KEY

First Name:_____ Last Name:_____

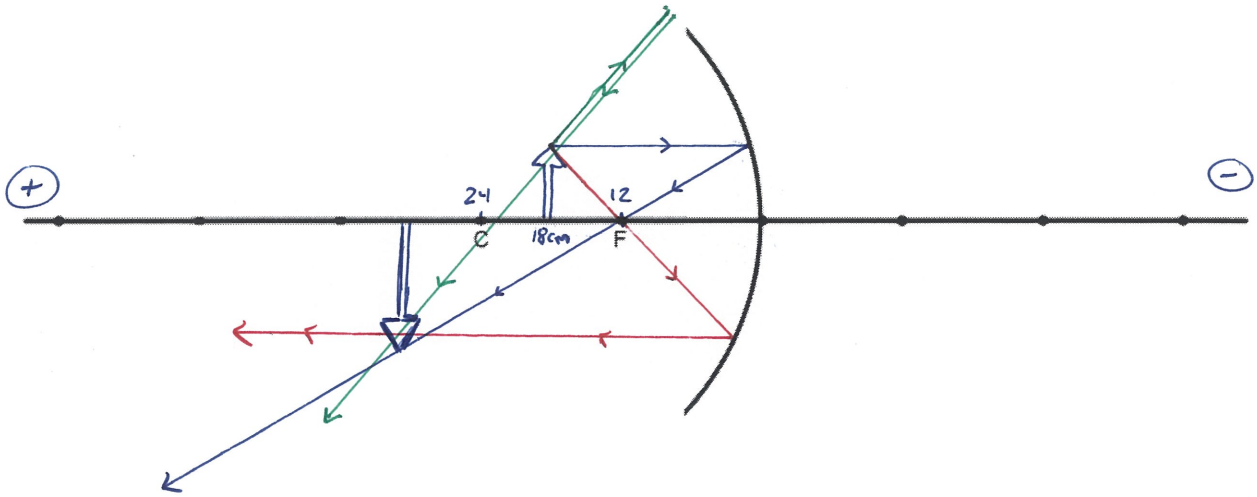
L04 – Worksheet – Reflection Ray Diagrams

Introduction Questions

Use the following information to answer Q1-Q2:

> A converging (concave) mirror has a focal distance of 12cm. A 5cm tall object is placed 18 cm away from the vertex.

Q1: Sketch the ray diagram.



Q2: Calculate the image distance, magnification, and attributes (real/virtual, erect/inverted, enlarged/diminished).

$f = +12$

$d_o = +18$

$d_i = ?$

$$\frac{1}{f} = \frac{1}{+d_o} + \frac{1}{d_i}$$

$$\frac{1}{+12} = \frac{1}{+18} + \frac{1}{d_i}$$

$d_i = +36\text{cm}$

Real

$$m = \frac{-d_i}{d_o} = \frac{-36}{18} = -2$$

Negative means inverted

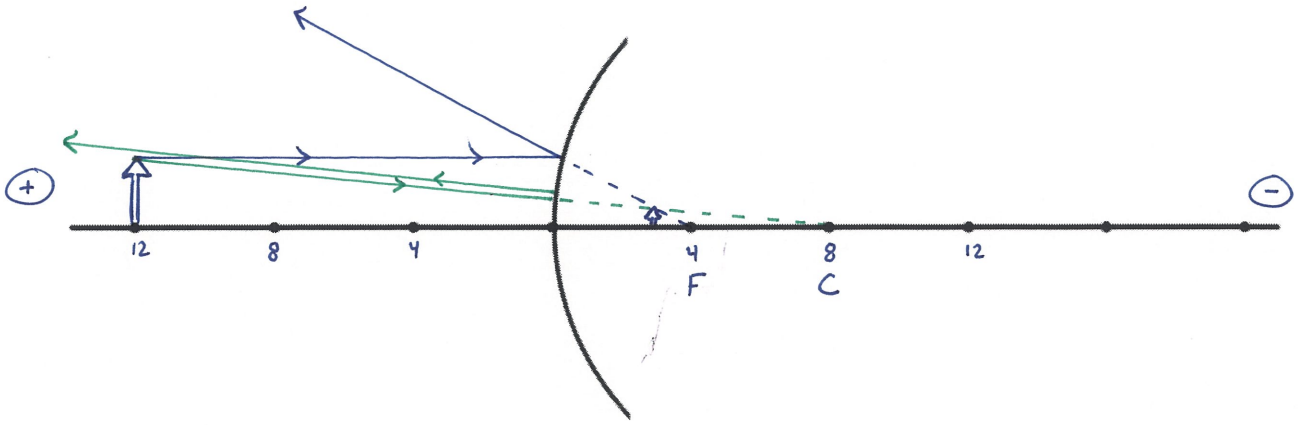
$m > 1$ means enlarged.

KEY

Use the following information to answer Q3-Q4:

A diverging (convex) mirror has a focal distance of 4 cm. A 5cm tall object is placed 12 cm away from the vertex.

Q3: Sketch the ray diagram.



Q4: Calculate the image distance, magnification, and attributes (real/virtual, erect/inverted, enlarged/diminished) using your equations.

$f = -4$

$d_o = +12$

$d_i = ?$

$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

$\frac{1}{-4} = \frac{1}{12} + \frac{1}{d_i}$

$d_i = -3\text{cm}$

Virtual

$m = \frac{-d_i}{d_o} = \frac{-(-3)}{12} = +0.25$

Positive means erect

$m < 1$ means diminished

KEY

Textbook Questions

Pg 664 #2: Determine the image distance, magnification, and attributes for the following:

(a) A converging mirror with a focal length of 12.0 cm with an object 6.0 cm from the mirror.

$f = +12.0\text{cm}$
$d_o = +6.0\text{cm}$
$d_i = ?$
$m = ?$
Real/Virtual ?

$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

$\frac{1}{12} = \frac{1}{6} + \frac{1}{d_i}$

$d_i = -12.0\text{cm} \rightarrow$ VIRTUAL

$m = -\frac{d_i}{d_o} = \frac{12.0}{6.0} = 2\times \rightarrow$ ENLARGED

ERECT (Positive)

(b) A diverging mirror of focal length 5.00 cm with an object 10.0 cm from the mirror.

$f = -5.00\text{cm}$
$d_o = 10.0\text{cm}$
$d_i = ?$
$m = ?$
Real/Virtual ?

$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

$\frac{1}{-5} = \frac{1}{10} + \frac{1}{d_i}$

$d_i = -3.33\text{cm} \rightarrow$ VIRTUAL

$m = -\frac{d_i}{d_o} = \frac{3.33}{10.0} = 0.333\times \rightarrow$ DIMINISHED

ERECT (Positive)

(c) A diverging mirror of focal length 10.0 cm with an object 2.0 cm from the mirror.

$f = -10.0\text{cm}$
$d_o = 2.0\text{cm}$
$d_i = ?$
$m = ?$
Real/Virtual?

$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

$\frac{1}{-10} = \frac{1}{2} + \frac{1}{d_i}$

$d_i = -1.67\text{cm} \rightarrow$ VIRTUAL

$m = -\frac{d_i}{d_o} = \frac{1.67}{2} = 0.83\times \rightarrow$ DIMINISHED

ERECT (Positive)

Pg 664 #3: A 5.0-cm-high object is placed 2.0 cm in front of a converging mirror and the image is magnified -4x. Where does the image form and what is the focal length of the mirror?

$h_o = 5.0\text{cm}$
$d_o = 2.0\text{cm}$
$m = -4x$
$d_i = ?$
$f = ?$

INVERTED
ENLARGED

$m = \frac{-d_i}{d_o}$

$-4 = \frac{-d_i}{2}$

$d_i = 8.0\text{cm} \rightarrow$ REAL

$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

$\frac{1}{f} = \frac{1}{2} + \frac{1}{8}$

$f = 1.6\text{cm}$

Pg 664 #5: Light from a distance plant is incident on a converging mirror. The image of the plant forms on a screen 15.0 cm from the vertex of the mirror. Find the focal length of the mirror and the image characteristics.

$d_i = 45.0\text{cm}$
$d_o = ?$ Let's say... INFINITY!! :)
$f = ?$
$h_i = ?$
$h_o = ?$

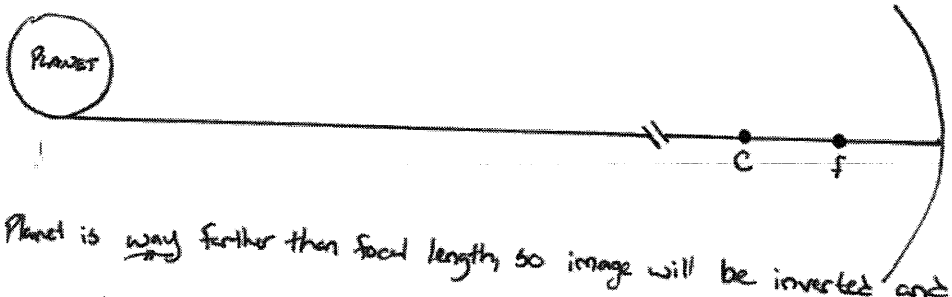
$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

$\frac{1}{f} = \frac{1}{\infty} + \frac{1}{45}$

$\frac{1}{f} = \frac{1}{45}$

$f = 45.0\text{cm}$

LET'S DIAGRAM THIS...



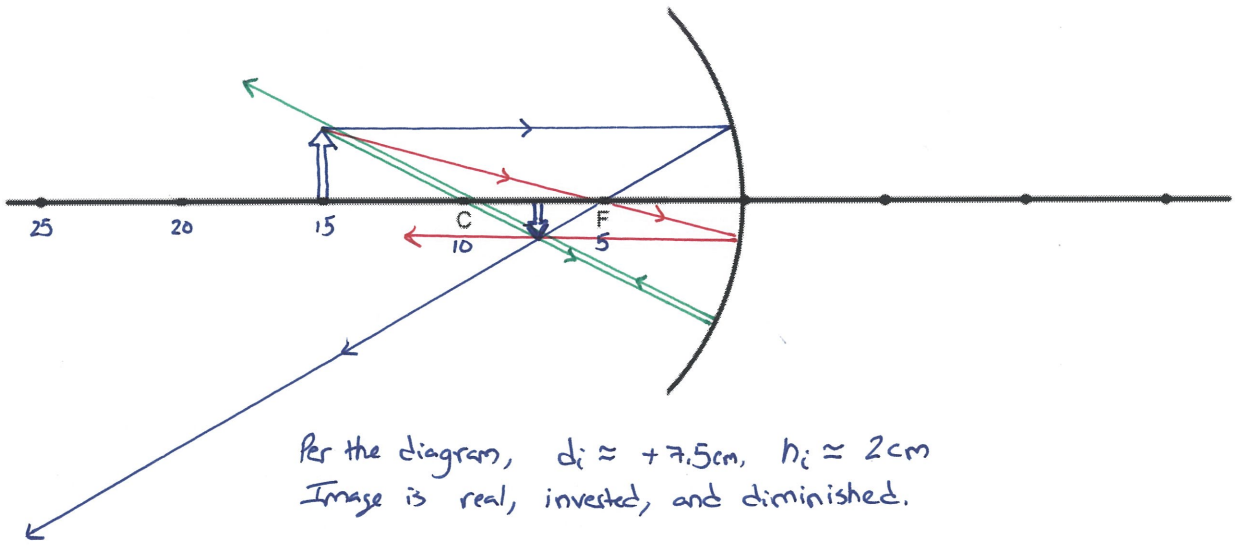
Planet is way further than focal length, so image will be inverted and real.

$m = \frac{-d_i}{d_o} = \frac{-45\text{cm}}{\text{SUPER BIG NUMBER}} =$ tiny negative number

DIMINISHED INVERTED

KEY

Pg 664 #4: A 4.0-cm-high object is placed 15.0 cm from a concave mirror of focal length 5.0 cm. Determine the image characteristics using a ray diagram and the mirror equation.



Per the diagram, $d_i \approx +7.5\text{cm}$, $h_i \approx 2\text{cm}$
Image is real, inverted, and diminished.

Equations

$d_o = +15$
$f = +5$
$d_i = ?$

$\frac{1}{F} = \frac{1}{d_o} + \frac{1}{d_i}$

$\frac{1}{5} = \frac{1}{15} + \frac{1}{d_i}$

$d_i = +7.5\text{cm}$

Real

$m = \frac{-d_i}{d_o} = \frac{-7.5}{15} = -0.5$

Negative means inverted

$m < 1$ means diminished.

$m = \frac{h_i}{h_o}$

$-0.5 = \frac{h_i}{4}$

$h_i = -2\text{ cm}$

Negative means inverted

Less than h_o means diminished.

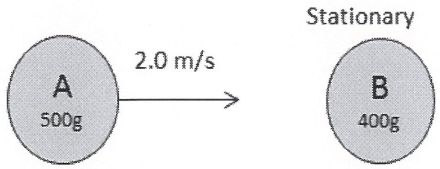
KEY

Cumulative Review from Previous Units

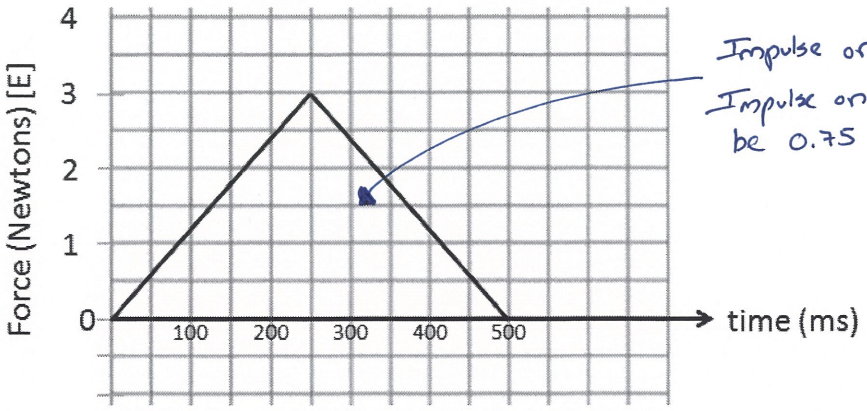
Use the following information to answer Q1:

Two Object Collision

A 500.0g ball moving at 2.000 m/s collides with a 400.0g ball, per the diagram below.



As a result of this collision, the 400.0g ball experiences a force, per the chart below.



Impulse on 400g ball is 0.75 Ns [E]
Impulse on 500g ball therefore would be 0.75 Ns [W]

Q1: The final velocity of the 500.0g ball is ***a.bc*** x 10^{-d} m/s [E], where ***a, b, c,*** and ***d*** are ___, ___, ___, and ___.

*(Record your **four-digit** answer in the numerical response boxes below.)*

5	0	0	1

Option #1: 500g ball

$F\Delta t = m\Delta v$

$0.75\ Ns\ [W] = (0.5kg)\Delta v$

$\Delta v = 1.5\ m/s\ [W]$ or $-1.5\ m/s\ [E]$

$\Delta v = v_f - v_i$

$-1.5 = v_f - (+2)$

$v_f = +0.5\ m/s\ [E]$

Option #2: 400g ball

$F\Delta t = m\Delta v$

$0.75\ Ns\ [E] = (0.4)\Delta v$

$\Delta v = 1.875\ m/s$

$v_f = 1.875\ m/s$

Now $p_i = p_f$

$(0.5)(2) + (0.4)(0) = (0.5)(v_f) + (0.4)(1.875)$

$1 + 0 = (0.5)v_f + 0.75$

$v_f = +0.5\ m/s\ [E]$