Errors and Uncertainty Assignment

A scientist is determining the acoustic impedance (Z) of water using the following equation:

$$I=Zv^2$$

- I Sound Intensity $[W/m^2]$
- Z Impedance [Pa*s/m]

v - Particle Velocity [m/s]

To determine the acoustic impedance of water, the scientist collects the following data.

Table 1: Sound Intensity and particle velocity observed from acoustic impedance experiment.

Particle Velocity [m/s] Uncertainty: ±1%	Sound Intensity [W/m ²] Uncertainty: ±5%
2.1e-15	6.4e-24
2.8e-15	1.1e-23
4.1e-15	2.5e-23

Make a plot of I versus v^2 . Draw the error bars on the plot for both I and v^2 . Calculate the best estimate of impedance, with an uncertainty, for each measurement. Based on your plot, what can you say about the proportionality between I and v^2 ?

$$d = \frac{m}{\pi r^2 l}$$

m - mass = 0.029 ± 0.005 kg r - radius = 8.2 ± 0.1 mm l - length = 15.4 ± 0.1 mm

What is the resulting value of the density with its absolute uncertainty?

The focal length, f, of a thin lens is to be measured using the equation:

$$\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$$

where o is the object distance and i is the image distance. Calculate the value of the focal length, its absolute uncertainty, and its relative uncertainty, if o = 0.154 ± 0.002 m and i = 0.382 ± 0.002 m.