

Splitting light, coloured filters, lenses and the eye

Grade 8 science (Year 9 · Class 8) · Lab

Name: _____ Date: _____ Class: _____

How does the image made by a converging lens change as an object moves closer to it? In this lab you find the focal length of a lens from a distant object, then measure image distance and image height for several object distances and compare the magnification you get in two ways.

Level: Grade 8 science (Year 9 · Class 8) · **Curriculum:** MS-PS4-2

Aim

To find the focal length of a converging lens and to see how the image changes as the object moves closer to the lens.

Equipment

- Converging lens (f about 10 cm) in a holder
- Bright LED torch or phone light with an arrow cut out of card
- White card screen in a holder
- Metre rule
- Ruler for measuring image height

Safety

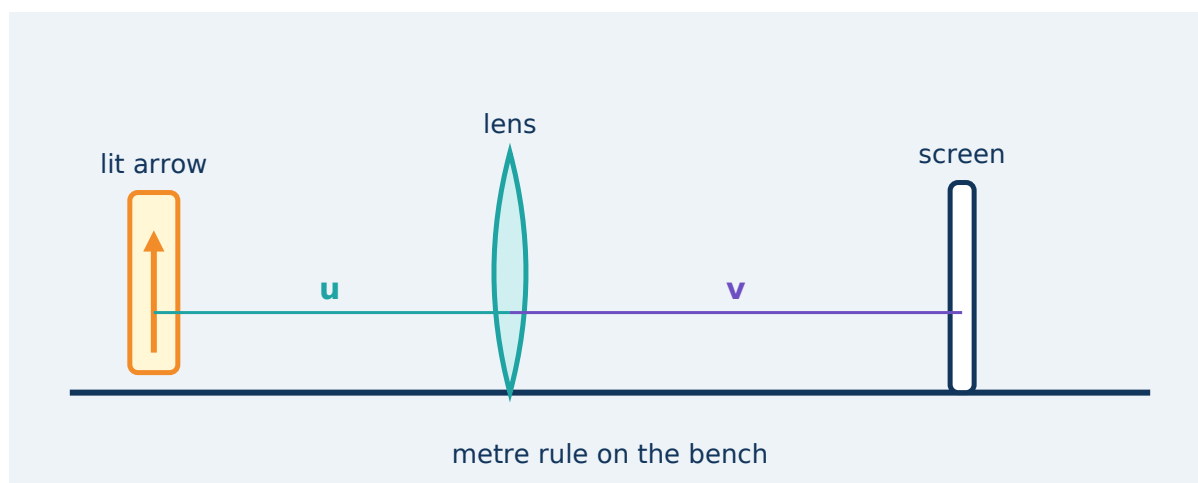
Safety

Never look at the Sun through a lens, and never point a lens at the Sun, because the focused light can burn skin and damage eyes. Keep the lens away from paper and curtains near windows.

Method

1. Hold the lens near a window and move the screen until a sharp picture of a distant building appears. Measure the lens-to-screen distance. Repeat three times.
2. Put the lit arrow at one end of the metre rule (the arrow is 2.0 cm tall) and the lens 40.0 cm from it.
3. Move the screen until the arrow image is sharp, then measure v and the image height.
4. Repeat with $u = 30.0, 20.0, 15.0$ and 12.0 cm.

5. Move the lens to $u = 8.0$ cm and try to find an image on the screen, then look through the lens at the arrow.



Keep the arrow, lens and screen on one straight line and darken the room to see the image clearly.

Results

Focal length from a distant object:

Trial	Lens to screen (cm)
1	10.1
2	10.3
3	10.0

Images of the 2.0 cm arrow:

u (cm)	v (cm)	Image height (cm)	Image description
40.0	13.5	0.7	smaller, inverted
30.0	15.0	1.0	smaller, inverted
20.0	20.0	2.0	same size, inverted
15.0	29.5	3.9	larger, inverted
12.0	58.0	9.6	larger, inverted
8.0	no image on screen	-	looking through the lens: upright, larger

Analysis questions

Question 1 Mean focal length

Calculate the mean lens-to-screen distance from the distant-object table and state it as the focal length.

Question 2 Magnification of one image

Calculate the magnification for $u = 40.0$ cm in two ways: using image height $\div$ object height, and using $v \div u$.

Question 3 Larger images

Calculate the magnification for $u = 15.0$ cm and $u = 12.0$ cm, using image height $\div$ object height.

Question 4 Describing the trend

Describe how v and the image height change as u decreases from 40.0 cm to 12.0 cm.

Question 5 Image at 2F

Use the row where the image is the same size as the object to estimate the focal length, and compare it with your answer to question 1.

Question 6 Uncertainty

The sharpest position of the screen can be judged only to ± 1.0 cm. Calculate the percentage uncertainty in v for $u = 40.0$ cm and for $u = 12.0$ cm, and state which is more reliable.

Question 7 Object inside the focal length

Explain why no image appears on the screen at $u = 8.0$ cm, and describe what you see through the lens.

Question 8 Sharper focus readings

Propose two changes to the procedure that would make the screen position easier to judge and the readings of v more trustworthy.