mole conversions - practice problems

It is important to be able to convert between units of mass and volume measurement and ‘moles.’ The mole is a unit for counting atoms and molecules representing \(602,000,000,000,000,000,000,000\) particles. This is often written as \(6.02 \times 10^{23}\) particles and is known as ‘Avogadro's number.’ Using the periodic table it is possible to calculate the ‘molar mass,’ or the mass of a single mole of a substance. The ‘molar volume’ is the volume of a single mole of gaseous substance. All gases have the same molar volume when measured at standard temperature and pressure or STP, which is 22.4 liters per mole.

<table>
<thead>
<tr>
<th>amount (moles)</th>
<th>mass (grams)</th>
<th>volume (liters)</th>
<th>particles</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) mol</td>
<td>(\frac{1\ mol}{\text{molar mass}})</td>
<td>(\frac{1\ mol}{22.4 \text{ L}})</td>
<td>(6.022 \times 10^{23}) particles</td>
</tr>
</tbody>
</table>

**example:**
Calculate the number of molecules in 1.62 grams of calcium chloride, \(\text{CaCl}_2\).

- develop a strategy: \(\text{grams} \rightarrow \text{moles} \rightarrow \text{particles}\)
- calculate and solve:

\[
1.62 \ g \ \text{CaCl}_2 \times \left(\frac{1\ \text{mol}}{111\ g}\right) \times \left(\frac{6.022 \times 10^{23} \ \text{particles}}{1\ \text{mol}}\right) = 8.79 \times 10^{21} \ \text{particles of CaCl}_2
\]

**practice problems:**

1. A sample of neon has a volume of 75.8 L at STP. Calculate the number of moles.
2. Calculate the mass of an 8.4 mole sample of iron.
3. Convert 0.45 g of sodium hydroxide, \(\text{NaOH}\), into moles.
4. Calculate the number of molecules in a sample of carbon dioxide with a mass of 168.2 grams.
5. Calculate the number of moles of potassium nitrate, \(\text{KNO}_3\), in a sample with a mass of 85.2 grams.
6. Calculate the mass of 0.94 moles of sodium bicarbonate, \(\text{NaHCO}_3\).
7. Convert 7.8 liters of carbon tetrafluoride, \(\text{CF}_4\), to grams.
8. Calculate the mass of \(3.47 \times 10^{23}\) gold atoms.
9. Calculate the volume, in liters, of 7500 g of helium atoms. Assume STP conditions.
10. Calculate the number of particles in 5.0 grams of \(\text{NaCl}\).
11. Calculate the mass of \(5.0 \times 10^{14}\) molecules of water.
12. Calculate the volume of 5.0 grams of \(\text{NO}\) gas at STP.
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It is important to be able to convert between units of mass and volume measurement and ‘moles.’ The mole is a unit for counting atoms and molecules representing $602,000,000,000,000,000,000,000$ particles. This is often written as $6.02 \times 10^{23}$ particles and is known as ‘Avogadro’s number.’ Using the periodic table it is possible to calculate the ‘molar mass,’ or the mass of a single mole of a substance. The ‘molar volume’ is the volume of a single mole of gaseous substance. All gases have the same molar volume when measured at standard temperature and pressure or STP, which is 22.4 liters per mole.

**example:**

Calculate the number of molecules in 1.62 grams of calcium chloride, CaCl₂.

- develop a strategy: grams → moles → particles

- calculate and solve:

\[
1.62 \text{ g CaCl}_2 \times \frac{1 \text{ mol}}{111 \text{ g}} \times \frac{6.022 \times 10^{23} \text{ particles}}{1 \text{ mol}}
\]

**practice problems:**

1. A sample of neon has a volume of 75.8 L at STP. Calculate the number of moles. $3.38 \text{ mol Ne}$

2. Calculate the mass of an 8.4 mole sample of iron. $469.14 \text{ g Fe}$

3. Convert 0.45 g of sodium hydroxide, NaOH, into moles. $0.0112 \text{ mol NaOH}$

4. Calculate the number of molecules in a sample of carbon dioxide with a mass of 168.2 grams. $2.30 \times 10^{24} \text{ molecules CO}_2$

5. Calculate the number of moles of potassium nitrate, KNO₃, in a sample with a mass of 85.2 grams. $0.843 \text{ mol KNO}_3$

6. Calculate the mass of 0.94 moles of sodium bicarbonate, NaHCO₃. $78.96 \text{ g NaHCO}_3$

7. Convert 7.8 liters of carbon tetrafluoride, CF₄, to grams. $30.64 \text{ g CF}_4$

8. Calculate the mass of $3.47 \times 10^{23}$ gold atoms. $113.52 \text{ g Au}$

9. Calculate the volume, in liters, of 7500 g of helium atoms. Assume STP conditions. $42000 \text{ L He}$

10. Calculate the number of particles in 5.0 grams of NaCl. $5.15 \times 10^{22} \text{ particles NaCl}$

11. Calculate the mass of $5.0 \times 10^{14}$ molecules of water. $1.49 \times 10^{-8} \text{ g H}_2\text{O}$

12. Calculate the volume of 5.0 grams of NO gas at STP. $3.73 \text{ L NO}$