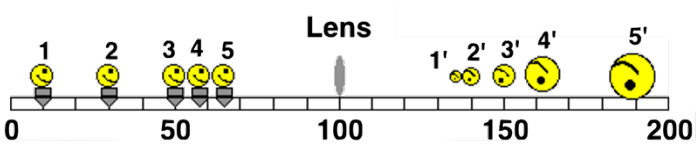
Magnification Lab

A lab is being done to quantify the dependence of the magnification of an image upon the object distance and the focal length of a lens. The **object distance (d_o)** is the distance between an object and the lens. The **focal length (f)** is the distance from the focal point (**F**) to the lens. The **magnification (M)** of an image is the ratio of the image height to the object height. Magnification values are negative for inverted images.

Students mark a *smiley face* upon a light bulb and mount it along a 2-meter stick. They place the lens at the 100-cm mark. They project the image of the light bulb onto a sheet of paper and measure the image height (h_i). See **Figure 1**. Object positions are labeled 1, 2, 3, 4, and 5 and result in images 1', 2', 3', 4' and 5'.

Figure 1



(Divisions on the 2-meter stick are 10-cm apart; every 50-cm is labeled.)

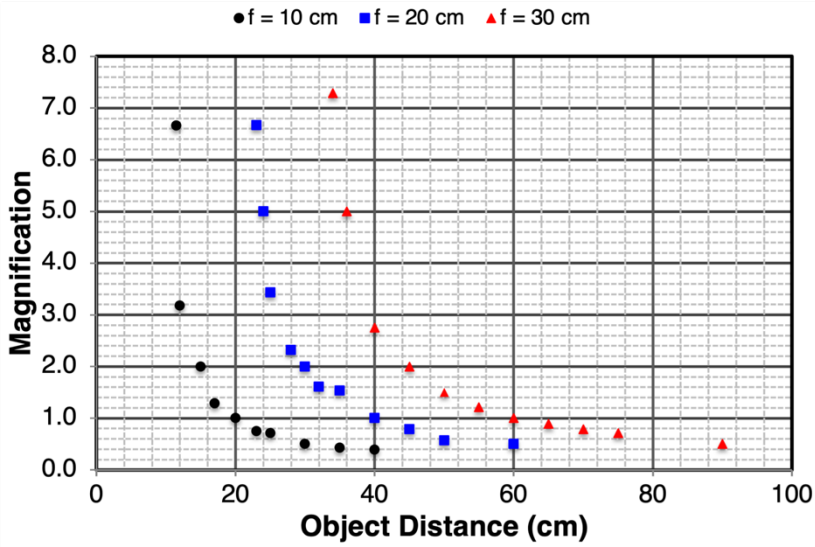
Table 1 shows the results for several trials with three different focal lengths.

Table 1

f = 10 cm			f = 20 cm			f = 30 cm		
d_o (cm)	h_i (cm)	| M |	d_o (cm)	h_i (cm)	| M |	d_o (cm)	h_i (cm)	| M |
40.0	0.9	0.33	60.0	1.4	0.50	90.0	1.4	0.50
35.0	1.1	0.40	50.0	1.9	0.67	75.0	1.9	0.67
30.0	1.4	0.50	45.0	2.2	0.80	70.0	2.1	0.75
25.0	1.9	0.67	40.0	2.8	1.00	65.0	2.4	0.86
23.0	2.2	0.77	35.0	3.7	1.33	60.0	2.8	1.00
20.0	2.8	1.00	32.0	4.7	1.67	55.0	3.4	1.20
17.0	4.0	1.43	30.0	5.6	2.00	50.0	4.2	1.50
15.0	5.6	2.00	28.0	7.0	2.50	45.0	5.6	2.00
12.0	14.0	5.00	25.0	11.2	4.00	40.0	8.4	3.00

Figure 2

Figure 2 shows a plot of magnification versus object distance for the three different lenses.



Use the diagram, data, and plot to answer the next several questions.