An Investigation into Spectroscopy and Atomic Spectra

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Jared Compaleo Section 17M

Academic Honesty Statement

I have read and agree to the terms of the Academic Honesty Statement.

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22nd September 2019

Purpose

To investigate how matter, color, and source impact the atomic spectra.

Results

Table 5.1 Observable Helium Emission Lines in the Visible Spectrum

|  |  |  |
| --- | --- | --- |
| **Scale Reading** | **λ (nm)** | **Color** |
| 55 | 667.8 | Red |
| 43 | 587.6 | Yellow |
| 32 | 501.6 | Green |
| 30 | 492.2 | Blue-Green |
| 27 | 471.3 | Blue |
| 25 | 447.1 | Violet |

Figure 5.1 Calibration Graph Using Helium

Table 5.2 Wavelength Measurement for Mercury

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Scale Reading** | **Color** | **Expt nm ± 10%** | **Literature Value (nm)** | **% Error** |
| 40 | Orange | 561.76 | 576.96 | 2.63 |
| 35 | Green | 525.52 | 546.07 | 3.76 |
| 25 | Violet | 453.04 | 435.83 | 3.95 |

Table 5.3 Wavelength Measurement for Krypton

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Scale Reading** | **Color** | **Expt nm ± 10%** | **Literature Value (nm)** | **% Error** |
| 43 | Orange | 583.51 | 587.1 | 0.61 |
| 37 | Green | 540.02 | 557.0 | 3.05 |
| 24 | Violet | 445.79 | 450.2 | 0.98 |

Table 5.4 H-Atom Spectrum Results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **n1** | **n2** | **Theoretical λ (nm)** | **Scale reading** | **Expt λ (nm)** | **% Error** |
| 1 | 2 | 121.57 | UV - Not Experimentally Observable | | |
| 1 | 3 | 102.57 |
| 1 | 4 | 97.253 |
| 2 | 3 | 656.46 | 45 | 598.01 | 8.90 |
| 2 | 4 | 486.26 | 30 | 489.28 | 0.62 |
| 2 | 5 | 434.16 | 24 | 445.79 | 2.68 |
| 2 | 6 | 410.28 |  |  |  |
| 3 | 4 | 1875.6 | IR - Not Experimentally Observable | | |
| 3 | 5 | 1282.1 |
| 3 | 6 | 1094.1 |

Table 5.5 Observations of Mercury and Krypton

|  |  |
| --- | --- |
| **Element** | **Observation** |
| Mercury | Orange |
| Green |
| Violet |
| Krypton | Orange |
| Green |
| Violet |

Discussion and Conclusion

For mercury, all the experimental values were within 10% in either direction of the literature value (Sansonetti, 2019). For krypton, all the experimental values were within 10% in either direction of the literature value (Kramida, 2018). For hydrogen, all the experimental values were within 10% in either direction on the literature value (Sanders, 2019). The differences in all the experimental values are likely due to the fact that the instrument used for measuring the scale readings is not very accurate. The uncertainty in the H-atom measurements are likely random uncertainties due to difficulties in obtaining accurate measurements using our instrument. The appearance of each light can be achieved by mixing all the spectral lines for the element together.

Lights of similar wavelengths emit a similar color. This is supported by the experimental values having similar wavelengths also having a similar perceived color. This is further supported by the literature also having similar wavelengths attributed to similar colors (Sanders, 2019).

References

Kramida, A; Ralchenko, Y.; and Reader, J. *NIST Atomic Spectra Database* (ver 5.5.2); National Institute of Standards and Technology: Gaithersburg, MD. https://www.nist.gov/pml/atomic-spectra-database (accessed 28 January 2018).

Sansonetti, J. E.; Martin, W. C. https://www.nist.gov/sites/default/files/documents/srd/jpcrd690.pdf (accessed Sep 22, 2019).

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