Problem 1: Experiment FM

a. Measure the width of your magnets.

b. Measure the center-to-center distance between the magnets as a function of the force pressing the magnets together. (See Experiment FM for details).

c. Tabulate the data, with two columns labeled Force (in N), and Center-to-Center Distance, $S_c$ (in mm).

d. Make two plots of the data, one on linear paper and the other on log-log paper with center-to-center distance $S_c$ (in mm), along the horizontal axis and Force (in N) along the vertical axis.

e. **Analysis:** On the log-log paper try to fit a straight line between the data points to match your best-fit curve. If you cannot match one straight line, you may be able to find two different regions where there are straight-line fits. This means that the force between these magnets can be described by different inverse powers at different distances.

Calculate the slope of the log $F$ vs. log $S_c$ best-fit straight lines. This gives the approximate power law for the force between the magnets for different ranges of center-to-center separation distance. You may use a program to find the best-fit straight line. If you want to calculate the slope note that if the force is a power law

$$ F = a(S_c)^b, $$

where $a$ is a constant and $b$ is the power exponent, then

$$ \log F = \log(a(S_c)^b) = \log(a) + \log((S_c)^b) = \log(a) + b \log(S_c). $$

The slope of the log $F$ vs. log $S_c$ graph is the power exponent $b$, and the intercept is the constant $a$. On the log-log graph paper choose two points that lie on your best-fit straight line.

f. Try to explain your results. Why should the power law vary when the magnets are very close together or further apart?