Signal and sistems
Laboratory work - Inverted pendulum stabilization
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1 Incroduction

The objective of this work is to stabilize the inverted pendulum in an upright position. For stabilization is used feedback controller based on the pole placement method. The pendulum consists of a driven arm. This arm rotates in the horizontal plane, and a pendulum attached to that arm is free to rotate in the vertical plane $[-\frac{\pi}{8}, +\frac{\pi}{8}]$. The arm has powered by the $\pm$10V DC motor with constraints movement around.

The system is exceptionally non-linear due to the gravitational forces that affect him. To realize the stabilization of this system, we have the possibility to use two sensors that measure with a satisfactory defect. The first sensor measures the position of the rod angle relative to the vertical position, and the second sensor measures the position of the arm motor angle. Both sensors have powered a voltage of $\pm 1,33$V.

2 Model of a rotary pendulum

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, $M_{\mathrm{Mg}} = 16.00 \times \frac{1.31}{0.87} = 24.1 = 24\,\mathrm{g} \cdot \mathrm{mol}^{-1}$ (to two significant figures).

4 Results and Conclusions

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

5 Discussion of Experimental Uncertainty

The accepted value (periodic table) is $24.3\,\mathrm{g} \cdot \mathrm{mol}^{-1}$ 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

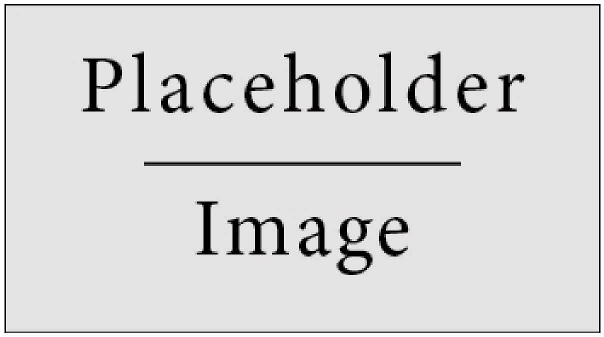

Figure 1: Figure caption.

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.