Atomic Constants

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ibrahim alshehri
201745170

[1]:
```
import sympy as sp
import numpy as np
import matplotlib.pyplot as plt
import scipy.constants
from scipy.constants import *

from matplotlib import rc
rc('font',**{'family':'sans-serif','sans-serif':['Helvetica']})
## for Palatino and other serif fonts use:
#rc('font',**{'family':'serif','serif':['Palatino']})
rc('text', usetex=True)
plt.rcParams["figure.figsize"] = (14,8)

from IPython.display import set_matplotlib_formats
set_matplotlib_formats('png', 'pdf')

from pprint import pprint
sp.init_printing()
```

1 Lab Report

1.1 Table

Color	Angle θ_R	Angle θ_L	n
Weak violet	7.105°	7.168°	6
Violet	7.565°	7.555°	5
Blue-Green	8.436°	8.432°	4
Red	11.438°	11.420°	3

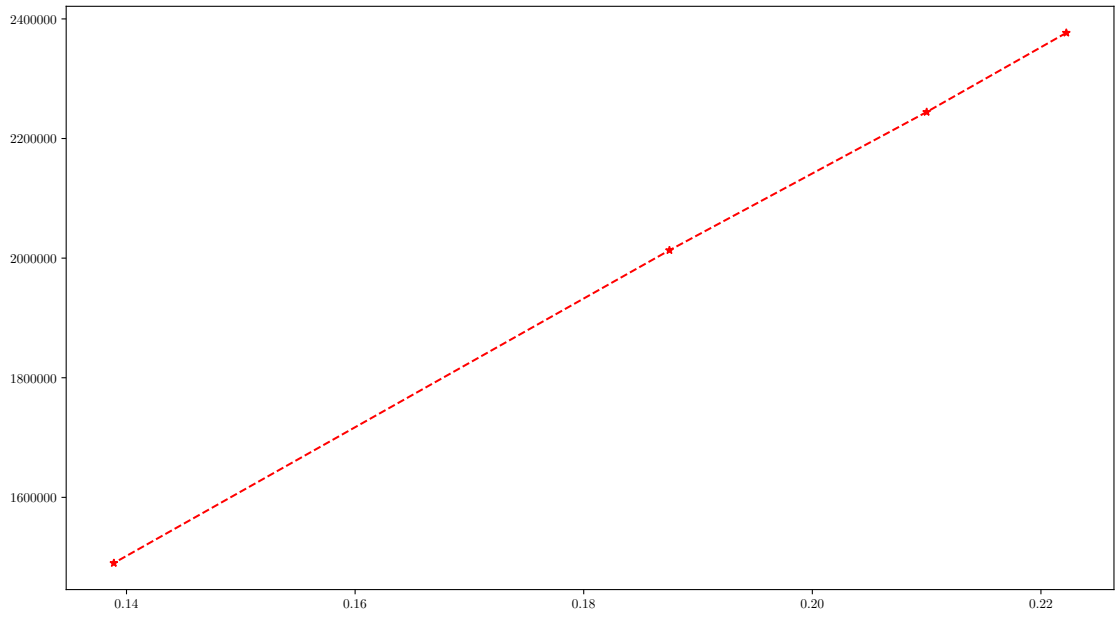
[2]:
```
theta_R = np.array([7.105, 7.565, 8.436, 11.438]) * pi / 180 # rad
theta_L = np.array([7.168, 7.555, 8.432, 11.420]) * pi / 180 # rad
n = np.array([6, 5, 4, 3])

d = 3.3867e-6 # m
```

```
theta = (theta_R + theta_L)/2 # rad
wavelengths = d * np.sin(theta) # m

for i, j in zip(theta, wavelengths):
    print(f"| {i / pi * 180 :6.3f} | {j * 1e9 : 6.2f}|")
```

```
|  7.137 |  420.74|
|  7.560 |  445.57|
|  8.434 |  496.73|
| 11.429 |  671.09|
```

Angle $\theta(°)$	Wavelength $\lambda(nm)$
7.137	420.74
7.560	445.57
8.434	496.73
11.429	671.09

[3]:
```
x = 1/2**2 - 1/n**2
y = 1/wavelengths

plt.plot(x, y, '*r--')
slope, intercept = np.polyfit(x, y, 1) # linear fit
R_H = slope
```



$$h = \frac{E_n - E_2}{c}\lambda_n = \left(\frac{1}{n^2} - \frac{1}{2^2}\right)\frac{E_1}{c}\lambda_n$$

[4]:
```
E_1 = -13.58 * 1.60e-19 # Joules
c = scipy.constants.physical_constants["speed of light in vacuum"][0]

h_measured = np.mean((1/n**2 - 1/2**2) * E_1 / c * wavelengths)
```

[5]:
```
print(f"h = {h_measured:.4e}, R_H = {R_H:.4e}")
# physical_constants[name] = (value, unit, uncertainty)
print(scipy.constants.physical_constants["Planck constant"])
print(scipy.constants.physical_constants["Rydberg constant"])
```

```
h = 6.7659e-34, R_H = 1.0624e+07
(6.62607004e-34, 'J s', 8.1e-42)
(10973731.568508, 'm^-1', 6.5e-05)
```

[6]:
```
# part (a)
print(f"Error in rydberg constant {abs(R_H - Rydberg)/Rydberg * 100 :.3f}%")
```

```
Error in rydberg constant 3.183%
```

[7]:
```
# part (b)
E_n = E_1 / n**2
for num, E in zip(n, E_n):
    print(f"E_{num:d} = {E/1.6e-19:.3f} eV")
```

```
E_6 = -0.377 eV
E_5 = -0.543 eV
E_4 = -0.849 eV
E_3 = -1.509 eV
```

[8]:
```
# part (c)
print(f"Error in planck constant {abs(h_measured - h)/h * 100 :.3f}%")
```

```
Error in planck constant 2.110%
```

[ ]:
```

```