Straight line

Date 28/03/22
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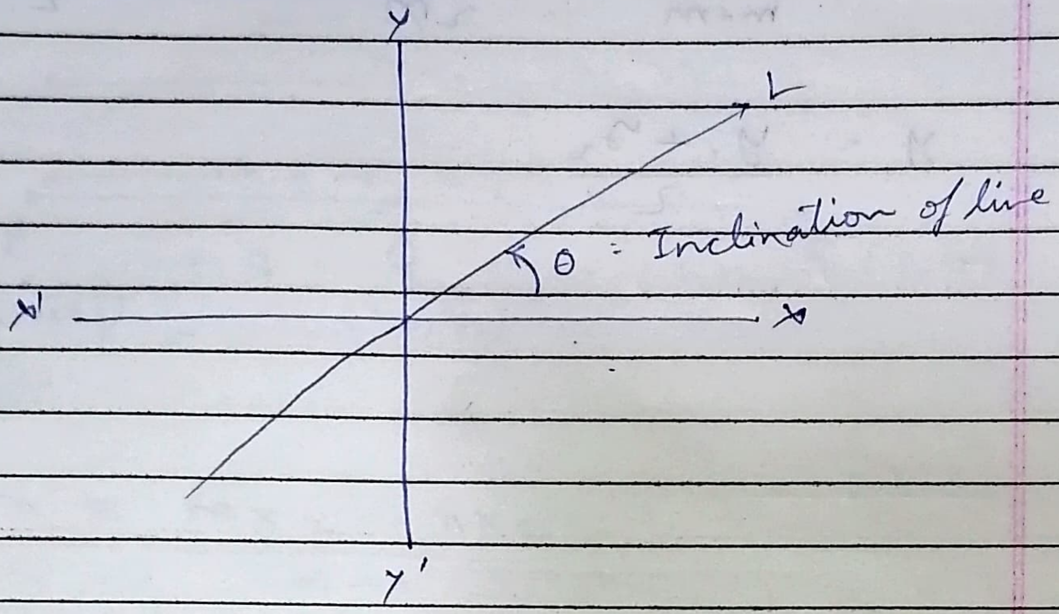
Slope of ~~line~~ line.



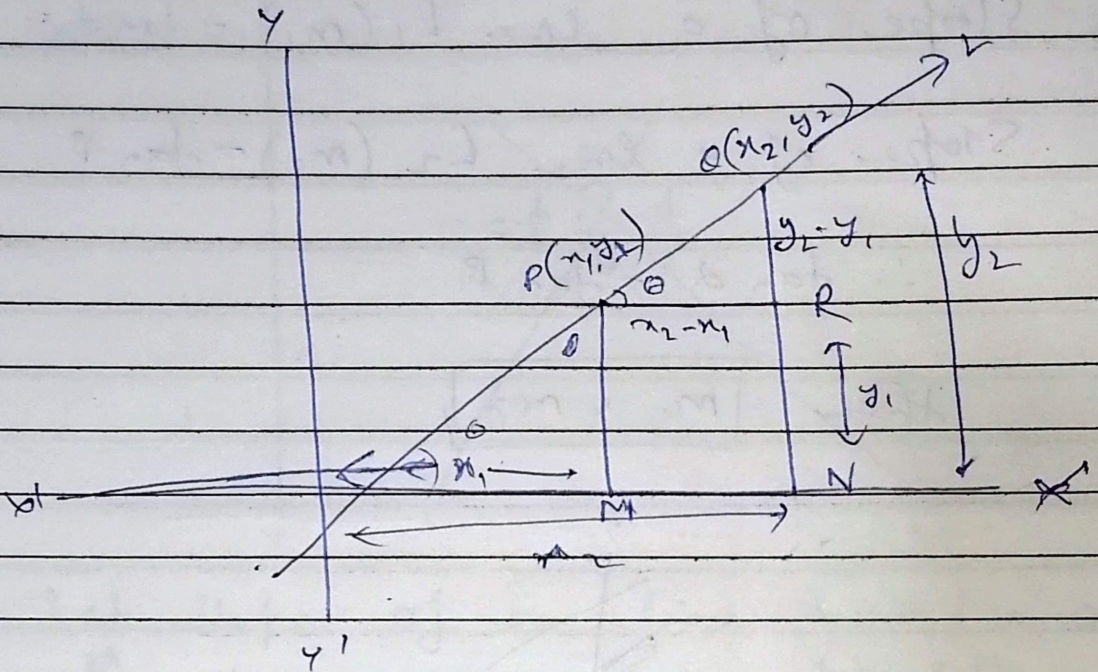
Definition:- If θ is a ~~integration~~ inclinatio of a line L then $\tan\theta$ is called the slope / gradient of a line L. The slope of a line is denoted by "m". Then slope of line ~~L is equal~~ L = m. i.e. $m = \tan\theta$.

$$\boxed{\text{Slope} = \tan\theta}$$

$$\boxed{m = \tan\theta}$$

$$\begin{aligned} \text{Slope} &= \tan\theta \\ &= \tan 30^\circ \\ &= \frac{1}{\sqrt{3}} \end{aligned}$$

Slope of a line passing through two points.



In Δ PRQ

$M = \tan\theta$

$$\boxed{m = \frac{y_2 - y_1}{x_2 - x_1}}$$

If a line passing through two point $P(x_1, y_1)$ and $Q(x_2, y_2)$ then slope of a line is $m = \frac{y_2 - y_1}{x_2 - x_1}$

$\frac{-6}{4}$ -1.5

Q. Passing through the points $(3, -2)$ and $(-1, 4)$ then find the slope of a line.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - (-2)}{(-1) - 3} = \frac{6}{-4} = \frac{-3}{2}$$

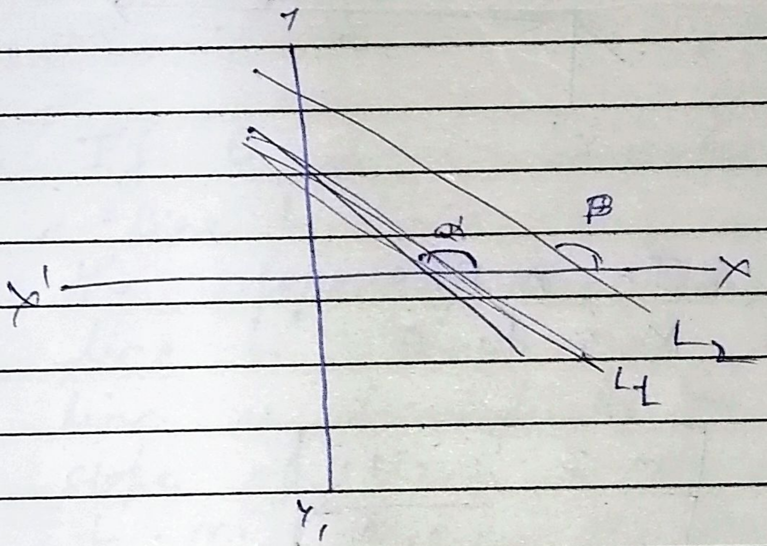
Condition of parallelism:

Slope of a line $L_1 (m_1) = \tan\alpha$.

Slope of a line $L_2 (m_2) = \tan\beta$

$\therefore \tan\alpha = \tan\beta$

then $\boxed{m_1 = m_2}$



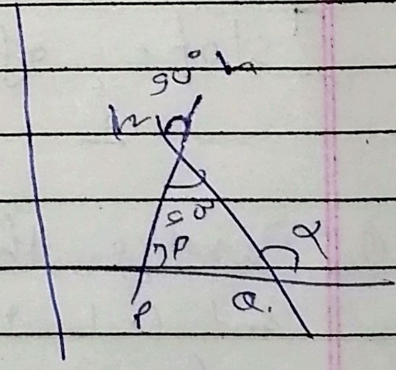
Conditionaly of perpendicularity

$\therefore \alpha = 90 + \beta$

$\Rightarrow \tan\alpha = \tan(90° + \beta)$

$\Rightarrow \tan\alpha = -\cot\beta$

$\Rightarrow \tan\alpha = -\dfrac{1}{\tan\beta}$



$\boxed{\tan\alpha \cdot \tan\beta = -1}$

$\boxed{m_1 \cdot m_2 = -1}$

H.W Ex 10.1 class 11

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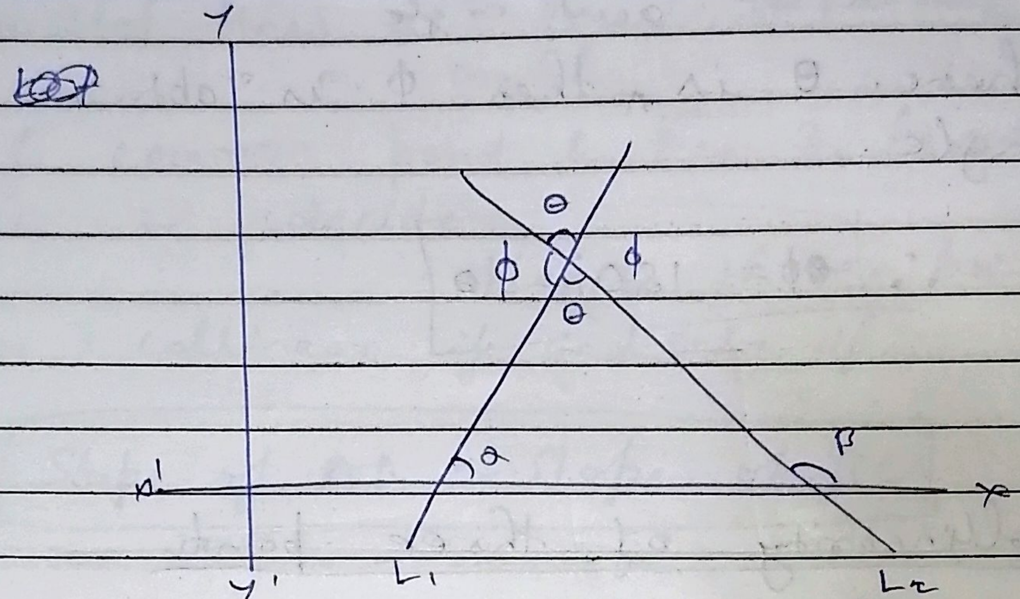
Angle between two lines



Let Slope of a line $L_1 = M_1$ and
" " " " $L_2 = M_2$.

we know that.

$\beta = \theta + \alpha$

$\Rightarrow \beta - \alpha = \theta$

$\Rightarrow \theta = \beta - \alpha$.

$\Rightarrow \tan\theta = \tan(\beta - \alpha)$

$\Rightarrow \tan\theta = \dfrac{\tan\beta - \tan\alpha}{1 + \tan\beta \cdot \tan\alpha}$

$\tan\theta = \dfrac{m_2 - m_1}{1 + m_2 \cdot m_1}$

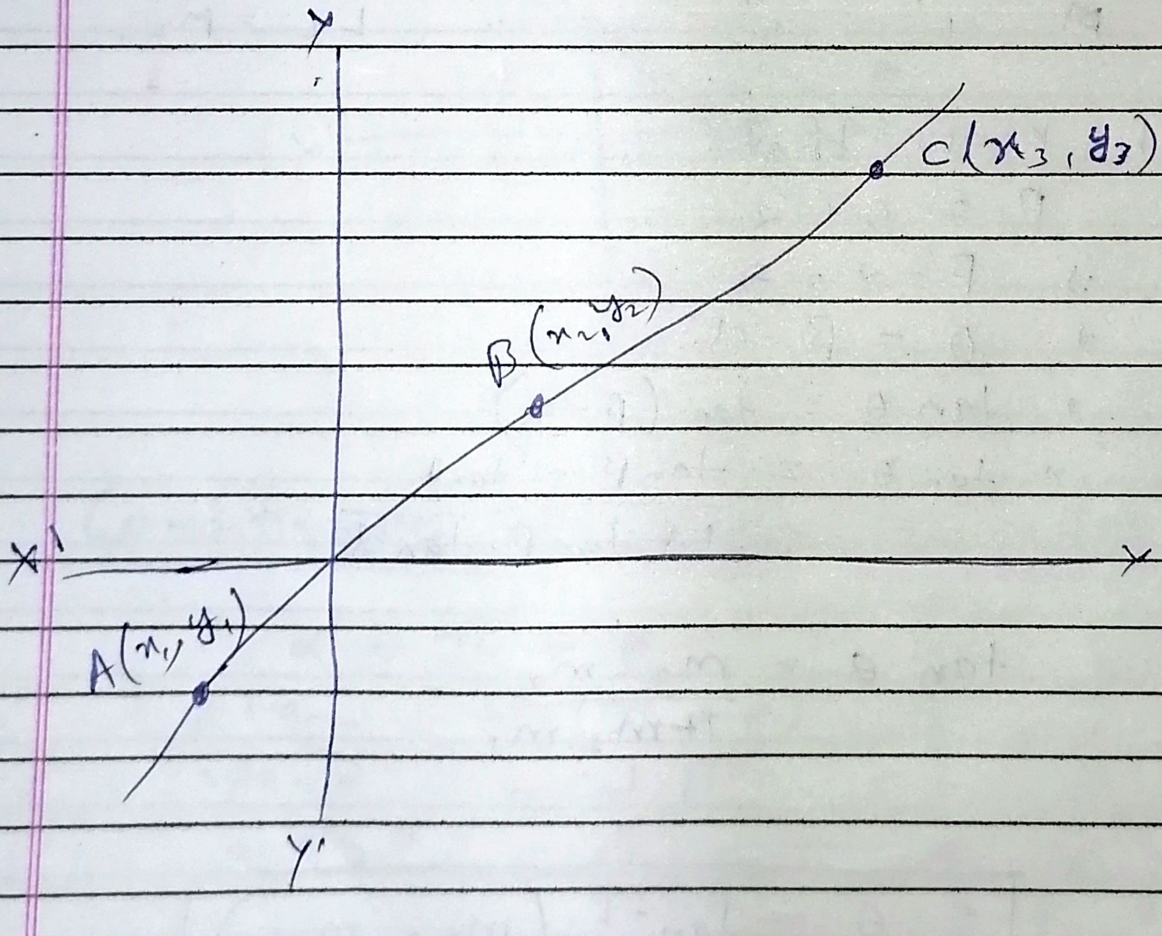
$$\boxed{\therefore \theta = \tan^{-1}\left(\frac{m_2 - m_1}{1 + m_2 \cdot m_1}\right)}$$

~~Collinearity~~ ~~θ~~

Where θ is acute angle then φ is obtuse angle.

$$\therefore \boxed{\phi = 180° - \theta}$$

Collinearity of three points.



~~Slope of AB = Slope of BC~~

We know that slope of two parallel lines are equal, ~~$\therefore m_1 = m_2$~~

$\therefore m_1 = m_2$

If common point B then 2 lines will be coincide.

Hence three points are collinear if and only if

$$\boxed{\text{Slope of AB} = \text{Slope of BC}}$$

Ex: 10.1

NCERT

class 11

Q.8 $\frac{y_2 - y_1}{x_2 - x_1} = \frac{y_2 - y_1}{x_2 - x_1}$ (Slope of AD = Slope of BC)

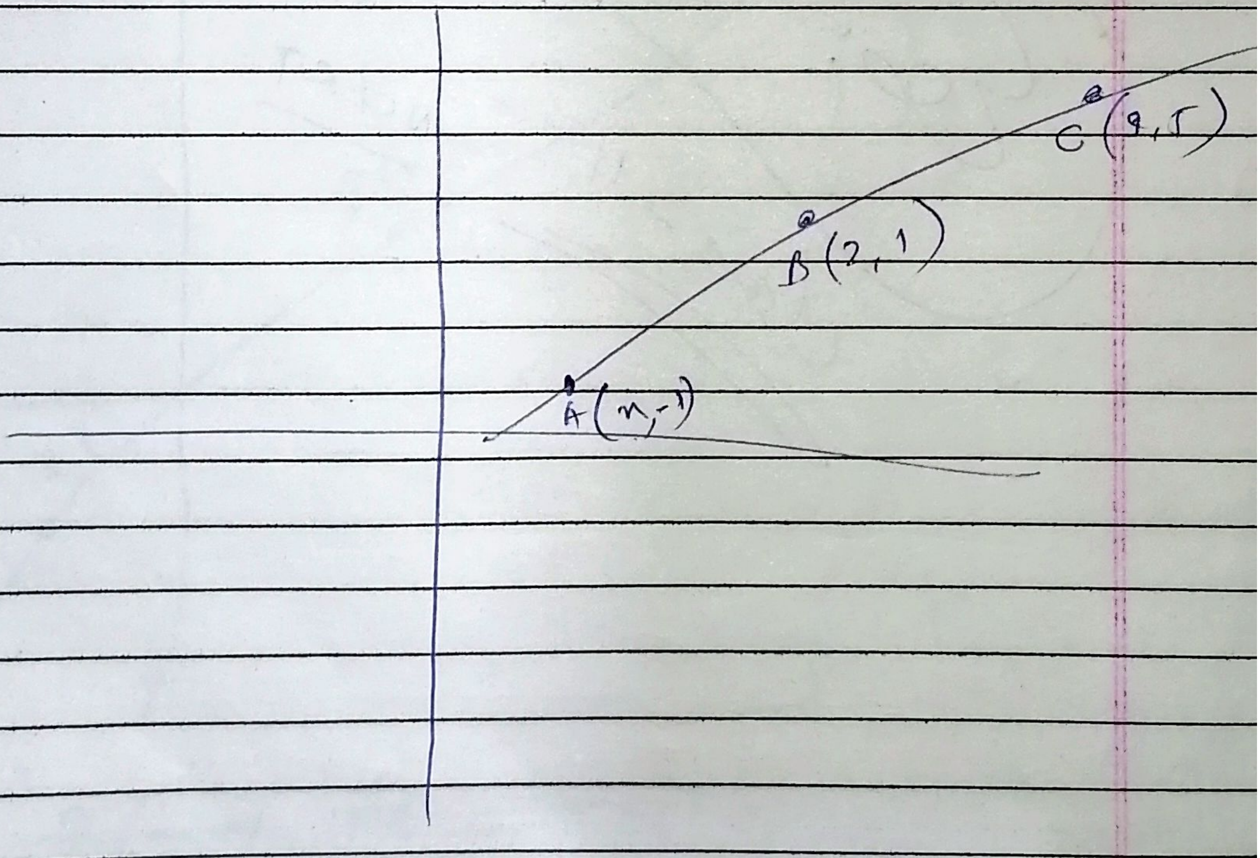
$= \frac{1+1}{2-x} = \frac{5-1}{4-2}$

$\frac{2}{2-x} = \frac{4}{2}$

$4 - 2x = 2$

$-2x = -2$

$x = 1$ Ans



(19) Slope of AB = Slope of BC

$$\frac{y_2 - y_1}{x_2 - x_1} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\Rightarrow \frac{97 - 92}{1995 - 1985} = \frac{k - 97}{2010 - 1995}$$

$$\Rightarrow \frac{5}{10} = \frac{k - 97}{15}$$

$$= 75 = 10k - 970.$$

$$10k = 970 + 75$$

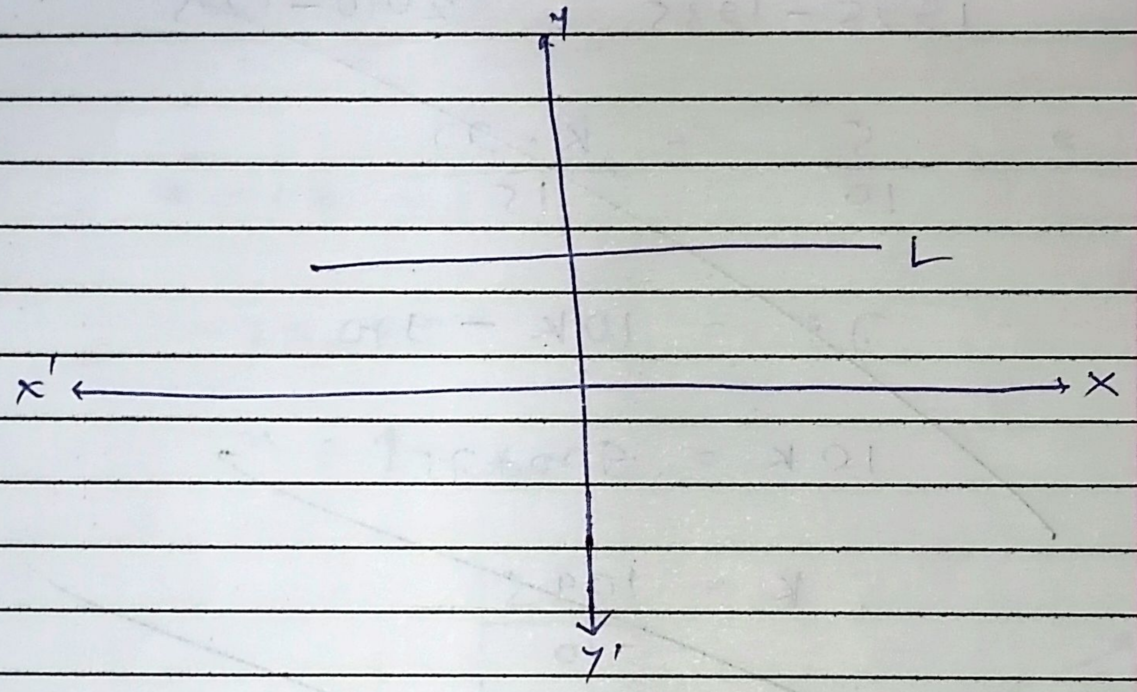
$$k = \frac{1045}{10}$$

$$k = \underline{104.5}$$

Various form of the equation of the line:

Horizontal line:

If a line parallel to x-axis then the line is horizontal.



In a horizontal line, the distance of y-coordinate is fixed and x-coordinate always change.

$$\therefore \boxed{y = c}$$

The equation of x-axis is $\boxed{y = 0}$.

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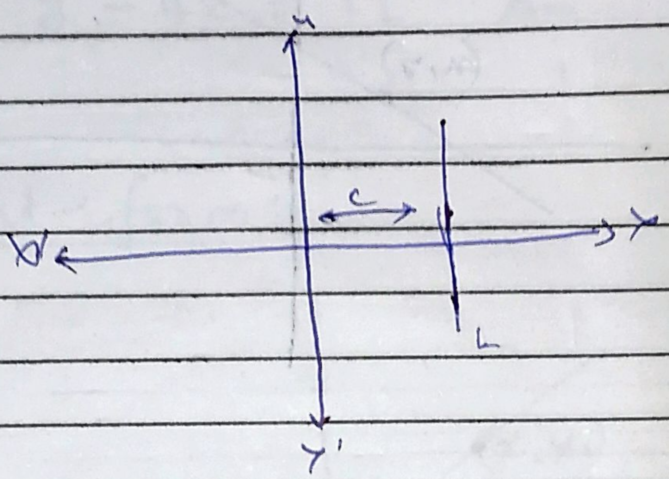
Verticle line:

If a line parallel to y-axis then the line is Vertical.

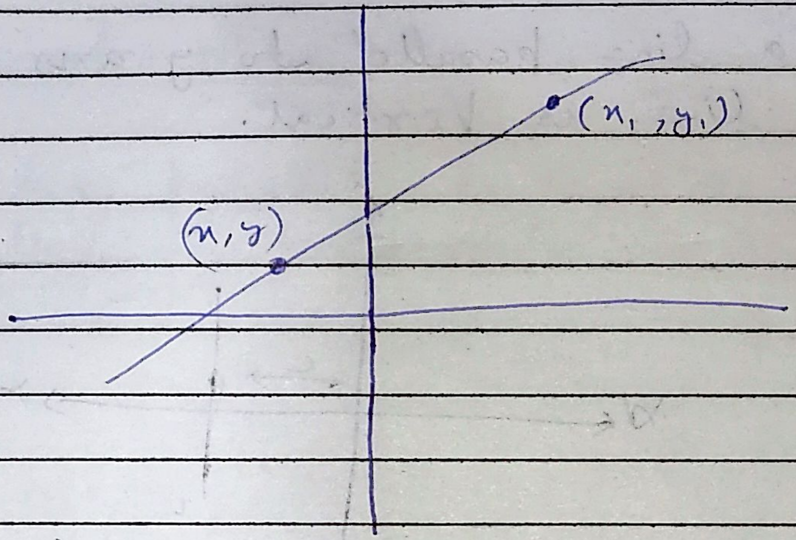


In a vertical line, the distance of x-~~axis~~ coordinate is fixed and y-coordinate always change.

$\therefore \boxed{x = c}$

The equation of y-axis is $\boxed{x = 0}$.

Point Slope form :-



Given the slope of line m and the point of a line $= (x_1, y_1)$

we know that.

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\Rightarrow m = \frac{y - y_1}{x - x_1}$$

$$\Rightarrow \boxed{y - y_1 = m(x - x_1)}$$

Q. Find the equation of a line passes through $(-2, 3)$ and with slope $= 4$.

$(x_1, y_1) = (-2, 3)$ $\quad m = 4$.

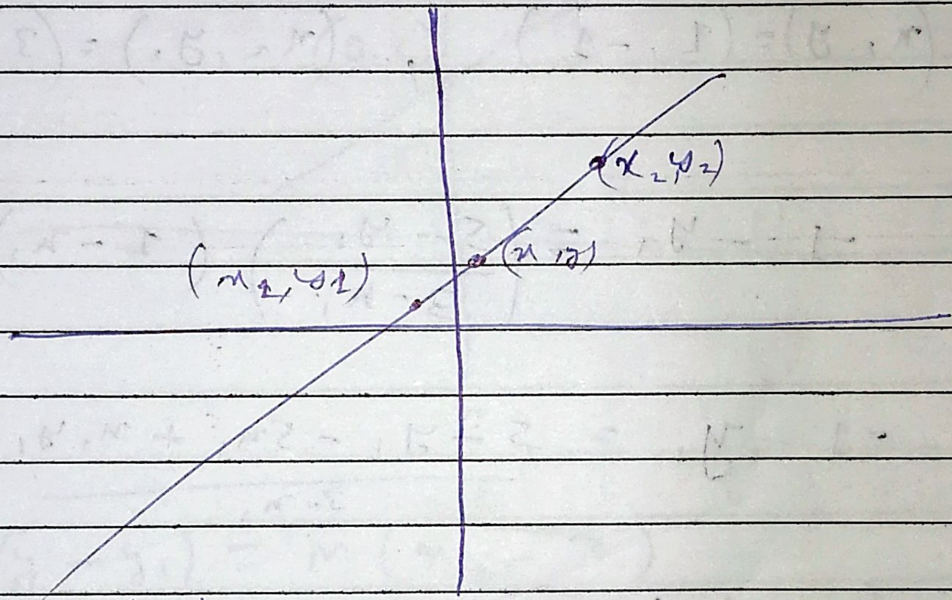
$$y - y_1 = m(x - x_1)$$

$$y - 3 = 4(x - (-2))$$

$$y - 3 = 4x + 8$$

$$\Rightarrow \quad y - 4x = 11 \quad \text{Ans}$$

Two point form :-



Slope of A and B.

Slope $\boxed{m = \frac{y_2 - y_1}{x_2 - x_1}}$

Slope of A and C.

$$y - y_1 = m(x - x_1)$$

$$\boxed{y - y_1 = \left(\frac{y_2 - y_1}{x_2 - x_1}\right)(x - x_1)}$$

Q. Write the equation of the line passing through the point $(1,-1)$. and $(3,5)$.

$$y - y_1 = \left(\frac{y_2 - y_1}{x_2 - x_1}\right)(x - x_1).$$

$$(x, y) = (1, -1) \quad , \quad (x_2, y_2) = (3, 5)$$

$$-1 - y_1 = \left(\frac{5 - y_1}{3 - x_1}\right)(1 - x_1)$$

$$-1 - y_1 = \frac{5 - y_1 - 5x_1 + x_1 y_1}{3 - x_1}$$

$$(3 - x_1)(-1 - y_1) = 5 - y_1 - 5x_1 + x_1 y_1$$

$$-3 - 3y + x_1 + x_1 y_1 = 5 - y_1 - 5x_1 + x_1 y_1$$

$$-3 - 3y + x_1 + \cancel{x_1 y_1} - 5 + y_1 + 5x_1 - \cancel{x_1 y_1} = 0$$

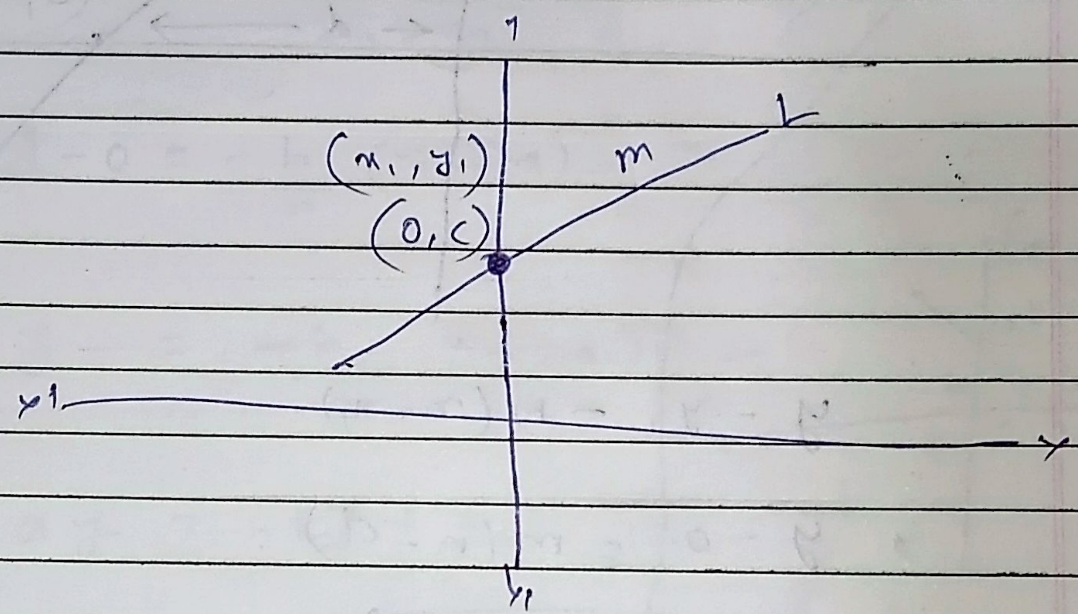
$$\boxed{-8 - 2y + 6x_1 = 0.}$$

$$\rightarrow \boxed{6x_1 - 2y - 8 = 0} \text{ Ans}$$

Slope Intercept form.

Case I:

Given y-intercept



$$(y - y_1) = m(x - x_1)$$

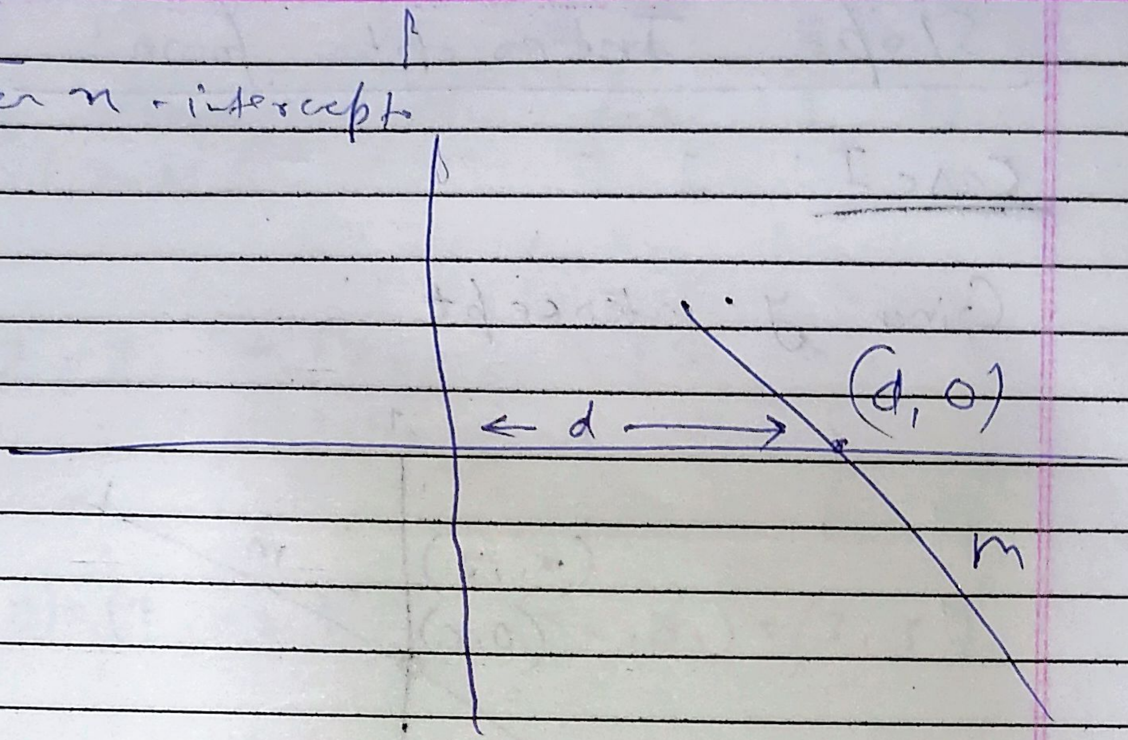
$$\Rightarrow y - c = m(x - 0)$$

$$\Rightarrow y - c = mx$$

$$\boxed{y = mx + c}$$

Case II

Given x - intercept



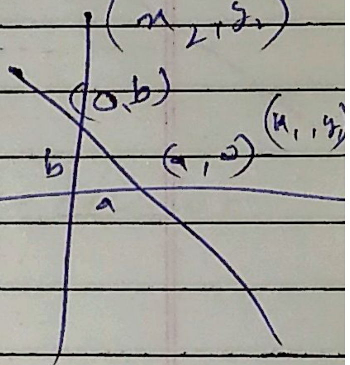
$$y - y_1 = m(x - x_1)$$

$$\Rightarrow y - 0 = m(x - d)$$

$$\Rightarrow \boxed{y = m(x - d)}$$

Intercept form :-

Slope of line L $= \frac{y_2 - y_1}{x_2 - x_1} = \frac{b - 0}{0 - a} = \frac{-b}{a}$



$$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$$

$$y - 0 = -\frac{b}{a}(x - a)$$

$$y = \frac{-b}{a}(x - a)$$

$$ay = -b\cancel{x} + ba$$

$$ay = -bx + ab$$

$$\Rightarrow bx + ay = ab$$

Dividing ab on both sides

$$\frac{\cancel{b}x}{a\cancel{b}} + \frac{\cancel{a}y}{\cancel{a}b} = \frac{\cancel{ab}}{\cancel{ab}}$$

$$\Rightarrow \boxed{\frac{x}{a} + \frac{y}{b} = 1}$$

Q. Find equation of the line which makes intercepts (-3 and 2) on the x and y-axis.

$$\frac{x}{a} + \frac{y}{b} = 1.$$

$$\frac{x}{-3} + \frac{y}{2} = 1.$$

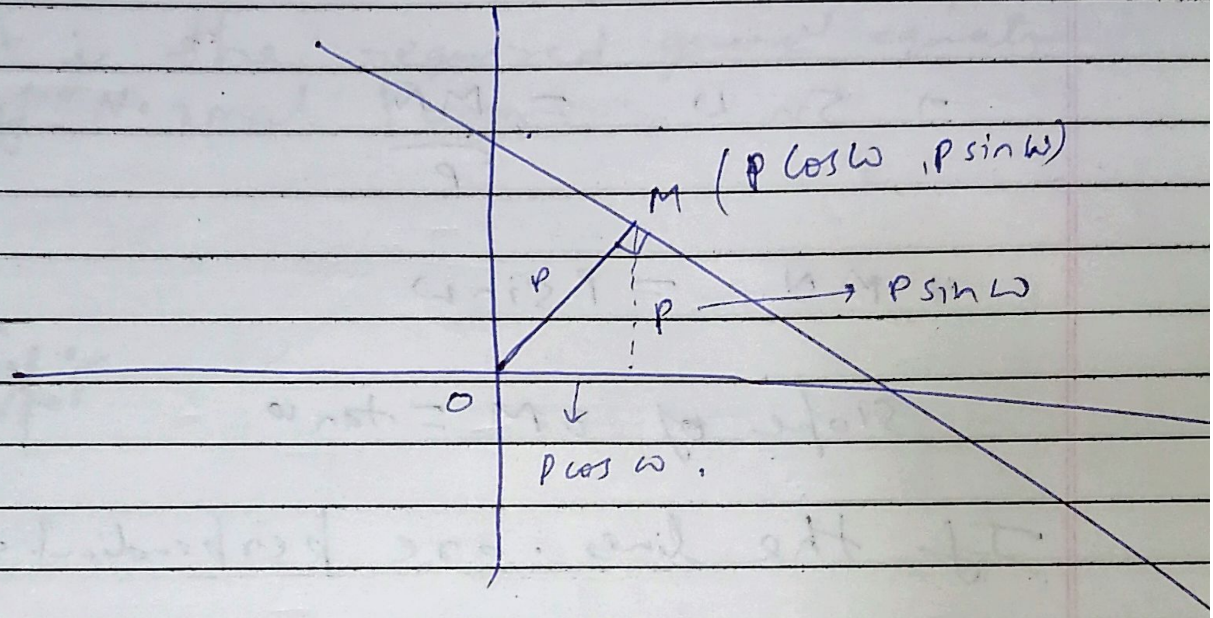
$$\frac{-2x + 3y}{+6} = 1$$

$$\boxed{-2x + 3y = +6.}$$

$$\boxed{-2x + 3y - 6 = 0}$$

Ans.

Normal Form:



Given that the line of perpendicular (P) from origin to the line.

And angle ω is given.

In ΔOMN

$$\cos\omega = \frac{ON}{OM}$$

$$\cos\omega = \frac{ON}{P}$$

$$\Rightarrow ON = P\cos\omega$$

Again.

$$\sin\omega = \frac{MN}{OM}$$

$$\sin\omega = \frac{MN}{OM}$$

$$\Rightarrow \sin\omega = \frac{MN}{p}$$

$$\Rightarrow MN = p\sin\omega$$

Slope of $OM = \tan\omega$

If the lines are perpendicular

Slope of OM × slope of L = -1

$\tan\omega$ × slope of L = -1

$\Rightarrow$ slope of $L = \frac{-1}{\tan\omega} = \frac{-1}{\frac{\sin\omega}{\cos\omega}} = \frac{-\cos\omega}{\sin\omega}$.

$$y - y_1 = m(x - x_1)$$

$$y - p\sin\omega = -\frac{\cos\omega}{\sin\omega}(x - p\cos\omega)$$

$$\Rightarrow y\sin\omega - p\sin^2\omega = -x\cos\omega + p\cos^2\omega$$

$$y\sin\omega + x\cos\omega = p\cos^2\omega + p\sin^2\omega$$

$$x\cos\omega + y\sin\omega = p(\cos^2\omega + \sin^2\omega)$$

$$\boxed{x\cos\omega + y\sin\omega = p}$$

It is the required general equation of the Normal Form.

Ex :-

Ex. 10.2

(16)

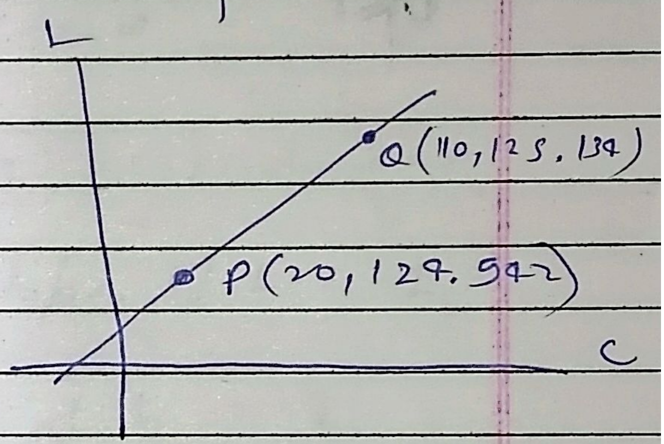
$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$

$\frac{L = 124.942}{C = 20}$ l_1

$\frac{L = 125.134}{C = 110}$ l_2

$\Rightarrow$ ~~L - 124.942~~

= ~~125.134 - 124.942~~



$\Rightarrow L - 124.942 = \frac{125.134 - 124.942}{110 - 20}(c - 20)$.

$110L - 13743.62 - 20L + 2498.84$

$= 125.134C - 124.942C - 2502.68 + 13743.62$.

$90L - 13743.62 + 2498.84$

$= 0.192C - 2502.68 + 13743.62$.

$\boxed{90L - \cancel{0.192} \; 0.192C - 22485.72 = 0}$

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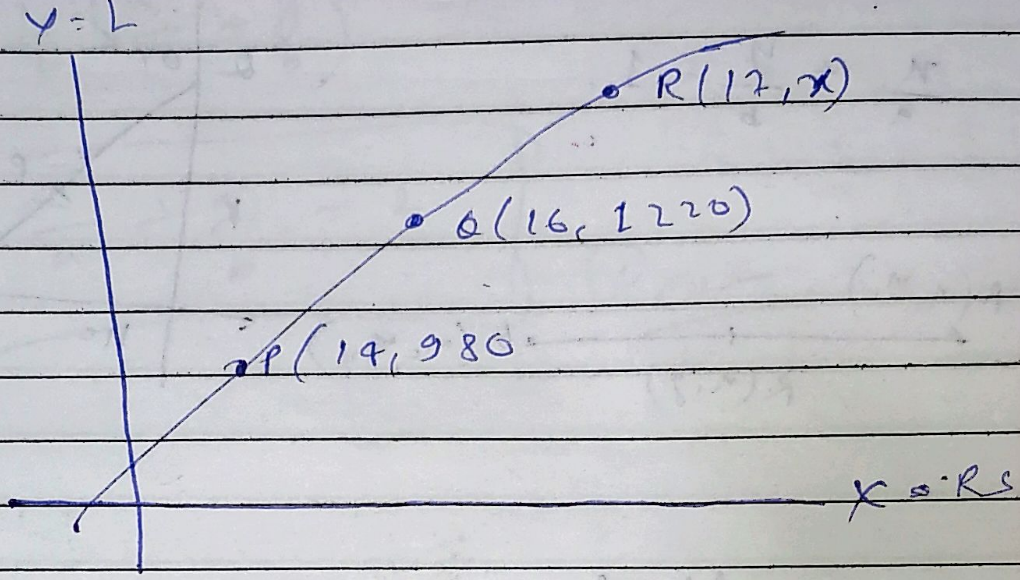


Slope of PO = slope of ~~P~~QR.

$$\frac{y_2 - y_1}{x_2 - x_1} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\Rightarrow \frac{1220 - 980}{16 - 14} = \frac{x - 1220}{17 - 16}$$

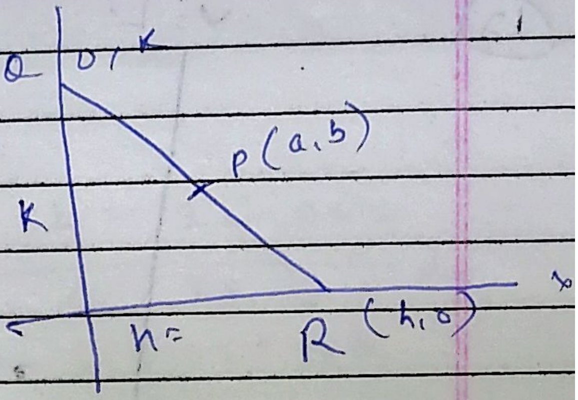
$$\Rightarrow \frac{240}{2} = \frac{x - 1220}{1}$$

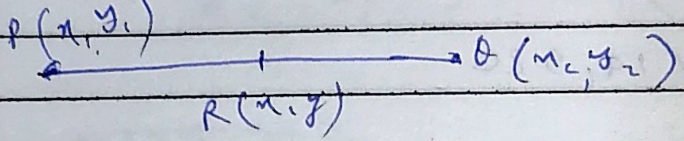
$$\Rightarrow x = 1220 - 120$$

$$x = 1340$$

(18)

$$\frac{x}{a} + \frac{y}{b} = 1.$$





$$x\text{-coordinate} = \frac{x_1 + x_2}{2}$$

$$a = \frac{0 + h}{2}.$$

$$\Rightarrow h = 2a$$

$$y\text{-coordinate} = \frac{y_1 + y_2}{2} = \frac{k + 0}{2}$$

$$b = \frac{k}{2}.$$

$$k = 2b.$$

$$\frac{x}{h} + \frac{y}{k} = 1$$

$$\frac{x}{2a} + \frac{y}{2b} = 1.$$

$$\frac{1}{2}\left(\frac{x}{a} + \frac{y}{b}\right)$$

$$\boxed{\frac{x}{a} + \frac{y}{b} = 2.}$$

Prov.

$y = mx + c$

$y = m(x - d)$

$\boxed{\frac{x}{a} + \frac{y}{b} = 1}$

$y - y_1 = m(x - x_1)$

$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$

$x\cos\omega + y\sin\theta = p$

General Equation of a line.

We have studied general equation of 1^{st} degree in two variable.

$$\boxed{Ax + By + C = 0.}$$

Where A, B and C are constant. Such that A and B are not zero.

Graph of the equation $Ax + By + C = 0$ is always a straight line.

$\therefore$ Therefore, any equation of the from $Ax + By + C = 0$ where A and B are not zero.

Simultaneously, that is called general equation or general linear eq^n.

Reduction of the general equation of a line to different standard form.

The general eq^n of a line can be reduced into various form of eq^n of a line.

1) Slope intercept form.

To reduce the eq^n $Ax + By + C = 0$ to the form $y = mx + c$, given the eq^n

$$Ax + By + C = 0$$

$$\Rightarrow By = -Ax - C$$

$$y = -\frac{A}{B}x - \frac{C}{B}$$

$$y = \left(-\frac{A}{B}\right)x + \left(-\frac{C}{B}\right)$$

$\downarrow$

It is a slope of the eq^n.

which is of the form $y = mx + c$.

Then slope $(m) = \left(-\frac{A}{B}\right)$ and $c = -\frac{C}{B}$

Slope $\Rightarrow -\frac{\text{coefficient of } x}{\text{coefficient of } y}$.

Q. Find the slope of the eqⁿ.

$$4x + 5y + 8 = 0.$$

$\Rightarrow$ Slope $= -\frac{4}{5}$ Ans.

(ii) <u>Intercept form</u>

To reduce equation $Ax + By + C = 0$. to the ~~form~~ from $\frac{x}{a} + \frac{y}{b} = 1$.

This reduction is possible only when ~~C does not equal~~ $C \neq 0$.

Given the equation:-

$$Ax + By + C = 0.$$

$$\Rightarrow Ax + By = -C$$

$$\Rightarrow Ax + By = 1 \times (-C)$$

$$\Rightarrow \left(\frac{-A}{C}\right)x + \left(\frac{-B}{C}\right)y = 1.$$

$$\Rightarrow \boxed{\frac{x}{\left(\frac{-C}{A}\right)} + \frac{y}{\left(-\frac{C}{B}\right)} = 1.}$$

Which is the form of $\frac{x}{a} + \frac{y}{b} = 1.$

where

$$\boxed{a = \frac{-c}{A}, \text{ and } b = \frac{-C}{B}}$$

Q. Equation of a line is $3x - 4y + 10 = 0$.
Find
(i) Slope
(ii) x and y intercept.

$\Rightarrow$

$a = \frac{-10}{3}, \quad b = \frac{+10}{+4} = \frac{5}{2}$

(i) Slope

Sol: $3x - 4y + 10 = 0$

$-4y = -3x - 10$

$y = \frac{3}{4}x + \frac{5}{2}$

slope.

ii) x and y Intercept.

Given the eqn

$$3x - 4y + 10 = 0$$

$$3x - 4y = \cancel{0} - 10$$

$$-\frac{3x}{10} + \frac{4}{10}y = 1.$$

$$\Rightarrow \frac{x}{\frac{-10}{3}} + \frac{y}{\frac{5}{2}} = 1.$$

$\therefore$ x - intercept is $= -\frac{10}{3}$,

y - intercept is $= \frac{5}{2}$.

iii) Normal form.

To reduce the eqn $Ax + By + c = 0$ to the form $x\cos w + y\sin w = p$.

$$Ax + By + c = 0.$$

$$\Rightarrow Ax + By = -c.$$

Put

$$\frac{A}{\cos w} = \frac{B}{\sin w} = -\frac{c}{p}.$$

We take

$$\frac{A}{\cos w} = \frac{C}{P}$$

$$\Rightarrow AP = -C \cdot \cos w.$$

$$\Rightarrow \cos w = \frac{-AP}{C}$$

And

$$\frac{B}{\sin w} = \frac{-C}{P}$$

$$\sin w = \frac{-BP}{C}.$$

Now

$$\sin^2 w + \cos^2 w = 1.$$

$$\Rightarrow \left(\frac{-BP}{C}\right)^2 + \left(\frac{-AP}{C}\right)^2 = 1.$$

$$\Rightarrow \frac{B^2P^2}{C^2} + \frac{A^2P^2}{C^2} = 1$$

$$\Rightarrow \frac{P^2}{C^2}(B^2 + A^2) = 1.$$

$$\Rightarrow P^2 \cdot (A^2 + B^2) = C^2$$

$$p^2 = \frac{C^2}{A^2+B^2}$$

$$\Rightarrow p = \sqrt{\frac{C^2}{A^2+B^2}}$$

$$p = \pm \frac{C}{\sqrt{A^2+B^2}}$$

Thus
~~Now~~ $\cos w = -\frac{Ap}{C}$

$$= -\frac{A}{C}\left(\pm \frac{C}{\sqrt{A^2+B^2}}\right)$$

~~Now~~

~~$\sin^2 w + \cos^2 w = 1.$~~

$$\cos w = \pm \frac{A}{\sqrt{A^2+B^2}}$$

$$\sin w = \pm \frac{B}{\sqrt{A^2+B^2}}$$

$$\boxed{Ax + By + C = 0}$$

Intercept form → $\boxed{y = mx + c}$

$= \boxed{y = m(x - d)}$

$$\boxed{\frac{x}{a} + \frac{y}{b} = 1}$$

Normal Form :- $\boxed{x\cos\omega + y\sin\omega = p}$

Maths Classwork

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Reduce the General Eqn.

Ex:→

Q Reduce the eqn $\sqrt{3}x + y - 8 = 0$ into Normal form. Find the value of P and ω.

⇒ Given Eqn. is

$$\sqrt{3}x + y - 8 = 0.$$

$A = \sqrt{3}$, $B = 1$, $C = -8$.

$$P = \frac{C}{\sqrt{A^2+B^2}} = \frac{-8}{\sqrt{(\sqrt{3})^2+(1)^2}} = \frac{-8}{2} = -4.$$

Distance is always +ve.

$\therefore P = 4$

$$\cos \omega = \frac{\sqrt{3}}{2} = \frac{A}{\sqrt{A^2+B^2}} = 30^\circ$$

$$\sin \omega = \frac{B}{\sqrt{A^2+B^2}} = \frac{1}{2} = 30^\circ.$$

Obtuse angle $= 180^\circ - 30^\circ = 150^\circ$

Maths

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Q. Find the angle between the line $y - \sqrt{3}x - 5 = 0$. And $\sqrt{3}y - x + 6 = 0$

$\Rightarrow$ Given the eqn.

$y - \sqrt{3}x - 5 = 0$ —— (I)

And $\sqrt{3}y - x + 6 = 0$ —— (II)

Solving eqn (I), we have.

$y - \sqrt{3}x - 5 = 0$.

$\Rightarrow y = \sqrt{3}x + 5$

$\therefore m_1 = \sqrt{3}$

Solving eqn. (II)

$\sqrt{3}y = x + 6$

$y = \frac{1}{\sqrt{3}}x - \frac{6}{2\sqrt{3}}$

$= \frac{1}{\sqrt{3}}x - 2\sqrt{3}$

$\therefore m_2 = \frac{1}{\sqrt{3}}$

Hence.

$\tan\theta = \frac{m_2 - m_1}{1 + m_2 m_1} = \frac{\frac{1}{\sqrt{3}} - \sqrt{3}}{1 + \frac{1}{\sqrt{3}}.\sqrt{3}} = \frac{\frac{1-3}{\sqrt{3}}}{2}$

$= \frac{2}{\sqrt{3}} \times \frac{1}{2} = \frac{1}{\sqrt{3}} = 30°$ Ans.

Maths

Q. Show that two lines $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2$ where b_1 and $b_2 \neq 0$, are.

Parallel

(i) If $\frac{a_1}{a_2} = \frac{b_1}{b_2}$

(ii) Perpendicular if $a_1a_2 + b_1b_2 = 0$.

(i) ⇒ Given the Eqⁿ :-

$$a_1x + b_1y + c_1 = 0 \quad \text{--- (I)}$$

and

$$a_2x + b_2y + c_2 = 0 \quad \text{--- (II)}$$

From eqⁿ (I), we have.

$$a_1x + b_1y + c_1 = 0.$$

$$\Rightarrow b_1y = -a_1x - c_1$$

$$\Rightarrow y = -\frac{a_1x}{b_1} - \frac{c_1}{b_1}$$

$$\therefore m = -\frac{a_1}{b_1}$$

From Eq^n (ii), we have,

$$y = -\frac{a_2 x}{b_2} - \frac{c_2}{b_2}$$

$$\therefore m_2 = -\frac{a_2}{b_2}$$

If the lines are parallel.

$\therefore$ Slope of L_1 = Slope of L_2

$$\Rightarrow -\frac{a_1}{b_1} = -\frac{a_2}{b_2}$$

$$\Rightarrow \frac{a_1}{b_1} = \frac{a_2}{b_2}$$

$$\Rightarrow \therefore \boxed{\frac{a_1}{a_2} = \frac{b_1}{b_2}}$$ Proved

(ii) $\therefore m_1 m_2 = -1,$

$$\Rightarrow -\frac{a_1}{b_1} \times -\frac{a_2}{b_2} = -1.$$

$$\Rightarrow \frac{a_1 a_2}{b_1 b_2} = -1.$$

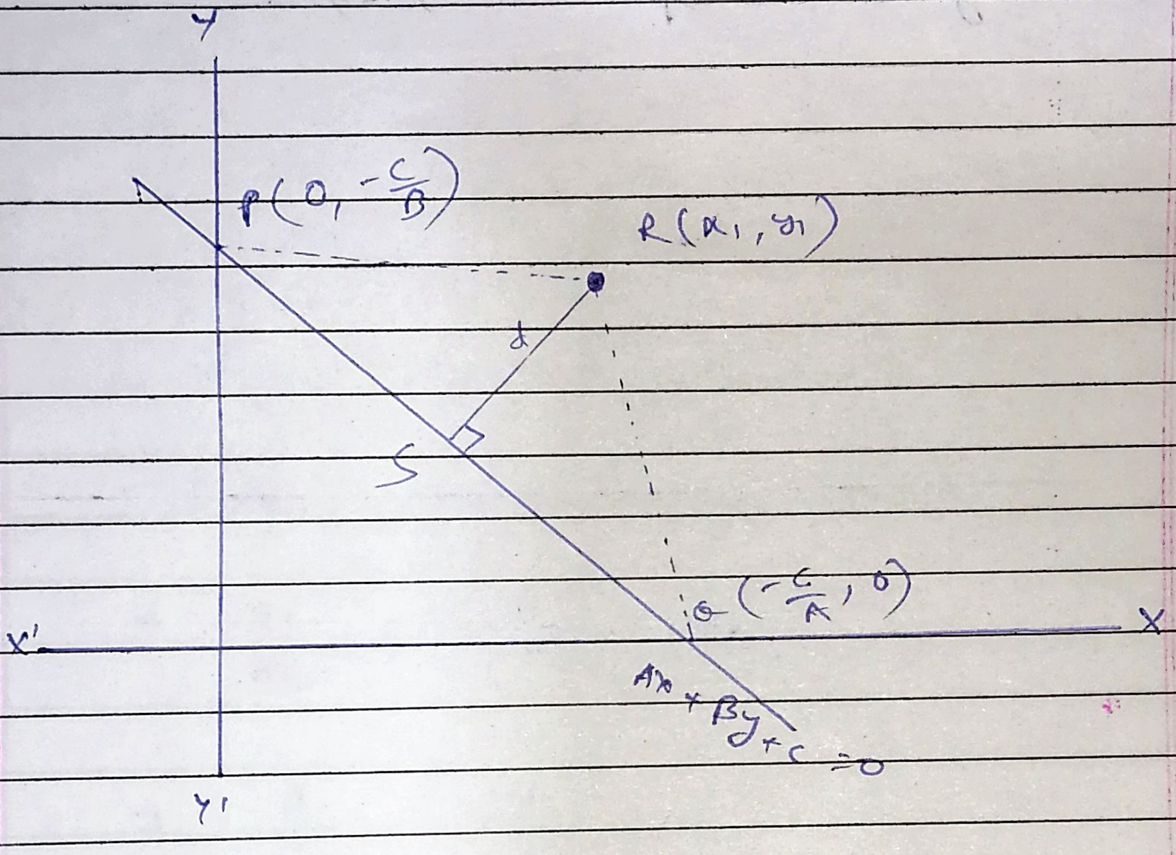
$$\Rightarrow a_1 a_2 = -b_1 b_2$$

$$\Rightarrow \therefore \boxed{a_1 a_2 + b_1 b_2 = 0}$$ Proved

Q. Find the Eq^n of a line $\perp$ to the line $x - 2y + 3 = 0$ and passing through the point $(1, -2)$.

Maths

Distance of a ~~point~~ point ~~line~~ from a ~~point~~ line.



~~Here~~

~~PQ~~ = ~~d~~

The distance of a point from a line is the length of a perpendicular drawn from the point to the line. $Ax + By + C = 0$ whose distance from the point $R(x_1, y_1)$ is d"

The line meets the x and y-axis at the point ~~and~~ Q and P respectively.

∴ Points are

$$Q = \left(-\frac{C}{A}, 0\right)$$

$$P = \left(0, -\frac{C}{B}\right).$$

$$\text{Area of } \Delta = \frac{1}{2}\left| x_1(y_2-y_3) + x_2(y_3-y_1) + x_3(y_1-y_2)\right|$$

$$\Rightarrow \frac{1}{2} PQ.SR = \text{Area of } \Delta$$

$$\therefore SR = \frac{\text{Area of } \Delta}{\frac{1}{2} PQ.} \quad \text{— ①}$$

Here.

$$\text{Area of } \Delta = \frac{1}{2}\left| x_1\left(-\frac{c}{B} - 0\right) + 0(0-y_1) + \left(-\frac{c}{A}\right)\left(y_1 + \frac{c}{B}\right)\right|$$

$$= \frac{1}{2}\left| -\frac{C}{B}x_1 - \frac{C}{A}y_1 - \frac{C^2}{AB}\right|$$

$$= \frac{1}{2}\left| -\frac{C(Ax_1 + By_1 + C)}{AB}\right|$$

$$= \frac{1}{2}\left|\frac{C}{AB}\right|(Ax_1 + By_1 + C).$$

$$PQ = \sqrt{\left(0 + \frac{C}{A}\right)^2 + \left(\frac{-C}{B} - 0\right)^2}$$

$$= \sqrt{\frac{C^2}{A^2} + \frac{C^2}{B}}$$

$$= \left|\frac{C}{AB}\right| \sqrt{A^2 + B^2}$$

From (1).

$$SR(d) = \frac{\frac{1}{2}\left|\frac{C}{AB}\right|(Ax_1 + By_1 + C)}{\frac{1}{2}\left|\frac{C}{AB}\right|\sqrt{A^2 + B^2}}$$

$$\boxed{d = \frac{Ax_1 + By_1 + C}{\sqrt{A^2 + B^2}}}$$ Proved.

Q. Find the distance of the point (3, -5) from the line $3x - 4y - 26 = 0$.

$\Rightarrow$ $$d = \frac{3x - 4y - 26}{\sqrt{3^2 + (4)^2}}$$

$$d = \frac{3x - 4y - 26}{5}$$

$x_1 = 3, \quad y_1 = -5$

$$\therefore d = \frac{3(3) - 4(-5) - 26}{5}$$

$$= \frac{9 + 20 - 26}{5}$$

$$= \frac{3}{5} \quad \text{Ans.}$$

Distance between two parallel lines.

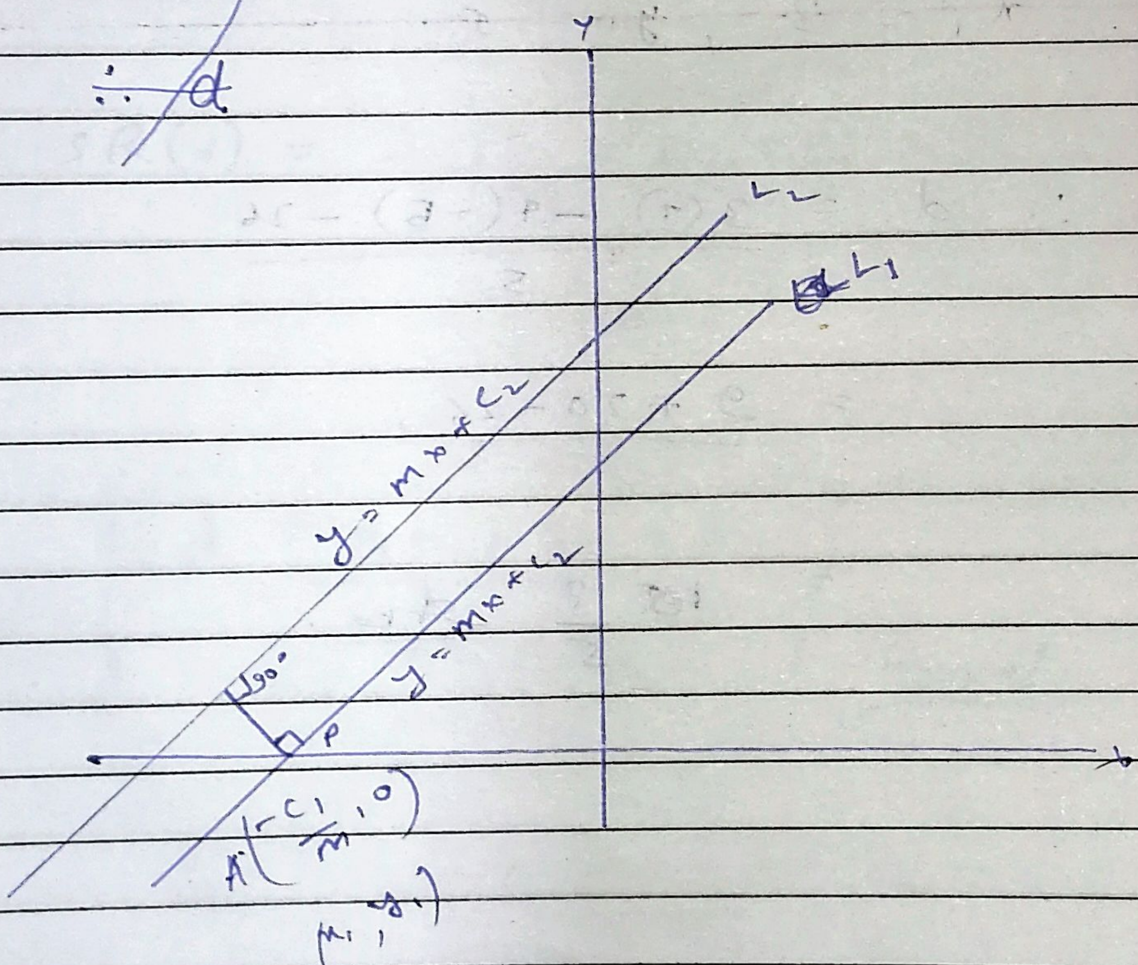
Given the eq^n of line L_2

$L_2 : y = mx + c$

$\Rightarrow mx - y + c_2 = 0$.

$\therefore A = m, \quad B = -1, \quad C = c_2$.

$\therefore d$



We know that slope of two parallel lines are equal.

$$y = mx + c_1$$
$$y = mx + c_2$$

Line L_2 will ~~interest~~ intersect x-axis at the point $\left(-\frac{c_1}{m}, 0\right)$

Therefore distance between two line is equal to the length of the perpendicular from point A to L2. Hence distance between the line L_1 and L_2

~~Given the~~

$$L_2 : y = mx + c_2$$

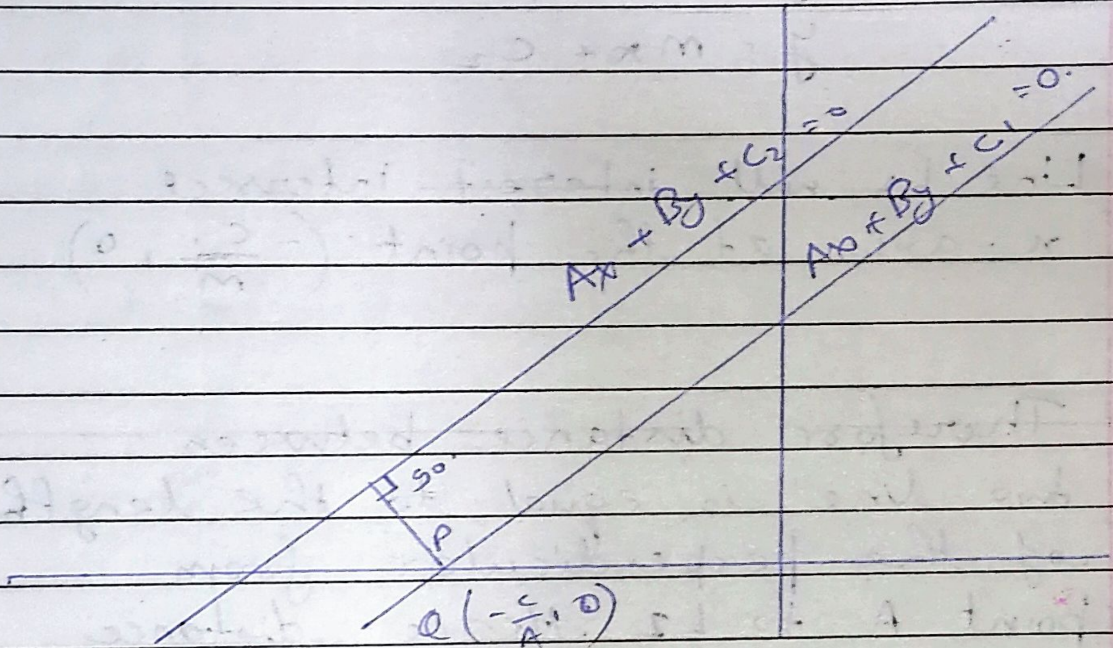
$$\Rightarrow mx - y + c_2 = 0$$

$$\therefore A = m,\ B = -1,\ C = c_2$$

$$\therefore \text{distance} = \left| \frac{Ax_1 + By_1 + c}{\sqrt{A^2 + B^2}} \right|$$

$$= \left| \frac{m \cdot \left(-\frac{c_1}{m}\right) + (-1)(0) + c_2}{\sqrt{m^2 + (-1)^2}} \right|$$

The



$L_2 : \quad Ax + By + C_2 = 0$

And the point of line L_1

$$Q \equiv \left(-\frac{C}{A}, 0\right)$$

Distance $=$

Given the two lines L_1 and L_2 whose equations are $Ax + By + C_1 = 0$ and $Ax + By + C_2 = 0$ respectively.

The line L_1 passing through $Q\left(-\frac{C_1}{A}, 0\right)$

then.

$$\text{Distance} = \left| \frac{Ax_1 + By_1 + C}{\sqrt{A^2 + B^2}} \right|$$

$$= \left| \frac{A.\left(\frac{-C_1}{A}\right) + B.0 + C_2}{\sqrt{A^2 + B^2}} \right|$$

$$= \left| \frac{C_2 - C_1}{\sqrt{A^2 + B^2}} \right|$$ Proved.

Q. Find the distance between two parallel lines $3x - 4y + 7 = 0$ and $3x - 4y + 5 = 0$

$C_1 = 7$, $C_2 = 5$
$A = 3$, $B = 4$

$$D = \frac{C_2 - C_1}{\sqrt{A^2 + B^2}} = \frac{7 - 5}{\sqrt{9 + 16}}$$

$$= \frac{2}{5}$$ Ans