Mirror Equation

$$\frac{1}{p}+\frac{1}{q}=\frac{1}{f} \quad \text{or} \quad \frac{1}{d_o}+\frac{1}{d_i}=\frac{1}{f}$$

* $\frac{1}{\text{Object dist}}+\frac{1}{\text{image distance}}=\frac{1}{\text{focal length}}$

* **Equation for Magnification**

$$M=\frac{h'}{h}=-\frac{q}{p} \quad \text{or} \quad M=\frac{h_i}{h_o}=-\frac{d_i}{d_o}$$

$$\text{Magnification} = \frac{\text{image height}}{\text{object height}} = \frac{\text{image distance}}{\text{object distance}}$$

Orientation of image w/respect to object	Sign of M	Type of image this applies to
Upright	+	virtual
inverted	−	real

Value of Magnification

$M = 1$	same size
$M > 1$	larger
$M < 0$	smaller

Sample Problem 14B

$f = +10\,cm$

$p = +30\,cm$

Draw Ray diagram to confirm calculations.

$q = ?$

$M = ?$

- use formula to find q.

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$$

Rearrange → $\frac{1}{q} = \frac{1}{f} - \frac{1}{p}$

Solve for q → $\frac{1}{q} = \frac{1}{10\,cm} - \frac{1}{30\,cm}$

$\frac{1}{q} = 0.1_{cm} - 0.033\,cm$

$\frac{1}{q} = 0.067\,cm$ * Swap!

$q = \frac{1}{0.067\,cm}$

$[q = 14.95 \approx 15\,cm]$

- Find M

$$M = -\frac{d_{image}}{d_{object}} = -\frac{q}{p}$$

$M = -\frac{15}{30} = -0.5$ ← what does this tell you?

1) Image is smaller because $M < 0$
2) Image is inverted because of (−) sign. (real)

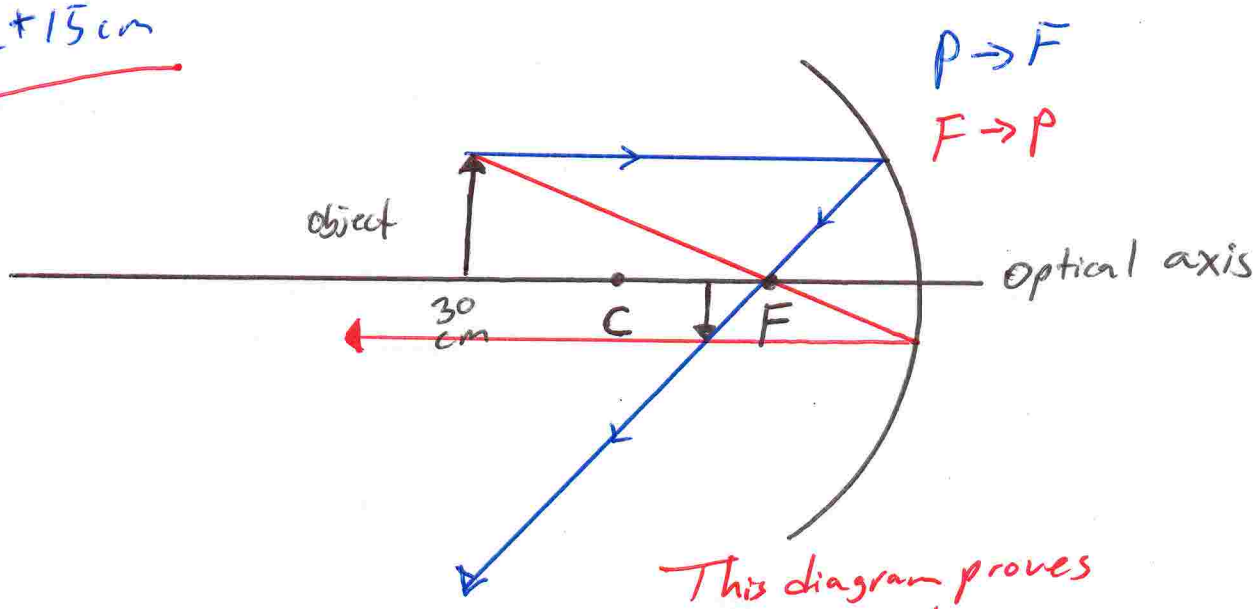
Mirror Ray Diagram to prove calculations

$f = +10\,cm$

$p = +30\,cm$

$q = +15\,cm$

Concave Mirror



This diagram proves calculations!

#1

Page 536

#1 is a continuation of the example on page 535.

$p_1 = 10\,cm$

$p_2 = 5\,cm$

$F = 10\,cm$

real or virtual?

$q = \underline{\quad ? \quad}$

~~##~~ Attempt p_1

Use $\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$

Rearrange to solve for q.

$$\frac{1}{q} = \frac{1}{f} - \frac{1}{p}$$

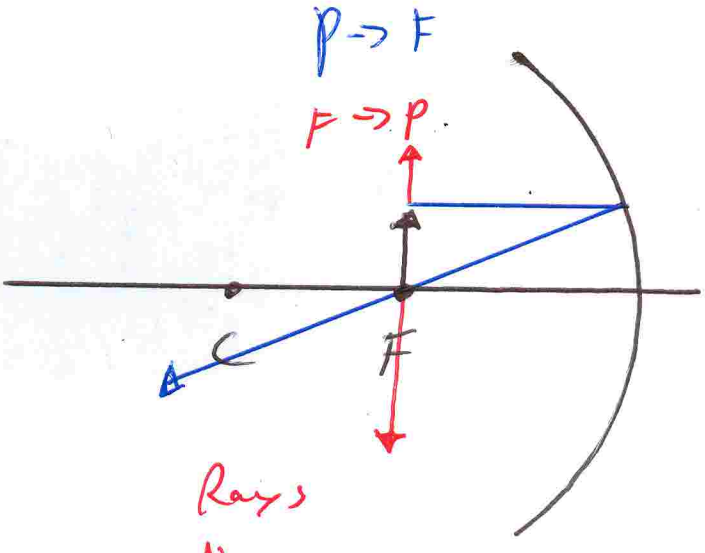
$$\frac{1}{q} = \frac{1}{10cm} - \frac{1}{10cm}$$

$$\frac{1}{q} = 0cm\ ?$$

$$\frac{1}{q} = \frac{1}{0cm}$$

So, did you get an error? Look at where object is located.

On Focal point! (∞ Infinity/no Image)



Rays Never Meet!!

#1 pg 536 part B.

$p = 5.00\text{cm}$

$q = ?$

$f = 10.0\text{cm}$

$\mu = ?$

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$$ re-arrange

$$\frac{1}{q} = \frac{1}{f} - \frac{1}{p}$$

$$\frac{1}{q} = \frac{1}{10\text{cm}} - \frac{1}{5\text{cm}}$$

$$\frac{1}{q} = -0.1$$

$$q = -10$$

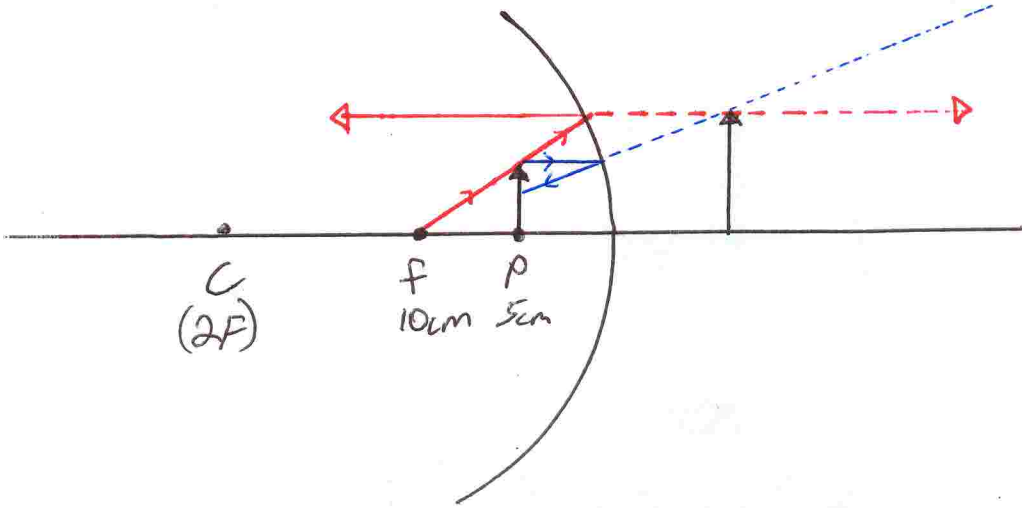
$$\mu = -\frac{q}{p} = -\frac{di}{do}$$

$$\mu = -\left(\frac{-10}{5}\right)$$

$$\mu = {}^{+}2$$

Image is upright (+)

Image is twice size of object.



Pg 536 #2.

$f = 33\,cm$

$p = 93\,cm$

$q = ?$

$M = ?$

$\frac{1}{q} = \frac{1}{f} - \frac{1}{p}$

$\frac{1}{q} = \frac{1}{33} - \frac{1}{93}$

$\frac{1}{q} = 0.0195$

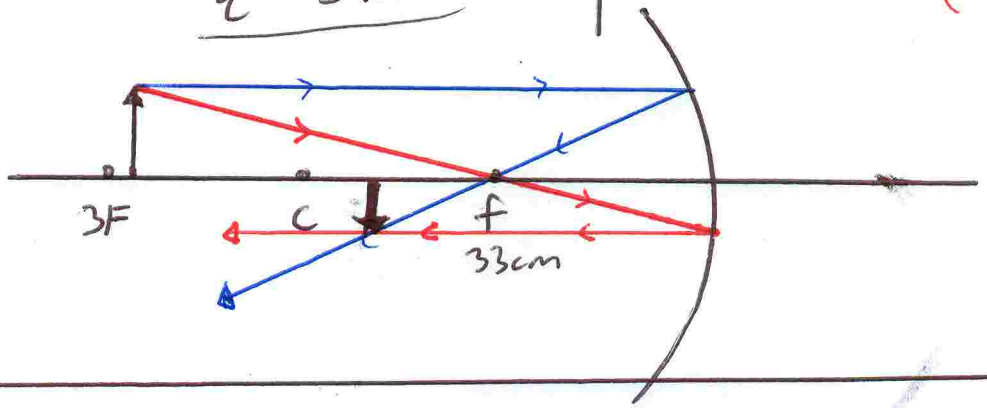
$q = 51.15$

$M = -\frac{q}{p}$

$M = -\frac{51.15}{93}$

$M = -0.55$

Image is inverted and half object size. (Real)



Pg 536 #3.

$p = 25\,cm$

$q = 50\,cm$

$f = ?$

$M = ?$

$\frac{1}{f} = \frac{1}{p} + \frac{1}{q}$

$\frac{1}{f} = \frac{1}{25cm} + \frac{1}{50cm}$

$\frac{1}{f} = 0.06\,cm$

$f = 16.67\,cm$

$M = -\frac{q}{p}$

$M = -\frac{50}{25}$

$M = -2$

Radius?

$C = f \times 2$

$C = 16.67_{cm} \times 2$

$C = 33.34\,cm$

Inverted and twice size of object. (Real)