

CASE STUDY QUESTION 46

Read the following and answer any four questions from (i) to (v)

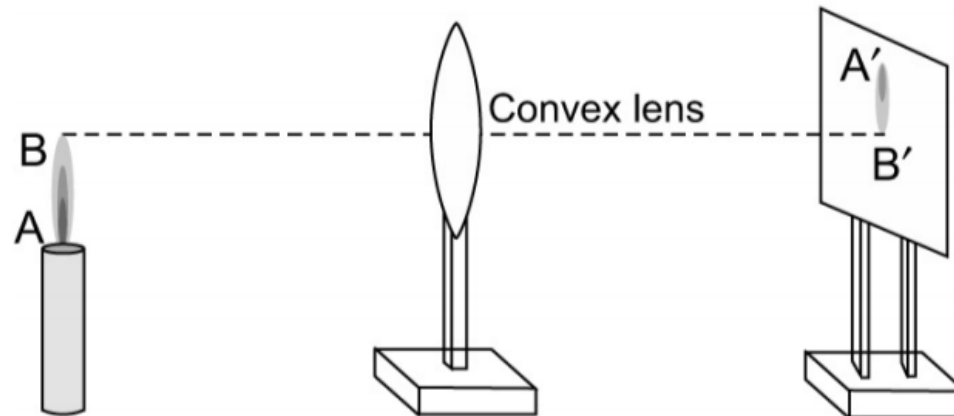
Aditya and his friend Manoj placed a candle flame in front of a convex lens at various distances from it and obtained the image of the candle flame on a white screen.

He noted down the position of the candle, screen and the lens as under

Position of candle = 20 cm

Position of convex lens = 50 cm

Position of the screen = 80 cm



(i) What is the position of the image formed from the convex lens?

(a) 80 cm (b) 50 cm (c) 30 cm (d) 60 cm

Image distance, v = Position of screen - Position of convex lens

$$\begin{aligned}v &= 80 - 50 \text{ cm} \\ &= \mathbf{30 \text{ cm}}\end{aligned}$$

(ii) What is the focal length of the convex lens?

(a) 30 cm (b) 15 cm (c) -16 cm (d) 16 cm

Object distance, u = Position of convex lens - Position of candle

$$u = -(50 - 20) = \mathbf{-30 \text{ cm}}$$

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{30} - \left(\frac{-1}{30}\right) \Rightarrow \frac{1}{f} = \frac{1}{30} + \frac{1}{30} = \frac{2}{30}$$

$$\therefore \mathbf{f = 15 \text{ cm}}$$

(iii) Where will the image be formed if he shifts the candle towards the lens at a position of 35 cm?

(a) At focus (b) Between focus and pole (c) At infinity (d) Between f_2 and f_1

When the candle is shifted towards the lens at a position of 35 cm.

Object distance, $u = -(50 - 35) = -15$ cm

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{15} = \frac{1}{v} + \frac{1}{15}$$

$$\Rightarrow \frac{1}{v} = 0$$

$$\Rightarrow v = \infty \text{ (Infinite)}$$

When object is placed at focus, image is formed at **infinity**.

(iv) Which of the following statement describes the best about the nature of the image formed if Aditya shifts the candle towards the lens to 36 cm?

(a) The nature of the image formed will be virtual, inverted and magnified.

(b) The nature of the image formed will be virtual, erect and magnified.

(c) The nature of the image formed will be virtual, erect and diminished.

(d) The nature of the image formed will be real, inverted and diminished.

(b) The nature of the image formed will be virtual, erect and magnified.

(v) Manoj noted following observations at different positions of candle from the lens. According to Aditya one set of observations is incorrect. Find out if Aditya is right or not.

- (a) Distance of the flame from the lens = 60 cm;
Distance of the screen from the lens = 20 cm
- (b) Distance of the flame from the lens = 45 cm;
Distance of the screen from the lens = 22.5 cm
- (c) Distance of the flame from the lens = 30 cm;
Distance of the screen from the lens = 30 cm
- (d) Distance of the flame from the lens = 10 cm;
Distance of the screen from the lens = 15 cm

The observation (d) is incorrect. For this observation $v = 15$, i.e., the image is at the focus and the object must be formed at infinity and not 10 cm.

- (d) Distance of the flame from the lens = 10 cm;
Distance of the screen from the lens = 15 cm