

Chapter 9: Chemical Quantities

1. Solve stoichiometry problems using grams \rightarrow moles \rightarrow moles \rightarrow grams calculations. Examples below:

a. Calculate moles/grams of $(\text{NH}_4)_2\text{SO}_4$ produced when 30.0 moles of NH_3 react with H_2SO_4 .



$$30.0 \text{ moles} \times 1 \text{ mol}/2 \text{ mol} = 15.0 \text{ moles}$$

$$15.0 \text{ moles } (\text{NH}_4)_2\text{SO}_4 \times 132.2 \text{ grams/mole} = 1983 = 1980 \text{ grams (to 3 s.f.)}$$

b. $\text{Na}_2\text{CO}_3 + 2\text{HNO}_3 \rightarrow 2\text{NaNO}_3 + \text{CO}_2 + \text{H}_2\text{O}$. How many moles/grams of sodium nitrate are produced by the complete reaction of 100. grams of sodium carbonate? Moles of nitric acid needed to produce 500.0 grams of sodium nitrate? *Be able to calculate grams or moles of any reactant or product given a quantity of reactant or product.*

Grams \rightarrow Moles \rightarrow Moles \rightarrow Grams

$$100. \text{ g Na}_2\text{CO}_3 \times 1 \text{ mol}/106.0 \text{ g} \times 2 \text{ mol NaNO}_3 / 1 \text{ mol Na}_2\text{CO}_3 \times 85.00 \text{ g/mol} = 160.4 \text{ g}$$

$$500.0 \text{ g NaNO}_3 \times 1 \text{ mol}/85.00 \text{ g} \times 2 \text{ mol} / 2 \text{ mol} \times 63.02 \text{ g/mol} = 370.7 \text{ grams}$$

2. Calculate percent yield of products. Example below using (b) above.
What is the theoretical yield of NaNO_3 if 100.0 grams of Na_2CO_3 are used in the reaction? What is the percent yield of NaNO_3 if 130.5 grams of NaNO_3 are actually collected?

Theoretical yield = 160.4 grams (answer from above)

$$\text{Percent Yield} = (\text{Actual Yield/Theoretical Yield}) \times 100 = (130.5 \text{ g}/160.4 \text{ g}) \times 100 = 81.36\%$$

3. What is a limiting reactant in a chemical reaction? The reactant that is used up first, thereby limiting the amount of product that can be formed.

Chapter 10: Modern Atomic Theory

4. Describe Rutherford's model of the atom. What could it not explain?

Nucleus (very small) consisting of protons with electrons in orbits around the nucleus. Could not explain how the electrons remained in orbit.

5. Define electromagnetic radiation, wavelength, and frequency.

6. How do atoms gain energy to become excited? Absorb a photon of energy.

How do they lose energy to return to their ground state? Release a photon of same energy as that absorbed.

7. What is the evidence that energy absorbed by the hydrogen atom is quantized? Specific wavelengths of light seen in emission spectra for atoms (page 285-86)

8. Describe the Bohr model of the atom. How did it improve on Rutherford's model?

Same as Rutherford with respect to nucleus. Electrons located on orbits at specific distances from nucleus.

9. Draw the orbital diagram (with the arrows) for an element: for example, phosphorus, sodium, and fluorine.

See book, notes, probs 54, 96

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**George Dinsmore Stoddard, University
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