom are chemists able to achieve a 100% yield of a product from a chemical reaction. However, the yield of a reaction is usually important because of the expense involved in producing less product. For example, when magnesium metal is heated in a crucible at high temperatures, the product magnesium oxide, MgO , is formed. Based on your analysis of the reaction, describe some of the actions that you would take to increase your percentage yield. The reaction is as follows:
- $$2\text{Mg}(\text{s}) + \text{O}_2(\text{g}) \longrightarrow 2\text{MgO}(\text{s})$$