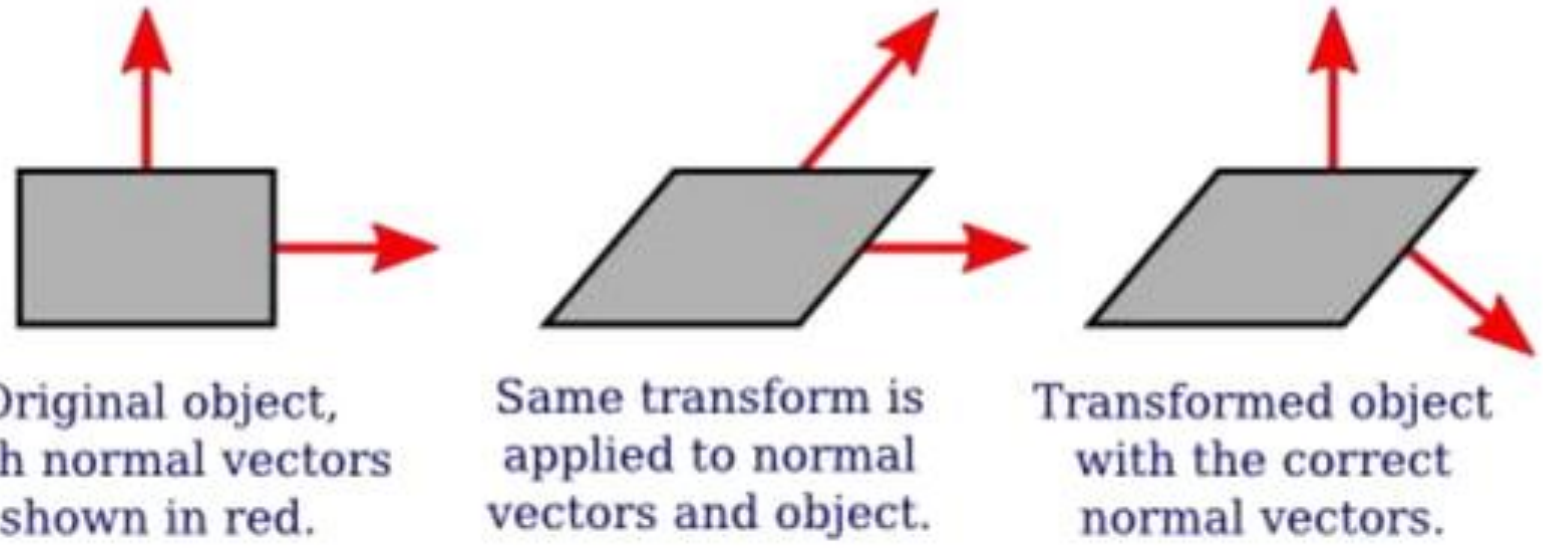
Geometric Transformation

Geometric transformations

- It can changes the orientation, size, and shape of the objects in the database as well as on the graphics image, as shown in figure below. This alter the coordinate descriptions of objects.



- **Use of Geometric Transformations :-**

The geometric transformations are used for the following purposes:

i. In a construction of a model;

ii. In editing the model using the commands like : translate, rotate, zoom, mirror, array, etc;

iii. For obtaining orthographic, isometric and prospective views of the model;

iv. To view the model from different positions; and

v. In animations.

Basic geometric transformations :

The basic geometric transformations used in modelling are:

1) **Translation**

2) **Rotation**

3) **Scaling**

4) **Reflection**

5) **Shear**

6) **Concatenated (Composite) Transformation**

Reflections :- These are like mirror images as seen across a line or a point.

Translations :- This moves the figure to a new location with no change to the looks of the figure.

Rotations :- This turns the figure clockwise or counter-clockwise but doesn't change the figure.

TRANSLATION

A **translation** is a transformation that slides a figure across a plane or through space.

With translation all points of a figure move the same distance and the same direction.

Translations

If a figure is simply moved to another location without change to its shape or direction, it is called a translation (or slide).

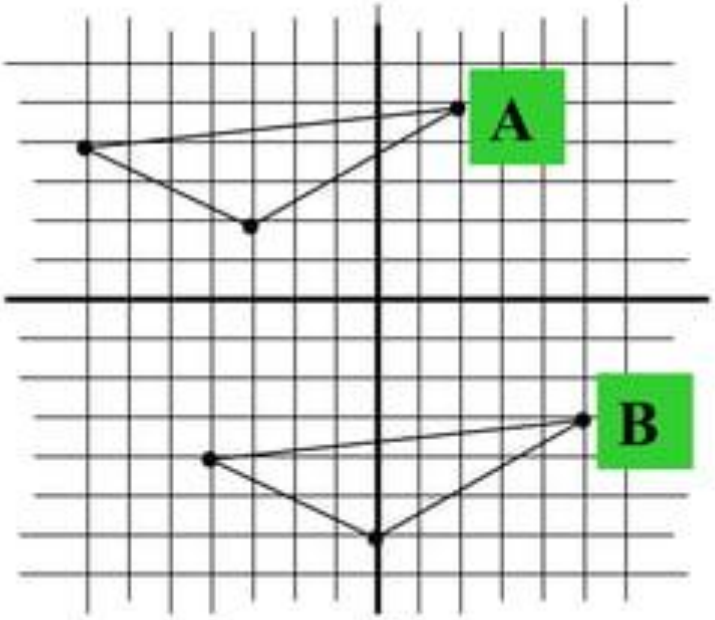
If a point is moved "a" units to the **right** and "b" units **up**, then the translated point will be at **(x + a, y + b).**

If a point is moved "a" units to the **left** and "b" units **down**, then the translated point will be at **(x - a, y - b).**

Example:

Image A translates to image B by moving to the right 3 units and down 8 units.

A (2, 5) → B (2+3, 5-8) → **B (5, -3)**



ROTATION

A **rotation** is a transformation that *turns* a figure about (around) a point or a line.

Basically, rotation means to spin a shape.

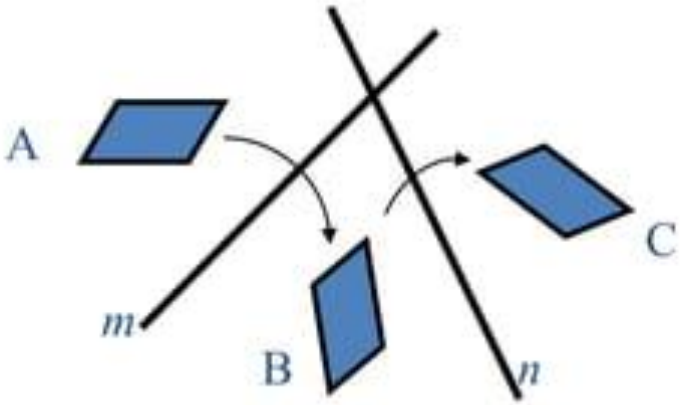
The point a figure turns around is called the **center of rotation**.

The center of rotation can be on or outside the shape.

Rotations

- An image can be rotated about a fixed point.
- The blades of a fan rotate about a fixed point.
- An image can be rotated over two intersecting lines by using composite reflections.

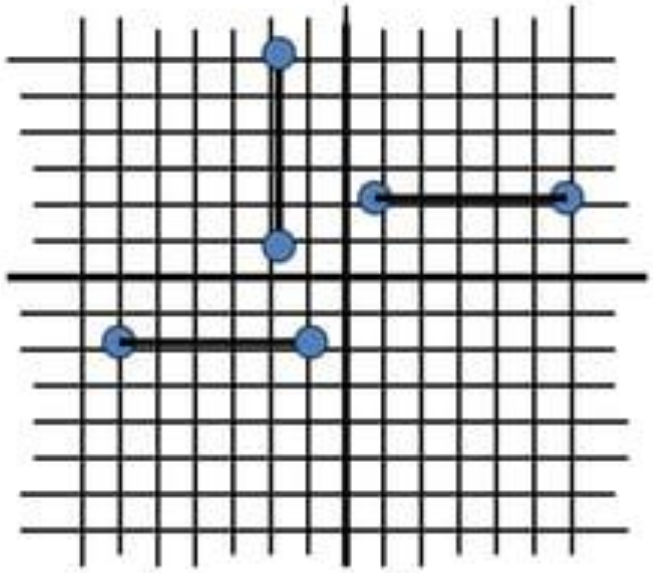
  Image A reflects over line *m* to B, image B reflects over line *n* to C. Image C is a rotation of image A.



Example :- (1,2)→ (-2,1) & (6,2) → (-2, 6)

When a figure is rotated **180°** about the origin, multiply both coordinates by -1. **(x, y)→ (-x, -y)**

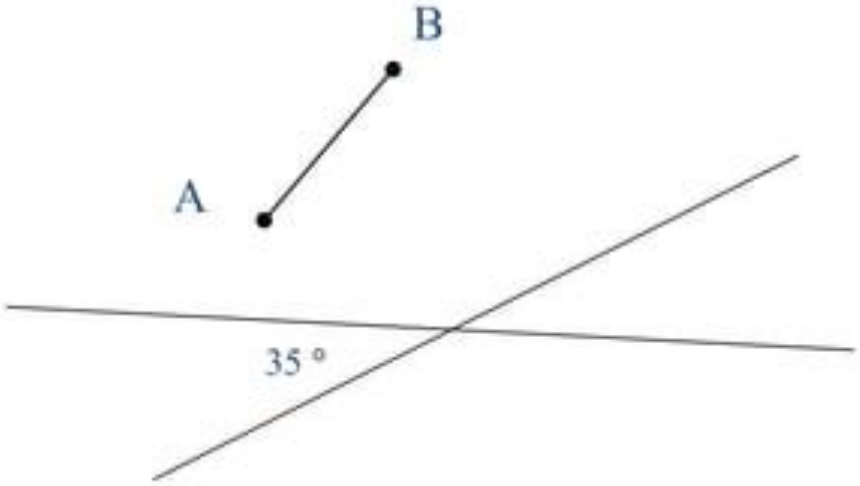
Ex: (1,2)→ (-1,-2) & (6,2) → (-6, -2)



Angles of rotation

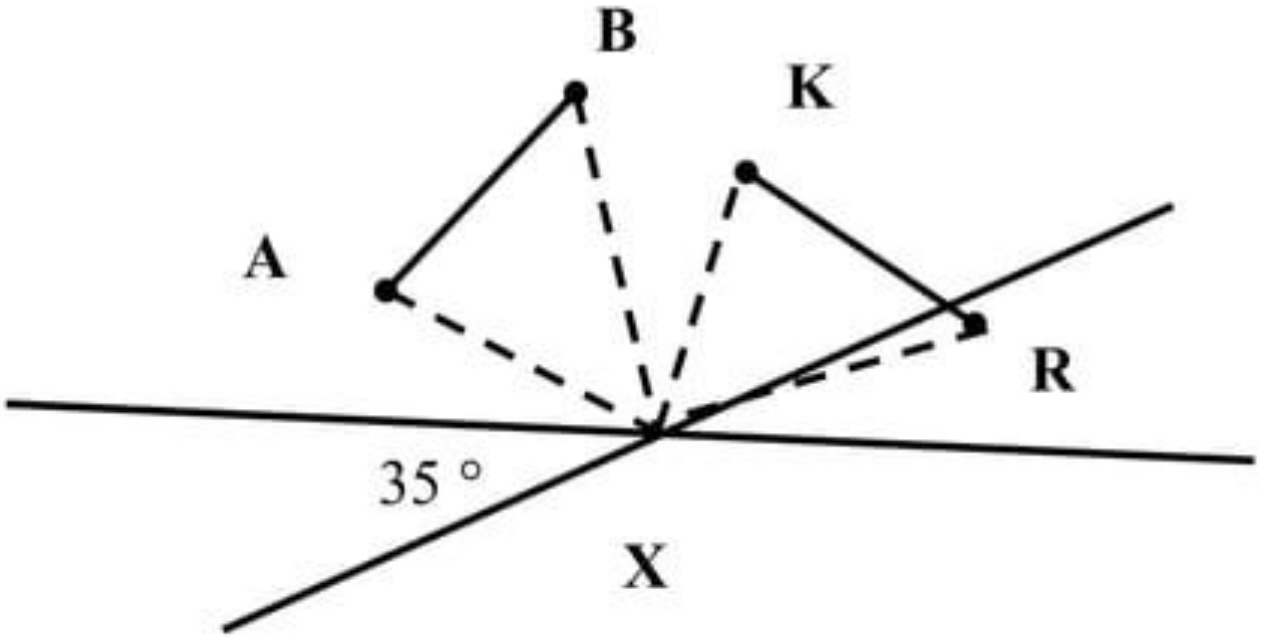
In a given rotation, where A is the figure and B is the resulting figure after rotation, and X is the center of the rotation, the measure of the angle of rotation $\angle AXB$ is twice the measure of the angle formed by the intersecting lines of reflection.

Example: Given segment AB to be rotated over lines *l* and *m*, which intersect to form a 35° angle. Find the rotation image segment KR.



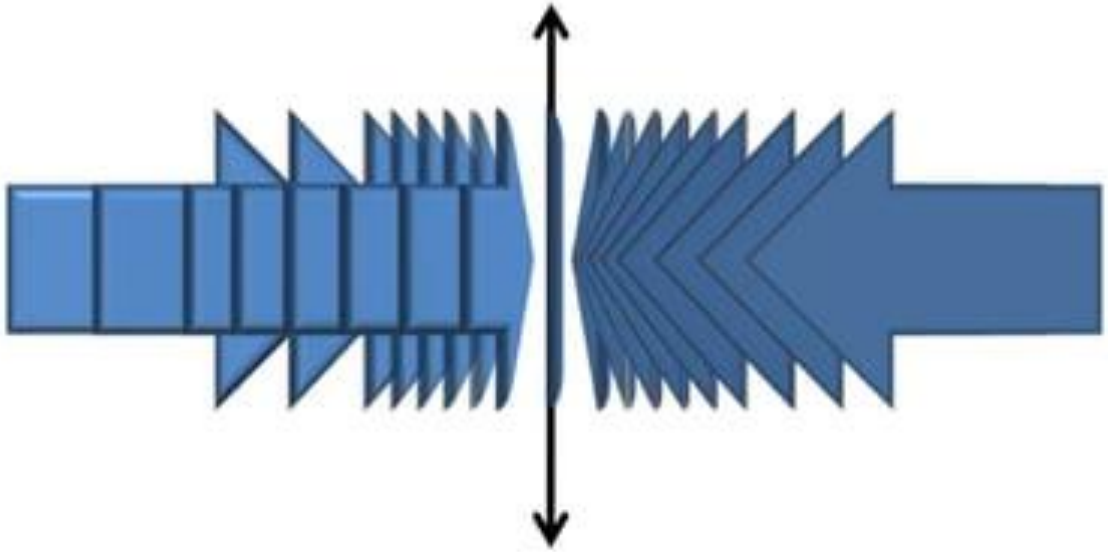
Since the angle formed by the lines is 35°, the angle of rotation is 70°.

1. Draw ∠AXK so that its measure is 70° and AX = XK.
2. Draw ∠BXR to measure 70° and BX = XR.
3. Connect K to R to form the rotation image of segment AB.



REFLECTION

A **reflection** is a transformation that flips a figure across a line.



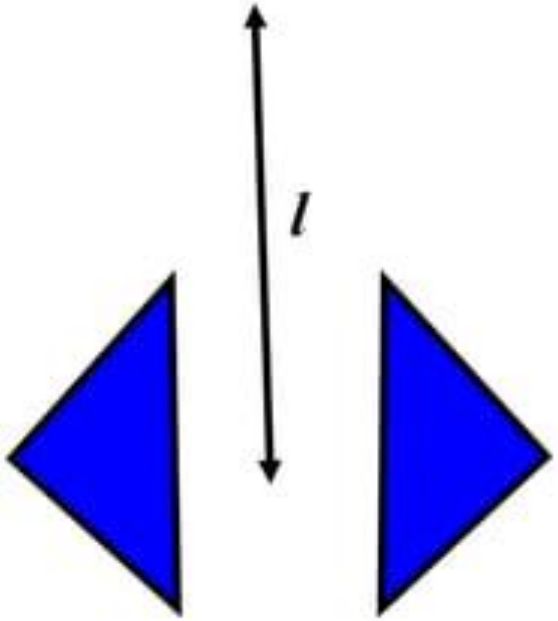
A REFLECTION IS FLIPPED OVER A LINE.

Reflections

You can reflect a figure using a line or a point. All measures (lines and angles) are preserved but in a mirror image.

Example: The figure is reflected across line l .

You could fold the picture along line l and the left figure would coincide with the corresponding parts of right figure.



Reflection across the x-axis: the x values stay the same and the y values change sign. **(x , y) → (x, -y)**

Reflection across the y-axis: the y values stay the same and the x values change sign. **(x , y) → (-x, y)**

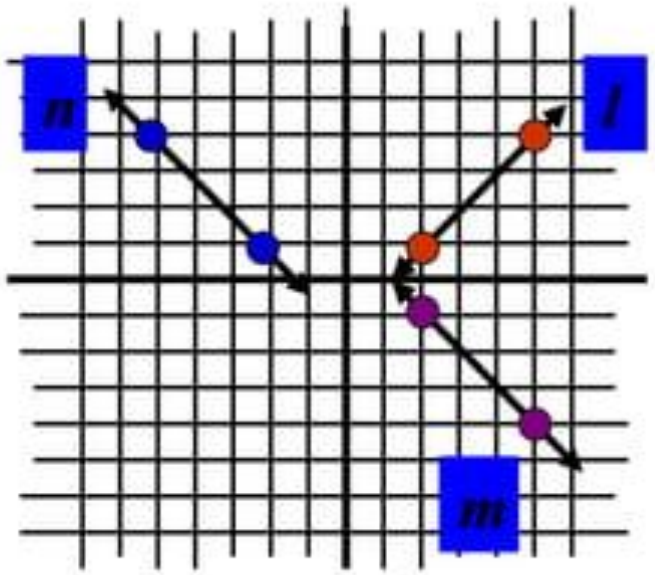
Example: In this figure, line *l* :

- reflects across the y axis to line *n*

  (2, 1) → (-2, 1) & (5, 4) → (-5, 4)

- reflects across the x axis to line *m*.

  (2, 1) → (2, -1) & (5, 4) → (5, -4)

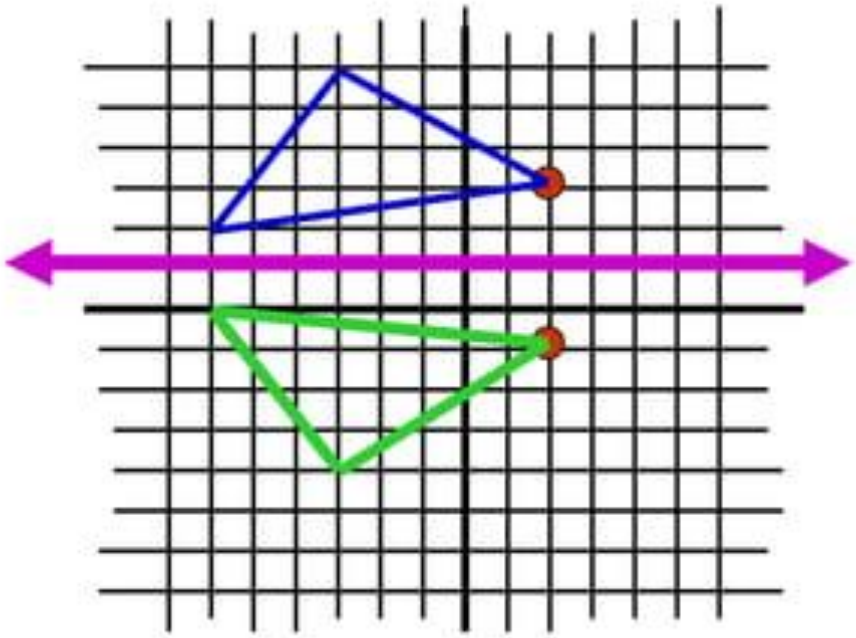


Example: Reflect the fig. across the line y = 1.

(2, 3) → (2, -1).

(-3, 6) → (-3, -4)

(-6, 2) → (-6, 0)




Thank
you