

## Self – Study Pack

- Subject: - Science
- Grade: - 7
- Term: - Second Term
- Unit: - Light (Unit 9)
- Learning Outcomes –
  - Describes factors affecting formation of shadows
  - Demonstrate formation of the shadow by an opaque object
  - Design activities to demonstrate formation of umbra and penumbra
  - State the uses of different types of mirrors
  - Describe the nature of images formed by plane and curved mirrors
  - Conduct simple activities to demonstrate nature of shadows using convergent, divergent and parallel light beams.
  - Conduct simple activities to observe the nature of images formed in plane mirrors and curved mirrors
  - Accept that the formation of shadows and images are different phenomena.

### Activity 1

Some instances that you can experience in your day today life are shown below.



Those given above can be called as shadows or umbra. You also experience similar situations in your home environment as much as possible. Engage in such enjoyable activities as much as possible.

### Activity 2

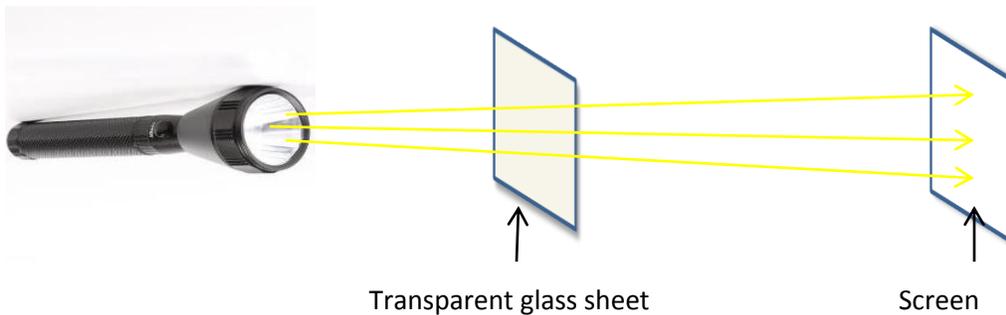
#### **How does a shadow form?**

Things needed: -

- An electric torch, a thin glass sheet, a white screen, a sheet of cardboard

Method: -

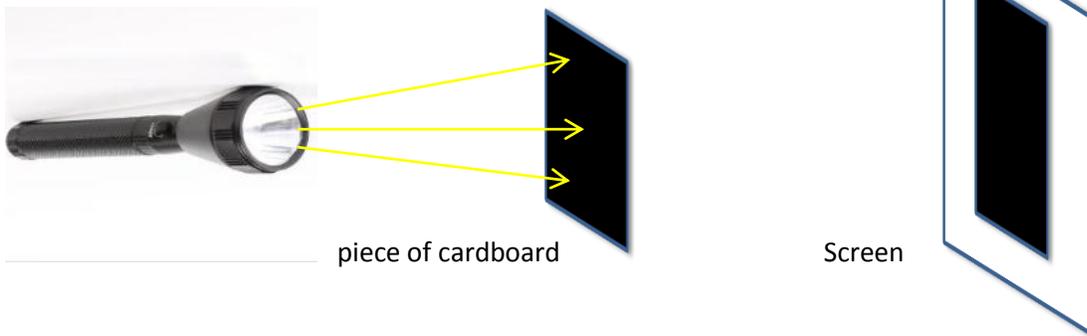
- Keep the glass sheet between the torch and the screen and record your observations.



Observation - .....

**Light transmits well through transparent objects. A shadow is not formed.**

- Then remove the glass sheet and keep the sheet of cardboard (opaque object) between the torch and the screen. Record your observations.



Observation: - .....

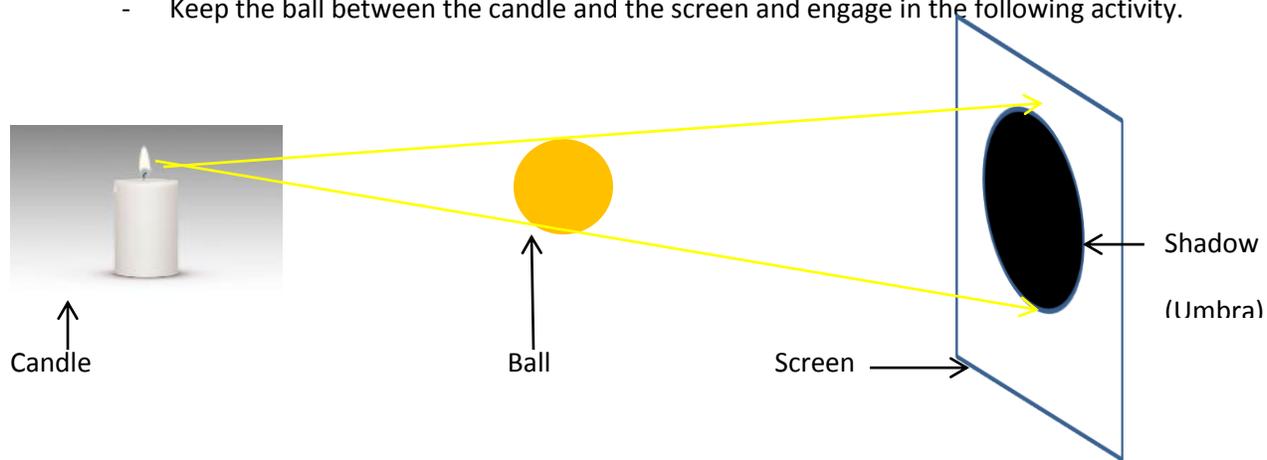
**Light does not transmit through opaque objects. A shadow gets formed on the screen.**

### Activity 3

(Let us investigate further about formation of shadows due to blockage of light by opaque objects.)

Things needed: -

- A candle, a white screen, a ball
- Keep the ball between the candle and the screen and engage in the following activity.



Observation - .....

**For your knowledge –**

**A shadow/umbra forms due following reasons.**

- **As light from the candle does not pass through opaque objects, a shadow is formed.**
- **Furthermore, shadows are so formed due to rectilinear propagation of light.**
- **If there is a source of light, all opaque objects form shadows. A screen is used for observing them.**

#### Activity 4

Let us see how the umbra gets changed when the distance between the object and the screen is changed.

Use the above things and perform the following activity. Record the observations.

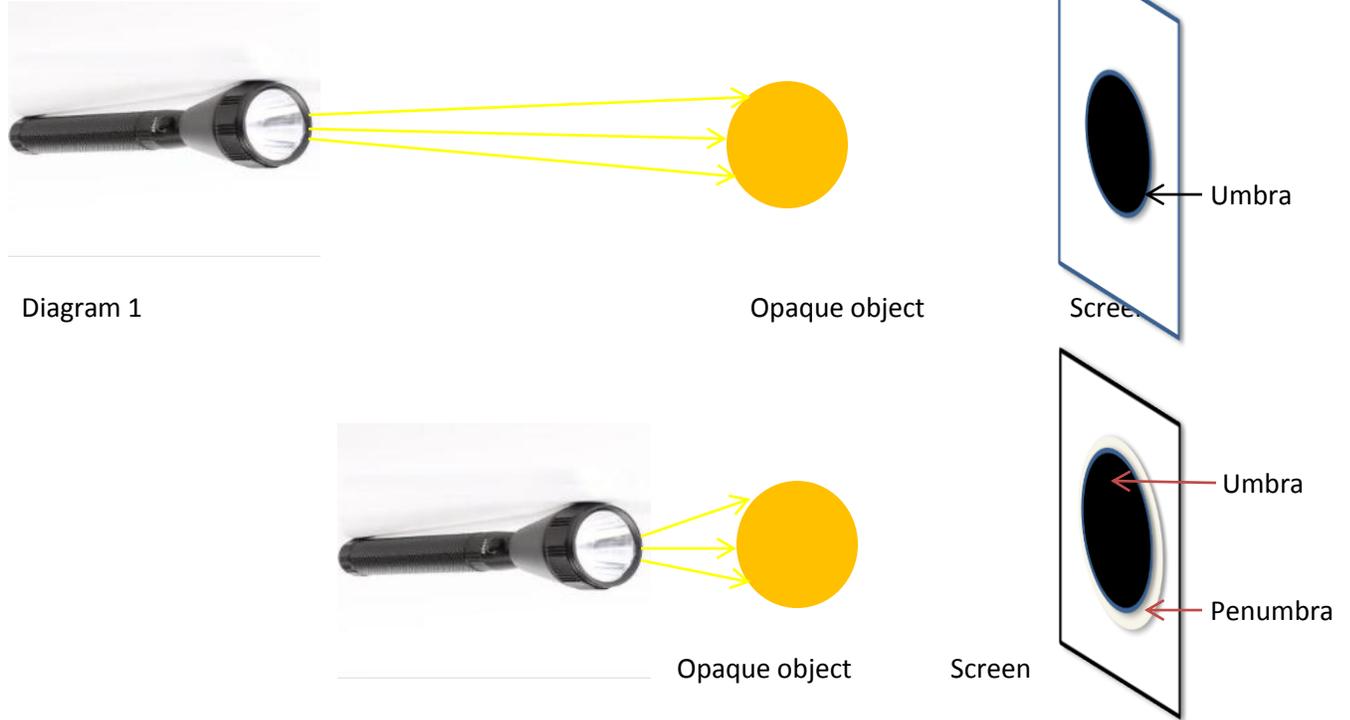


Diagram 2

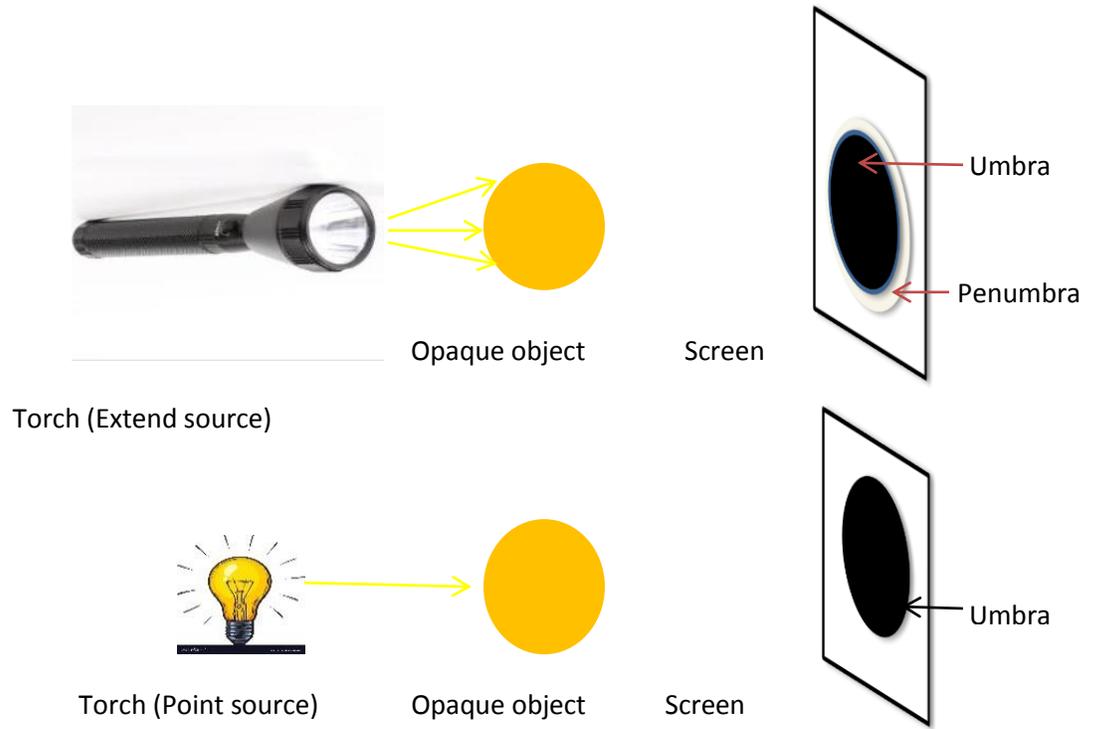
Observations - .....

#### For your knowledge –

- When the distance between the source of light and the opaque object increases (No. 1), a clearer umbra (dark umbra) is formed.
- When the distance between the source of light and the opaque object decreases (No. 2), an umbra (dark colour part) and, around it, a penumbra (less dark colour part), get formed.
- That means, when the distance to the source of light from the object decreases both umbra and penumbra get formed.

### **Activity 5**

Demonstrate the nature of shadows formed by point sources of light (a torch bulb) and extended source of light (torch light)

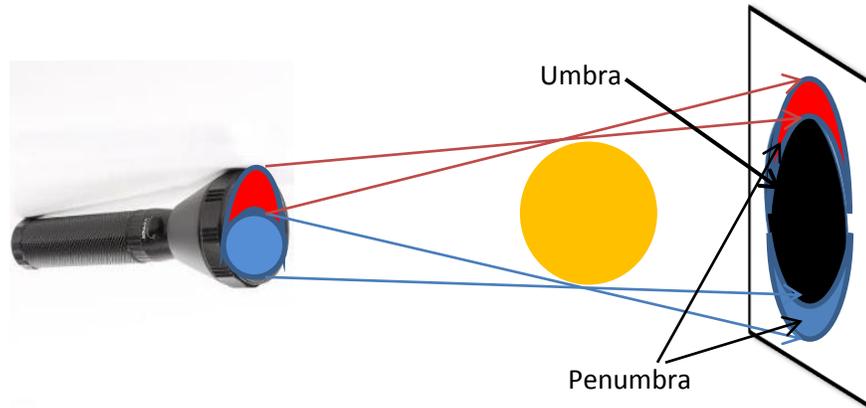


#### **For your knowledge –**

- **Both umbra and penumbra are formed by extended sources of light.**
- **Only umbra is formed by point sources of light.**

Let us investigate more about penumbra.

Colour upper half of the glass plate of the reflecting surface of a torch with red and lower part of it with blue. Perform Activity 4.2 again. Record your observations.



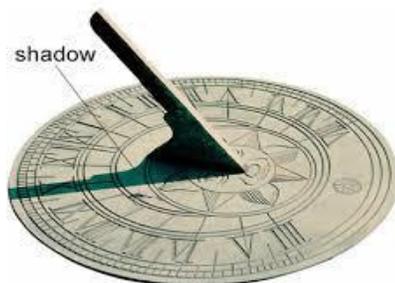
Observations - .....

**For your knowledge -**

**It is clear that each part of the penumbra is formed by light from only the relevant part of the source. (I.e. Upper part of the penumbra is formed by light from upper part of the source of light.)**

Because of shadows/umbra,

1. Sundial (ancient man had used this as an arbitrary unit of measuring time)



## 2. Shadow shows

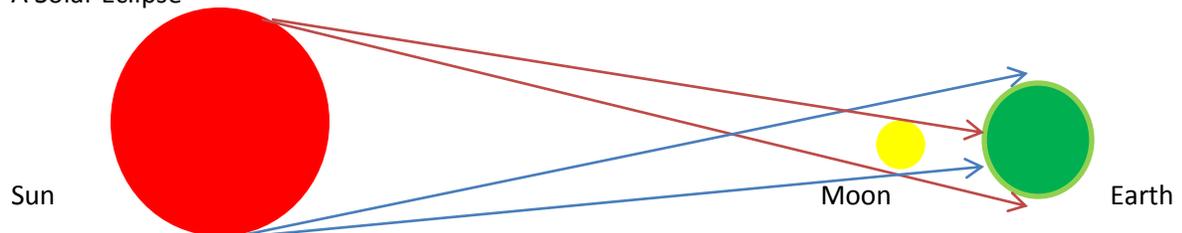


## 3. Shadow creations

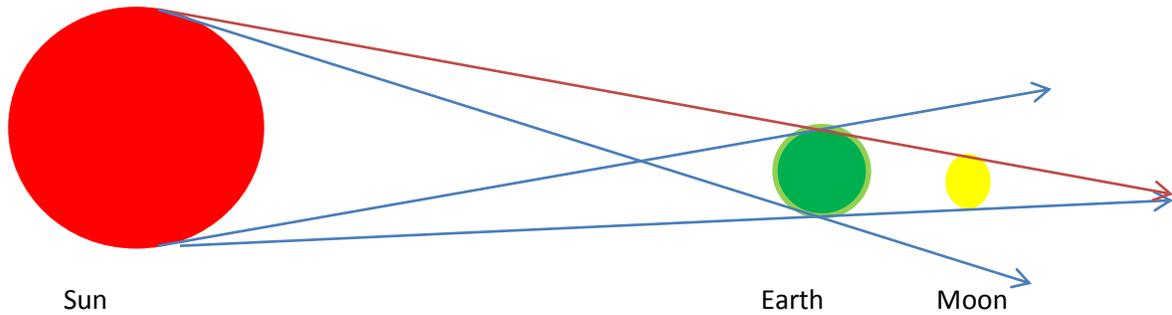


## 4. Solar eclipses and lunar eclipses

A Solar Eclipse



A Lunar Eclipse



For your knowledge –  
Solar eclipses and lunar eclipses are two natural phenomena that show formation of shadows in space.

**Activity 6**

Let us find out about mirrors

**Smooth, polished surfaces are known as mirrors. Mirrors are used for manipulating light as required.**

According to the nature of the surface, there are three types of mirrors. Find the objects/surfaces similar to these types of mirrors from your immediate surrounding as much as possible and complete the table given below.



Plane Mirror



Concave Mirror

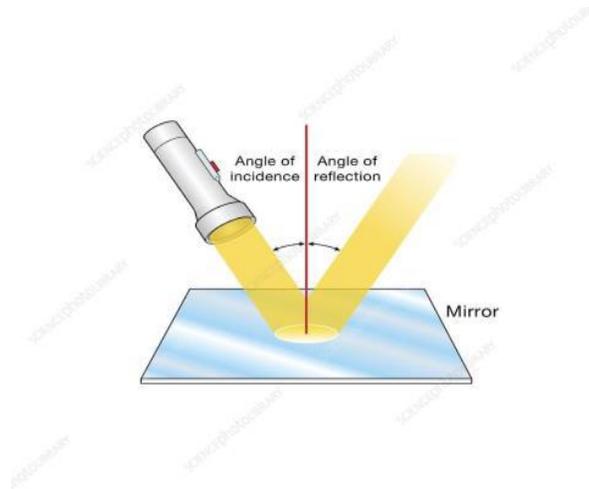


Convex Mirror

Plane Mirrors	Concave Mirrors	Convex Mirrors

## Activity 7

Why the images are get formed by mirrors? Let us find out.



For your knowledge –

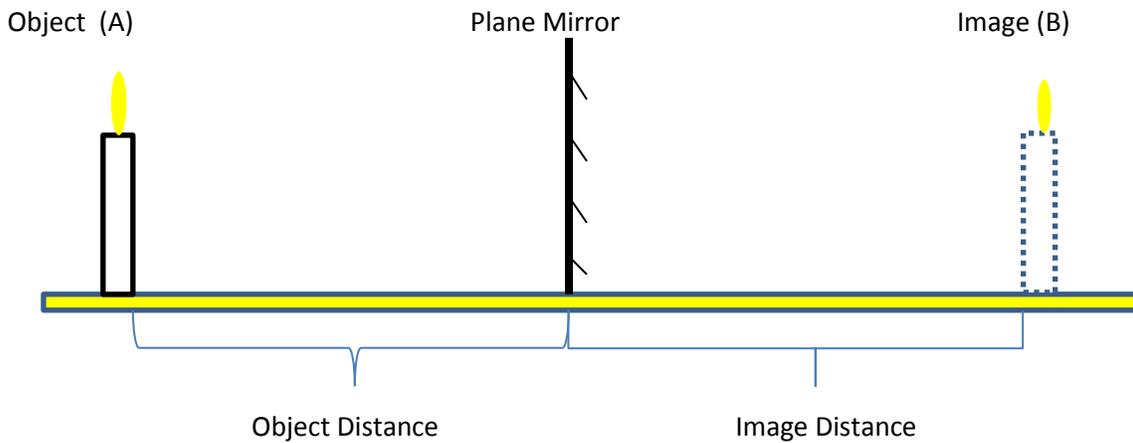
- Mirrors change the path of light rays. (Manipulates light). Images form as a result of reflection of light.
- Reflection is bouncing off/returning of light into same medium after incidence at a certain surface.

### Activity 8

Let us identify the features of images formed by plane mirrors.

Things needed – A plane mirror, a meter ruler, a candle

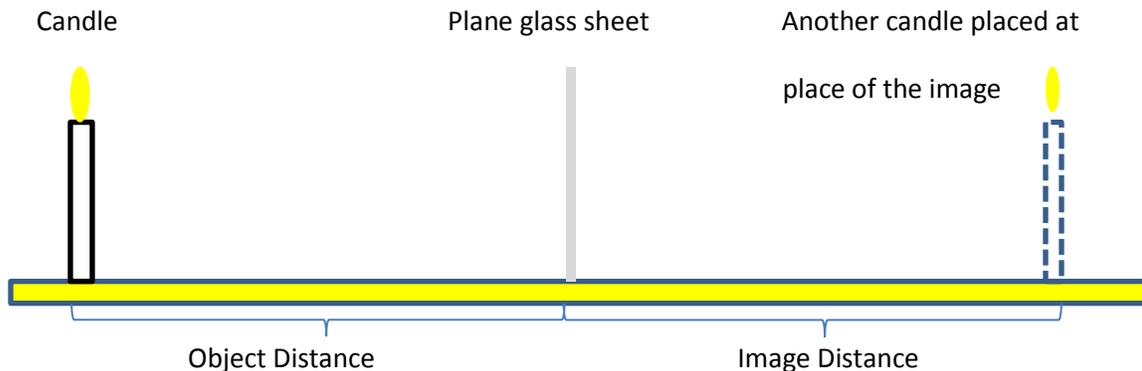
- Light a candle and fix it before a plane mirror as illustrated in the diagram. Mention the observations you make as follows.



- Nature of object A and image B (upright/inverted) .....
- Size of the object A and image B .....
- Can the image be taken on to a screen? .....
- Distance from the object to the mirror (object distance) and the image to the mirror (image distance) .....
- Has the image laterally inverted? (Has the left and right sides of the image exchanged?) .....

Let us find out relationship between object distance and image distance

Perform Activity 8 again using a plane glass sheet instead of the plane mirror. Keep the glass sheet before the candle and observe the image of the candle formed by the glass sheet. (It is better to carry out this activity in a dark place). Use another candle to find out the place that the image has formed. Record your observations.



**For your knowledge –**

**Accordingly object distance (distance between object and the glass sheet) and image distance (distance from the glass sheet to the candle kept on the place where the image has formed) are equal to each other.**

### **What is lateral inversion?**

Take a plane mirror and keep letters of the English alphabet in front of it one by one. Observe the images of letters formed in the mirror. Illustrate your observations using suitable diagrams.



Observations - .....

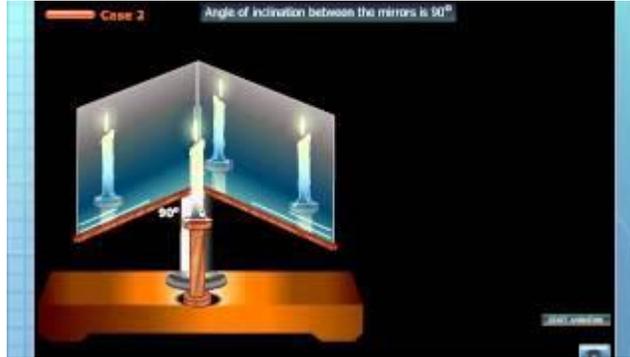


**For your knowledge –**

**Appearance of right side of the object as its left side and vice versa in its image formed by the plane mirror is known as lateral inversion.**

### Let us observe Multiple Images

Keep two plane mirrors inclined to each other as illustrated in the diagram given below. Keep a candle between the mirrors and observe the images formed by the candle. Change the inclination between the mirrors with a protractor and take observations again and again.



Angle between the mirrors	No. of Images
$90^{\circ}$	.....
$60^{\circ}$	.....
$45^{\circ}$	.....
$30^{\circ}$	.....

#### For your knowledge –

When the angle between the plane mirrors decreases, number of images formed by them increases. When the two mirrors are kept parallel to each other infinite number of images are formed by them.

The phenomenon of formation of more than one image by two or more mirrors kept inclined or parallel to each other is known as Multiple Image formation

- ❖ Let us note down the features of images formed by plane mirrors as follows.
  - The image cannot be taken to a screen. It is virtual
  - Size of the object and the image are equal.
  - Object distance and image distance are equal.
  - The image is laterally inverted.

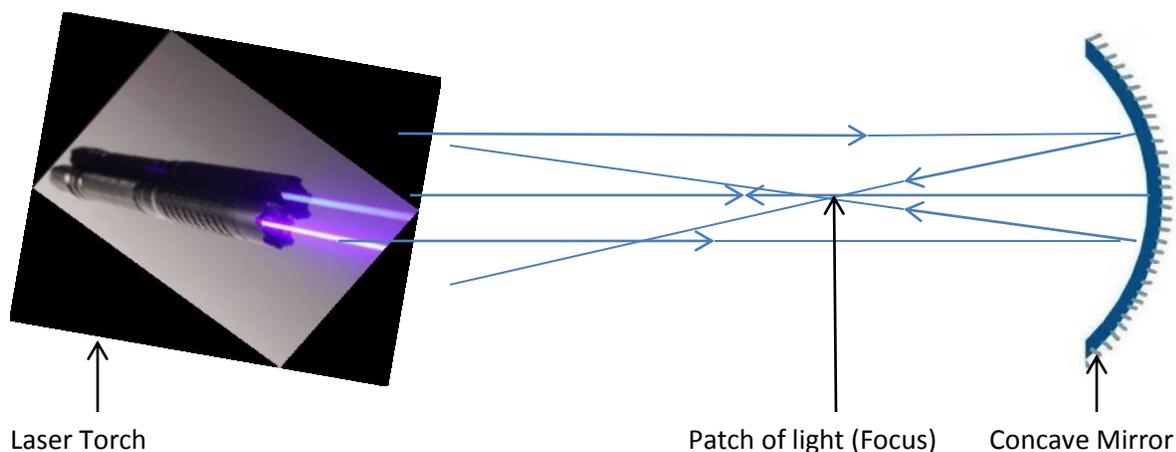
## Activity 9

### What happens to a parallel beam of light that falls on convex and concave mirrors?

Things needed: - a concave mirror (a mirror that magnifies your face), a convex mirror (a side mirror of vehicles), a laser torch that can emit a parallel beam of light.

Direct a parallel beam of light on to the concave mirror and convex mirror separately with the laser torch.

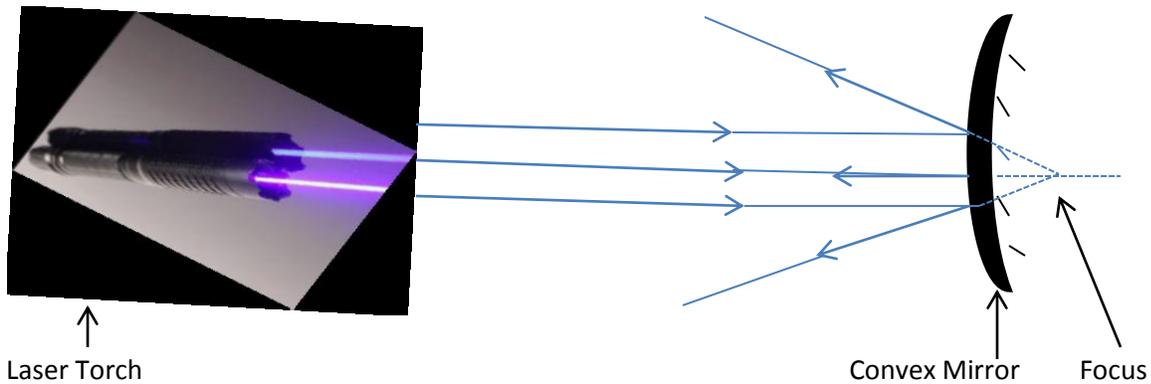
**Important;** when directing a parallel beam of light, prevent your body and eyes coming into contact with laser rays.



#### For your knowledge –

- A parallel beam of light that incidents on a concave mirror, converges on to a single point after reflection. This point is called the focus. (Focal point). Let us imagine that the distance from the mirror to this point is 10cm.
- As parallel light rays that fall on concave mirrors, converge on to a single point, they are also called convergent mirrors.

2.



**For your knowledge**

- A parallel beam of light that incidents on a convex mirror, diverges after reflection as they are coming from a single point behind the mirror. This point where the rays seem to be diverges from is called the focal point. (focus)
- As the convex mirrors diverges a parallel beam of light that falls on it, they are called divergent mirrors.

Activity 10

**Let us observe the images formed by concave mirrors.**

Things needed – a concave mirror, a candle, a screen, a meter ruler

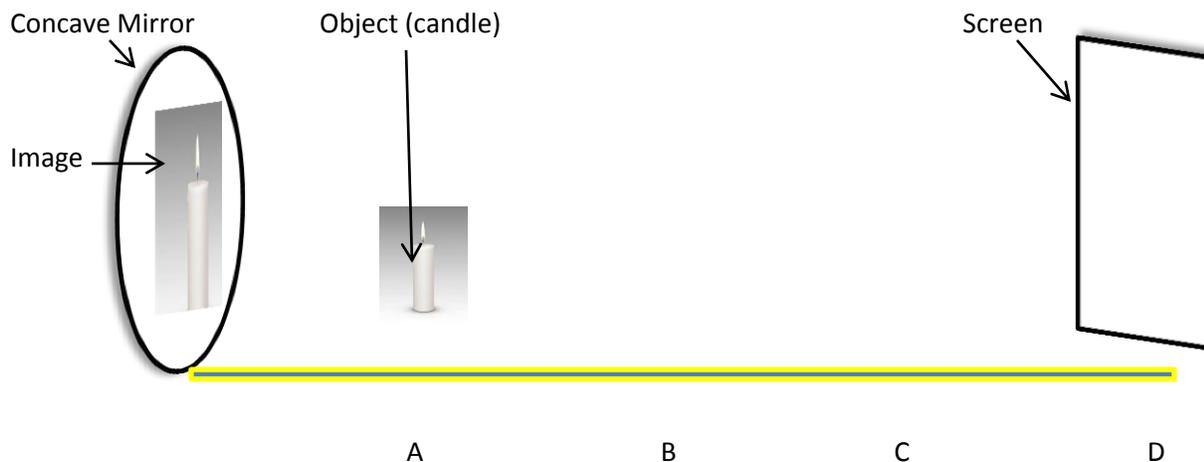
Keep the candle in front of the concave mirror as instructed below.

Point A – Very close to the mirror (this distance should be less than 10cm; the focal length of the concave mirror)

Point B – on the focus

Point C – 20cm away from the mirror

Point D – 30cm away from the mirror



Change the position of the screen and try to obtain images. Tabulate the observations as given below.

Position of the candle	Can the image be taken to a screen ; Yes/No	Whether image is upright or inverted	Size of the image
<b>A</b>	.....	.....	.....
<b>B</b>	<b>Image forms at infinity</b>		
<b>C</b>	.....	.....	.....
<b>D</b>	.....	.....	.....

**For your knowledge –**

**When the object is kept very close to the concave mirror (less than 10cm), an enlarged and upright image is formed behind the mirror. This phenomenon is made use of for various day today purposes.**

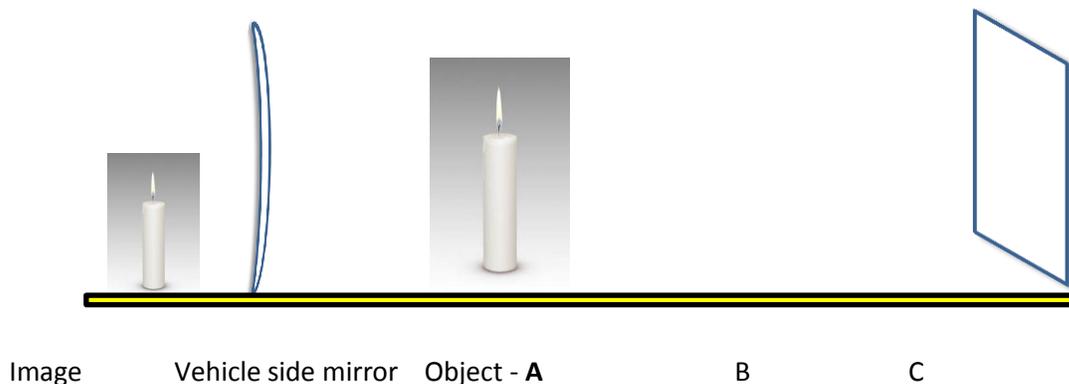


**Activity 11**

**Let us observe images formed by convex mirrors.**

Things needed: - A convex mirror (a side mirror of a vehicle), a candle, a screen, a meter ruler

As illustrated in the following diagram, keep a candle before a convex mirror at several positions called A, B and C. See whether you can obtain the image on to a screen or not. If not, observe the image in the mirror.



Tabulate your observations as follows

Place of the candle	Can/can't the image be obtained on a screen	Whether Upright/ Inverted	Size of the image
A	.....	.....	.....
B	.....	.....	.....
C	.....	.....	.....

For your knowledge,

Convex mirrors always give diminished, upright and virtual images irrespective of the place where the object is kept before the mirror. Therefore convex mirrors are used for following purposes.

WHY CONVEX MIRRORS ARE USED  
IN REAR VIEW MIRRORS IN  
VEHICLES?



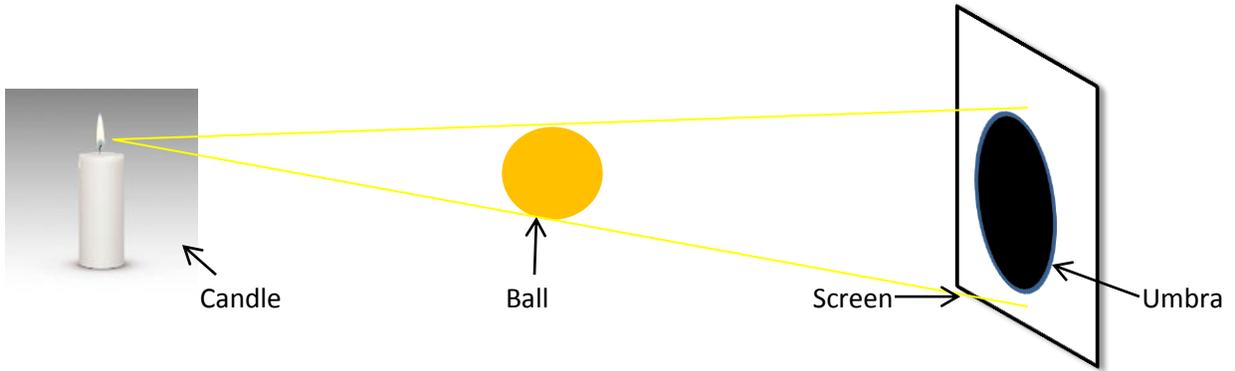
Let us measure knowledge

- 1) Classify the following substances as transparent, translucent and opaque. Write them in the correct columns of the table given below.

Thin glass sheet      Metal sheet      Paper      Decorated glass sheet      Oil paper  
Piece of cardboard      Polythene used as covers of books,      Tissue paper

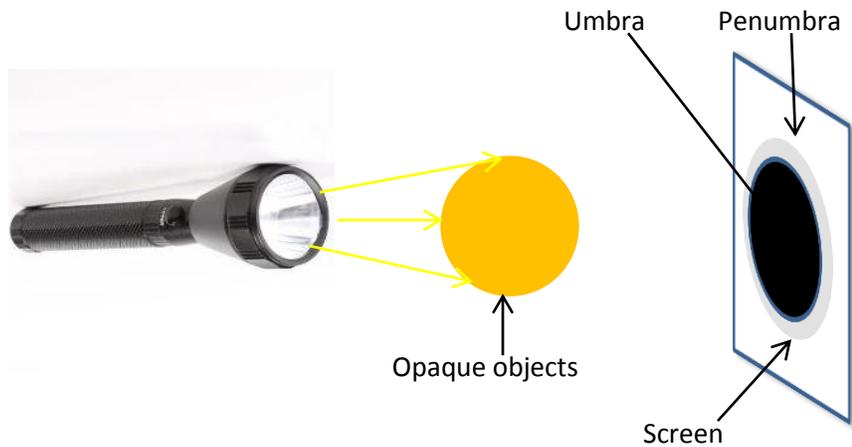
Transparent substances	Translucent substances	Opaque substances

2) According to Activity 3, write down three characteristics of light which are necessary for formation of a shadow/umbra.



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 .....

3) The diagram given below illustrates an instance of formation of both umbra and penumbra as in Activity 4. Answer the questions in relation to that instance.



i) Write down a change that can be done to this set up in order to obtain a clear umbra.

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 .....

ii) Why is an opaque object used for this activity?

.....  
 .....

4) Name the type of mirror in the following items.



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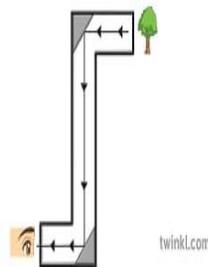
5) Write down the characteristics of images formed by plane mirrors according to Activity 8

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 .....  
 .....  
 .....

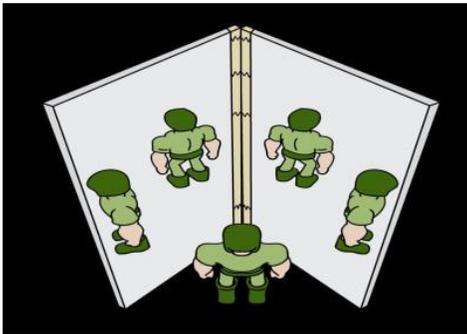
6) Name the following occasions where plane mirrors are used.



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.....  
 7) Explain the reason for calling a concave mirror as a convergent mirror using a suitable ray diagram.

8) Explain the reason for calling a convex mirror as a divergent mirror using a suitable ray diagram.

9) Find out the instances where concave mirrors are used and write down them in the spaces given below.

.....	.....
.....	.....
.....	.....

10) According to all activities, write down a feature relevant to shadows and a feature relevant to images as you have identified.

Shadows	Images

The Summary of the Whole Lesson

