To Obtain a Lens Combination With the Specified Focal. Length By Using two Lenses From the Given Set Of Lenses

Aim

To obtain a lens combination with the specified focal length by using two lenses from the given set of lenses.

Apparatus and material

Apparatus. No particular apparatus is needed.
Material. A set of thin convex lenses, one of these is of given focal length (say 15 cm), (we have to select a second lens such that the combination gives a single lens of focal length f_c = 10 cm), lens holder with stand, a white painted vertical wooden board with broad stand, half metre scale.

Theory

1. The reciprocal of focal length in metre is called power of lens in diopter (D).

$$P = \frac{1}{f}$$

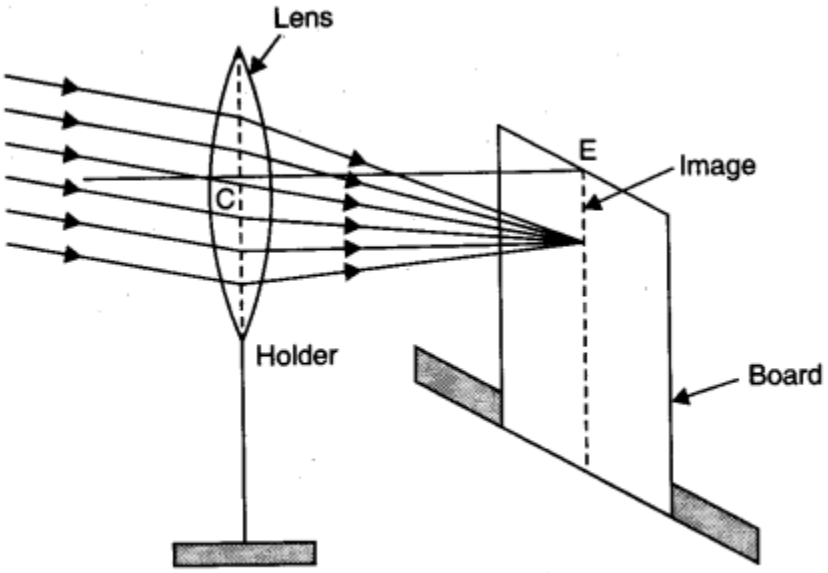
2. With a convex lens, the real image of a distant object is formed at a distance equal to its focal length.

3. If f_1 and f_2 be the focal lengths of the two lenses and F be the focal length of the combination.

Then, $$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$$

For lenses of power P_1 and P_2 and combination of power P.
Then, $$P = P_1 + P_2$$

Diagram



Measurement of focal length of convex lenses.

Procedure

1. Keep the white painted vertical wooden board to serve as a screen.
2. The convex lens (known focal length f_1 = 15 cm), fixed into a holder stand is put on the left of the screen. There are sunlight illuminated green trees at large distance on the left of the lens.
3. The lens is moved towards and away from the screen till a sharp, inverted image of trees is formed on the screen.
4. Distance between central lines of the screen and holder stand is measured by a half metre scale.
5. The distance gives the focal length of the convex lens about 15 cm.
6. Replace first lens by second convex lens of required power and repeat the steps from 2 to 5. This gives the focal length of second convex lens.
7. Now bring both lenses in contact and repeat the steps from 2 to 5. This gives the combined focal length.
8. Determine the focal length with other given lens. Determine the focal length of about six of the convex lenses.

Calculations

Let $F = 10$ cm, so that $P = 10$ D $\quad \left(\because \ P(\mathrm{D}) = \dfrac{100}{F\ (\mathrm{cm})}\right)$

Following combinations will be suitable.

Power		Focal length	
$P_1(D)$	$P_2(D)$	f_1 (cm)	f_2 (cm)
2	8	50	12.5
4	6	25	16.7
5	5	20	20

(**Note.** The ideal values are as sample.)

Verification

The above combinations may be tried and result verified.

Precautions

1. Thin lenses should be taken.
2. Lenses should have same aperture.

Sources of error

1. Lenses may not be thin.
2. Lens apertures may not be same.