

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01X

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Problem Set 5 Solutions

Problem 1: Experiment FM

a. Measure the width of your magnets.

I measured a width of 4 mm for each magnet.

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 newtons), and Center to Center Distance, S_c .

My data is shown in table 1.

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 newtons) along the vertical axis.

See graphs 1 and 2.

e. On the log-log plot try to fit a straight line between the data points to match your best fit curve. You may need two different straight lines. Calculate the slope of these straight lines for the $\log F_m$ vs. $\log S_c$ best fit curve. This gives the approximate power law for the force between the magnets for different ranges of center to center separation distance.

I found two straight lines fit the data.

The first covered the range of values $9 \text{ mm} < S_c < 23 \text{ mm}$. This corresponded to the most widely separated distances between the faces of the magnet. For this range my best straight line fit on the log-log graph corresponded to a power law behavior

$$F = 33.4 (S_c)^{-1.97}$$

where S_c is measured in mm and the force is measured in newtons.

The second covered the range of values $5 \text{ mm} < S_c < 9 \text{ mm}$. This covered the distances when the magnets were very closely together although I noticed that the point in which the magnets were practically touching did not lie on the straight line. I did not include the point ((4.1 mm, 0.711 N) in my power law fit. For this range my best straight line fit on the log-log graph corresponded to a power law behavior

$$F = 2.69 (S_c)^{-0.896}$$

where S_c is measured in mm and the force is measured in newtons.

table I

Trial	wgt (g)	force (N)	center to center (mm) S_c
magnet m	7.6	0.074	22
m + cup c	10.1	0.099	19
m+c+ 5 pennie	22.6	0.221	13
m+c+10 p	35.1	0.344	10
m+c+15 p	47.6	0.466	7
m+c+20 p	60.1	0.589	5.5
m+c+25 p	72.6	0.711	4.1

