

# Determination of the Atomic Weight of Magnesium PHYS 442

Chimere

November 16, 2015

Date Performed: September 18, 2015  
Partners: Maida  
Instructor: Dr Schultz

## 1 Objective

Explored the motion of a particle under the influence of a gravitational force. Specifically we looked at escape velocity, circular orbits, kinetic energy, potential energy and elliptical orbits. (as defined in 1.1):

$$F_g = \frac{mMG}{r^2}$$

### 1.1 Definitions

**Gravitational constant** The universal gravitation constant  $G$  determines the strength of the gravity force from a given mass. It may also be seen as the force 1 kg exerts on another 1 kg mass separated by 1 meter.

$$G = 6.67 \times 10^{-11} \frac{Nm^2}{kg^2}.$$

**Escape Velocity** Escape velocity is the initial velocity required to escape gravitational attraction. An object launched at the escape velocity will never come back (escape).

$$v_{escape} = \sqrt{\frac{2MG}{r}}$$

**Kinetic energy** Kinetic energy is the energy associated with motion.

$$KE = \frac{mv^2}{2}$$

**Potential energy** The potential energy associated with the universal gravitational force is written as follows.

$$PE = -\frac{mMG}{r}$$

**Circular orbit** A circular orbit is an orbit with a constant radius  $r$ .

**Elliptic Orbit** An elliptic orbit is a closed orbit with changing radius  $r$ .

## 2 Experimental Data

Mass of empty crucible	7.28 g
Mass of crucible and magnesium before heating	8.59 g
Mass of crucible and magnesium oxide after heating	9.46 g
Balance used	#4
Magnesium from sample bottle	#1

## 3 Sample Calculation

Mass of magnesium metal	= 8.59 g - 7.28 g
	= 1.31 g
Mass of magnesium oxide	= 9.46 g - 7.28 g
	= 2.18 g
Mass of oxygen	= 2.18 g - 1.31 g
	= 0.87 g

Because of this reaction, the required ratio is the atomic weight of magnesium: 16.00 g of oxygen as experimental mass of Mg: experimental mass of oxygen or  $\frac{x}{1.31} = \frac{16}{0.87}$  from which,  $M_{\text{Mg}} = 16.00 \times \frac{1.31}{0.87} = 24.1 = 24 \text{ g mol}^{-1}$  (to two significant figures).

## 4 Results and Conclusions

The atomic weight of magnesium is concluded to be  $24 \text{ g mol}^{-1}$ , as determined by the stoichiometry of its chemical combination with oxygen. This result is in agreement with the accepted value.



Figure 1: Figure caption.

## 5 Discussion of Experimental Uncertainty

The accepted value (periodic table) is  $24.3 \text{ g mol}^{-1}$  Smith and Jones (2012). The percentage discrepancy between the accepted value and the result obtained here is 1.3%. Because only a single measurement was made, it is not possible to calculate an estimated standard deviation.

The most obvious source of experimental uncertainty is the limited precision of the balance. Other potential sources of experimental uncertainty are: the reaction might not be complete; if not enough time was allowed for total oxidation, less than complete oxidation of the magnesium might have, in part, reacted with nitrogen in the air (incorrect reaction); the magnesium oxide might have absorbed water from the air, and thus weigh “too much.” Because the result obtained is close to the accepted value it is possible that some of these experimental uncertainties have fortuitously cancelled one another.

## 6 Answers to Definitions

- a. The *atomic weight of an element* is the relative weight of one of its atoms compared to C-12 with a weight of 12.0000000. . . , hydrogen with a weight of 1.008, to oxygen with a weight of 16.00. Atomic weight is also the average weight of all the atoms of that element as they occur in nature.
- b. The *units of atomic weight* are two-fold, with an identical numerical value. They are g/mole of atoms (or just g/mol) or amu/atom.
- c. *Percentage discrepancy* between an accepted (literature) value and an experimental value is

$$\frac{\text{experimental result} - \text{accepted result}}{\text{accepted result}}$$

## References

Smith, J. M. and Jones, A. B. (2012). *Chemistry*. Publisher, 7th edition.