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7 Math Skills

# Converting Amount to Mass

Hydrogen (molar mass = 2.02 g/mol) is the most common element in the universe, and it is usually found in the molecular form $H_2$. Determine the mass in grams of 7.50 mol of molecular hydrogen.

1. **List the given and unknown values.**

| | |
|---|---|
| *Given:* | amount of hydrogen = 7.50 mol $H_2$ |
| | molar mass of hydrogen = 2.02 g/mol $H_2$ |
| *Unknown:* | mass of hydrogen = ? g |

2. **Write down the conversion factor that converts moles of molecular hydrogen to grams.** The conversion factor you choose should have what you are trying to find (grams of $H_2$) in the numerator and what you want to cancel (moles of $H_2$) in the denominator.

$$\frac{2.02\ \text{g}\ H_2}{1\ \text{mol}\ H_2}$$

3. **Multiply the amount of hydrogen in moles by the conversion factor you have chosen, and solve.**

$$7.55\ \text{mol}\ H_2 \times \frac{2.02\ \text{g}\ H_2}{1\ \text{mol}\ H_2} = 15.3\ \text{g}\ H_2$$

## Practice

1. Uranium (molar mass = 238.03 g/mol) has the largest molar mass of any element naturally found on Earth.
   **a.** What is the mass of 7.50 mol of uranium?
   **b.** How many times more massive is 7.50 mol of uranium than 7.50 mol of $H_2$?
2. Oxygen (molar mass = 32.00 g/mol) is the most common element in Earth's crust. It combines with other elements to form various compounds that make up 46.6 percent of the crust's mass. Calculate the mass of 65.0 mol of oxygen.
3. Ruthenium (101.07 g/mol) is used as a catalyst and to improve titanium's resistance to corrosion. It is also one of the rarest elements in Earth's crust, making up less than one ten-millionth of the crust's total mass. Calculate the mass of 37.0 mol of ruthenium.
4. Large deposits of manganese (54.94 g/mol), a metal used to form many different types of alloys, have been found on the floors of oceans and large lakes. Suppose one of these deposits contains 383 mol of manganese. What is the mass of the manganese deposit?
5. Sodium chloride (58.44 g/mol), commonly known as table salt, is the most common type of salt. What is the mass of 29.0 mol of sodium chloride?

**6.** Oxygen gas is most often found as $O_2$ (molar mass = 32.00 g/mol). However, under certain conditions, a compound called ozone, $O_3$ (molar mass = 48.00 g/mol), is formed. Ozone, which is highly reactive and unstable, is formed when $O_2$ is exposed to ultraviolet radiation. Ozone is able to absorb other ultraviolet radiation, protecting life on Earth's surface from this harmful radiation.
   **a.** What is the mass of 17 mol of $O_2$?
   **b.** What is the mass of 17 mol of $O_3$?

**7.** After oxygen, silicon is the most common element found in Earth's crust. Both elements are found in silicon dioxide (molar mass = 60.09 g/mol), which is the main component in sand. Suppose you have 893 mol of silicon dioxide in a sample of sand. What is the mass of the silicon dioxide?

**8.** Carbon dioxide (molar mass = 44.01 g/mol) is an inert gas that plants need for photosynthesis.
   **a.** Calculate the mass of 893 mol of carbon dioxide.
   **b.** How does the mass you obtained in part (a) compare with the mass of 893 mol of silicon dioxide?

**9.** Both marble and limestone contain the same mineral, calcite, which consists of the compound calcium carbonate (molar mass = 100.09 g/mol). What is the mass of a block of calcite if it contains 37 mol of calcium carbonate?

**10.** While limestone is almost pure calcium carbonate, marble also contains the mineral dolomite. Dolomite consists of both calcium carbonate and magnesium carbonate. Suppose there are 29 mol of magnesium carbonate (molar mass = 84.31 g/mol) in a sample of marble. What is the mass of the magnesium carbonate?

**11.** Protactinium (molar mass = 231.04 g/mol), one of the rarest of the naturally occurring radioactive elements, may also be the most expensive. A gram of protactinium costs about $2800, or about 300 to 350 times the price of gold. Suppose you could collect 1.0 mol of protactinium. How much would it be worth?

**12.** The first element ever to be produced artificially was technetium (molar mass = 97.91 g/mol), whose name is derived from the Greek word for "artificial." Created in 1937, technetium is a light, radioactive element that occurs naturally in stars but not on Earth. It is now produced in large enough quantities that 1 g costs less than $100. If a laboratory sold 6.5 mol of technetium for $100/g, what was the total cost?