Lecture 37

Mon: HW 5pm

Weds: Discussion/quiz Ex 224, 225, 226, 227, 228, 229, 230, 232

Thurs: Warm Up 14

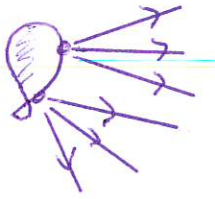
Geometric Optics

The wave picture of light successfully describes interference and diffraction phenomena. However, a more convenient way to describe ordinary optical phenomena uses "rays" of light. The basic aspects are:

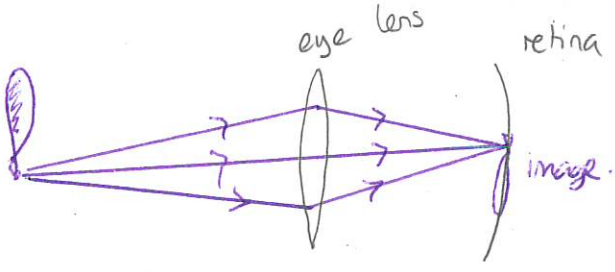
1) Light sources generally produce rays that in all directions

2) Rays in a uniform homogeneous medium travel in straight lines.

3) Most objects produce rays from many sources. Most objects reflect rays from many sources



4) The human eye and cameras have lenses that can focus diverging rays



The interesting and complicated optical processes occur when light passes from a medium with one set of properties to another medium with a different set of properties.

Demo: PhET Bending Light

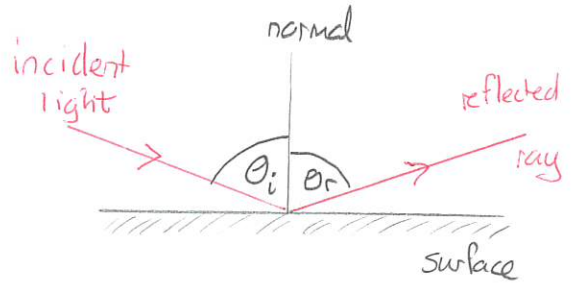
Intro Tab → show reflected
→ show refracted
→ show waves

Reflection

Reflection is the process where light traveling through one medium encounters a surface and rebounds. We use this to describe

1) operation of mirrors and beamsplitters
2) how most objects are visible.

In the simplest situation the reflecting surface is flat. We would like to predict the direction of the reflected wave if the direction of the incident wave is known



Demo: Blackboard Optics

Observations of this and detailed electromagnetic theory result in the law of reflection. This requires

1) a normal perpendicular to the surface at the point of incidence
2) the angles θ_i = angle between incident ray and normal
θ_r = " " reflected " "

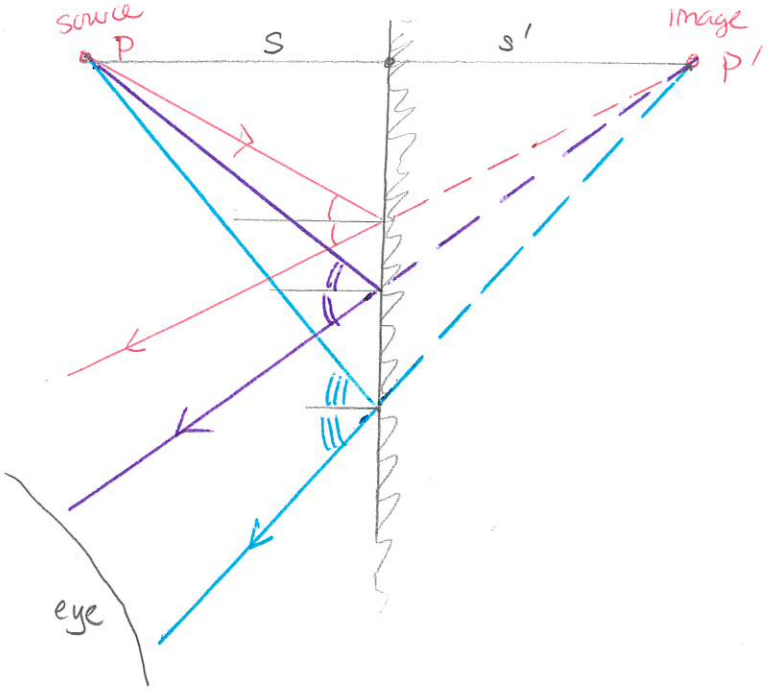
Then the law of reflection states:

$$\theta_r = \theta_i$$

Image formation by a flat mirror

The law of reflection predicts how an mirror forms an image. Consider:

* a flat mirror
* a point source in front of the mirror, P
* rays that travel from the source to the mirror and are reflected



The law predicts:

1) the reflected rays diverge
2) the diverging reflected rays all appear to emanate from a point behind the mirror

This point is the image of the source. We label this P'.

The situation can then be analyzed geometrically. We find..

1) the image is behind the mirror. Then with

s = distance from source to mirror
s' = " " image to mirror

$\} = 0$ $\boxed{s' = s}$

2) the image always exists and it is always in the same location behind the mirror, regardless of any observer. In order to see the image at least one ray must travel: source → mirror → observer

3) no light actually travels to of from the image location ⇒ image is virtual

Warm Up 1

Quiz 1 ~40% ~> 80%

Quiz 2

Demo: Infinity Mirror Rooms