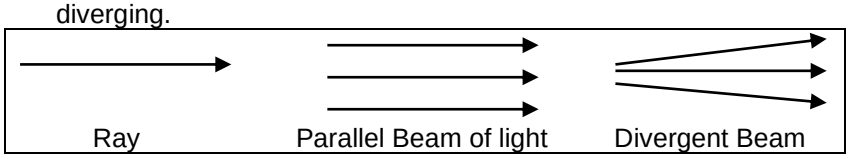
SMARTLAB EDUCATION CENTRE
Believe in yourself

Lower Secondary Science

Light
Notes

1. Light is a form of energy.

a. Light travels in straight lines. Light travels along paths called **rays**. A **beam** of light is a stream of light energy, or a bundle of rays which can be parallel, converging or diverging.



b. Light travels in vacuum with a speed of 300 million m/s (in standard form, 3 x10^8m/s). This is an incredibly high speed, 3 hundred thousand kilometres in a single second!

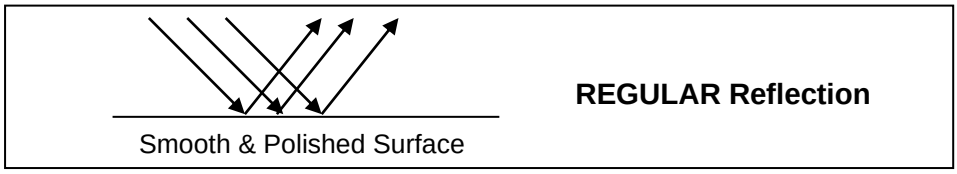
2. **Luminous vs non-luminous objects**
Luminous objects give out light of their own. E.g. sun, stars, flame, lamp and fireflies.
Non-luminous objects do not give out light of their own. E.g. moon, paper etc.

Non-Luminous objects have different degrees o***f transparency***:

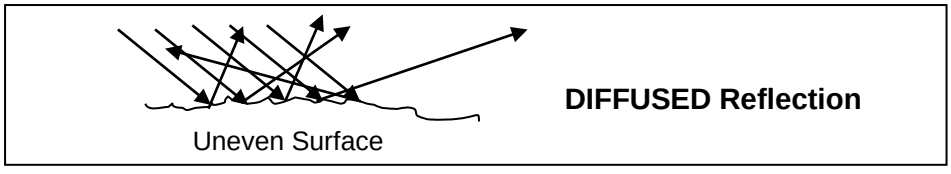
a. Opaque – objects that do not allow light to pass through. We cannot see through them. Most of the objects around us are opaque.
b. Transparent – objects that allow almost all the light falling on them to pass through. We can see clearly what is behind a transparent object.
c. Translucent – objects that diffuse or scatter light, allow only some light to pass through. We cannot see clearly what is behind a translucent object. E.g. frosted window and veil. A translucent object is something that is in between an opaque object and a transparent object.

3. **Reflection** is the bouncing of light off an object.

a. Reflection from a smooth surface is called **regular reflection.** Mirrors and polished metals have smooth surfaces which produce regular reflections and sharp images.

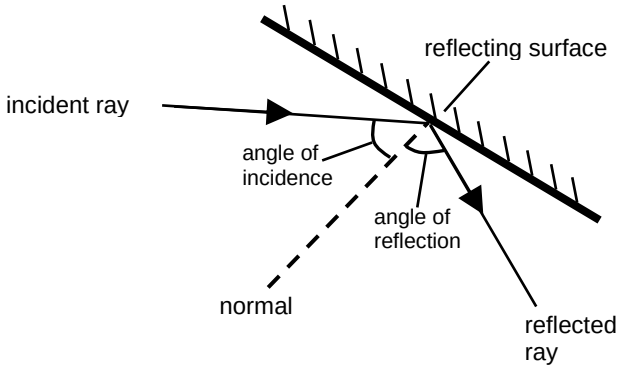


b. **Diffused reflection** occurs when a parallel beam of light falls on a rough surface and is reflected in various different directions or is scattered. NO image is formed in diffused reflection. E.g. Paper has uneven surface, we cannot see an image of ourselves in an ordinary piece of paper.



4. Laws of Reflection

- The angle of incidence equals to the angle of reflection.



Q: What is the angle of incidence?

The angle of incidence is the angle between the incident ray and the normal

- The incident ray, the reflected ray and the normal all lie on the same plane.

5. **Mirror** consists of a piece of thin, flat glass with a coating of silver or aluminum on one side protected by a coat of paint. Image formed by a mirror has the following characteristics**: VS FLU**
   (1) **Virtual** (not real and image cannot be caught on screen)
   (2) Same **Size** as object
   (3) As **Far** behind the mirror as the object is in front of it
   (4) **Laterally inverted** (Images turn from left to right)
   (5) **Upright**

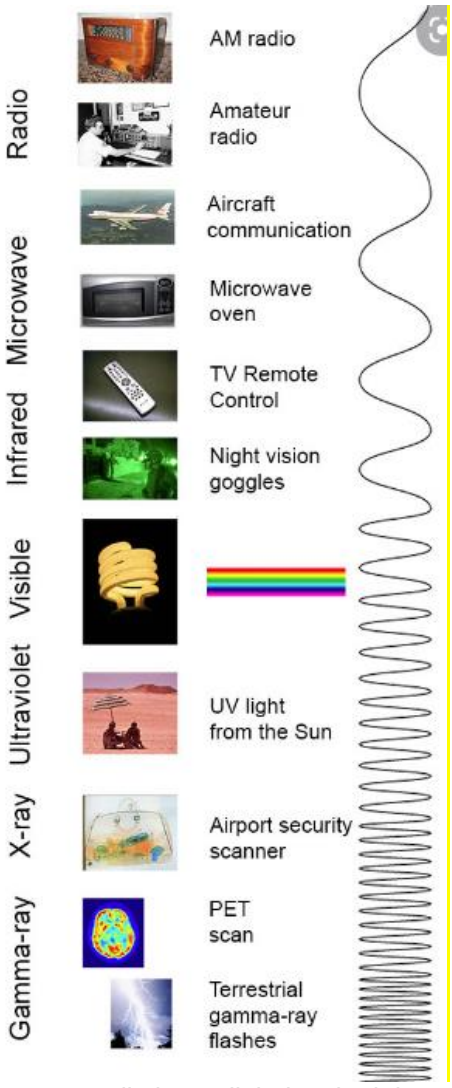
   Virtual Images
   Are images which seem to be there but no light actually reaches. Eg:
   1. Images in mirrors
   2. Enlarged words when magnifying glasses are used to read

What is the difference between a real and a virtual image?
A real image is an image that can be captured on a screen.
A virtual image is an image that cannot be projected or captured on a screen.
It is produced by rays which seem to come from the image but do not actually pass through it.

Uses of Reflection

Reflecting Surface	Concave	Convex	Plane
Image	• Larger than the actual object if the object is near the mirror	• Wider scope of view • Upright images	• Same size as the object
Uses	• Cosmetic mirror • Dentist's mirror • Microscope • Car headlights • Searchlights	• Blind corner mirrors • Car wing mirrors	• Periscope • Kaleidoscope

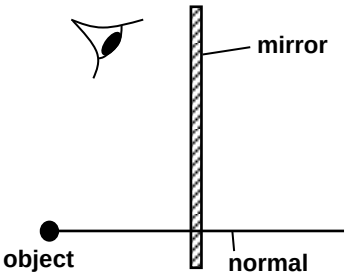
6. EM (electromagnetic) radiation is made up of the following:



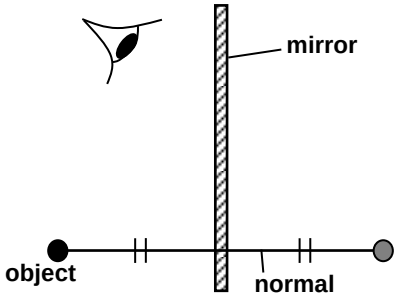
7. EM radiation or light has both beneficial (applications) and harmful effects(cause cancer, light pollution, disorientation of birds and uses up a lot of electrical energy)

8. **Method for Constructing Reflection Ray Diagrams**

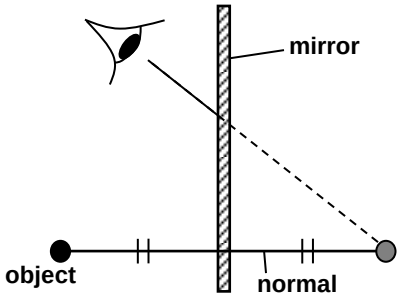
Step 1 Draw a normal perpendicular to the mirror from the object.



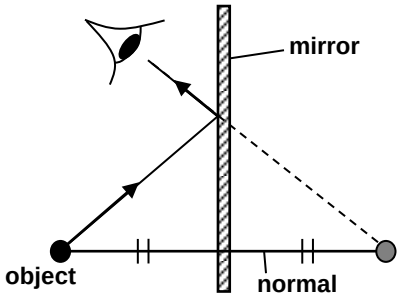
Step 2 Measure the distance of the object to the mirror, (let it be ***x*** cm). Along the normal, ***x*** cm behind the mirror is the location of the image.



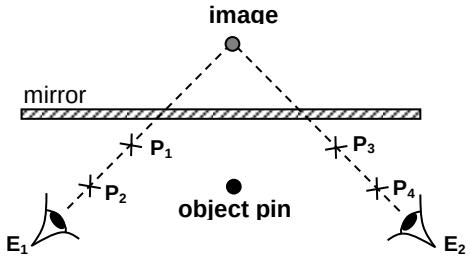
Step 3 Draw a light ray from the image to the eye. The ray between the mirror and the eye are actual light ray (to be drawn as complete line). The rays behind the mirror are virtual light rays (to be drawn with dotted lines)



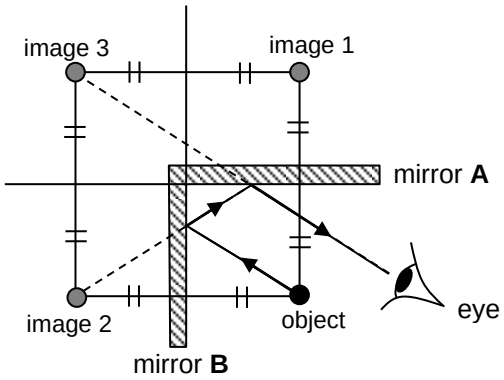
Step 4 Join the incident ray from the object, to the reflected ray which are drawn earlier. Finally add in the arrows to indicate the directions of light rays.



9. **Lab work** to obtain the image formed by the mirror:
a. Fixed a pin as the object
b. Observed its location from one side and pinned 2 pins that directly obstruct the image seen
c. Repeat that on the other side
d. Extrapolate the line P_1P_2 and P_3P_4, and point of connection is the image location.



10. Images from two plane mirrors perpendicular to each other.



This is an example of multiple reflections from 2 plane mirrors. Image 3 is actually the image reflected from both Image 1 and 2. Consider how light from Image 3 reaches the observer, the ray diagram shows how light from the object reaches the observer.

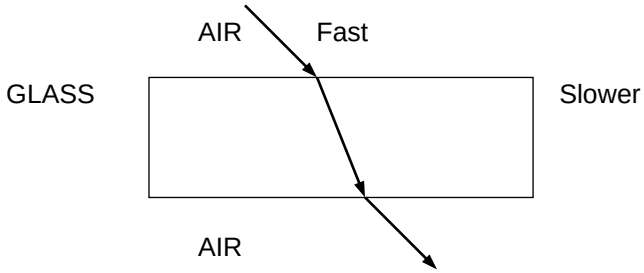
11. **Number of Images formed by 2 plane mirrors (optional)**

Formula: Number of image = 360/angle between mirrors – 1

Example: Number of image formed between 2 mirrors positioned at right angle to each other is 3 ($360^o/90^o$ - 1).

Refraction

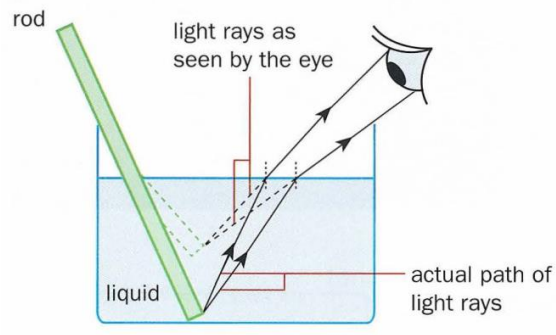
Refraction **is the bending of light when it passes from one transparent material to another. Refraction is due to the different speeds of light in different media.**



12. Effects of refraction:

c. An object in water appears nearer to the surface than it really is; e.g. swimming pools appear shallower than they actually are, and glass look thinner than it really is.

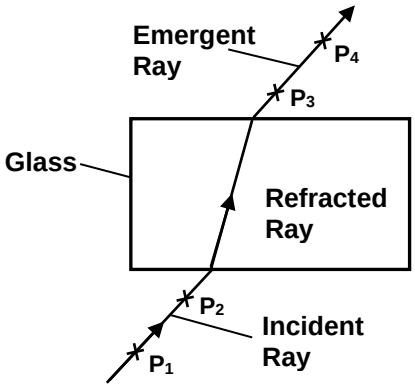
d. An object half immersed in water appears to be bent at the water surface.



e. Refraction allows our eyes to focus.

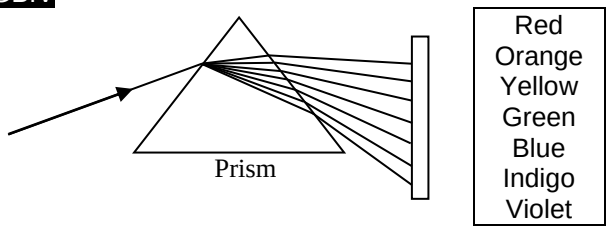
f. Dispersion of white light

13. Refractive index is a **material constant**. The denser the material is, the higher is the refractive index of the material.

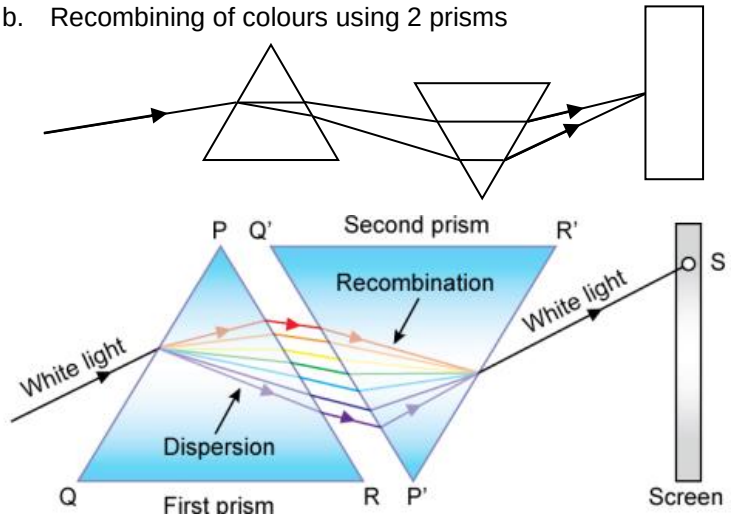


14. A **Spectrum** is a band of colours. Refraction causes the different colours of white light to be bent at different angles.

a. **Dispersion** is the splitting of white light into its component colours as follows: ROYGBIV



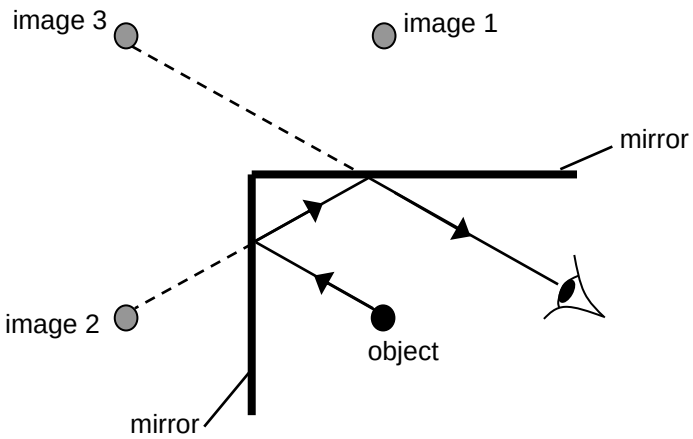
b. Recombining of colours using 2 prisms



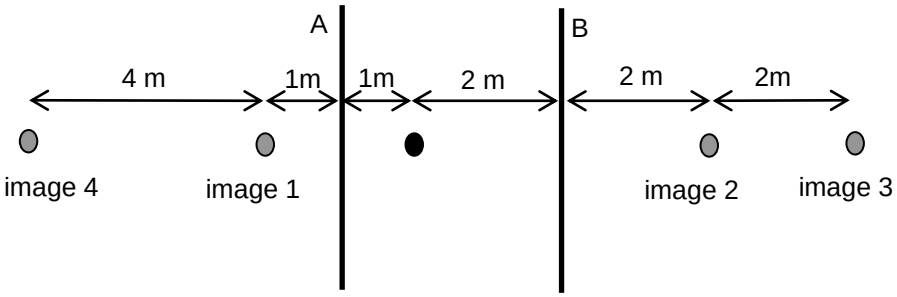
c. Spin the Newton's 7-colour (ROYGBIV) disc to get a white disc.

15. <u>Ray Diagrams</u>

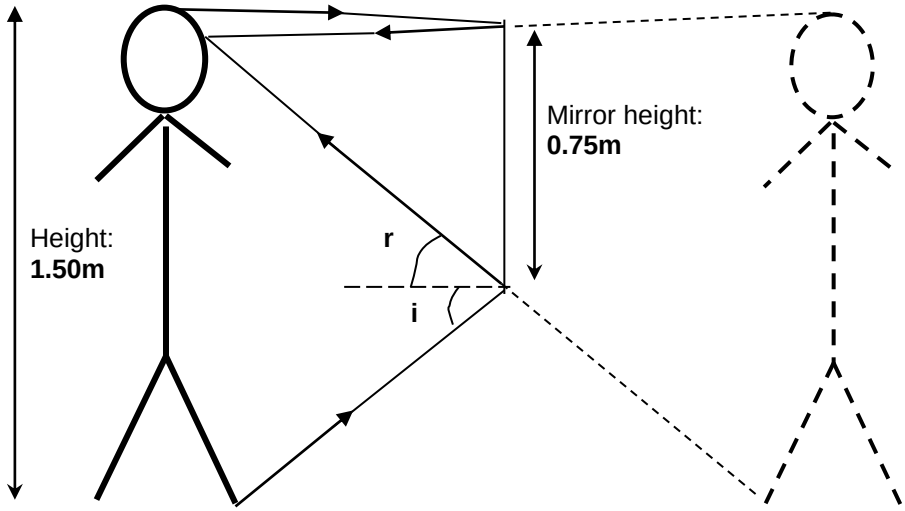
i) Draw a ray diagram of how 3 images are formed from two plane mirrors placed perpendicular to each other can be seen by an observer.



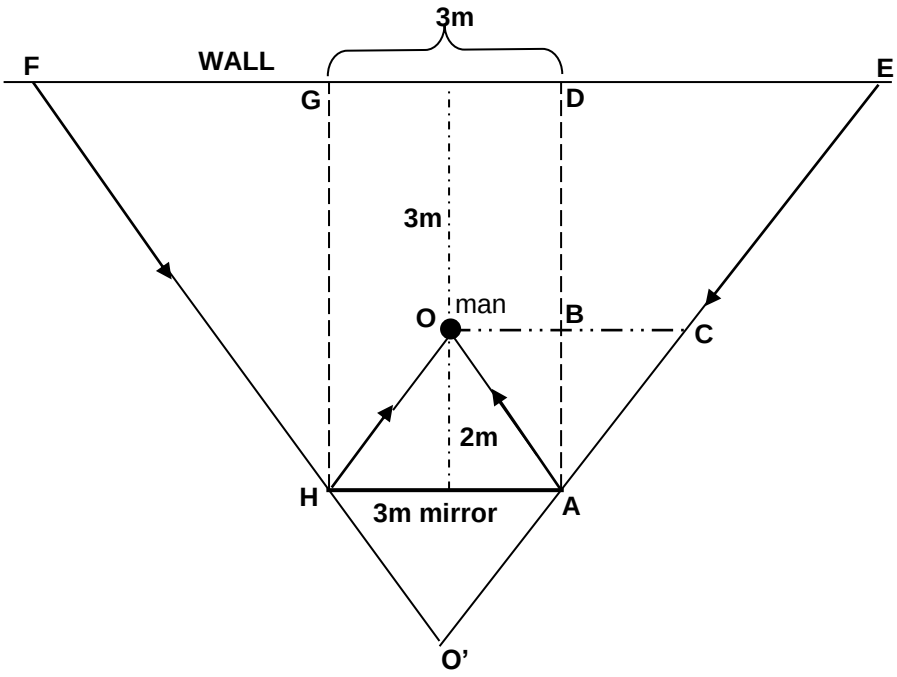
ii) Draw the first 4 images (labeled with distances) from the two mirrors, A and B. The object is 1m from mirror A and 2m from mirror B. (Hint: Draw the first two images for each mirror first, then draw the next two from these.)



iii) Minimum length of mirror needed to see the whole length of the body.
The length of the mirror needed is always half the length of the body, this is because the angle of incidence always equals the angle of reflection.

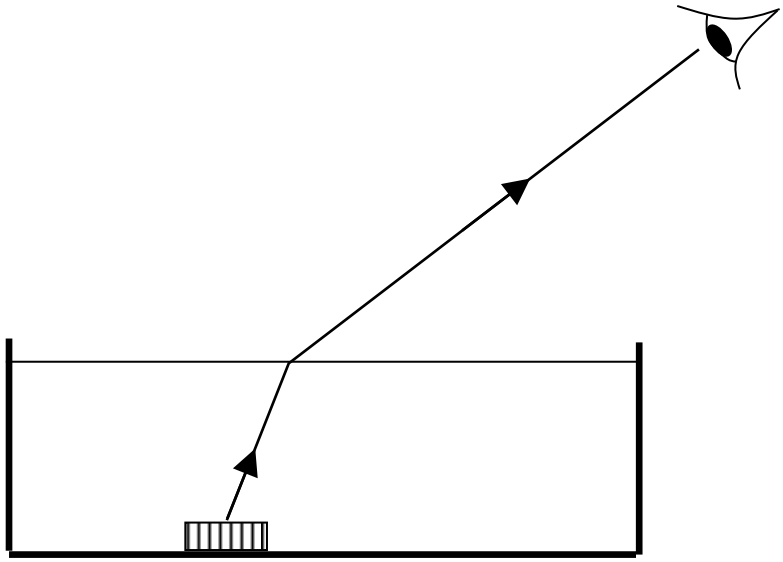


iv) A man is standing 2m in front and at the centre of a 3m mirror. A wall is 3m behind him as shown in the diagram below. What is the maximum width of the wall that he can see? (Hint: make use of similar triangles for your calculations)

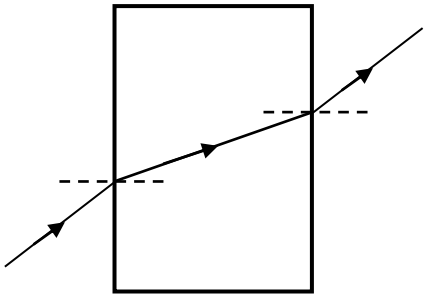


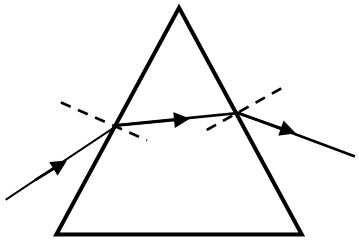
O' is the image point of O. Height of triangle O'AH is 2m.
Triangle O'AH is similar to triangle O'FE.
Height of O'FE = 3 + 2 + 2 = 7m
By law of similar triangles, FE = (Height of triangle O'AH) / (Height of O'FE) x AH = 7/2 x 3 = 10.5m
Maximum width man can see is 10.5m.

v) By drawing a light ray from the coin at the bottom of a water trough, show how the observer is able to see the coin.

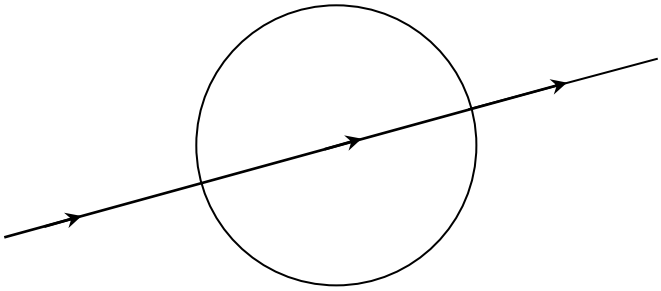


vi) Light passing through glass block and a prism. (Hint: Draw the normals first.)





vii) When light meets a circular object perpendicularly, it passes through the center of the circle.



viii) Draw the ray diagram for a light ray meeting a circular object at an angle. (Hint: the normal is always perpendicular to surface where light incident upon.)