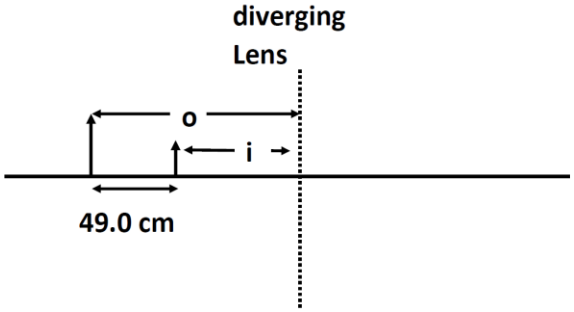
27. The distance between an object and its image formed by a diverging lens is 49.0 cm. The focal length of the lens is - 233.0 cm. Find **(a)** the image distance and **(b)** the object distance.



In this case we have

$$\boldsymbol{o + i = 49.0\ cm}$$

Remember image distance will be negative since the image is virtual.
Solve for object distance

$$\boldsymbol{o = 49.0\ cm - i}$$

Lens equation

$$\boldsymbol{\frac{1}{f} = \frac{1}{o} + \frac{1}{i} = \frac{1}{49.0\ cm - i} + \frac{1}{i} = \frac{i + 49.0\ cm - i}{i(49.0\ cm - i)} = \frac{49.0\ cm}{i(49.0\ cm - i)}}$$

Now solve for i

$$\boldsymbol{i(49.0\ cm - i) = f(49.0\ cm)}$$

$$\boldsymbol{i(49.0\ cm) - i^2 = f(49.0\ cm)}$$

$$\boldsymbol{i^2 - i(49.0\ cm) + f(49.0\ cm) = 0}$$

$$\boldsymbol{i^2 - i(49.0\ cm) + (-233.0\ cm)(49.0\ cm) = 0}$$

$$\boldsymbol{i^2 - i(49.0\ cm) - (\ 11,417 cm^2) = 0}$$

So solving the quadratic formula

$$\boldsymbol{i = \frac{-(-49.0\ cm) \pm \sqrt{(-49.0\ cm)^2 - 4(1)(-11,417 cm^2)}}{2(1)}}$$

$$\boldsymbol{i = \frac{49.0\ cm \pm \sqrt{4.807\ x\ 10^4\ cm^2}}{2(1)}}$$

$$i = \frac{49.0\ cm \pm 219.2\ cm}{2(1)} = 24.5\ cm \pm 109.6\ cm = 134.1\ cm, -85.1\ cm$$

Since this is a virtual image we need to use the negative distance so

$$i = -85.1\ cm$$

We find the object distance from

$$o = 49.0\ cm - i = 49.0\ cm - (-85.1\ cm) = 134.1\ cm$$

$$i = -85.1\ cm$$
$$o = 134.1\ cm$$

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This page last updated on January 7, 2021