Phys 112 2019

Lecture 28

Tues: Discussion / quiz
Supp 94, 95, 96, 97, 98
Ch 17 Q 10, 11 Prob 60

Weds Relabs

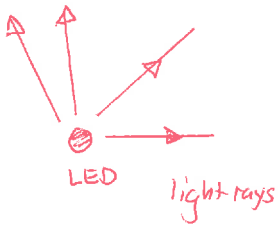
Ray Optics

The wave model of light, which is successful for describing interference and diffraction phenomena, is not the most convenient for describing ordinary optical phenomena such as image production by lenses and mirrors. In many situations it is useful to use a model in which light consists of rays. We will trace how these rays propagate.

The basic features of this are (see pg 621 → 624)

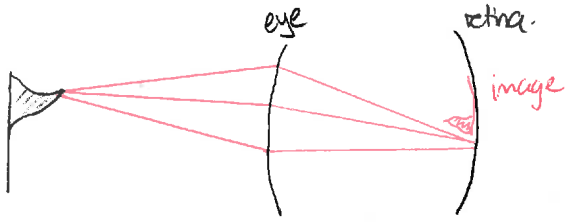
1) In a uniform medium (material) light rays travel in straight lines.

2) Most light sources emit light rays that travel in all directions. A laser is one exception.



3) Most light sources emit light from many locations. Most objects reflect light from many locations

4) The human eye (and cameras) have lens systems that focus divergent rays.

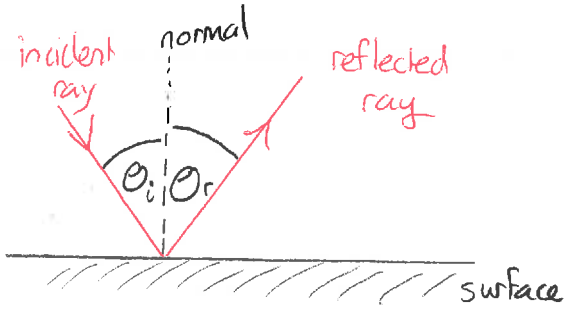


The interesting features of ray optics arise when light traveling through one medium encounters another medium (or the same medium with different properties)

Demo: PhET Bending Light

→ Intro → show reflected
→ show refracted
} → show with waves

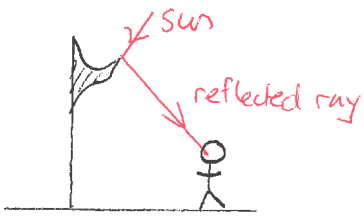
Reflection



Reflection is the process by which a light wave that is incident on a surface rebounds from the surface. This eventually describes:

1) how one observes most everyday objects

2) how mirrors form images



Demo: Blackboard optics - reflection

The law of reflection provides a rule relating the direction of the reflected ray to the incident ray. This entails:

1) draw a normal line = perpendicular to the surface
2) let θ_i = angle between incident ray and normal
θ_r = " " reflected " " "

Then the law of reflection states

$$\boxed{\theta_r = \theta_i}$$

This will describe all processes related to reflection

This applies to any surface, including curved surfaces and irregular surfaces.

Quiz 1 80%

Warm Up 1

Note that most surfaces are irregular allowing reflection at multiple angles.

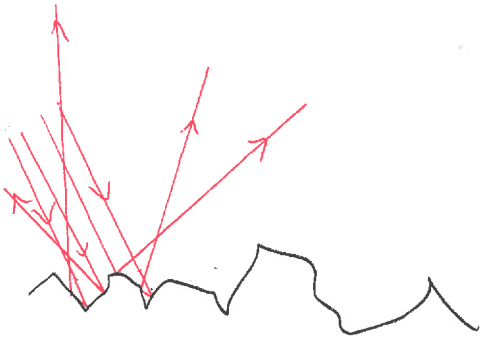
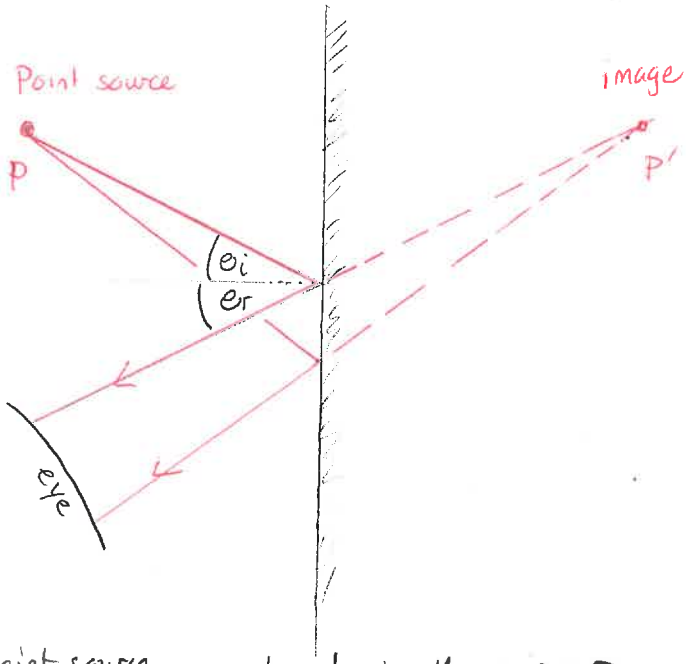


Image formation by a flat mirror

Consider a point light source in front of a flat mirror. We can use the law of reflection to determine where the image will be located. We trace rays from the source to the mirror. We see that

1) the reflect rays diverge.

2) the reflect rays all appear to emanate from a point P' behind the mirror.



This point is the image of the point source produced by the mirror

The geometry shows that:

1) no light actually travels to/from the image (image location). Whenever this occurs we say that the image is virtual.

2) the image always exists. However, for an observer to see the image, at least one ray must travel from the object to the mirror and then to the observer.

3) The image is behind the mirror. Let

s = distance from object/source to mirror

s' = " " image to mirror.

Then the geometry of the situation gives

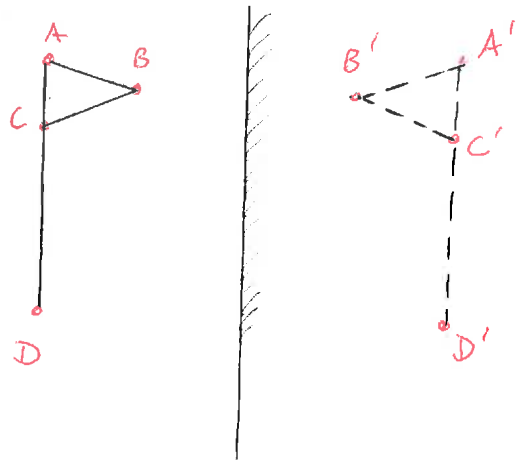
$$\boxed{s' = s}$$

Warm Up 2

Quiz 2 50% – 80%

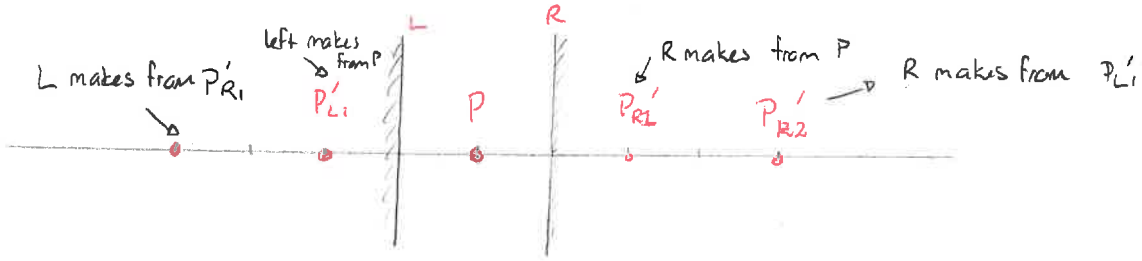
Quiz 3 60%

We can apply these rules in a pointwise fashion to construct images of composite objects



Quiz 4

Multiple mirrors will produce multiple reflections. The image produced by one mirror serves as an additional object for the other mirrors



Google: Infinity Mirror Room