

2012 MAR 14

RAY TRACING

CONCAVE MIRROR

RAY TRACING RULES

- ① A RAY ENTERING PARALLEL TO AXIS
EXITS THROUGH THE FOCAL POINT.
- ② A RAY ENTERING THROUGH THE FOCAL POINT
EXITS PARALLEL TO THE AXIS.
- ③ A RAY ENTERING THROUGH CENTER
EXITS THROUGH CENTER.

d_o = OBJECT DISTANCE

= DISTANCE FROM OBJECT TO MIRROR

d_i = IMAGE DISTANCE

= DISTANCE FROM IMAGE TO MIRROR

AN IMAGE IS UPRIGHT OR INVERTED (UPSIDE DOWN).

AN IMAGE IS REAL OR VIRTUAL



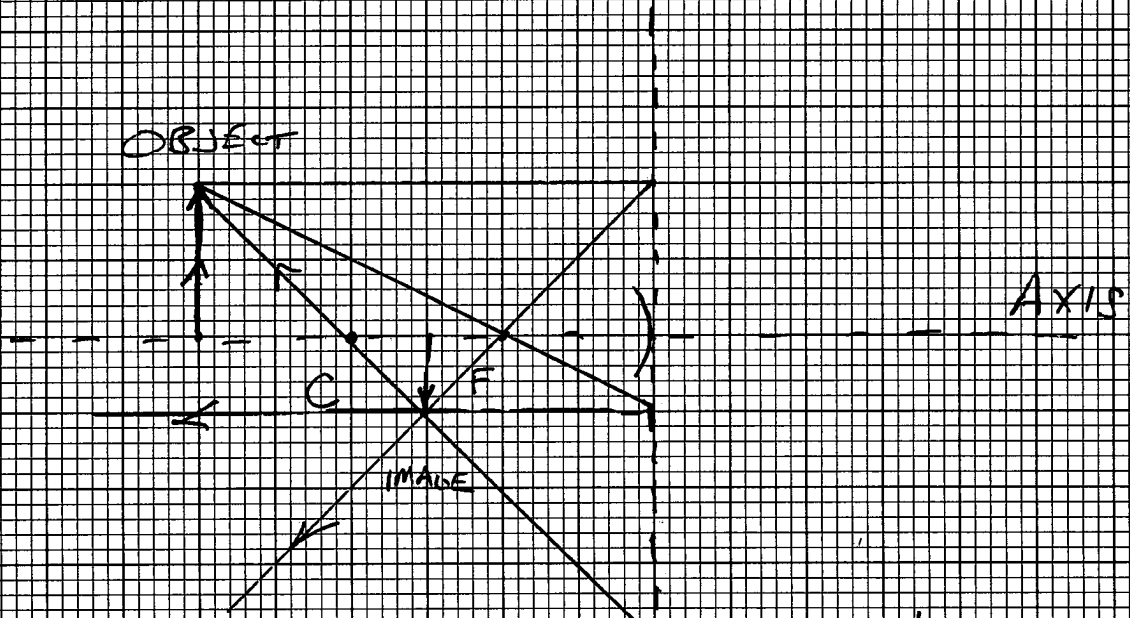
ACTUAL RAYS OF LIGHT
ARE CONVERGING.

$$M = \frac{-d_i}{d_o} = \text{MAGNIFICATION}$$

EXAMPLE 1

5 cm
←→

1 cm
↑↓



$d_i = 15 \text{ cm}$

INVERTED

$M = -\frac{1}{2}$

THIN LENS EQUATION

4

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

FOR OUR EXAMPLE 1,

$$d_o = 30 \text{ cm}$$

$$f = 10 \text{ cm}$$

$$f = \frac{15}{2}$$

$$\frac{1}{30 \text{ cm}} + \frac{1}{d_i} = \frac{1}{10 \text{ cm}}$$

$$\frac{1}{d_i} = \frac{1}{10 \text{ cm}} - \frac{1}{30 \text{ cm}} = \frac{3}{30 \text{ cm}} - \frac{1}{30 \text{ cm}} = \frac{2}{30 \text{ cm}}$$

$$d_i = 15 \text{ cm}$$

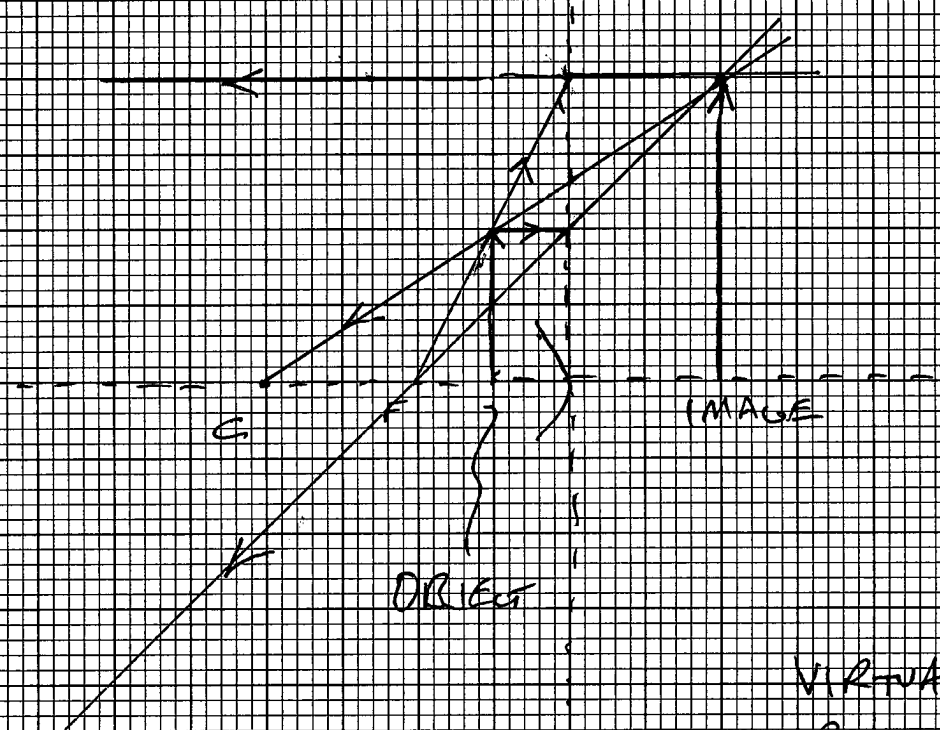
$$m = \frac{-d_i}{d_o} = \frac{-15}{30} = -\frac{1}{2}$$

INVERTED
REAL

EXAMPLE 2

5cm
←→

5



VIRTUAL
UPRIGHT

$$d_i = -10 \text{ cm} \quad (\text{NEGATIVE FOR VIRTUAL IMAGE})$$

$$M = -\frac{d_i}{d_o} = -\frac{(-10 \text{ cm})}{5 \text{ cm}} = 2$$

EXAMPLE 2

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

$$\frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o} = \frac{1}{10\text{cm}} - \frac{1}{5\text{cm}} = \frac{-1}{10\text{cm}}$$

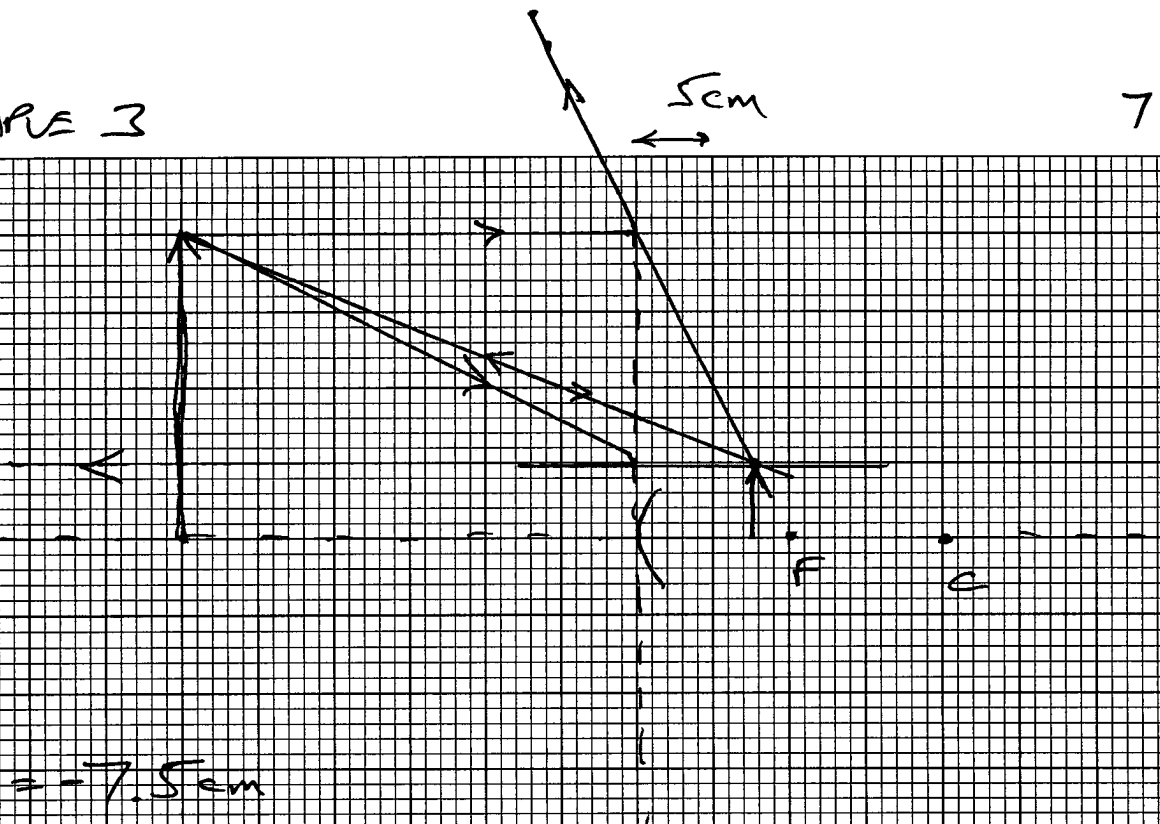
$$d_i = -10\text{cm}$$

$$m = \frac{-d_i}{d_o} = \frac{-(-10\text{cm})}{5\text{cm}} = 2 \quad (\text{UPRIGHT})$$

BECAUSE $d_i < 0$, IMAGE IS VIRTUAL.

EXAMPLE 3

7



$$d_1 = -7.5\text{ cm}$$

UPRIGHT
VIRTUAL

$$M = \frac{-(-7.5\text{ cm})}{20\text{ cm}} = +\frac{1}{4}$$

EXAMPLE 3

8 ~~8~~

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

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

$$= \frac{1}{-10\text{cm}} - \frac{1}{30\text{cm}} = \frac{-4}{30\text{cm}}$$

$$d_i = -7.5\text{cm}$$

$$M = \frac{1}{4} \quad \text{UPRIGHT, VIRTUAL}$$