**Affine Transformations Continued…**

**2-Stretching**

A transformation defined by,

Is said to be stretching along x-axis by factor k if

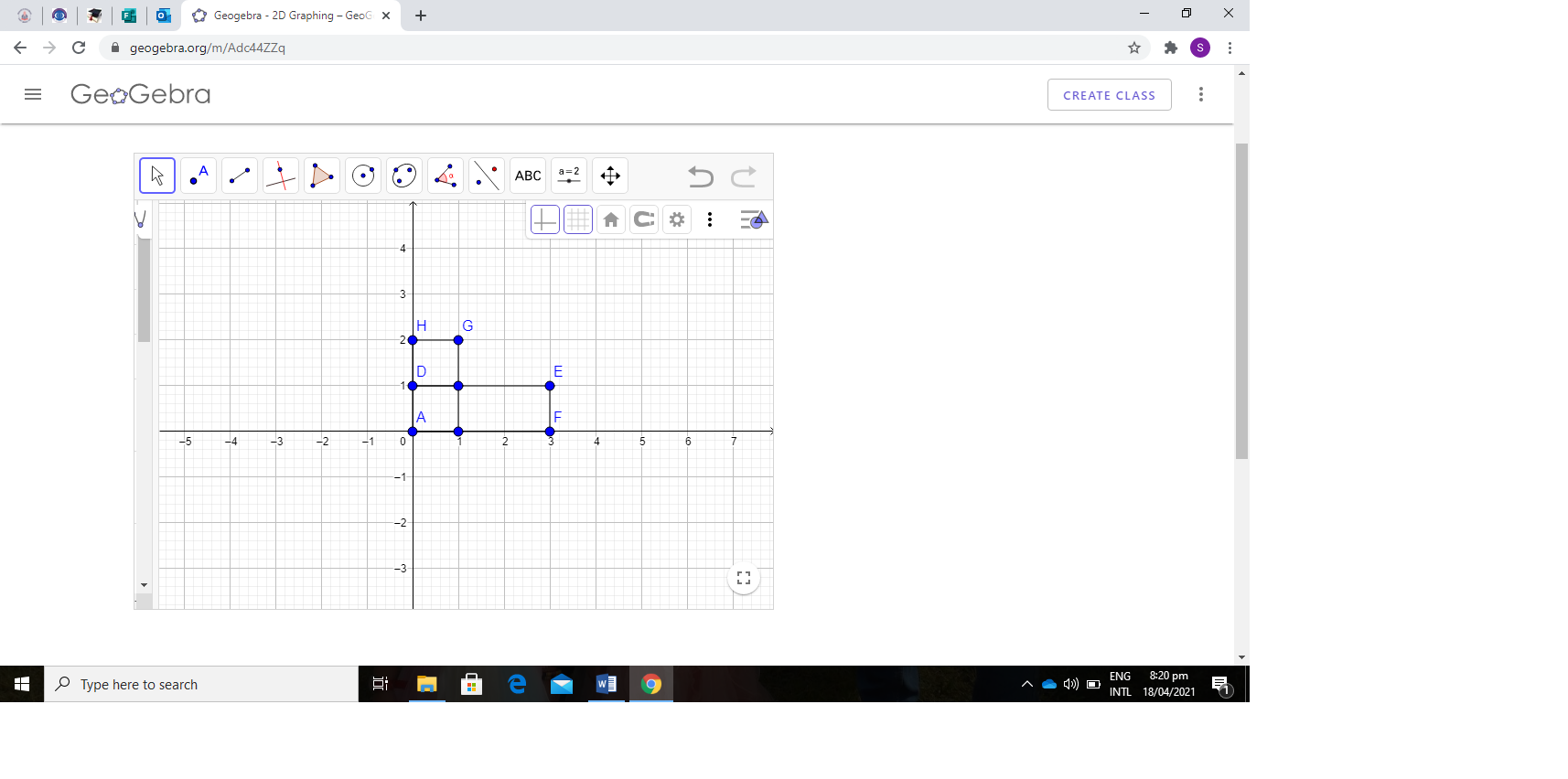
And along y-axis by a factor k if

**Example 1: (Stretching of a square)**

Find the image of a square with vertices , when it is stretched along

1. X-axis with factor 3.
2. Y-axis with factor 2.

**Solution: (along x-axis)** As



**Along y-axis**

As

**Example 2: (Stretching of triangle)**

Find the image of a triangle with vertices , when it is stretched along

1. X-axis with factor .
2. Y-axis with factor .

**Solution: (along x-axis)** As

**Along y-axis:** As

**Example 3: (Stretching of Circle)**

Let be a circle. Find its equation and image under stretching along x-axis by factor 2.

**Solution:** As

Put value of and in original equation of circle and get

It represents the ellipse.

**Practice Problems**

Q1. Let be a circle. Find its equation and image under stretching along Y-axis by factor .

Q2. Find the stretching of an ellipse along x-axis by factor 2.

Q3. Find the image of a triangle with vertices , when it is stretched along

1. X-axis with factor 3
2. Y-axis with factor .

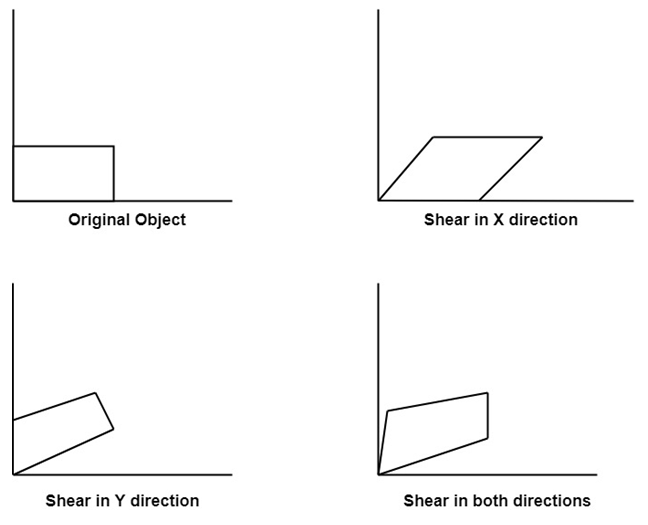
**3- Shearing**

Shearing of a point along x-axis by factor k can be defined as:

The movement of point parallel to x-axis keeping the distance of the point from the x-axis. i.e. the movement of point parallel to x-axis depending upon the y-component of the point.

* Shearing at a point along x-axis by factor k in the matrix form can be represented as

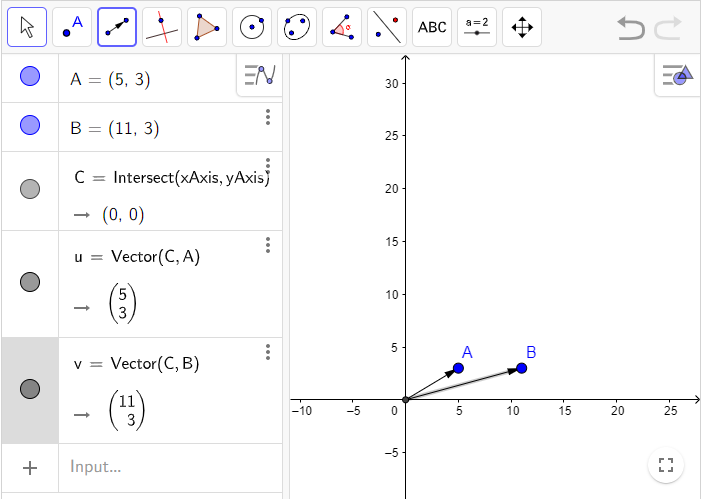
Where



**Example 1: (Shearing of vector)**

Shear a point along x-axis by the factor 2.

**Solution:** As



**Note:**

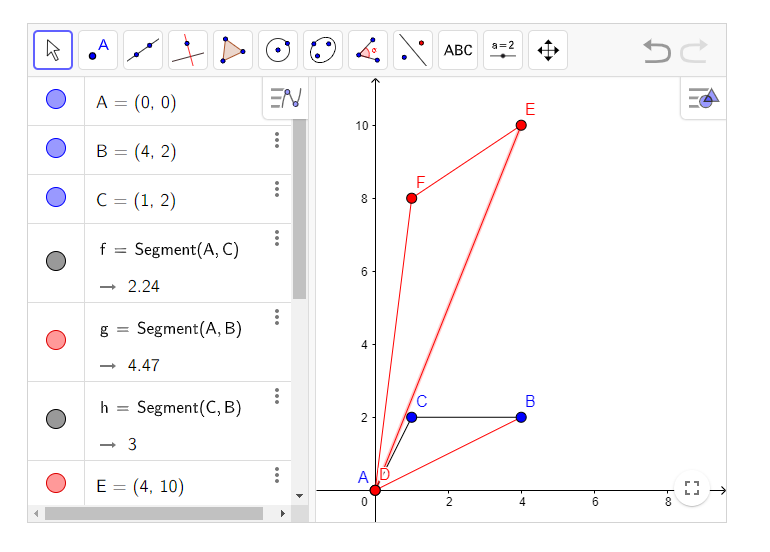
1. A transformation that slants the shape of an object is called the shear transformation.
2. Shearing of an object along y-axis by factor k in matrix form can be expressed as:

Where

**Example 2: (Shearing of Triangle)**

A triangle with vertices . Find the image of triangle when it will be shear along y axis by factor 2.

**Solution:** As



**Example 3: (Shearing of Rectangle)**

Consider the rectangle with vertices . Shear this rectangle along x-axis by factor 2.

**Example 4: (Shearing of Rectangle)**

Consider the rectangle with vertices . Shear this rectangle along y-axis by factor -3.

**Example 5:**

In each part describe the matrix operator corresponding to A and show it effect on unit square

**Example 6:** Let be a circle. Find its equation and image under the effect of shear parallel to x-axis by factor -2.

**Solution:** As

Put value of and in original equation of circle:

equation of circle:

For plotting we can neglect the dash (‘) from our sheared equation of circle.

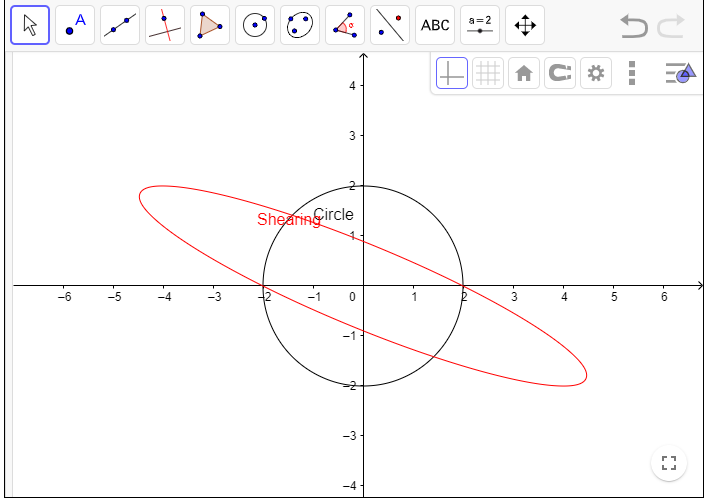
**General equation of Conics:**

On Comparing, we get:

So we get ellipse.

**Remarks: General equation of Conics:**

1. If
2. If
3. If



**Example 6:** Let be a circle. Find its equation and image under the effect of shear parallel to y-axis by factor .

**Solution:**As

Put value of and in original equation of circle:

On Comparing with General equation of Conics, we get:

So we get ellipse.

**Work to do:**

**Q1.**  Let be a circle. Find its equation and image under the effect of shear parallel to x-axis by factor .

**Q2**. Find the vertices of unit square after shearing it along y-axis by a factor 2 and then translating the sheared square by the vector (2, 1).