

## Molar Volume

### Calculations

For this lab, you measured the volume of H<sub>2</sub> gas evolved as several different metal elements were dissolved in acid.

You need to determine

- slope
- adjusted slope
- equivalent mass of the metal from the volume of hydrogen gas produced
- atomic mass of the metal
- percent error

The slope represents ml (gas)/g (metal).

Remember: 1 mole of a gas has a volume of 22.4 liters at STP

1 mole of a gas has a volume of about 24.0 L at 21°C.

*Use this value for the calculations, since the data was gathered at 21°C.*

(Hint: 22.4 L = 22 400 mL and 24.0 L = 24 000 mL)

#### Calculate Equivalent Mass

1. Write the balanced equation for the reaction  
Determine mole ratio: metal reactant / H<sub>2</sub> gas produced
2. Determine slope (change in y) / (change in x)  
units: (ml/mg)
3. Adjust slope for the effect of the partial pressure of water vapor  
See *Procedure* for conversion chart  
Readings at 21 °C are about 2.5% too high  
*(Hint: actual slope = calculated slope – (0.025 x calculated slope))*
4. Divide 24 000 ml by the actual slope  
(24 000 ml/mol) / (slope ml/mg) = equivalent mass  
*(Hint: convert answer from mg to g)*
5. Equivalent mass is the atomic mass if the metal loses 1 electron

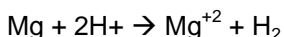
#### Calculate Atomic Mass

1. Multiply equivalent mass by mole ratio (Metal Reactant/H<sub>2</sub> Product) from the balanced equation.

#### Determine Percent Error

1. Percent Error = ((actual value - experimental value) / (actual value)) x 100
2. Use the atomic mass from the period chart as the actual value
3. Use the atomic mass you determined above for the experimental value

#### Example: Magnesium



Mole ratio is 1 mole Ca / 1 mole H<sub>2</sub>

Slope = (415.5-0) / (390-0) = 1.06 ml/mg

Adjusted slope = 1.06 ml/mg – (0.025 x 1.06 ml/mg) = *1.03 ml/mg*

Equivalent mass = 24 000/1.03 = 20 000 mg/mol = *23.3 g/mol*

Atomic masses = equivalent mass x 1 = 23.3 g/mol x 1 = *23.3 g/mol*

Percent Error = ((actual value - experimental value))/(actual value)

$$((24.3 - 23.3) / (24.3)) \times 100 = *4.11\%*$$