5 Mirrors and Reflections

When we observe objects, animals, birds, sceneries, colourful butterflies etc. in the vicinity, we enjoy it and feel happy.

Why are we able to see the objects?

What is required?   a small plain mirror and a laser torch
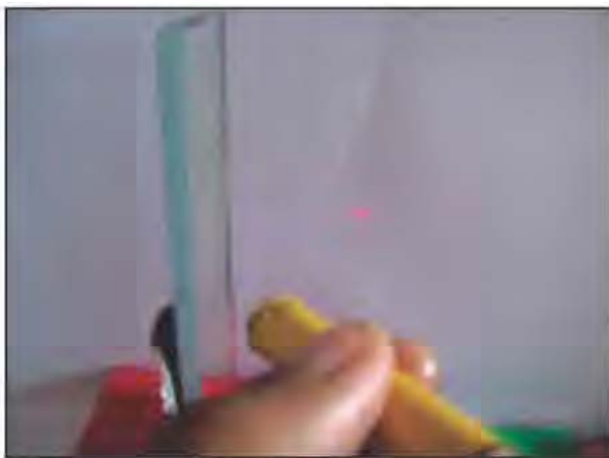
What to do?

Figure 5.1

Figure 5.2

- Take a small plane mirror. Allow light from lasser torch to fall on the mirror and try to see the reflection of light on a wall or on clothed screen.

- The bright ray of light is reflected from polished and smooth surface of the plane mirror. Similarly, light from the surrounding comes back from the objects, which enters in our eyes, which makes us see the objects but we do not see the reflected ray of light.

- The Phenomenon of ray of light, coming back after getting incident on surface of an object is known as reflection of light.

Let us understand the phenomenon of reflection of light

What is required? a plane mirror, a stand, a drawing paper, a torch, a scale, a pencil

What to do?

- Place the drawing paper on a plain surface.

- Draw a line segment AB on paper as shown in Fig.

- Place a plain mirror vertically on it.

- Allow ray of light from torch to be incident on the surface show of plain mirror by adjusting the torch very near to the surface show the path of the ray of laser light.

Figure 5.3

- Mark points P and Q shown in Fig. 5.4 on the path generated by ray of laser light using pencil.

Figure 5.4

- Similarly, mark points R and S as shown in fig. on the path generated by reflected ray of laser light using pencil. Remove the plain mirror from the paper.

- Draw the ray PQ passing through points P and Q.

- Draw the ray RS passing through points R and S.

- Mark point 'O' on line segment $\overline{AB}$ where the ray $\overrightarrow{PQ}$ and ray $\overrightarrow{RS}$ intersect using pencil.

- Draw a $\overrightarrow{ON}$ perpendicular to AB from point 'O'

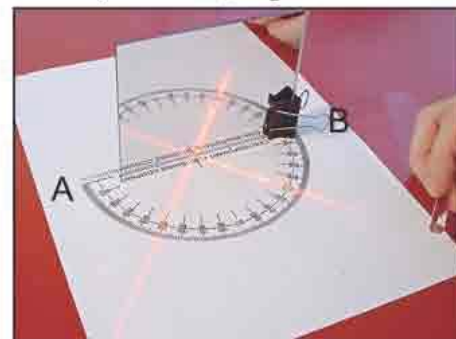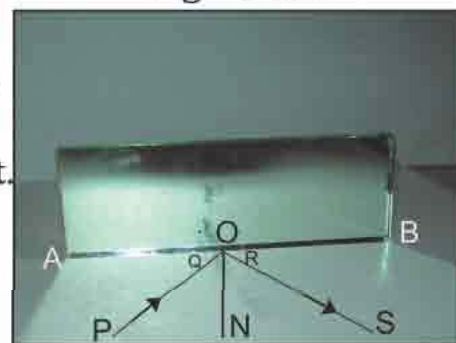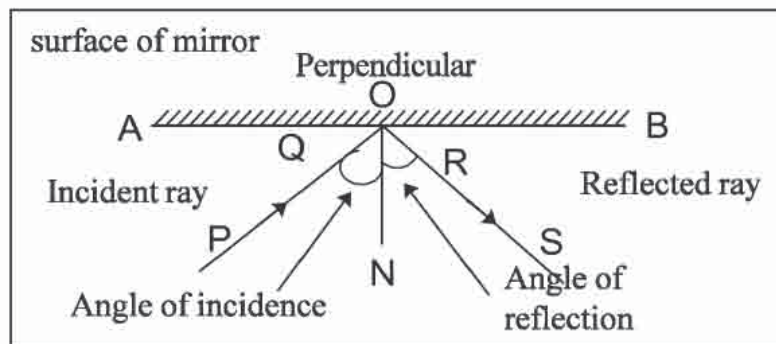- You will be able to see the figure as follows on the paper.

Figure 5.5

- **Incident ray** – The ray of light coming from laser torch on the surface AB of plane mirror at point 'O' is an incident ray as shown in Fig. $\overrightarrow{PQ}$ is an incident ray.
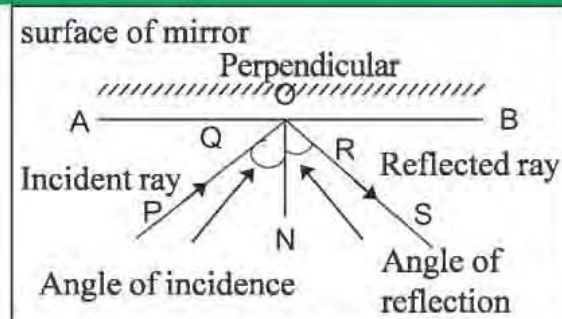
- **Point of incidence :** The point on the surface AB of a plane mirror where the incident ray from laser torch incident is known as point of incidence as shown in fig. 5.6 'O' is the point of incidence in the figure.

surface of mirror

Figure 5.6

- **Perpendicular (normal):** A line making an angle of 90^0 with surface AB of plain mirror at point of incidence 'O' is known as perpendicular (normal)

- **Angle of incidence :** Angle subtended between incident ray and perpendicular at point of incidence is known as angle of incidence. ∠PON shown in the fig. is the angle of incidence

- **Reflected ray:** The ray of light coming back from point of incidence is known as reflected ray. $\overrightarrow{RS}$ is reflected ray shown in fig. 5.6

- **Angle of reflection :** Angle subtended between reflected ray and perpendicular drawn at the point of incidence is known as the angle of reflection ∠SON as shown in fig. 5.6 Repeat the activity by making ray of light incident on the plain mirror and prepare the tabulation as given below.

Trial of expt.	Angle of incidence (in degree)	Angle of reflection (in degree)
1		
2		
3		

- Is the angle of incidence and reflection remain same or differant in each trial?

_____

_____

- Are the ray of incidence and the ray of reflection on the same side of the perpendicular or opposite side?

_____

_____

- Does the plain of incident ray, reflected ray and perpendicular changes or remains the same?

_____

_____

The following rules can be deduced form these observations.

- **Laws of reflections of light:**
    - Incident ray and reflected ray are on the opposite sides of the perpendicular drawn from point of incidence.
    - The level of of incidence and angle of reflection are always equal.
    - Incident ray, reflected ray and perpendicular drawn from point of incidence are in the same plane.

What is required? a polished paper, a torch, a plane paper

What to do?

Figure 5.8

Figure 5.9

- Take a polished paper, observe your face in it,
- Make light incident on polished paper and try to observe reflection on the simple paper
- Rush the polished paper slowly and try to see your face in it.
- Make light incident on this wrinkled paper and observe the reflection on plane paper.

Note your observations

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_____

_____

We can observe that parallel rays made incident on polished surface get reflected parallally, such reflection is known a uniform reflection.

While parallel rays made incident on uneven surface (wrinkled polished paper) does not get reflected, such reflections are known as non uniform reflections.
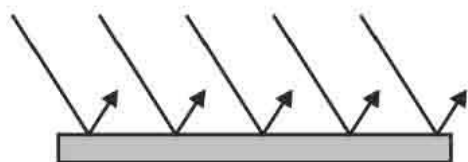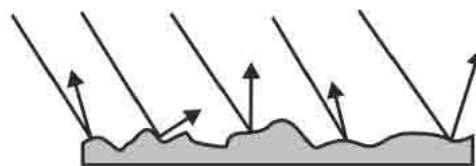

Figure 5.9 Uniform reflections.

Figure 5.10 Non-uniform reflections.

Why do we see sometimes deshaped face in some special mirrors?

Think and discuss :

•   Does each law of reflection obey when reflection of light takes place from un even surface? yes/no.?

Study of images obtained by reflections of light from plain mirrors.

What is required? a plan mirror, a scale, a drawing paper, two candles, a stand, a thermocole

Figure 5.11

Figure 5.12

What to do?

•   Place a thermocole sheet on the table.

•   Put the drawing paper on it and draw a line segment AB on it.

•   Place a plain mirror on line segment AB vertically.

•   Place a candle at a distance 10 cm, away from plain mirror (candle should have similar or smaller height than mirror) in front of polished surface of plain mirror

- Try to observe the reflection of candle in the plain mirror.

- Now. adjust a little longer candle behind the mirror in such a way that the positions of both, the candle adjusted behind the plain mirror and the image of the candle in the plain mirror should coincide.

- Make sure the colinearity of the candle and the image of the candle by observing the arrangement from different positions.

- Now, remove the mirror

- Measure the distance of the position of candle placed behind the mirror from line segment AB.

- Place the candle in front of plain mirror at different distance and repeat the activity and note your observations in the following table.

Trial number	Distance of candle in front of mirror	Distance of candle at rear side of mirror	Is the size of the candle placed in front of mirror and its image observed is same or different?
1	10 cm		
2			
3			

We know that, the image that can not be obtained(received) on the screen is known as virtual image.

What is required : a plain mirror

What to do?

- Answer the following question after observing your image in plain mirror.

- When you lift your right hand, which hand is raised in your image in the mirror.

- Which hand would / you need to raise to observe right hand raised in your image?

- If you hold the right ear, which ear would you observe hold in your image?

- Write the letters ABC on a paper and observe the image in the plain mirror.

- How do letters appear to you? Draw its figure in the following box

- Observe the images formed by placing letters A to Z in front of plain mirror.

- Which letters appear same, even in images? List them

- Write the characteristics of images formed by plain mirror based on the observations from above activities.

What is required? Two plain mirrors, a stand, a small things like eraser and sharpeners

What to do?

- Place two mirrors perpendicular to each other on stands as shown in fig. Place eraser or sharpner between mirror and observe the images in the mirrors
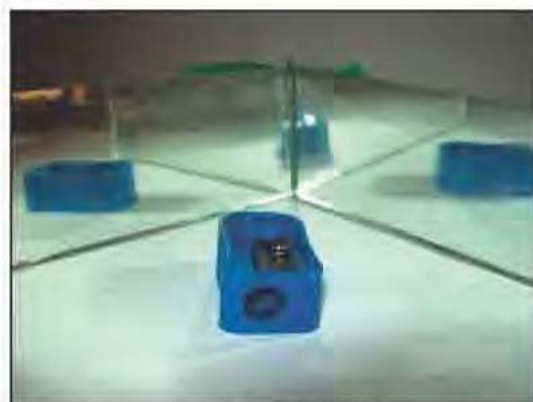

Figure 5.13

- How many images of objects (Eraser or sharpener) are seen?

- Now, change the angles between the two mirrors by 30^0, 45^0 and 120^0 and repeat the activity and note your observations in the table.

No of Trial	Angle between two mirrors	Total number of images observed
1	30^0	
2	45^0	
3	120^0	

Does the number of images observed in the plain mirrors increase or decrease with increase in the angle between the plain mirrors?

Why do we get more than one image of an object placed between, two mirrors?

What degree angle is to be adjusted between the mirrors to get 5 images of an object placed between them?

From above activity, we can derive the following formula to find the number of images.

$$\text{No. of images} = \frac{360^0}{(\text{Angle between two mirrors})} - 1$$

Solve the following examples using the formula :

- Calculate the number of images formed by placing an object – between two plane mirrors when the angle between by the plain mirrors is 40^0.

What should be the angle between by two plain mirrors to get 9 images of an object kept between the two plane mirrors?

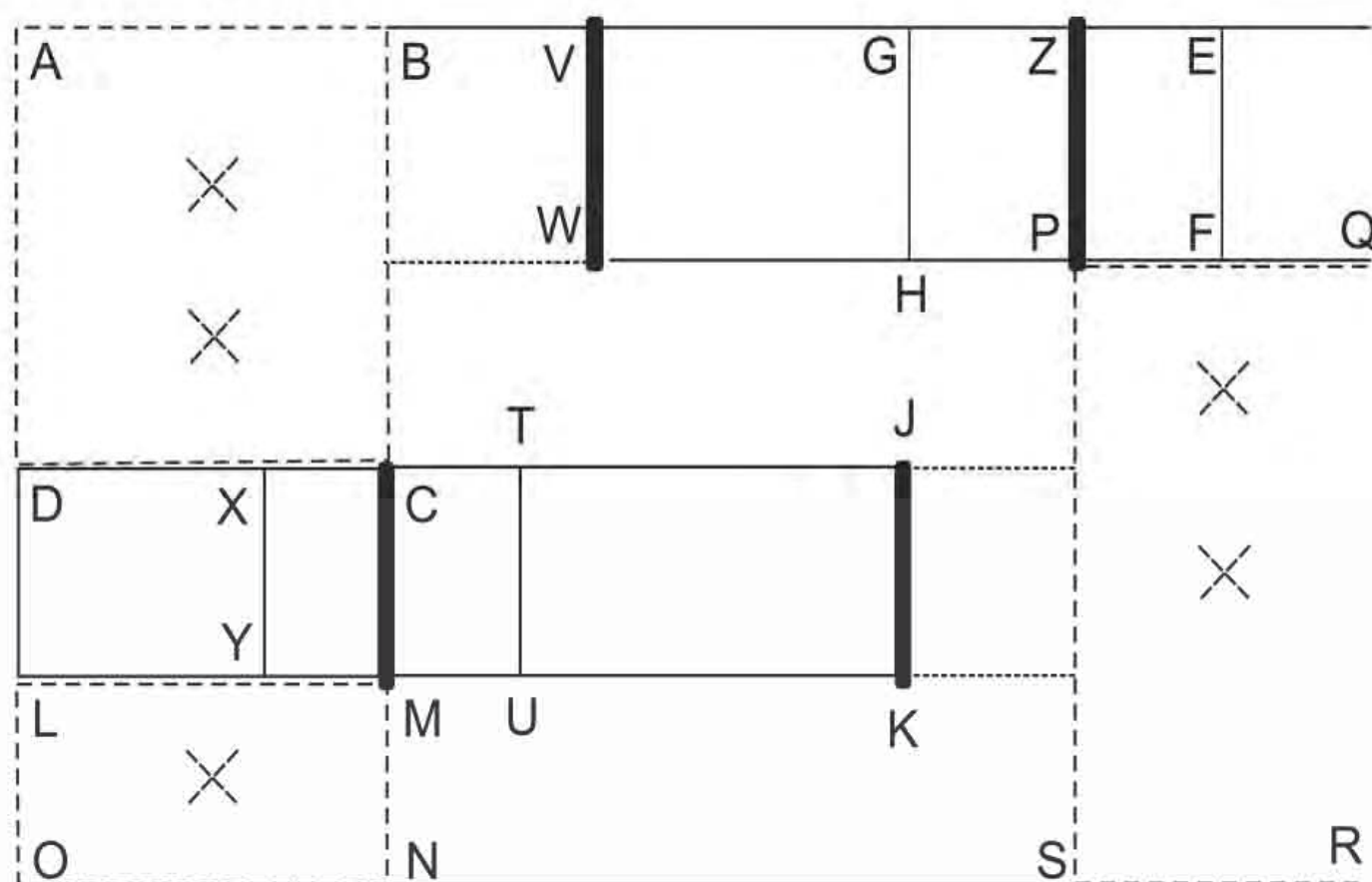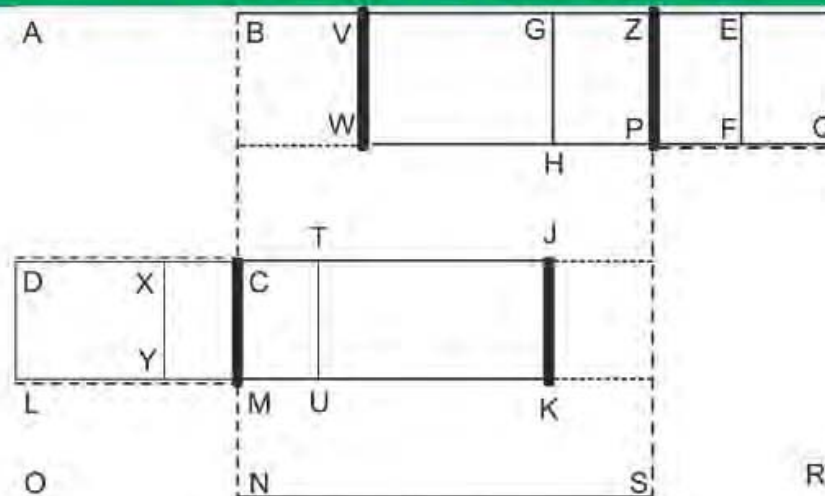**Let us prepare an apparatus which is working on the basis of the principle of reflection of light..**

Figure 5.14

What is required? Hard board, two plain mirrors, gum, a cutter, a cissors, a scale, a pencil etc.

What to do?

• Draw the figure on a hard board as shown in fig. 5.14.

• Cut and remove, rectangular pieces ABCD, LMNO, PQRS. We observe the following type of shapes as in fig. 5.15.

Figure 5.15

Put a soft cut on the hard board at W, J and K and fold the board at line segments $\overline{VW}$, $\overline{ZP}$, $\overline{CM}$, $\overline{JK}$, $\overline{PW}$, $\overline{CJ}$ and $\overline{MK}$ (Board should not get cut). Paste line segments $\overline{EF}$ and $\overline{XY}$ on the edges of plain mirror using adhesive tapes or gum, and paste line segments $\overline{GH}$ and $\overline{TU}$ at an angle 45^0 on the other edge as shown in fig. 5.17. We will get the structure as shown in fig. 5.17.

Paste the hard board pieces on the cut line parts. This type of apparatus is known as periscope.
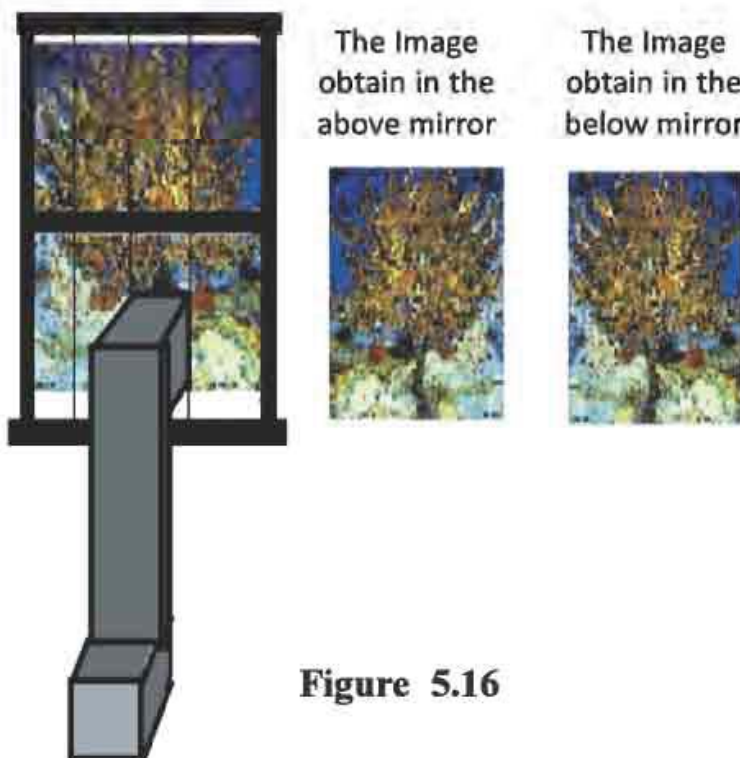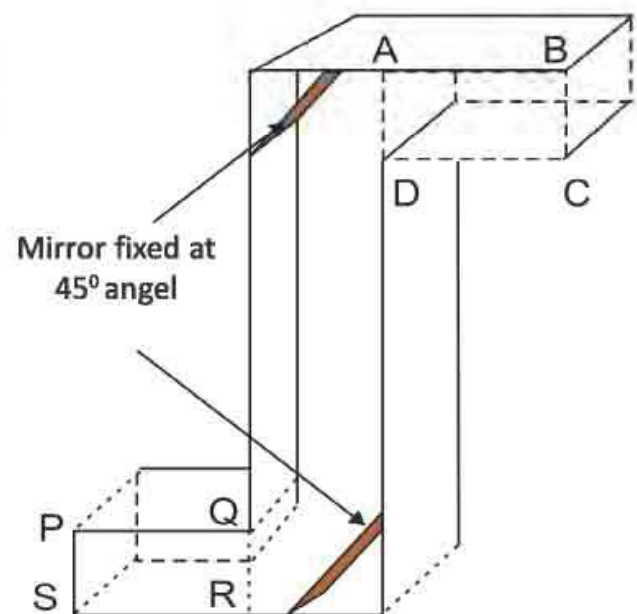

The Image obtain in the above mirror

The Image obtain in the below mirror

Figure 5.16

Mirror fixed at 45^0 angel

Figure 5.17

By adjusting periscope in different positions, as shown in figure observe the sceneries outside; by hiding yourself.

Figure 5.18   Figure 5.19

- Why is the object seen even when a board is in its from, when to be seen from the end of peristion?

_____

- What type of shape of periscope is required to observe, different parts of your body?

Figure 5.20

Figure 5.21   Figure 5.22   Figure 5.23

Submarines are used to travel in side sea water as the fishes do. Periscope is useful to observe the activities taking place on and above surface of sea level even keeping the submaries in deep waters. Similarly, the army requires such units (Periscopes) to observe activities of army keeping our army men hidden inside the bunkers.

Using characteristics of multiple images generated by plain mirrors, we can have a magical painter.

What is required? There are small plain mirrors of rectangular or square shape, card papers, gum, adhesive tapes, opaque plastic, small pieces of bangles, rubber bands, etc.
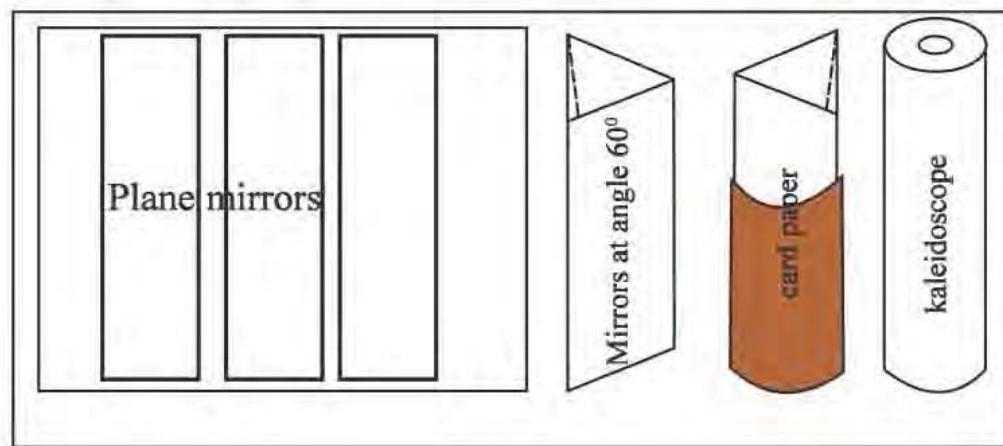
Figure 5.24

What to do?

- Paste three plain mirrors on a card paper keeping 2 to 3 mm distance. between them using gum [Polished surface must be kept at the upper end.] as shown in fig. 5.24.

- Keeping the angle of 60° among three mirrors, paste them with rubber bands or adhesive tapes.

- Cover the system now with card board or card paper and close one of the ends by pasting opaque semi transparent plastic.

- Put 5 to 6 pieces of bangles from the open end. Paste a card paper on the open end and close it.

- Make a small hole at the centre of this end of the card paper. Here is our magic painter, known as kaleidoscope, rotating this kaleidoscope slowly, observe the different design.

Why do we get such designs in kaleidoscope?

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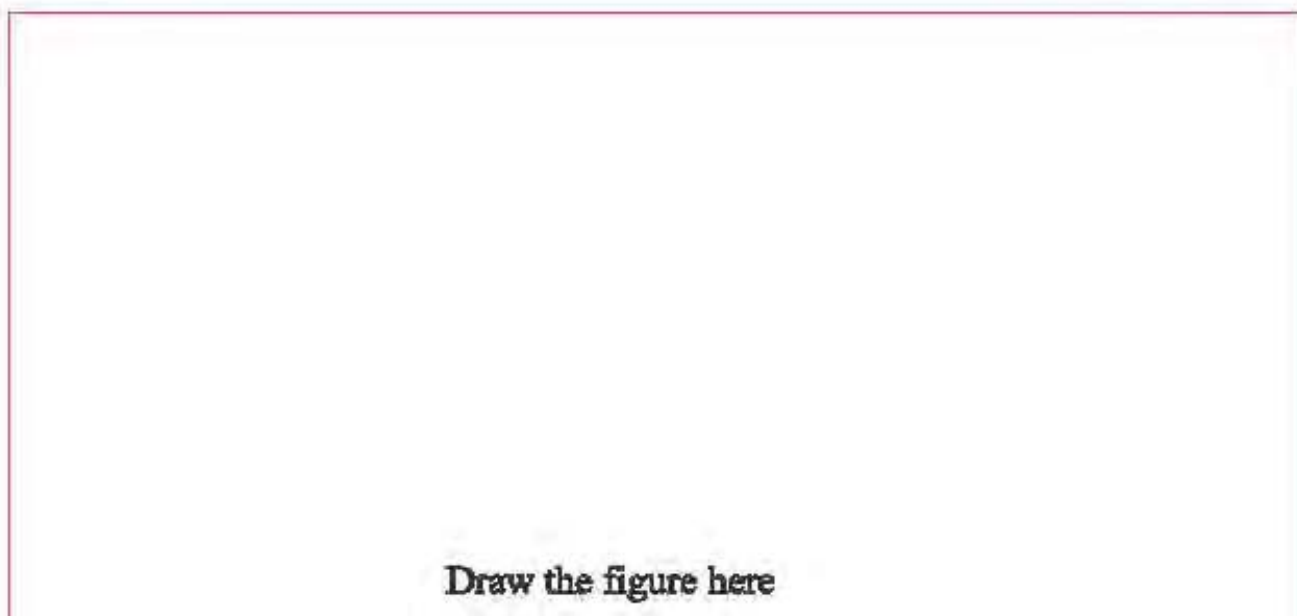**Q.1** The word AMBULANCE is printed as shown below on the abulance van, why?

ƎƆИАⱭUꓭMA

_____

Q.2 Place the plain mirrors on the side AB, in the fig.picture given below.

Q.3 Prepare a solar cooker with the help of your friends and teacher and describe the method of preparing it by listing the objects you are using for it.

Material :

_____

_____

_____

Draw the figure here

Method of preparation :

_____

_____

_____

_____

_____

_____