KEY

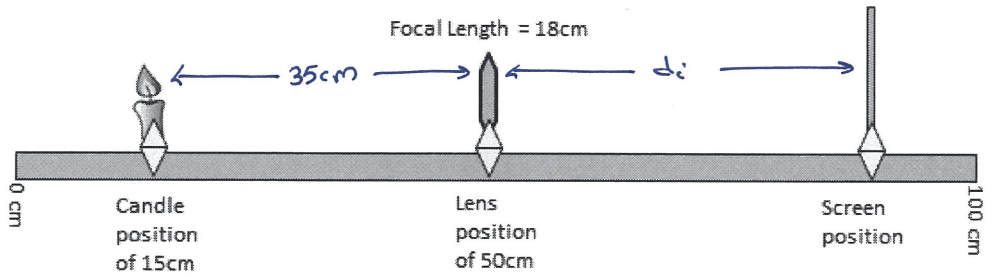
First Name:_____ Last Name:_____

L07 – Worksheet – Refraction Lenses Graphing and Optics Rails

Optics Rails

Use the following information to answer Q1-Q2:

A candle, converging lens, and a screen are placed on a meter stick. The position of the screen is adjusted until an image of the candle comes into focus.



Q1: When the image of the candle is in focus, the screen is positioned at the ____ cm mark.

*(Record your **three digit** answer in the Numerical Response boxes below)*

8	7	.	1

$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$

$\frac{1}{18} = \frac{1}{d_i} + \frac{1}{35}$

$d_i = 37.0588\text{cm}$

So 37.1 cm from vertex (at 50cm).

So screen at 87.1 cm

Q2: The image formed is __*i*__ and __*ii*__.

	i.	*ii.*
A.	erect	diminished
B.	erect	enlarged
C.	inverted	diminished
D.	inverted	enlarged

$m = \frac{-d_i}{d_o} = \frac{-(37.0588)}{35}$

$m = -1.0588$

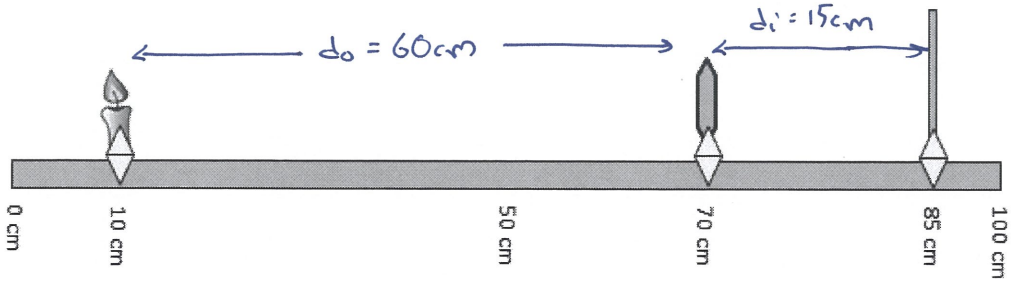
↙ Inverted

↘ $|m| > 1$ so enlarged

KEY

Use the following information to answer Q3:

A candle, converging lens, and a screen are placed on a meter stick. The position of the screen is adjusted until an image of the candle comes into focus.



Q3: The focal length of the converging lens is _____ cm.

*(Record your **three digit** answer in the Numerical Response boxes below)*

1	2	.	0

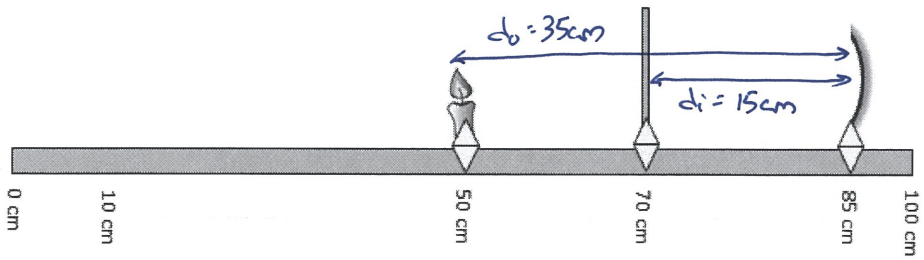
$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$\frac{1}{f} = \frac{1}{60} + \frac{1}{15}$$

$$f = 12.0\,cm$$

Use the following information to answer Q4:

A candle, concave mirror, and a screen are placed on a meter stick. The position of the screen is adjusted until an image of the candle comes into focus.



Q4: The focal length of the concave mirror is _____ cm.

*(Record your **three digit** answer in the Numerical Response boxes below)*

1	0	.	5

$$\frac{1}{F} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$\frac{1}{f} = \frac{1}{35} + \frac{1}{15}$$

$$f = 10.5\,cm$$

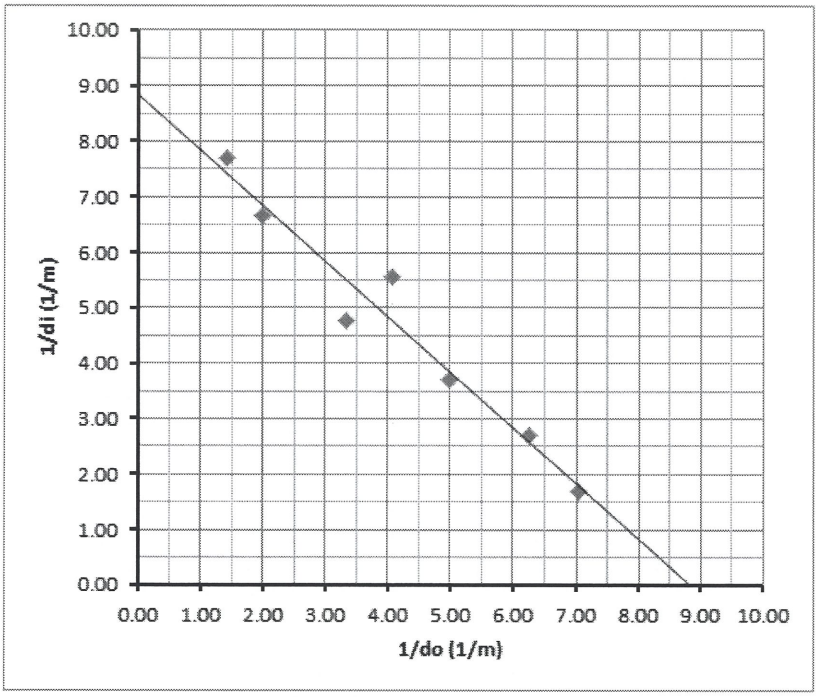
KEY

Refraction Lenses Graphing

Use the following information to answer Q5:

A student performing an Optics Rail experiment graphs the inverse of object distance versus the object of image distance, and plots the data below:

do	di	1/d0	1/di
0.70	0.13	1.43	7.69
0.50	0.15	2.00	6.67
0.25	0.18	4.08	5.56
0.30	0.21	3.33	4.76
0.20	0.27	5.00	3.70
0.16	0.37	6.25	2.70
0.14	0.59	7.04	1.69



Q5: If the image were formed by a converging lens, then the focal length of the lens is _____ cm.

*(Record your **three digit** answer in the Numerical Response boxes below)*

1	1	.	3

Accept 11.2 → 11.4

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$\frac{1}{d_i} = -1\left(\frac{1}{d_o}\right) + \frac{1}{f}$$

$$y = m(x) + b$$

So y-intercept $b = \frac{1}{f}$

If $b = 8.5$, $f = 0.1176\,m \rightarrow 11.8\,cm$
8.6, $f = 0.1163\,m \rightarrow 11.6\,cm$
8.7, $f = 0.1149\,m \rightarrow 11.5\,cm$
8.8, $f = 0.1136\,m \rightarrow 11.4\,cm$
8.9, $f = 0.1124\,m \rightarrow 11.2\,cm$
9.0, $f = 0.1111\,m \rightarrow 11.1\,cm$

Intercept actually 8.8472 per Excel.

KEY

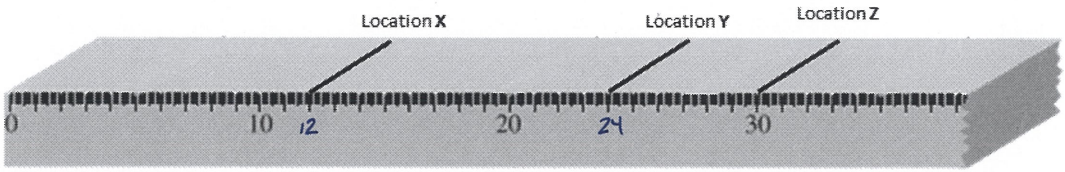
Challenge Questions

Use the following information to answer Q6:

Students use three of the optical apparatus illustrated below to produce a **focused, real** image in a darkened room. One of the apparatus has a focal length of 4.50 cm.

Sources		Lenses		Mirrors			Diffraction grating	Double-slit apparatus	Screen
									
0	1	2	3	4	5	6	7	8	9

The students place one apparatus at each labelled location on an optics bench, as shown below. The optics bench is scaled in millimeters and labelled in centimeters.



Note: The diagrams are **not** drawn to scale.

Q6: The apparatus placed at location

X is numbered _____ (Record in the **first** column)
Y is numbered _____ (Record in the **second** column)
Z is numbered _____ (Record in the **third** column)

*(Record your **three digit** answer in the Numerical Response boxes below)*

Accept 094, 194, 904, 914

Lens?

$d_o = 12cm$ $d_i = 6cm$

$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

$\frac{1}{f} = \frac{1}{12} + \frac{1}{6}$

$f = 4.00cm$

NOPE!

Mirror?

$d_o = 18cm$ $d_i = 6cm$

$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

$\frac{1}{f} = \frac{1}{18} + \frac{1}{6}$

$f = 4.50cm$

Yep!

9 → 0/1 → 4

or

0/1 → 9 ← 4