 Group:

Practical : Lenses, Light & Telescopes

Safety: HOT COMPONENTS

Please be aware that during this experiment the **lamps** may get quite **hot and are relatively bright.**

Handle them carefully and please take care not shine them into each others eyes.

Equipment:

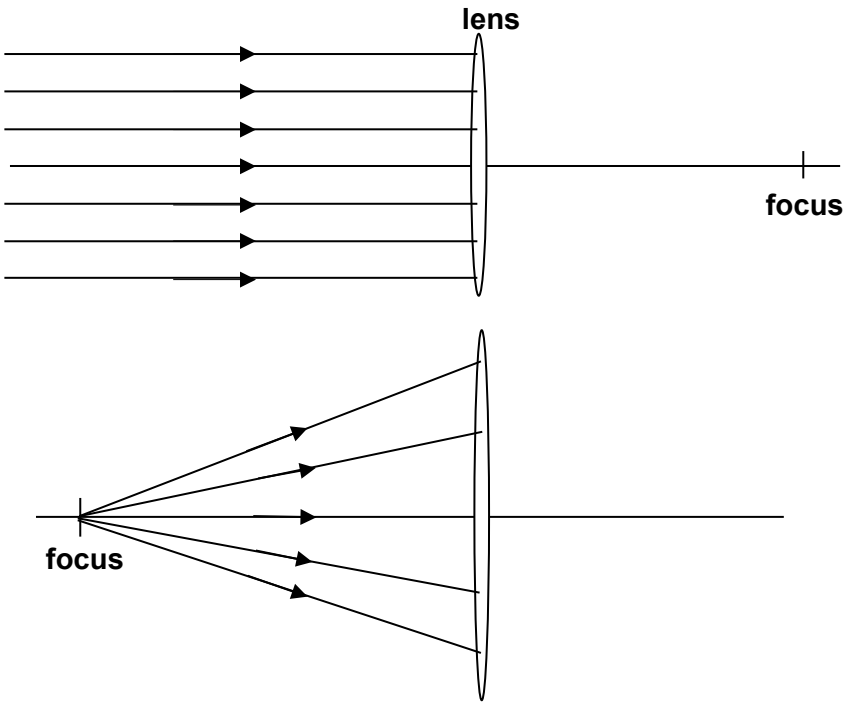
- Optical bench with metre rule
- 1 lamp
- Cork pointer
- Card with pin hole
- Card screen
- 2 lenses one labelled “15” one labelled “30”
- Mirror

Aim:

To investigate how lenses can be used to form images. Using two ***converging*** lenses with different focal lengths we will make a simple telescope.

Background & Theory:

***Converging* lenses and light:**

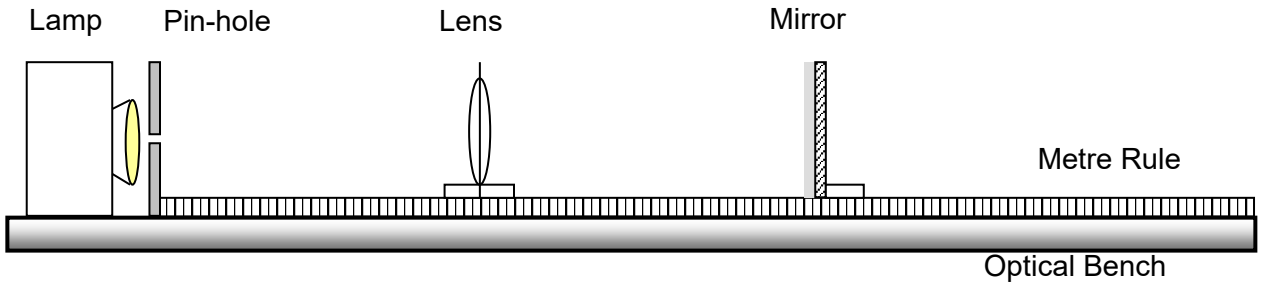


A - Measuring the focal length of a lens:

- The aim of this first part of the experiment is to measure the actual focal length of a lens.
- The focal lengths of the lenses provided are nominally 15cm and 30cm (though some are quite far from these values).
- Choose the lens labelled 15.

Experiment:

1. Place the lamp at the end of the ruler as shown.
2. Stand the card with the pin-hole in it up against the end of the ruler, using the lamp to keep it there.
3. Place the lens approximately 15cm from the hole with the mirror beyond it.
4. Turn the lamp on and adjust the position of the lens/mirror so that a focussed image of the hole is formed on the card close to the hole. (The mirror reflects the image back on to the card).



5. Once you see a clear image of the pin hole on the card read off the ruler the position of your lens.

   My lens is at _____cm.

6. **What do you think is happening to the light once it goes through the pin hole? Can you draw a sketch?**

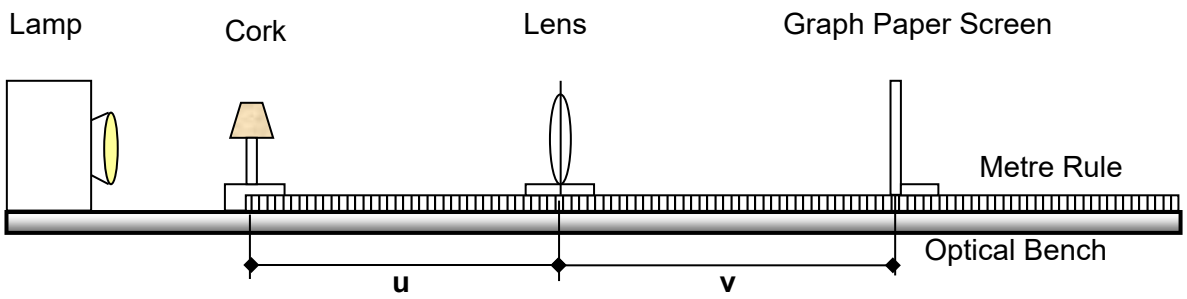
7. **What is the focal length of the lens, *f*?**

   ***f* =** _____

B – Lens Maker's Formula:

Experiment:

1. **Set up the optical bench with the light source as before, but this time without the card with the pin-hole, and move the lamp further away from the rulers.**



2. Put the small pointer and cork at the zero mark at the lamp end of the rulers

3. For about six different positions of lens, find the image by determining when the object is in focus on the viewing screen.
   - **Start with *u about 30 cm* and getting smaller.**
   - **Then work from *u = 30cm* getting larger.**

4. **You will need to measure:**
   - ***u***
   - ***v***

5. **Take measurements filling in the table below:**

u (cm)	*v (cm)*	*1/u (cm $^{-1}$)*	*1/v (cm $^{-1}$)*

6. **Using your measurements of u and v in cm, plot 1/u against 1/v and calculate the value of the gradient and the intercept with the "y"-axis?**

Gradient of graph = _____.

Intercept of graph = _____ cm^{-1} .

$\frac{1}{\textbf{intercept}}$ = _____cm.

What do you notice about this last value?

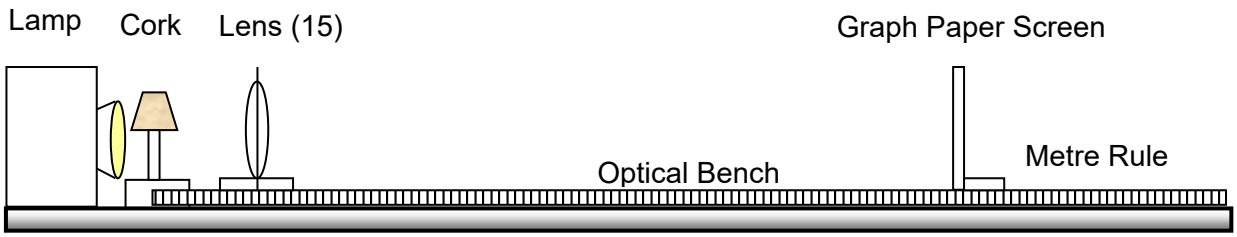
Can you put together an equation relating 1/u, 1/v and the intercept?

This is called the ***Lens maker's formula.***

C - Magnifying glass:

Experiment

1. Reassemble the optical bench with the light source and viewing screen.



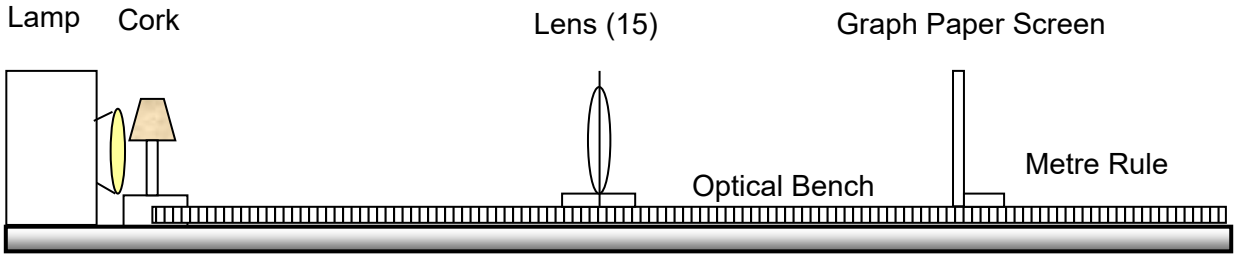
2. Now **MOVE THE LAMP TO THE SIDE AND REMOVE THE VIEWING SCREEN** so that when you look through the lens you are not looking straight at the light. Now put your eye up to the end of the ruler to look through the lens. **What do you see?**

_____

3. This is the normal situation used for a magnifying glass.

D - Making a telescope

1. **Put the lamp, pointer, lens and screen as shown in the diagram below.**



2. Move the lens so that your image is about two times the size of your object (magnification of 2). **Write down the focussed position of the screen.**

   Screen is at _____ cm

3. **REMOVE THE LAMP AND THE VIEWING SCREEN**

5. Put the 30cm focal-length lens about 10cm after the original screen position, and look through it from a position just part the end of the optical bench. Adjust its position, if necessary, until the image comes into focus.

   What can you see?_____

   How might you estimate the magnification of your telescope?

   _____

   _____

   _____