SCH3U3 Period # 2 / Room # 311

“Relative Atomic Weight of Magnesium”

Given: Sept.18, 2019

Due: Sept. 20, 2019

Lab Partners:

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Problem:

As it is nearly impossible to directly determine the weight of atoms, other methods must be used to approximate this weight, such as comparing it to the weight of another element using the law of definite proportions. This lab explores an approach to measure the weight of magnesium atoms by reacting it with oxygen and, using the resulting ratio as a measure of their relative weights, assigning a weight to magnesium atoms in atomic mass units.

Materials:

Crucible and cover
Clay triangle
Retort stand
Ring clamp
Bunsen burner
10 cm of magnesium ribbon
Flint striker
Flask tongs
Scoopula
Electronic scale

Procedure:

Please refer to the “The Relative Atomic Weight of Magnesium Lab” handout

Observations:

Crucible	Weight (g)	Difference in weight from empty crucible (g)
When Empty	28.361	0
Containing magnesium ribbon	28.536	28.536 - 28.361 = 0.175
Containing magnesium oxide	28.634	28.634 - 28.361 = 0.273

Table 1.1

During the experiment, these observations were recorded in this order, in thirty second intervals:

- The magnesium appeared grey and unburnt
- The magnesium still appeared grey and unburnt
- The magnesium touching the bottom of the crucible appeared slightly red
- A red spark on magnesium appeared
- The magnesium ribbon ignited, turned white, and shriveled up
- Smoke had begun to rise out of the crucible, the flame from the magnesium grew
- The magnesium ribbon glowed orange

- White smoke rose from magnesium ribbon
- The magnesium ribbon shriveled and an orange flame appeared across the top of the magnesium
- An orange flame appeared over the top of the magnesium
- The top level of the magnesium stopped burning
- The magnesium was white and shriveled from the outside, was brittle
- There are no observable changes to the magnesium after this observation

Analysis:

1. The original weight of magnesium can be derived by subtracting the weight of the empty crucible from the weight of the crucible containing the magnesium ribbon, as given in Table 1.1 to be 0.175 grams.

2. The weight of the magnesium oxide formed can be found by subtracting the weight of the empty crucible from the weight of the crucible containing the magnesium oxide, as given in Table 1.1 to be 0.273 grams.

3. The weight of the oxygen reacted is the difference between the weight of the formed magnesium oxide and the magnesium ribbon, which is 0.273 grams - 0.175 grams = 0.098 grams.

4. The ratio, by weight, between the magnesium and oxygen is given by the weight of the magnesium divided by the weight of the oxygen reacted, which is: 0.175 grams / 0.098 grams, or 1.7857.

5. The weight of one magnesium atom, in amu, given that one oxygen atom weighs 16 amu can be found by multiplying the ratio between magnesium and oxygen by 16: 1.7857 * 16 = 28.5712 amu.

6. Atoms are simply too small to be weighed directly by an electronic scale or current measurement techniques, and the weight of a single atom would be negligible to the scale.

7. To produce the same amount of product, the amount of oxygen must double so that each magnesium atom reacts with 2 oxygen atoms, implying that the ratio halves: 1.7857 / 2 = 0.89285.

8. Under the procedure of this lab, carbon would combine with oxygen to produce carbon dioxide or carbon monoxide, and then escape the crucible when the cover was removed to allow oxygen into the crucible. This would render the results of the experiment inaccurate.

9. The crucible was initially heated to evaporate any moisture that may have been in the crucible as to lessen its interference with the experiment. Moreover, since the crucible is porous, initially heating the crucible helps to avoid any interference that water may have in the experiment.

10. The percent yield of the experiment can be found by dividing the weight of magnesium, in amu, as found in this lab by the weight of magnesium, in amu, on the periodic table and multiplying by 100%: (28.5712 / 24.305) * 100% = 117.55%

Conclusion

Since the atomic weight of magnesium cannot be found through measuring its atoms directly, it must be found through other methods, such as comparing it to that of oxygen using the law of definite proportions. The mass of magnesium atoms in this lab was found to be 28.5712 amu, which is a percent yield of 117.55%. This difference from the atomic weight on the periodic table (24.305 amu) was due to sources of uncertainty in this experiment. The largest source of uncertainty was the sliding of the crucible cover to introduce oxygen, since an inconsistent and varied amount of oxygen reacted with the magnesium each time the cover was lifted. Moreover, the time the crucible cover was lifted from the crucible was not specified for each 30 second interval, further contributing to the inconsistent amount of oxygen that reacted with the magnesium. Finally, since it is impossible to ensure that every magnesium atom in the magnesium ribbon reacted with oxygen to produce magnesium oxide, a small amount of magnesium was included in the final measurement of magnesium oxide, underestimating the true atomic weight of magnesium.