Locating Images in a Plane Mirror

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A **plane** mirror is used to demonstrate the path of light when it hits the mirror.
A plane mirror is a mirror with a flat, reflective surface.

An object placed in front of a mirror is referred to as the *object*.

The likeness, (a reproduction), that is seen in the mirror of the object is referred to as the *image*.

Characteristics of an Image in a Plane Mirror

The *characteristics*, i.e. the kind of image, where it will be and what the image will look like, may all be predicted by applying the laws of reflection.

An image can be described by four characteristics: size, (or magnification), attitude, location (or position), type (i.e. kind).

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Size, (or Magnification): of the image compared to the object may be the same size, enlarged or diminished. The height of the object, h_0, in relation to the height of the image, h_i. ($M = h_i / h_0$)

Attitude: of image may be erect, (upright) or inverted compared to the object.

Location (or Position)**:** of an image created by a plane mirror is measured with reference to the reflecting surface (i.e. closer than, further than, or the same distance as the object to the plane mirror). Distance between the object and the lens, d_0, and the distance between the image and the lens, d_i.

Type of Image (or Kind)**:** describes whether the image is real or virtual. A real image is one that can be seen on a screen: light rays converge to a point. A *virtual image*, (i.e. the image is imaginary because you only imagine that an image forms at this location), can not be caught on a screen, but can be seen by the eye, and can be photographed, (consider your image in a mirror).
[A *virtual image* is any image formed by rays that do not come from the location of the image.]

[use the acronym **SALT**: to remember the four characteristics of an image
Size, **A**ttitude, **L**ocation, **T**ype]

Using Light rays to Locate an Image in a Plane Mirror

By applying the laws of reflection to rays going from the object, i.e. by drawing a ray diagram, we can predict where the image will be and what the image will look like, i.e., it is possible to predict the characteristics of the image.

How to draw a ray diagram for an object placed in a plane mirror:

1. Draw a line to represent a mirror, add hatch marks to show the non-reflecting surface of the mirror.

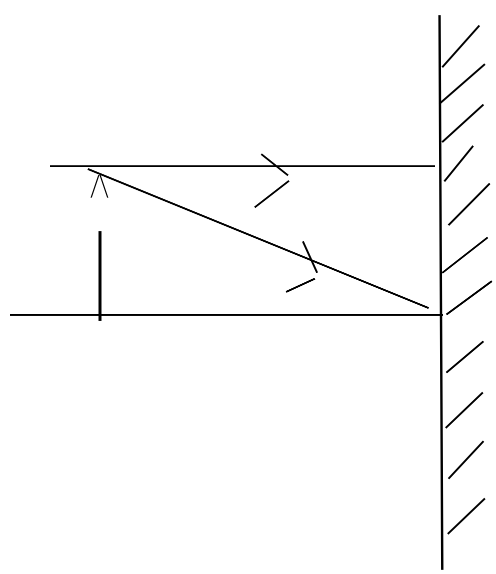
2. Draw the object as a vertical arrow in front of the plane mirror. *See diagram below*.

3. Draw an incident ray from the tip of the arrow at a 90^0 angle. Because this line is normal to the mirror, the angle of incidence is zero. Therefore, the angle of reflection is also zero. The reflected ray goes directly backward along the same line as the incident ray.

4. Draw a second incident ray at an angle to the mirror. At the point where the incident ray hits the mirror, draw a normal. Measure the angle of incidence with a protractor. Using the Law of reflection that the angle of reflection is equal to the angle of incidence, draw the reflected ray.

5. Using a dashed line, extend both of the reflected rays behind the mirror until they cross one another at the same point, i.e. at the point where they meet — this point is the image of the arrow tip. (*Dotted lines are used to draw a virtual image.*)

Diagram: Complete the diagram below:



Conclusions of the image formed by a plane mirror:

1. An image in a plane mirror is always the Same Size as the object. (**S**ize)
2. The image is upright. (**A**ttitude)
3. The image is located the same distance directly behind the mirror as the object is in front. (**L**ocation)
4. Since the rays of light do not actually come from the image, but only appear to do so, thus the image is virtual. (**T**ype)

To locate any point on the image, only two incident light rays are necessary.
Usually, any two of these rays are drawn from the tip of the object; the third ray serves as a check

The two light rays are:
1. A ray drawn from the top of the object parallel to the base line, i.e. a normal to the mirror.
2. A ray drawn from the top of the object to the point where the base line meets the mirror.

Lateral Inversion

Another important characteristic of images in plane mirrors is observed upon comparing writing in a plane mirror.
The writing looks as if is backwards, the order of the letters is reversed, right to left and left to right.

In other words, *each letter is flipped horizontally and the letters are in reverse order.*

This characteristic of images in plane mirrors is called *lateral inversion*.

Emergency vehicles are labelled in reverse printing so that their signs can be viewed correctly in an automobile rear-view mirror.

Assignment

1. There is a special incident ray that reflects right back on itself.
a. How would you aim this incident ray to achieve that effect?
b. What is the angle of incidence of this incident ray?

2. a. Name the four characteristics that describe any image.
   b. How is a real image different from a virtual image?

3. You stand 1.8 m in front of a plane mirror as you are brushing your teeth. Use SALT to describe the characteristics of the image.

4. You are wearing a T-shirt that has the word 'OPTICS' on it. You stand in front of a plane mirror. Write down how this word appears as you look in the mirror.

5. A periscope is a device that is used to see around corners, over a wall, or above water. Simple periscopes contain two plane mirrors.
a. Predict how these mirrors are arranged.
b. Draw a diagram to illustrate how such a periscope would work.

6. Emergency vehicles make use of lateral inversion when painting words and pictures on the hoods. Why do you think this is so ?

7. One of the most important application of total internal reflection is in the development of fibre optics. Surgeons can insert bundles of these optical fibres down a patient's throat into the lungs or stomach; also these fibres are far more efficient than copper wires in transmitting radio, television, and telephone signals. Explain the concept of total internal reflection and how it has led to the development of fibre optics.