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I st Mid-term
B Tech : III Year, V Semester
Computer Graphics & Multimedia. (5CS4-04).

Ans (1) Cathode Ray Tube (CRT). :-

Definition :- Cathode Ray tube, CRT is the heart of CRO which generates images when electron beam from the back of the tube strikes the fluorescent screen with sufficient energy.

CRT technique was basically employed in conventional TV and computer screens.

* Construction details of Cathode Ray Tube :-

CRT consist of the following parts:

1). Electron gun.
2). Deflection plate assembly.
3). Glass envelope
4). Fluorescent screen
5). Base, for connections.

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The diagram given below shows the internal structure of CRT.

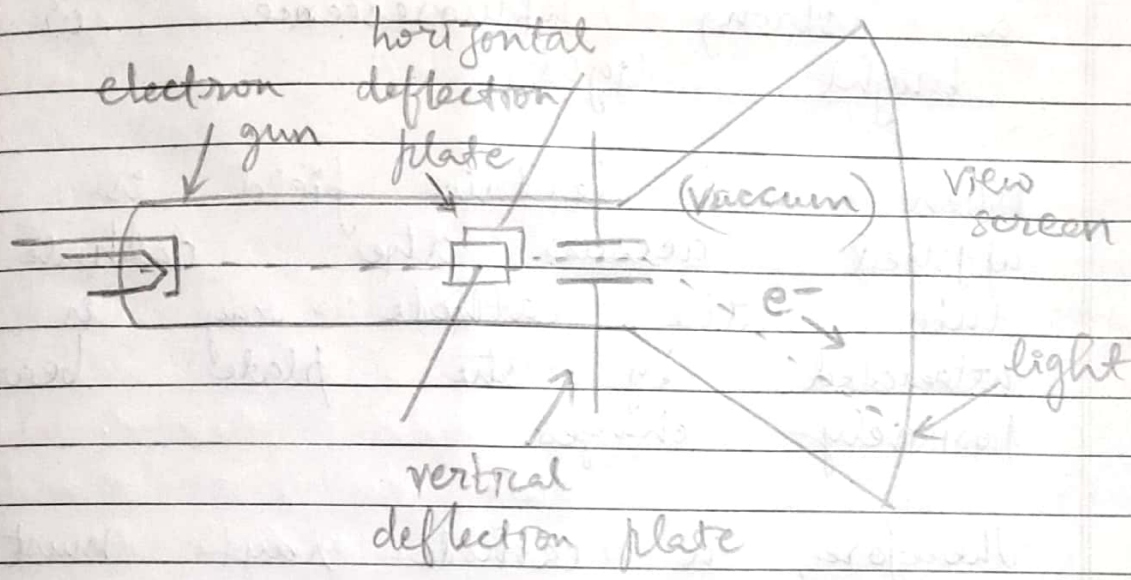


Fig. (Cathode Ray Tube)

* Working Principle of CRT :-

When the two metal plates are connected to a high voltage source, the negatively charged plate called the cathode ray emits an invisible ray. The cathode ray is drawn to the positively charged plate, called anode, where it passes through a hole and ~~contains~~ continuous travelling to the other end of the tube.

When the ray strikes the specially coated surface, the cathode ray produce a strong fluorescence or bright light.

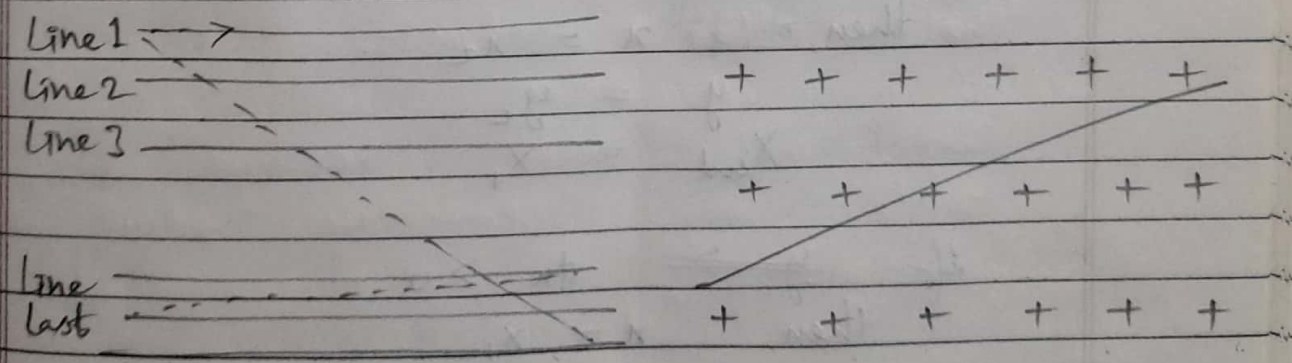
When an electric field is applied accross the cathode ray tube, the cathode ray is attracted by the plate bearing positively charges.

Therefore, a cathode ray must consist of negatively charged particle.

Ans (2)

	(Random Scan)	(Raster Scan)
(i)	The resolution of random scan is higher than raster scan.	While the resolution of raster scan is lesser or lower than random scan.
(ii)	It is costlier than raster scan.	While the cost of raster scan is lesser than random scan.

(iii) In random scan, any alternate is easy in comparison of raster scan.	While in raster scan, any alteration is not so easy.
(iv) In random scan, mathematical function is used for image or picture rendering.	While in which, for image or picture rendering, raster scan uses pixels.
(v) In random scan, interweaving is not used.	While in raster scan, interweaving is used.
(vi) It is suitable for applications requiring polygon drawing.	It is suitable for creating realistic scenes.



(Raster Scan)

(Random Scan)

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Ans ③ Brasenham's line Algorithm :-

Step 1 → Start

Step 2 → Declare varrable $x_1, x_2, y_1, y_2, i_1, i_2, dx, dy$.

Step 3 → Enter value of
$x_1, y_1 = 30, 20$
$x_2, y_2 = 40, 20$.

step. 4 → Calculate $dx = x_2 - x_1$
Calculate $i_1 = 2 * dy$
Calculate $i_2 = 2 * (dy - dx)$
Calculate $d = i_1 - d_x$

Step 5 → Consider (x, y) as starting & ending max. possible value of x.

if $dx < 0$,
then, $x = x_2$
$y = y_2$
$X_{end} = X_1$

if $dx > 0$
then, $x = x_1$
$y = y_1$
end $= x_2$.

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step (6) → Generate points at (x,y) coord.

step (7) → Check if whose the generated
if $x >= x_{end}$
stop.

step 8 → Calculate co-ordinate of the next pixel.
if $d < 0$
then, $d = d_1 + i_1$
if $d \geq 0$
then, $d = d_2 + i_2$
increase $y = y + 1$

step (9) :- Increment $x = x + 1$.

step (10) :- Draw a point of latest (x,y) coordinates.

step (11) :- Go to step (7)

step (12) :- End the algorithm.

Soln :- $x_1 = 30, \quad y_1 = 20$
$x_2 = 40, \quad y_2 = 28.$

$d_x = x_2 - x_1 = 10$
$d_y = y_2 - y_1 = 8.$
$i_1 = 2 * \Delta y = 2 \times 8 = 16$
$i_2 = 2 * (\Delta y - \Delta x) = -4.$
$d = i_1 - \Delta x = 16 - 10 = 6.$

Ans

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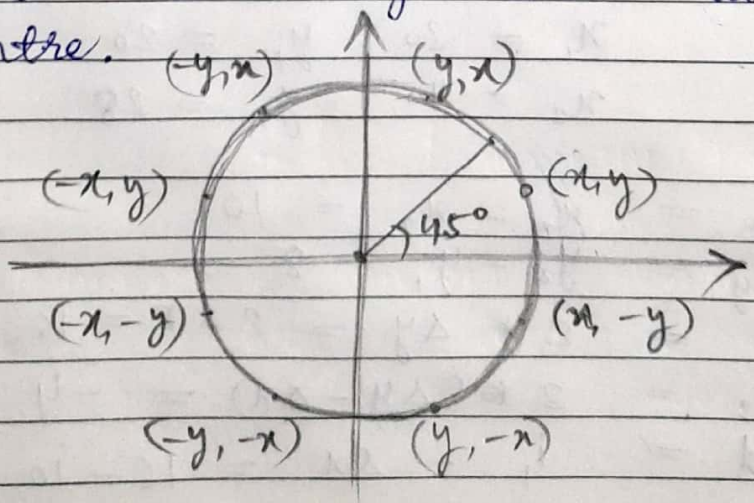
Ans. 4 Mid-point Circle Algorithm :-

It is based on the following function for testing the special relationship between the arbitrary point (x, y) and circle of radius r centred at the origin.

The mid-term point drawing algorithm is an algorithm used to determine the points needed for rasterizing a circle.

We use the mid-~~term~~ point algorithm to calculate all ~~gene~~ perimeter points of the circle in the first octant and then print them along with their mirror points in the other octants.

This will work because a circle is symmetric about its centre.



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The algorithm is very similar to the Mid-Point line Generated Algorithm. Here, only the boundary condition is different.

For any given pixel (x, y), the next pixel to be plotted is either $(x, y+1)$ or $(x-1, y+1)$. This can be decided by following the steps below.

(a) Find the mid-point p of the two possible pixels, i.e., $(x-0.5, y+1)$

(b) If p lies inside or on the circle perimeter, we plot the pixel $(x, y+1)$, otherwise if it is outside we plot the pixel $(x-1, y+1)$.

* Boundary Condition :- Whether the mid-point lies outside or ~~out~~ inside the circle can be decided by using the formula :-

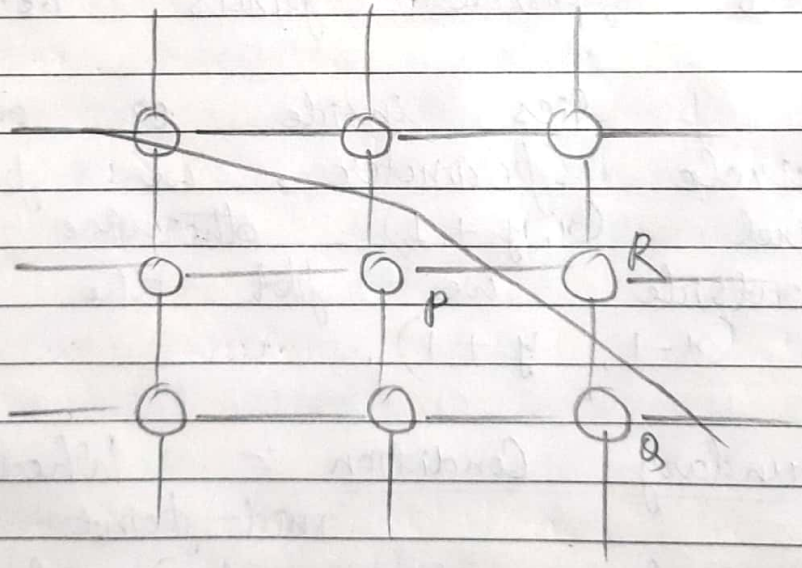
Given a circle centered at (0,0) and radius r and a point p(x,y).

$$F(p) = x^2 + y^2 - r^2.$$

if, $F(p) < 0$, the point is inside the circle.

if, $F(p) = 0$, the point is on the permeter.

if $F(p) > 0$, the point is outside the circle.



Ans:5

(2D Transformation)

Transformation means changing some graphics into something else by apping rules.

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We can have various types of transformations such as translation, scaling up or ~~dro~~ down, rotation, shearing, etc.

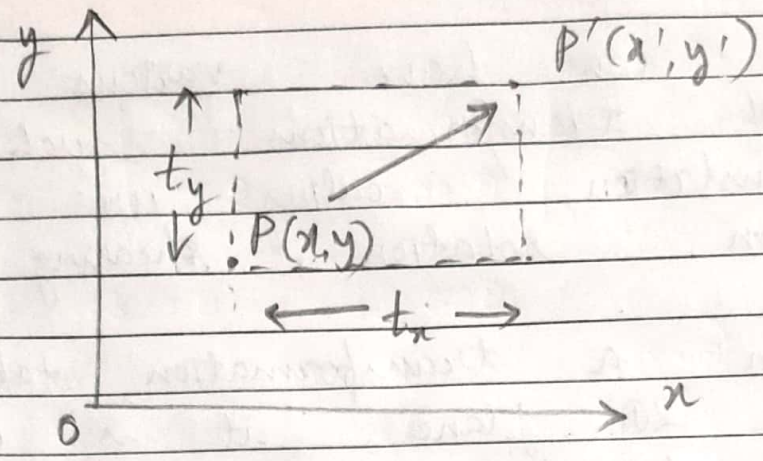
When a transformation takes place on 2D plane, it is called 2D transformation.

* **Homogeneous Coordinates:-**

To perform a sequence of transformation such as translation followed by rotation and scaling, we need to follow a sequence process -

- Translate the coordinates,
- Rotate the translated coordinate and then,
- Scale the rotated coordinate to complete the composite transformation.

* **Translation:-** A translated moves an object to different position on the screen, that is every point on the object is translated by same amount.



From the given figure, you can write that,

$$X' = X + t_x$$
$$Y' = Y + t_y$$

The pair (t_x, t_y) is called translation vector or shift vector.

$$P = \begin{bmatrix} X \\ Y \end{bmatrix}, \quad P' = \begin{bmatrix} X' \\ Y' \end{bmatrix}, \quad T = \begin{bmatrix} t_x \\ t_y \end{bmatrix}$$

We can write as, $\boxed{P' = P + T}$.

* **Rotation :-** In rotation, we rotate the object at particular angle θ (theta) from the origin.

Lets suppose you want to rotate it at the angle θ.

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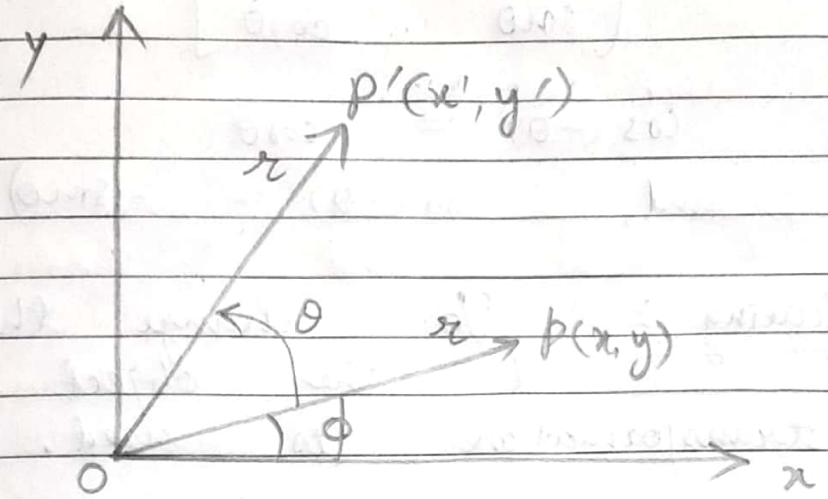
After rotation, new point $P'(X', Y')$.



Using standard trigonometric the original coordinate point $P(X, Y)$, can be represented as,

$$X = r\cos\phi$$
$$Y = r\sin\phi.$$

Same way, for $P'(X', Y')$,

$$x' = r\cos(\phi + \theta) = r\cos\phi\cos\theta - r\sin\phi\sin\theta$$
$$y' = r\sin(\phi + \theta) = r\cos\phi\sin\theta + r\sin\phi\cos\theta.$$

Substitution, $\begin{cases} x' = x\cos\theta - y\sin\theta \\ y' = x\sin\theta + y\cos\theta \end{cases}$

$$[X'\ Y'] = [XY]\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}. \text{ or,}$$

$$\boxed{P' = P.R}$$

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where, R is rotation index,

$$R = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$

(∵ $\cos(-\theta) = \cos\theta$
and, $\sin(-\theta) = -\sin\theta$)

* **Scaling** :- To change the size of the object, scaling transformation is used.

In scaling, you either expand or compress the dimensions of the object.

Scaling can be achieved by multiplying the original coordinates with the scaling factors.

Let us assume that the original coordinates : (X, Y),

Scaling factor : (S_x, S_y).

and,
produced coordinates : (X', Y').

This can be mathematically represented as,

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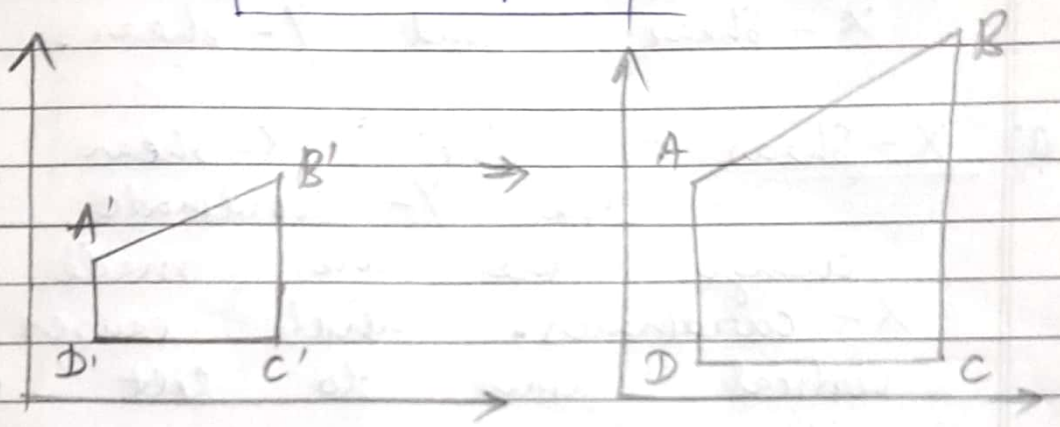
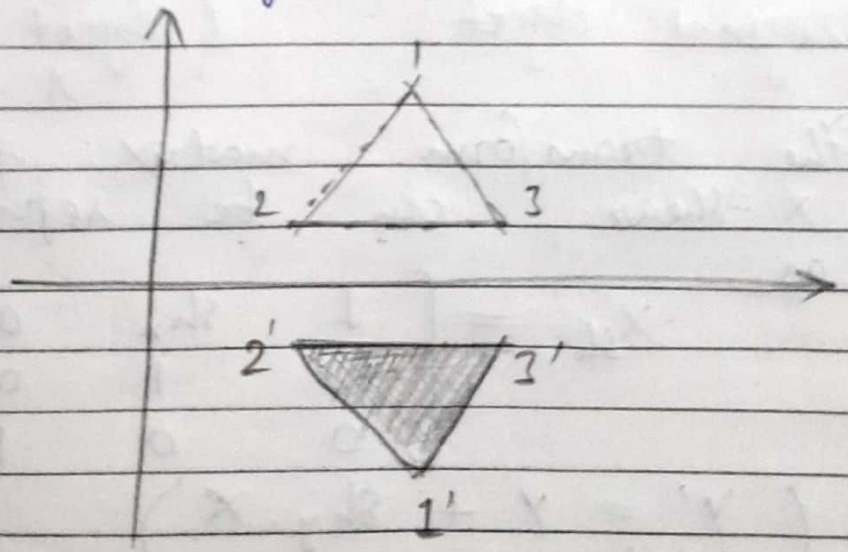
$(X' = X.S_x)$, $(Y' = Y.S_y)$.

$$\begin{pmatrix} X' \\ Y' \end{pmatrix} = \begin{pmatrix} X \\ Y \end{pmatrix} \begin{bmatrix} S_x & 0 \\ 0 & S_y \end{bmatrix}$$

or, $\boxed{P' = P.S.}$



* Reflection : Reflection is the mirror image of original object. It is rotation operation with 180°. In reflection, the size of the object does not changes.



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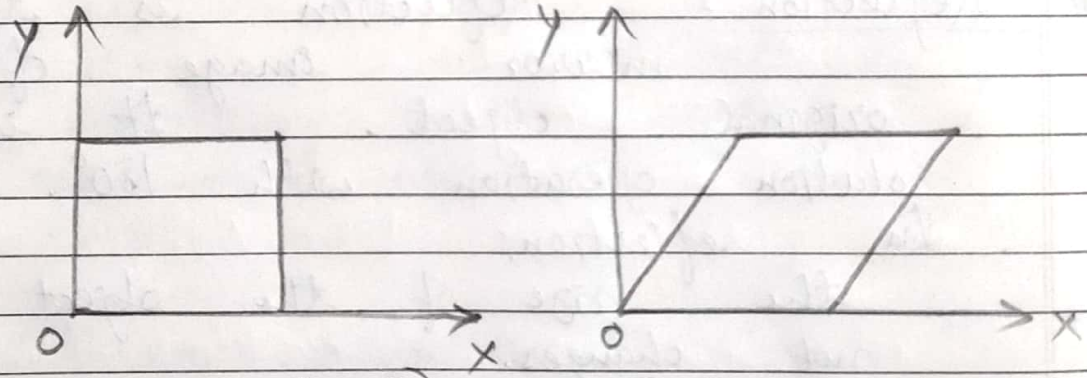
* **Shear :-** A transformation that slants the shape of an object is called the shear transformation.

There are two shear transformation X - Shear and Y - shear.

a) **X - Shear :-** The X - shear preserves the Y - coordinate and changes ~~the~~ are made to X - coordinates, which causes the vertical lines to tilt or left as shown.



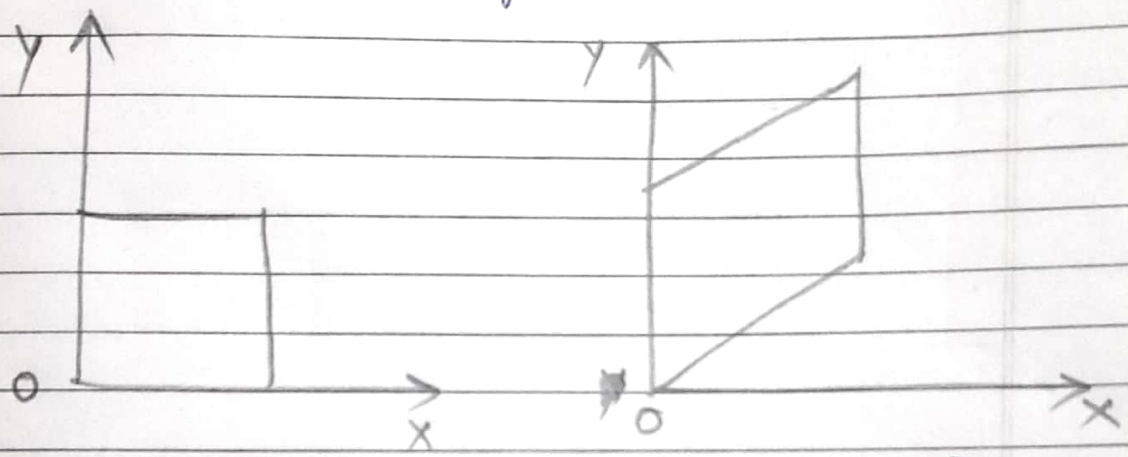
(Original object) (Object after X - shear)

The transform matrix for X - shear can be represented as,

$$X_{sh} = \begin{bmatrix} 1 & Sh_x & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$\begin{pmatrix} Y' = Y + Sh_y . X \\ X' = X . \end{pmatrix}$$

(b) Y-shear :- The Y-shears preserves the X-coordinate and change the Y-coordinate, which cause the horizontal lines to transform into lines which slopes up or down.



(original object) (object after Y-shear)

The Y-shear can be represented in matrix form as,

$$Y_{sh} = \begin{bmatrix} 1 & 0 & 0 \\ sh_y & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Ans

$$\begin{pmatrix} X' = X + sh_y \cdot Y \\ Y' = Y \end{pmatrix}$$
