Tender Heart High School, Sector 33B, Chd.

Class 10, Mathematics

Ms. Reena

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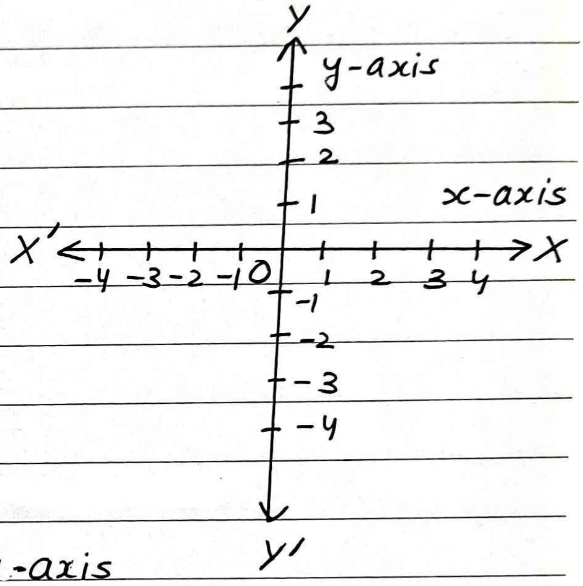
Reflection

Introduction :- Co-ordinate geometry is the branch of geometry in which two numbers, called co-ordinates, are used to locate the position of a point in a plane.



Co-ordinate Axes :-

The two mutually perpendicular number lines intersecting each other at their zeros, are called rectangular axes or co-ordinate axes or axes of reference.

XOX' $\longrightarrow$ x-axis YOY' $\longrightarrow$ y-axis

O is called origin

→ Consider a Point $P(x, y)$

Here, x is called abscissa or x-co-ordinate

y is called ordinate or y-co-ordinate

and $P(x, y)$ is called co-ordinates

Example :- Let us consider a co-ordinates $A(-2, 5)$

Here, -2 is abscissa

5 is ordinate

Important Note :-

1) In stating the co-ordinates of a point the abscissa precedes the ordinate. The two co-ordinates are separated by a comma and are enclosed in a bracket.
2) Co-ordinates of origin $O = (0, 0)$
3) Co-ordinates of a point on the x-axis $= (x, 0)$
4) Co-ordinates of a point on the y-axis $= (0, y)$

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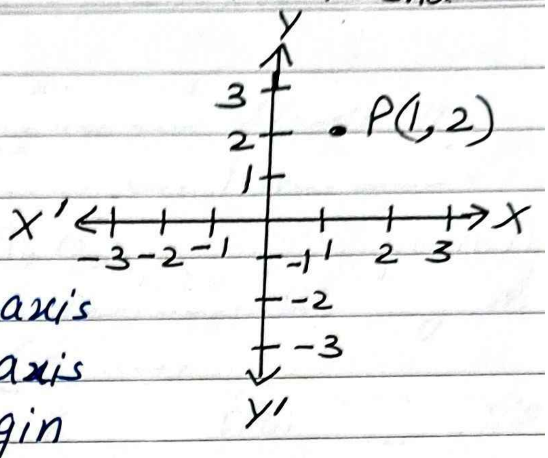

Reflection :-

The transformation which maps a point P to P′ is called reflection

M_x represents reflection in x-axis

M_y represents reflection in y-axis

M_o represents reflection in origin

Example :- Consider P (1, 2)

$P(1,2) \xrightarrow{x\text{-axis}} P'(1,-2)$

$P(1,2) \xrightarrow{y\text{-axis}} P'(-1,2)$

$P(1,2) \xrightarrow{\text{origin}} P'(-1,-2)$

Important Note :-

1) The line $y=0$ means the x-axis
i.e. $M_x(x,y) = (x,-y)$
Therefore, when a point is reflected in the x-axis, the sign of its ordinate changes.
e.g. $M_x(2,-3) = (2,3)$

2) The line $x=0$ means the y-axis
i.e. $M_y(x,y) = (-x,y)$
Therefore, when a point is reflected in the y-axis, the sign of its abscissa changes
e.g. $M_y(2,-3) = (-2,-3)$

3) Reflection in the origin
i.e. $M_o(x,y) = (-x,-y)$
Signs of its abscissa and ordinate both changes
e.g. $M_o(2,-3) = (-2,3)$

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Invariant Point :-

Any point that remains unaltered under a given transformation is called an invariant.

e.g. (i) $A(5,0) \xrightarrow{x\text{-axis}} A'(5,0)$

Here, the co-ordinates remain unchanged

(ii) $P(0,-3) \xrightarrow{y\text{-axis}} P'(0,-3)$

It is invariant under reflection in y-axis.

Example 1:- A point P under reflection in y-axis is mapped onto $P'(2,3)$

(i) Find the co-ordinates of P

(ii) Find the co-ordinates of the image of P under reflection in origin.

Solution:-

(i) $P(a,b) \xrightarrow{y\text{-axis}} P'(2,3)$

We know that under refection in y-axis, the sign of its abscissa changes

$\Rightarrow P(-2,3)$

(ii) $P(-2,3) \xrightarrow{\text{origin}} P''(2,-3)$

Example 2:- The triangle $A(1,2)$, $B(4,4)$ and $C(3,7)$ is first reflected in the line $y=0$ onto triangle $A'B'C'$ and then triangle $A'B'C'$ is reflected in the origin onto triangle $A''B''C''$. Write the co-ordinates of

(i) A' B' and C' Reflection in $y=0$ means x-axis

$A(1,2) \xrightarrow{x\text{-axis}} A'(1,-2)$

$B(4,4) \xrightarrow{x\text{-axis}} B'(4,-4)$

$C(3,7) \xrightarrow{x\text{-axis}} C'(3,-7)$

(ii) A'' B'' and C'' Reflection in origin

$A'(1,-2) \xrightarrow{\text{origin}} A''(-1,2)$

$B'(4,-4) \xrightarrow{\text{origin}} B''(-4,4)$

$C'(3,-7) \xrightarrow{\text{origin}} C''(-3,7)$

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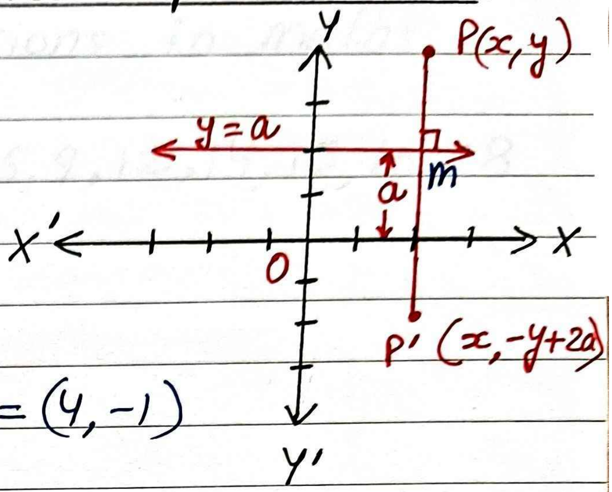
Reflection of a point in a line parallel to x-axis



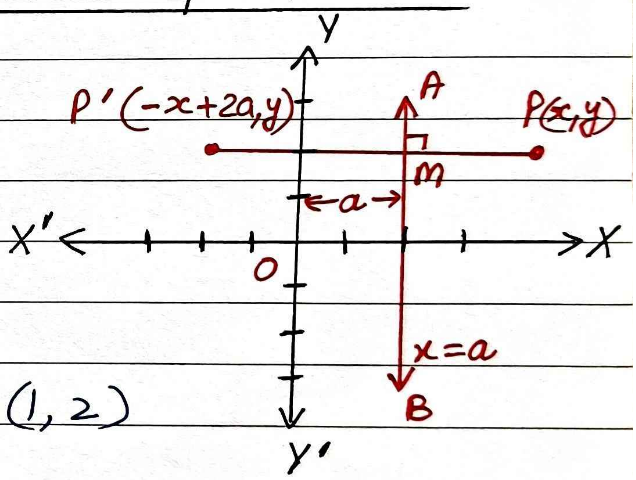
The reflection of the point $P(x,y)$ in the line $y=a$ is the point $P'(x,-y+2a)$

e.g.

$(4,5) \xrightarrow{y=2} (4,-5+2\times 2) = (4,-1)$

$(-3,4) \xrightarrow{y=-1} (-3,-4+2\times(-1)) = (3,-6)$

Reflection of a point in a line parallel to y-axis



The reflection of the point $P(x,y)$ in the line $x=a$ is the point $P'(-x+2a,y)$

e.g.

$(3,2) \xrightarrow{x=2} (-3+2\times 2,2) = (1,2)$

$(3,-5) \xrightarrow{x=-1} (-3+2\times(-1),-5) = (-5,-5)$

Example 3

(i) Find the reflection of the point $P(-1,3)$ in the line $x=2$

Using $P(x,y) \xrightarrow{x=a} (-x+2a,y)$

$P(-1,3) \xrightarrow{x=2} P'(1+2\times 2,3) \quad = P'(5,3)$

(ii) Find the reflection of the point $Q(2,1)$ in the line $y+3=0 \quad \Rightarrow y=-3$

Using $Q(x,y) \xrightarrow{y=a} Q'(x,-y+2a)$

$Q(2,1) \xrightarrow{y=-3} Q'(2,-1+2\times(-3)) = Q'(2,-7)$

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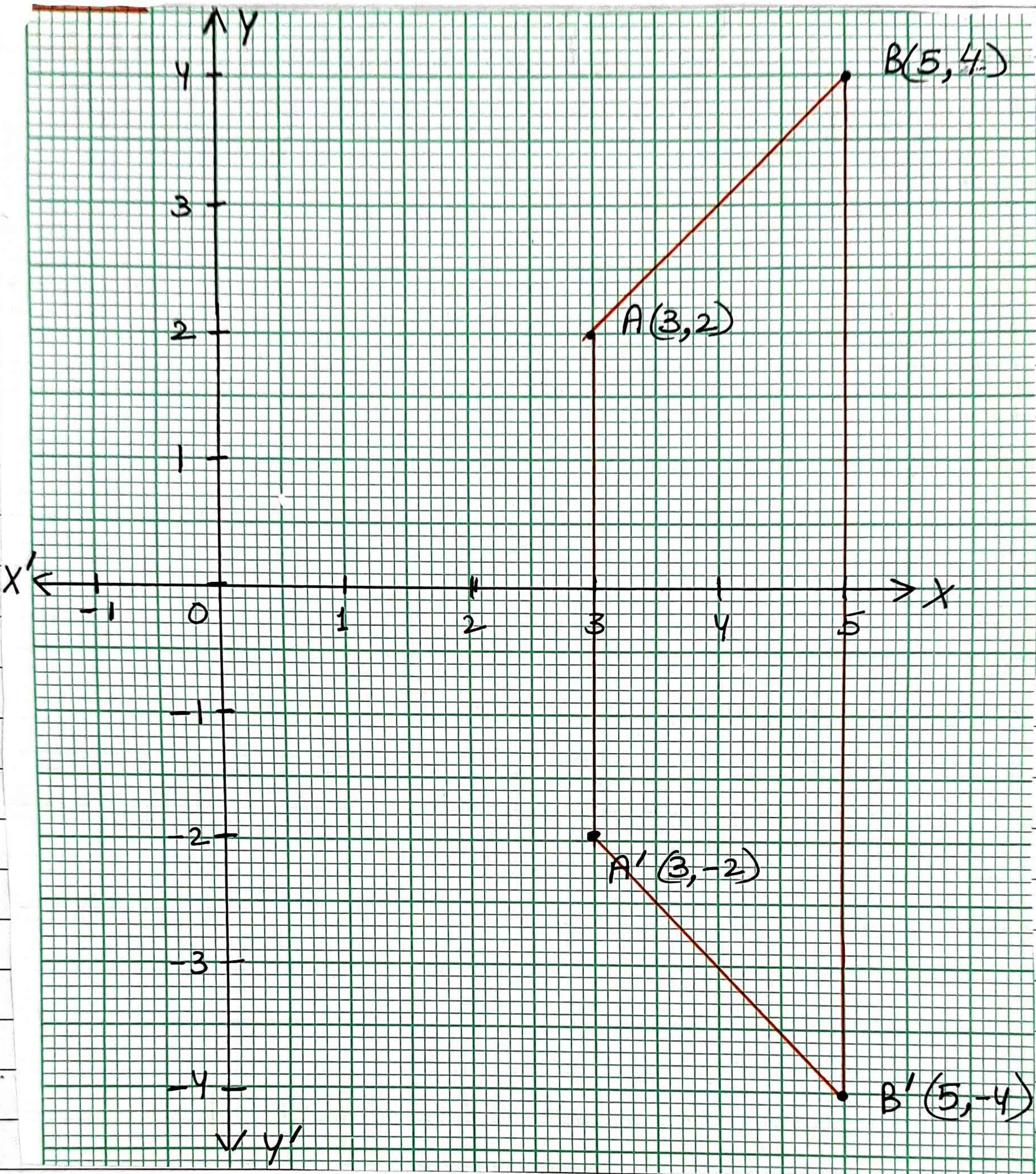

(ii) A (3, 2) $\xrightarrow{x\text{-axis}}$ A' (3, −2)

B (5, 4) $\xrightarrow{x\text{-axis}}$ B' (5, −4)

(iii) (a) ABB'A' is an isosceles trapezium

(b) not in syllabus (c) measure ∠ABB' = 45°

(d) A (3, 2) $\xrightarrow{\text{origin}}$ A'' (−3, −2)

(e) single transformation A' to A''

i.e. A' (3, −2) to A'' (−3, −2) is y-axis.

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Example 4 $P(3,-2)$

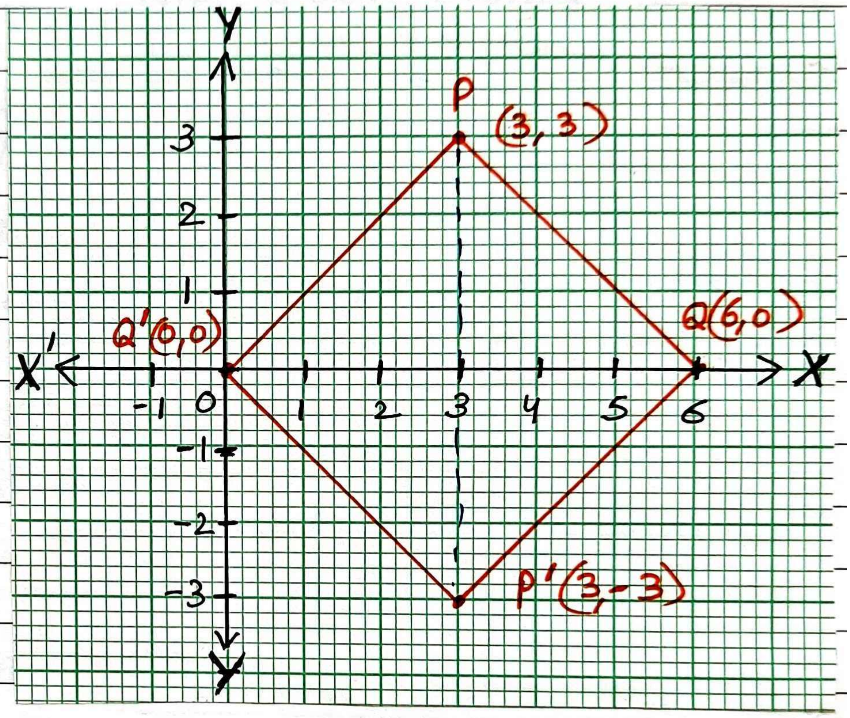
(i) $(3,-2) \xrightarrow{x\text{-axis}} (3,2)$

(ii) $(3,-2) \xrightarrow{y\text{-axis}} (-3,-2)$

(iii) $(3,-2) \xrightarrow{x\text{-axis}} (3,2) \xrightarrow{y\text{-axis}} (-3,2)$

(iv) $(3,-2) \xrightarrow{\text{origin}} (-3,2)$

Example 5



(i) $P(3,3) \xrightarrow{x\text{-axis}} P'(3,-3)$

(iii) $Q(6,0) \xrightarrow[x=3]{\text{line } PP'} (2a-x, y)$

$= Q'(2\times 3 - 6, y)$

$= Q'(0,0)$

(v) Q' is origin

(vi) Yes, PP' and QQ' are perpendicular to each other.

(vii) Quadrilateral $PQP'Q'$ is a square as all sides are equal and both diagonals are also equal.

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