Chapter 3 The Mole — The Central Unit of Chemistry

3.1 Relative Atomic Mass

Warm Up, p. 108

1. dozen, litres, kilograms
2. b. volume
   c. mass

Quick Check, p. 108

1. One object's mass relative to another's
2. You must have the same number of candies in each bag.

Practice Problems — Determining Relative Atomic Mass, p. 110

1. $\frac{276\ g}{26.4\ g} = 10.5$
   The mass of an AA battery is 10.5 times the mass of a watch battery.

2. $\frac{2.683\ g\ Sr}{0.490\ g\ O} = 5.48$
   A strontium atom weighs 5.48 times as much as an oxygen atom.

3. a. 4.218 g DBr − 0.337 g D = 3.881 g Br
   $\frac{0.337\ g\ D}{3.881\ g\ Br} \times 79.9\ u = 6.94\ u$

   b. Daltonium represents lithium.

Practice Problems — Determining Relative Atomic Mass (Non 1:1 Formulas), p. 111

1. $3 \times \frac{1.000\ g\ Al}{14.100\ g\ I} \times 126.9\ u = 27.00\ u$

2. $1.5 \times \frac{1.000\ g\ Al}{14.100\ g\ I} \times 126.9\ u = 13.5\ u$

3.1 Activity: The Relative Mass of Paper Clips, p. 112

For example:

Objects	Mass (g)
Small paper clips	5.6
Coupled paper clips	20.0
Large paper clips	14.4

1. $\frac{\text{Mass of some number of large paper clips}}{\text{Mass of the same number of small paper clips}} = \frac{14.4\ \text{g}}{5.6\ \text{g}} = 2.57$

   The mass of a large paper clip is 2.57 times the mass of a small paper clip.

4. 1.00 smu × 2.57 = 2.57 smu

7. All the paper clips of the same type may not weigh exactly the same.

3.1 Review Questions, p. 113

1. a. $\frac{2245\ \text{g}}{825\ \text{g}} = 2.72$ 2.72 × 1.00 mmu = 2.72 mmu

   b. The mass ratio of any equal number of identical items is the same.

2. a. 5.000 g NaCl – 1.965 g Na = 3.035 g Cl
   $\frac{1.965\ \text{g Na}}{3.035\ \text{g Cl}} = 0.6474$

   b. 0.6474 × 35.5 u = 23.0 u

3. a. 10.000 g ZuF – 8.503 g Zu = 1.497 g F
   $\frac{8.503\ \text{g Zu}}{1.497\ \text{g F}} \times 19.0\ \text{u} = 108\ \text{u}$

   b. silver

4. a. $\frac{2.037\ \text{g Zn}}{1.000\ \text{g S}} \times 32.1\ \text{u} = 65.4\ \text{u}$

   b. $2 \times \frac{2.037\ \text{g Zn}}{1.000\ \text{g S}} \times 32.1\ \text{u} = 130\ \text{u}$

   c. $0.667 \times \frac{2.037\ \text{g Zn}}{1.000\ \text{g S}} \times 32.1\ \text{u} = 43.8\ \text{u}$

5. a. $\frac{13.073 \text{ g Cu}}{1.647 \text{ g O}} \times 16.0 \text{ u} = 127 \text{ u}$

   b. $0.50 \times \frac{13.073 \text{ g Cu}}{1.647 \text{ g O}} \times 16.0 \text{ u} = 63.5 \text{ u}$

   c. $2.00 \times \frac{13.073 \text{ g Cu}}{1.647 \text{ g O}} \times 16.0 \text{ u} = 254 \text{ u}$

6. a. $\frac{25.0}{0.3864} = 64.7$

   b. 63.5 u Cu_2O

7. Al $\frac{25.0}{0.903} = 27.7$ (3% error)
   Mg $\frac{25.0}{1.05} = 23.8$ (–2% error)
   Ag $\frac{25.0}{0.23772} = 105$ (–3% error)

8.

Element	Mass of Gas (g)	Relative Atomic Mass (u)
H	0.210	1.0
Cl	7.455	**35.5**

9. A potassium atom weighs 39.1 times as much as a hydrogen atom.

10. a. 31.0 u
    b. 40.1 u
    c. 238 u

11. a. $\frac{628.2 \text{ g}}{213.1 \text{ g}} = 2.948$
    The mass of a knife is 2.948 times the mass of a fork.
    b. If eight knives weigh 2.948 times as much as eight forks then one knife will weigh 2.948 times as much as one fork.
    c. The average mass of a knife is 2.948 times the average mass of a fork.

12. For example: Weigh a pile containing one 10 g coin and two 20 g coins. If the pile weighs:
    49 g then the 10 g coin is actually 9 g
    48 g then the 20 g coin is actually 19 g
    50 g then the 30 g coin is actually 29 g