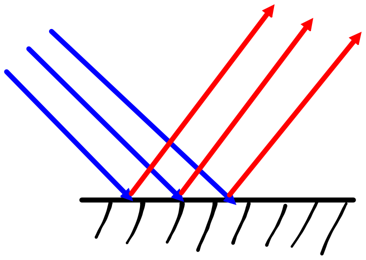
Mirrors

Plane Mirrors (Flat)

Reflection

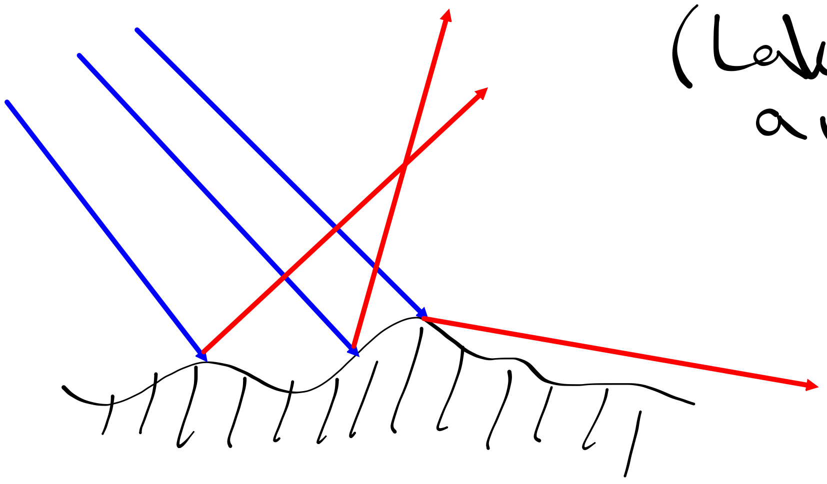
1.) Regular (Specular)

- Parallel rays are reflected in the same direction



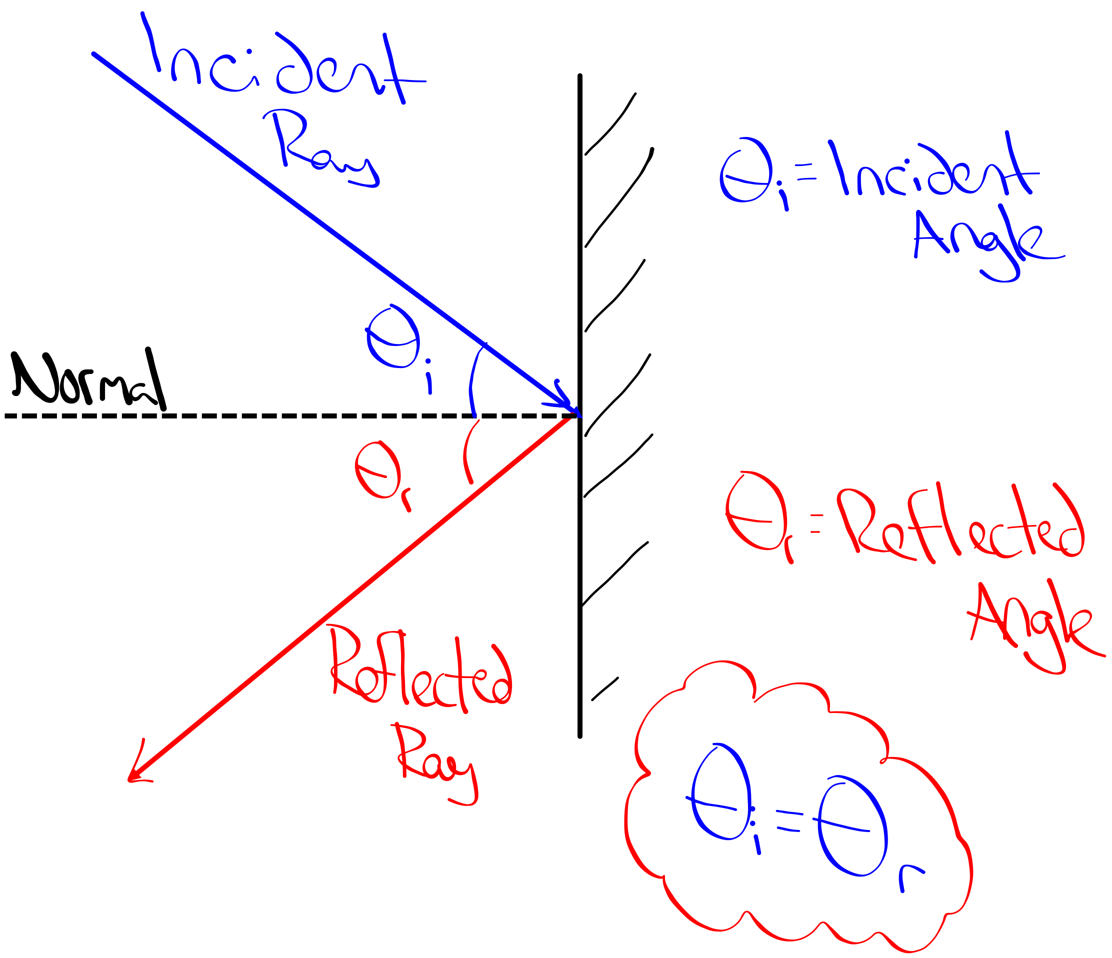
2.) Diffuse

- happens on uneven surfaces
- reflections are scattered in all directions



(Lake on a windy day)

Ray Reflection



Plane Mirror Properties

- image size is same as original — size
- upright — orientation
- image located behind the mirror — location
- virtual image — type

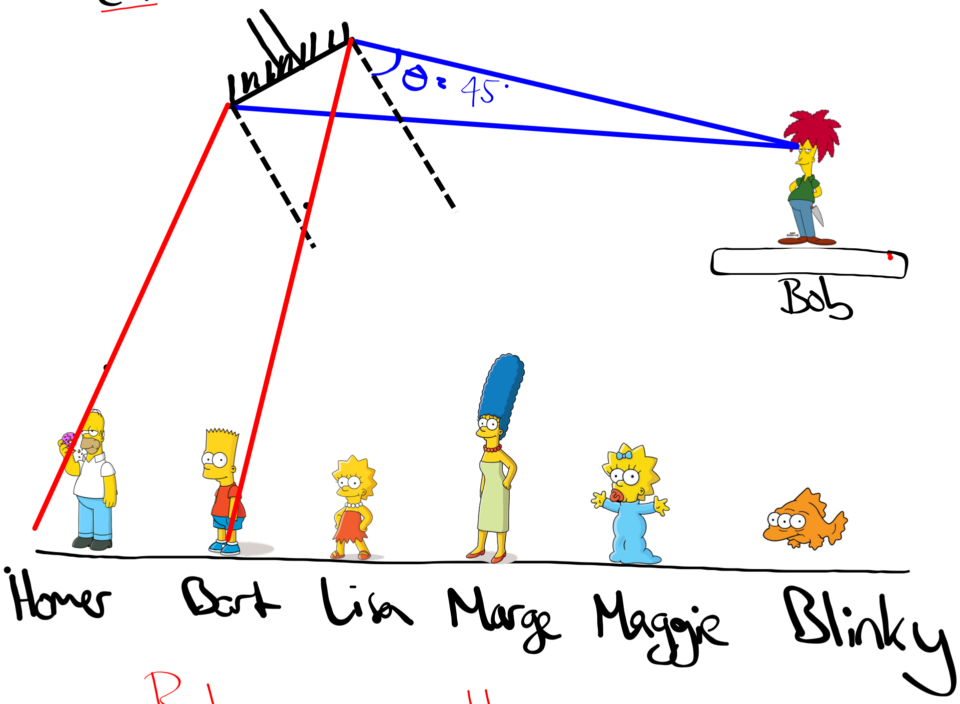
Virtual vs Real Images

i) Real - formed by converging rays
- pinhole camera

ii) Virtual - formed by diverging rays
- Plane mirror

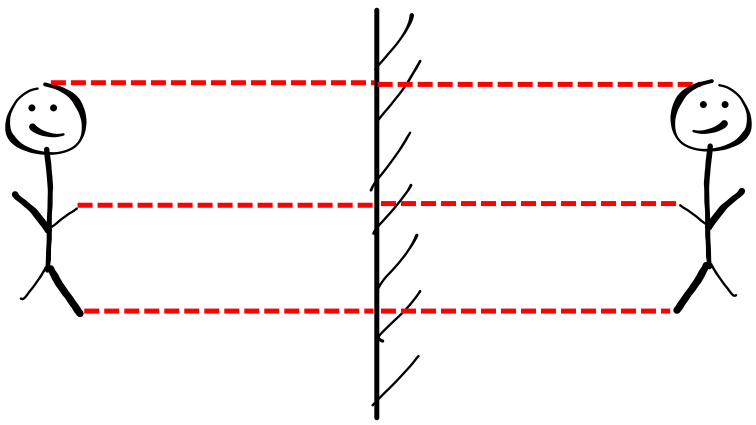
Field of Vision

Ex. Who can Bob see?



Bob can see Homer & Bart

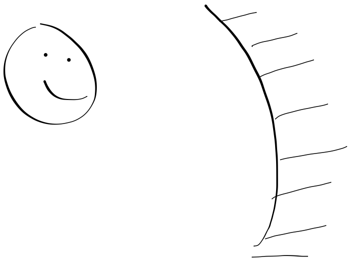
Reflection In A Plane Mirror



Size: Same
Type: Virtual
Location: Behind Mirror
Orientation: Upright

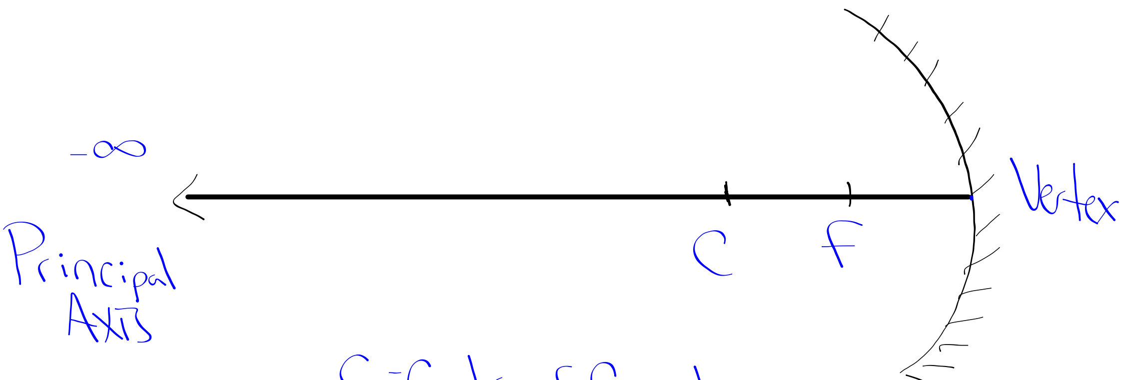
Curved Mirrors

Concave: Reflective surface is inside the curve
- Converging Rays



Convex: Reflective surface is outside the curve
- Diverging Rays

Concave Mirror

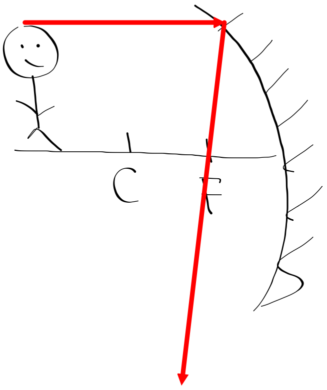


C = Centre of Curvature
F = Focal point

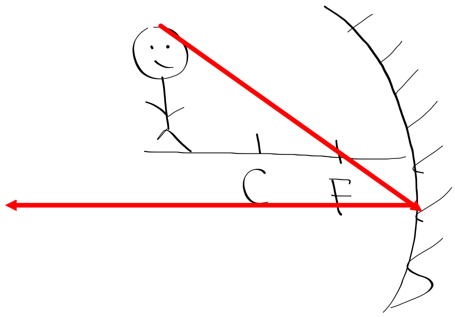
Rules for Drawing Rays

We will be drawing 3 rays

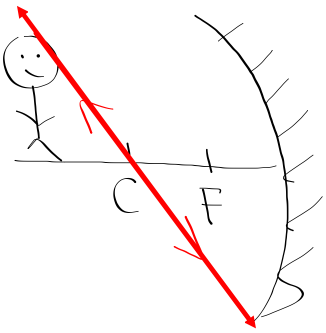
i) Incident ray travelling parallel to principal axis will reflect through F

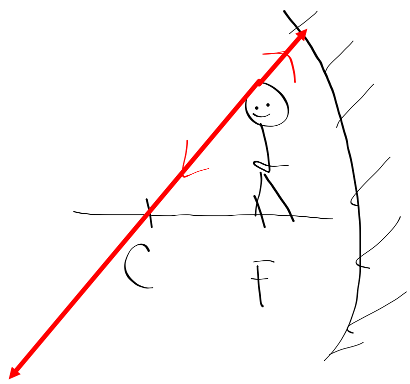


ii) Incident ray passes through F reflects parallel to principal axis

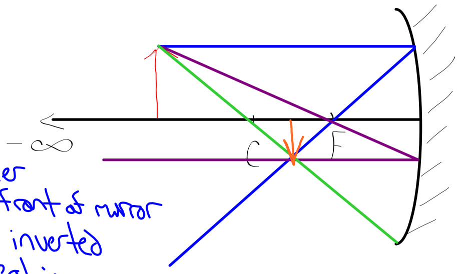


iii) Incident ray passes through C and reflect back through C



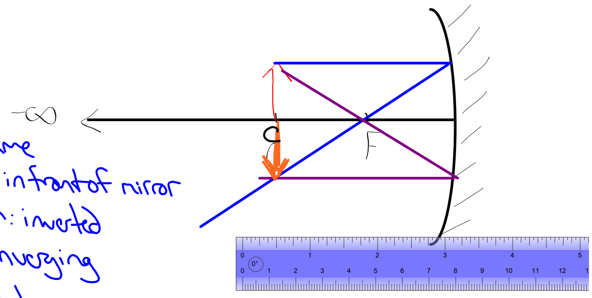


i)



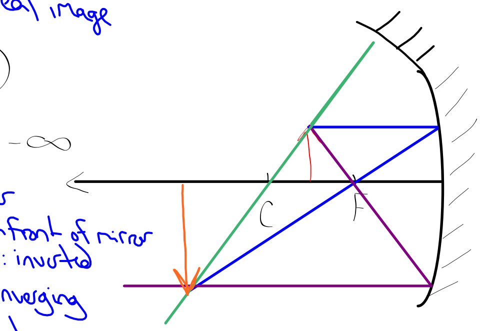
Size: Smaller
location: infront of mirror
Orientation: inverted
type: real image
rays: converging

ii)



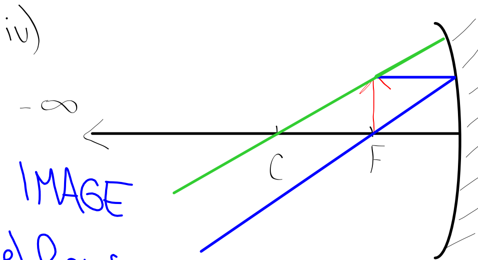
Size: Same
location: infront of mirror
orientation: inverted
rays: converging
type: real image

iii)



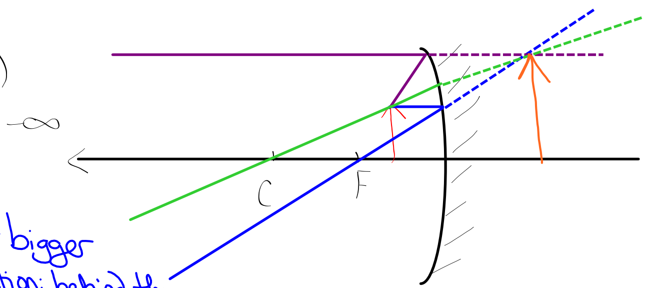
Size: bigger
location: infront of mirror
orientation: inverted
rays: converging
type: real

iv)



NO IMAGE
Parallel Rays

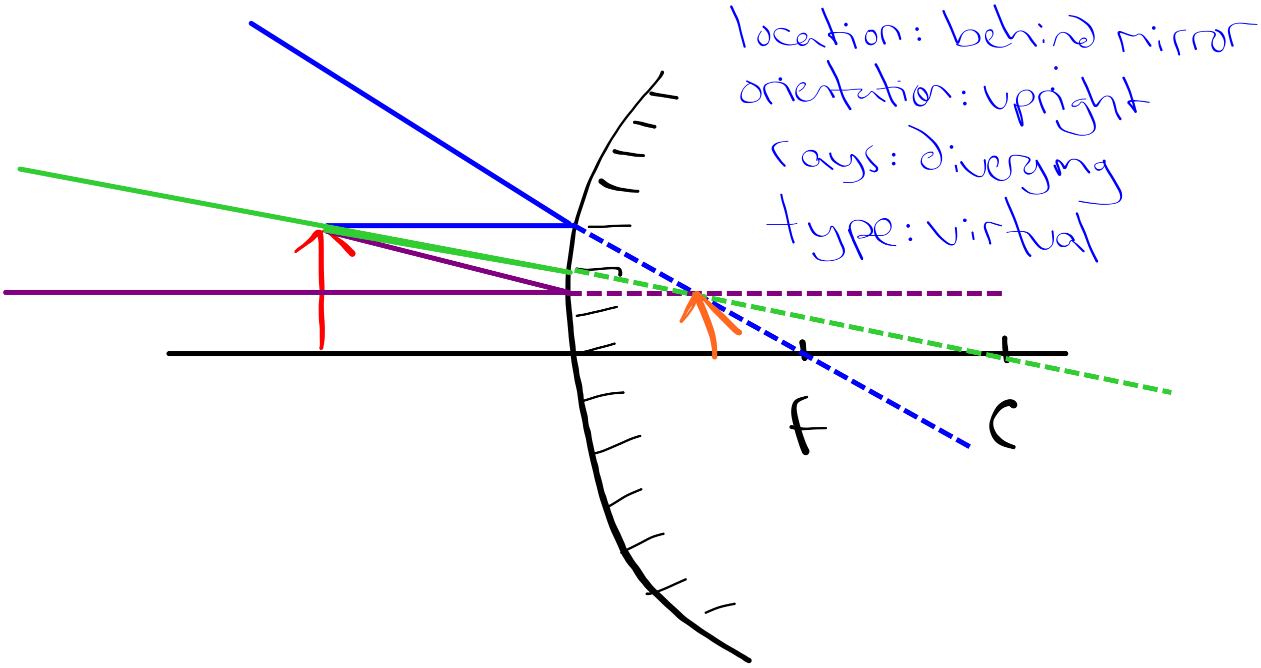
v.)



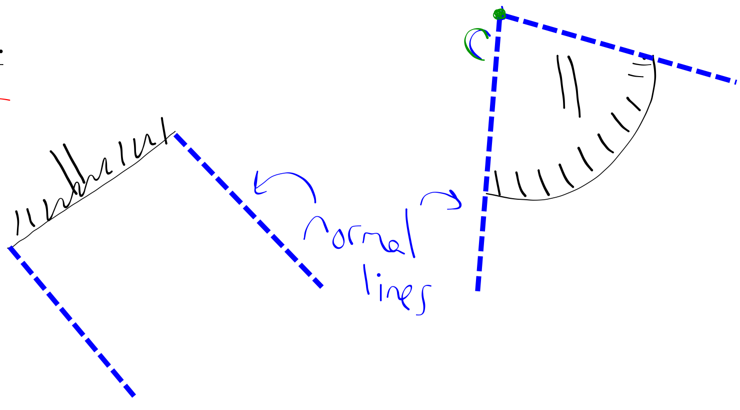
Size: bigger
location: behind the mirror
Orientation: upright
rays: diverging
type: virtual

Case	Object	Image				Beams
	Position	Position	Size	Orientation	Type	Type
1	$-\infty$ to C	C to F	smaller	inverted	real	converging
2	on C	on C	same	inverted	real	converging
3	C to F	$-\infty$ to C	bigger	inverted	real	converging
4	on F	—NO IMAGE—				parallel
5	F to V	V to ∞	bigger	upright	virtual	diverging

Convex Mirror



Note:



Equations for Curved Mirrors

d_i = image distance
d_o = object distance
h_i = image height
h_o = object height

f = focal point
M = magnification

$$M = \frac{h_i}{h_o} = \frac{-d_i}{d_o}$$

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

Recall:

$$\frac{3 \times 1}{3 \times 2} + \frac{1 \times 2}{3 \times 2}$$

$$= \frac{3}{6} + \frac{2}{6}$$

$$= \frac{5}{6}$$

Sign Convention for Curved Mirrors

	+	−
d_o	/	/
h_o	/	/
d_i	Real	Virtual
h_i	Upright	Inverted
f	Concave	Convex
M	Upright	Inverted

Ex.

An object 2cm in height is placed 12.5cm from a mirror. What is the image distance if the focal length is 5cm?

$h_o = 2cm$

$d_o = 12.5cm$

$d_i = ?$

$F = 5cm$

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

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

$$\frac{5\times 1}{5\times 5} - \frac{1\times 2}{12.5\times 2} = \frac{1}{d_i}$$

CD = 25

$$\frac{5}{25} - \frac{2}{25} = \frac{1}{d_i}$$

$$\frac{3}{25} = \frac{1}{d_i} \rightarrow d_i = 8.3cm$$

What is the image height?

$$\frac{h_i}{h_o} = \frac{-d_i}{d_o}$$

$$\frac{h_i}{2} = \frac{-8.3}{12.5}$$

$h_i = -1.3cm$