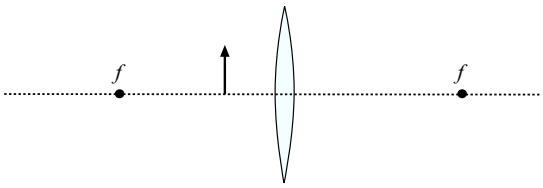
Name_____

Feb. 15, 2008

Quiz #2 — Spring 2008

Phys 2020

1. An object of height 2.0 cm is located 3.0 cm in front of a converging lens with a focal length of 10.0 cm.



a) Give the location of the image. Be clear about whether it is in front of the lens or on the other side.

Here we have $s = 3.0$ cm and $f = 10.0$ cm, so the lens equation gives:

$$\frac{1}{s'} = \frac{1}{f} - \frac{1}{s} = \frac{1}{10.0\text{ cm}} - \frac{1}{3.0\text{ cm}} = -0.233\text{ cm}^{-1} \quad \Longrightarrow \quad s' = -4.28\text{ cm}$$

Here the minus sign indicates that the image is also in front of the lens, so that the image is 4.3 cm in front of the lens.

b) Find the size of the image.

The magnification of the object is

$$m = -\frac{s'}{s} = -\frac{(-4.28\text{ cm})}{(3.0\text{ cm})} = 1.43 = \frac{h'}{h}$$

So the image height is

$$h' = (1.43)h = (1.43)(2.0\text{ cm}) = 2.86\text{ cm}$$

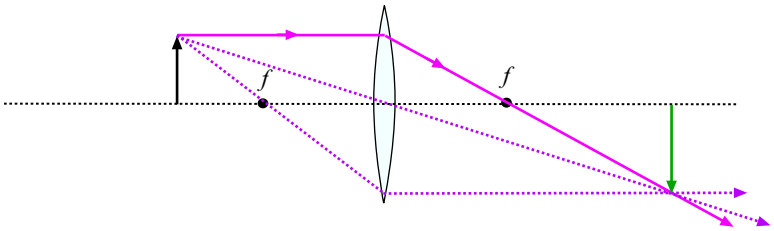
The plus sign indicates the image is upright.

c) Is the image real or virtual? Is it upright or inverted? (Explain the choice for each.)

The image is not one where the rays actually meet, since it is on the same side as the object, so it is virtual. Since m was positive, it is upright.

This is an example where a converging lens acts as a magnifying glass normally does.

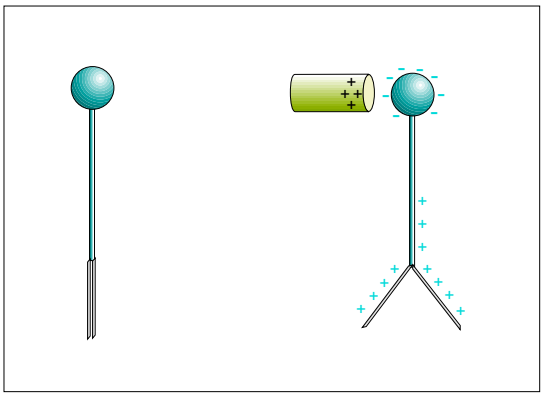
2. Below we see a diagram for an object in front of a converging lens. The focal points of the lens are shown. One of the three rays we use to locate the image graphically is shown.



Sketch in one more ray and thereby locate the image (graphically).

Two rays have been added to the original figure and the location (and orientiation) of the image given.

3. The electrometer demonstration done in class is shown at the right.



Explain why the leaves of the electrometer moved apart when the charged rod was brought near them. An illustration may help.

When the positively-charged rod is held near the round knob at the top, electrons (negatively-charged) move to this region, leaving a positive charge in the lower part of the conductor, including the leaves. (This is shown by the addition of charge symbols to the original figure.) As the leaves now both have a positive charge, they repel each other and lift up.

You must show all your work and include the right units with your answers!

$c = 3.00 \times 10^8 \frac{\text{m}}{\text{s}}$ Interference: $\sin\theta_{\text{br}} = m\frac{\lambda}{d}$ Diffraction: $\sin\theta_{\text{dark}} = p\frac{\lambda}{a}$

$\lambda f = v$ $n = \frac{c}{v}$ $n_1 \sin\theta_1 = n_2 \sin\theta_2$ $\sin\theta_c = \frac{n_2}{n_1}$ $\frac{1}{s} + \frac{1}{s'} = \frac{1}{f}$

$m = \frac{h'}{h} = -\frac{s'}{s}$ $F = K\frac{|q_1 q_2|}{r^2}$ $K = 8.99 \times 10^9 \frac{\text{N}\cdot\text{m}^2}{\text{C}^2}$