SNC2D PHYSICS

LIGHT & GEOMETRIC OPTICS

☞ The Curved Lens Equations (P.454-457)

Activity: Curved Lens Equations

ISSUE

As you have learned, you can use ray diagrams to determine the characteristics of an image. However, they are prone to errors and require patience and time. There is another method – a set of quantitative algebraic relationships that are derived using geometry. But in order to use the algebraic method there are some variables and sign conventions that must be defined first.

INSTRUCTIONS (2DPHYS - WS7)

A. Complete Part 1 (Lens Terminology) and Part 2 (Sign Convention).

Activity: Curved Lens Equations (WS7/Part 1)

d_o = distance from the object to the optical centre (O)

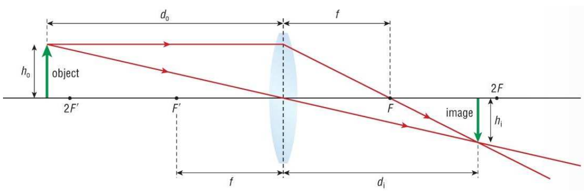
d_i = distance from the image to the optical centre (O)

h_o = height of the object

h_i = height of the image

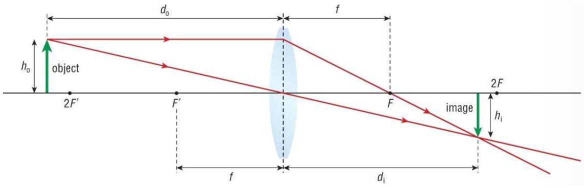
f = focal length of the lens (i.e. distance from O to F or F')

M = the magnification of the lens



Activity: Curved Lens Equations (WS7/Part 2)

d_o = always positive (never negative)
d_i = positive for real images, negative for virtual images
h_o = positive when measured upward, (never negative)
h_i = positive when measured upward, negative when downward
f = positive for a converging lens, negative for a diverging lens
M = positive for real virtual images, negative for real images

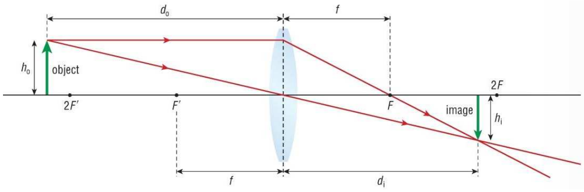


Activity: Curved Lens Equations (WS7/Part 2)

Variable	Sign	Condition	Image Type
d_o	+	always	n/a
	–	never	n/a
d_i	+	image on opposite side as object	real
	–	image on same side as object	virtual
h_o	+	always	n/a
	–	never	n/a
h_i	+	when measured upward	virtual
	–	when measured downward	real
f	+	converging lens	depends on object location
	–	diverging lens	virtual
M	+	upright image	virtual
	–	inverted image	real

The Thin Lens Equation

*Using triangle congruencies with the diagram below, a very useful equation that relates the focal length (f), the object distance (d_o), and the image distance (d_i) can be derived. The equation is called the **thin lens equation**.*

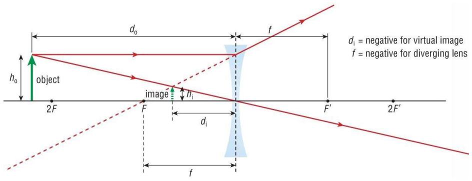


d_i is the distance from O to the image

Activity: The Thin Lens Equation

ISSUE

As you will discover, the thin lens equation can be used for both converging and diverging lenses. Recall that the focal length and image distance for a diverging lens are negative.

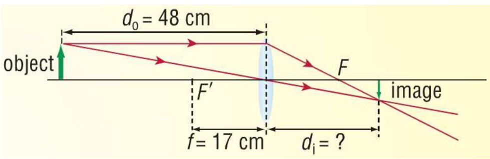


INSTRUCTIONS (2DPHYS - WS7)

A. Complete Part 3 (The Thin Lens Equation & …), questions 1 to 5.

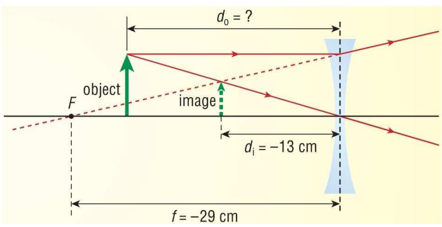
Activity: The Thin Lens Equation (WS7/Part 3)

1. A converging lens has a focal length of +17 cm. A candle is located +48 cm from the lens. What type of image will be formed, and where will it be located? (real, +26 cm)



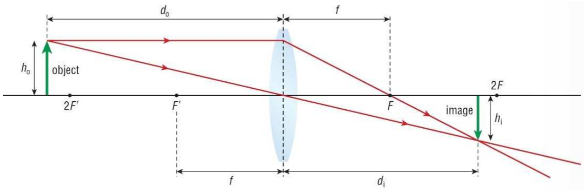
Activity: The Thin Lens Equation (WS7/Part 3)

2. A diverging lens has a focal length of -29 cm. A virtual image of a marble is located -13 cm in front of the lens. Where is the marble (i.e. the object) located? (+24 cm)



The Magnification Equation

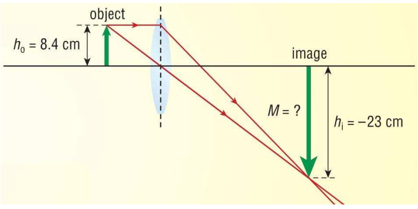
*Using the same process as before, another very useful equation known as the **magnification equation** can be derived. This equation relates both the heights and distances of the object and image.*



d_i is the distance from O to the image
d_o is the distance from O to the object

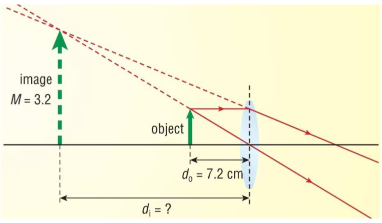
Activity: The Magnification Equation (WS7/Part 3)

3. A toy of height +8.4 cm is balanced in front of a converging lens. An inverted, real image of height -23 cm is noticed on the other side of the lens. What is the magnification of the lens? (-2.7 X)



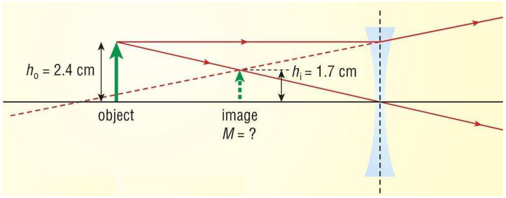
Activity: The Magnification Equation (WS7/Part 3)

4. A small toy building block is placed +7.2 cm in front of a lens. An upright, virtual image of magnification +3.2 is noticed. Where is the image located? (-23 cm)



Activity: The Magnification Equation (WS7/Part 3)

5. A coin of height +2.4 cm is placed in front of a diverging lens. An upright, virtual image of height +1.7 cm is noticed on the same side of the lens as the coin. What is the magnification of the lens? (+0.71)



✔ Check Your Learning

TEXTBOOK (more practice?)

P.455 Q.1-3
P.456 Q.1-3
P.457 Q.1-3

WIKI (PHYSICS)

✎.... 2DPHYS - WS8 (More Optics Problems)