PHYSICS 534

ANSWERS

EXERCISE-47 **Plane Mirrors**

RABI

Isidor Rabi was awarded the Nobel prize for physics in 1944 for his discovery of magnetic resonance.

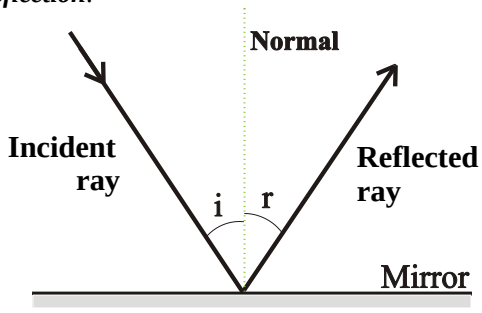
- **THE LAW OF REFLECTION**

When light strikes a surface and is reflected, it changes direction. The direction it takes depends upon the angle it strikes the surface. As illustrated below, a ray of light going ***towards*** a surface is called an ***incident*** ray while a ray of light which is reflected ***away*** from a source is called a ***reflected*** ray.

The law of reflection says that the angle of the incident ray with the ***normal*** equals the angle of the reflected ray (also with the ***normal***).

By definition, the angle which the incident ray makes with the normal is called the ***angle of incidence*** while the angle which the reflected ray makes with the normal is called the ***angle of reflection***.

↳ ***Note***: The incident ray, the reflected ray, and the normal, all lie on the same plane.



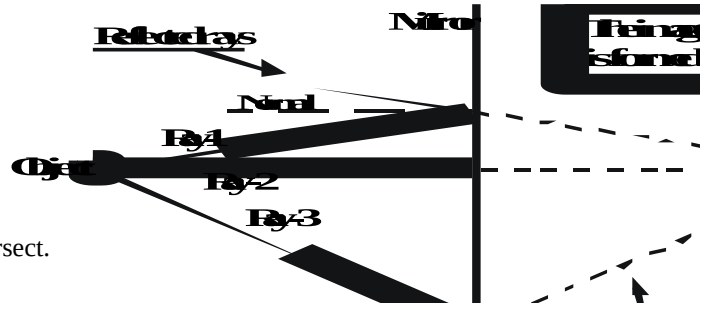
Angle of incidence (i) = Angle of reflection (r)

➢ ***Remember***: The angle of incidence is the angle formed by the incident ray and the ***normal*** (not the reflecting surface). The angle of reflection is the angle between the reflected ray and the ***normal***.

The law of reflection, therefore, simply states that when a ray of light is reflected from a surface, it is reflected in such a direction that the incident angle equals the reflected angle Using the law of reflection, we can determine the location of images formed by plane mirrors.

To locate the image formed by a plane mirror, follow these steps:

- Step-1: Draw ***three*** rays coming from the object; one ray ***above*** the horizontal (Ray-1), one ray ***along*** the horizontal (Ray-2), and one ray ***below*** the horizontal (Ray-3).
- Step-2: Using the law of reflection, draw the reflected rays from the mirror.
- Step-3: Extend the three ***reflected*** rays until they intersect.



Since actual objects consist of points, once we can locate a few "image points", it is a simple matter to locate the image of an object. Indeed, all we need to do is locate a few "strategic" points and we can locate the image of an object.

1. State the Law of Reflection.

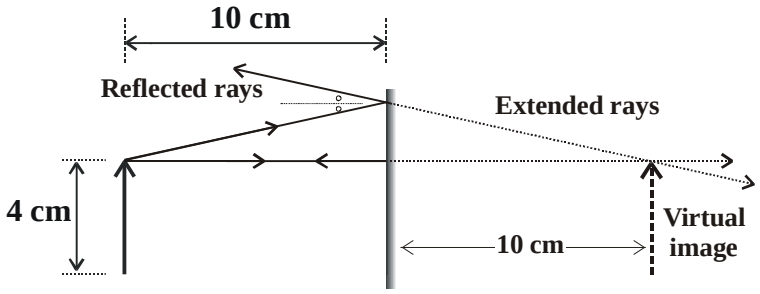
2. The diagram on the right represents an object in front of a plane mirror.

↳ ***Note***: Diagram not drawn to scale.

a) Draw the image.

b) How high is the image? **4 cm**

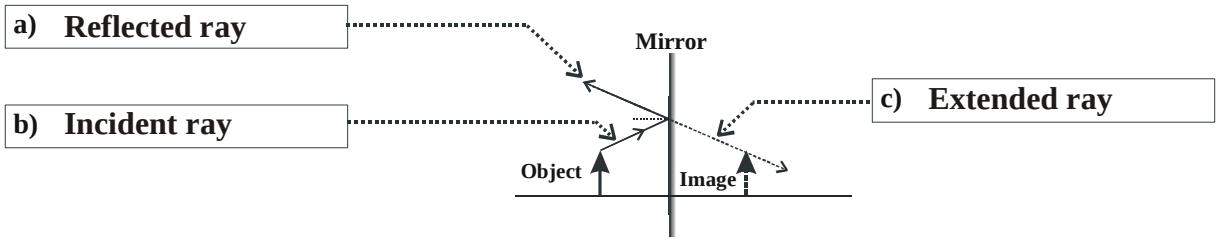
c) How far away is the image from the object? **20 cm**



3. Explain why there is only a ***lateral*** (left-right) reversal when we look at ourselves in a plane mirror.

Because when we turn towards a mirror, we do so by turning about the Y-axis (left-right) and not about the X-axis (top-bottom).

4. The diagram below illustrates the image of an object produced by a plane mirror. Label the incident ray, the reflected ray and the extended ray.

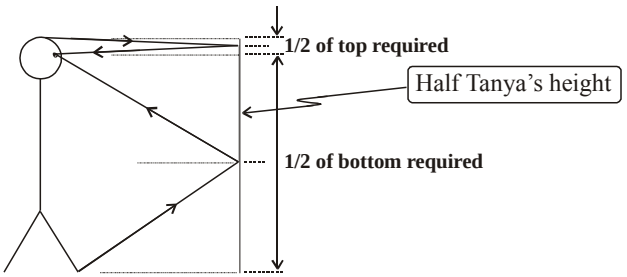


5. Explain how a ***real*** image is formed and how a ***virtual*** image is formed.

Real images are formed by the intersection of reflected rays, virtual images are formed by the intersection of extended rays.

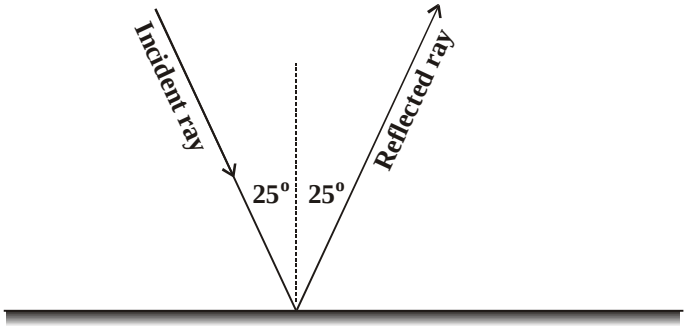
6. Tanya is 1.5 m tall. Prove that the shortest mirror necessary for Tanya to see her full height is 75 cm (half her height).

Divide Tanya's height into two parts, from her eyes to the top of her head, and from her eyes to her feet.

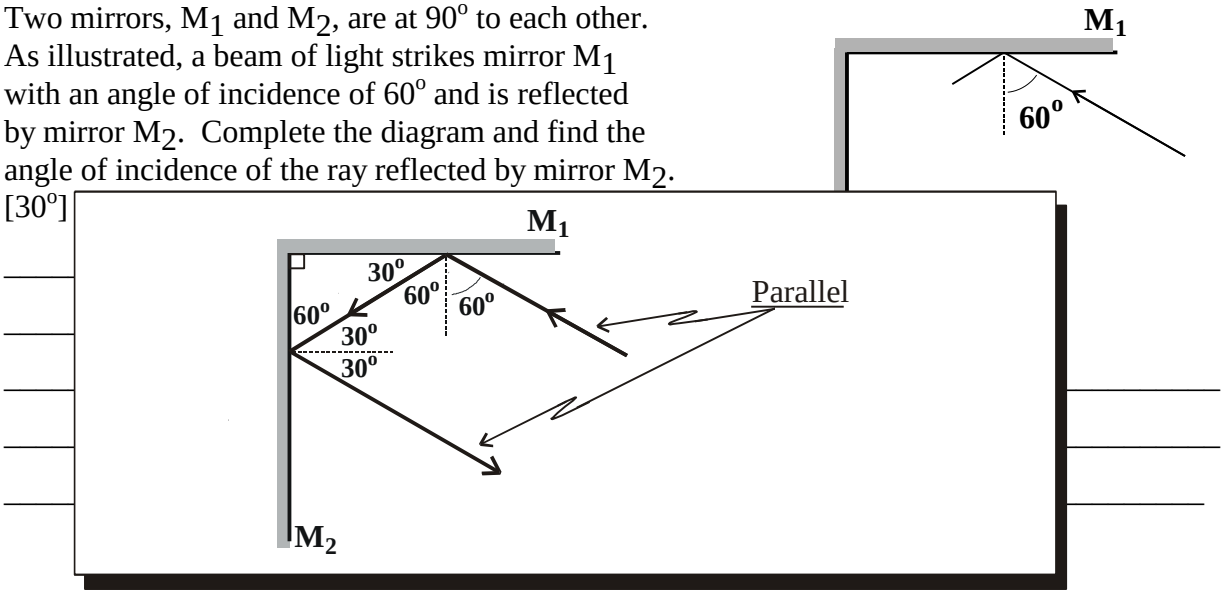


Answer: In order for a person to see their full image in a plane mirror, the minimum mirror required is a mirror half their height.

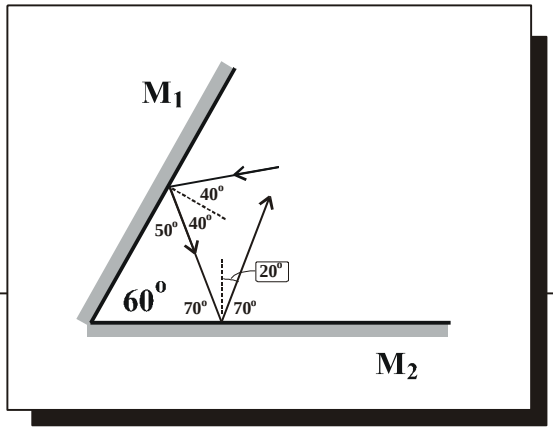
7. A beam of light is reflected from a plane mirror such that the angle between the incident ray and reflected ray is 50^o. Draw the beam and calculate the angle of incidence?



8. Two mirrors, M_1 and M_2, are at 90^o to each other. As illustrated, a beam of light strikes mirror M_1 with an angle of incidence of 60^o and is reflected by mirror M_2. Complete the diagram and find the angle of incidence of the ray reflected by mirror M_2. [30^o]

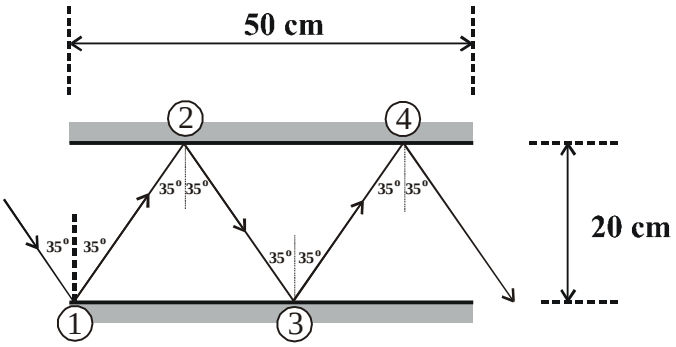


9. Two plane mirrors, M_1 and M_2, are at 60^o to each other as illustrated in the diagram on the right. A beam of light strikes mirror M_1 with an angle of incidence of 40^o. Complete the diagram and the angle of incidence of the beam reflected from mirror M_2? [20^o]



Using geometry, since the angle of incidence for mirror M_1 is 40^o, and since the angle between the two mirrors is given as 60^o, then using the triangle, we find the other two angles. As shown in the diagram, the other angles are 50^o and 70^o. Thus, we can find the angle of incidence to be 20^o.

10. Two mirrors are parallel to each other as illustrated in the diagram below. A beam of light strikes the beginning of one mirror at an angle of incidence of 35^o. Complete the diagram and find the number of times the beam is ***reflected*** before it emerges from the two mirrors? [4]



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