SHIRPUR EDUCATION SOCIETY

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The Shirpur Education Society's

R. C. Patel College of Engineering and Polytechnic, Shirpur

Department of Applied Sciences and Humanities

NAME OF COURSE: - Basic Mathematics

CODE OF COURSE: - 311302

SEMESTER: - FY CO/CW/EE/CE/ME- 1K

SUBJECT TEACHER: - Mr. Pankaj. G. Bhadane

subject :- Basic Mathematics (311302)
Unit - III - Straight line

* Introduction to straight line :-

It can be defined in simple words as the " shortest distance between to points. There are infinitely many points on a line. If we consider some points on a line, a relation between x and y co-ordinates is observed such a relation is nothing but the equation of line.

* Slope of line :-

If θ is the inclination of the line then $\tan\theta$ is called slope or Gradient of the line and it is denoted by m.

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

For example :. If $\theta = 30^\circ$ then

$$\text{slope} = m = \tan 30^\circ = \frac{1}{\sqrt{3}}$$

* Slope of line passing through two points :-

If the given line passing through two points $A(x_1, y_1)$ and $B(x_2, y_2)$ then,

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

ie $$m = \frac{\text{Difference in } y \text{ co-ordinate}}{\text{Difference in } x \text{ co-ordinate}}$$

* slope of General form of a line, $Ax+By+c=0$

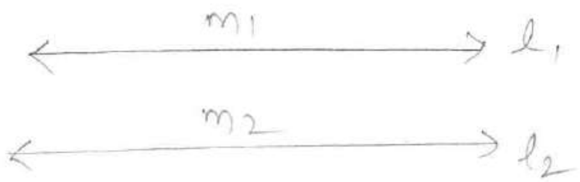
Slope of line $Ax+By+C=0$ is given by,

$$\text{Slope} = m = \frac{-(\text{coefficient of } x)}{(\text{coefficient of } y)}$$

ie $\boxed{m = \frac{-A}{B}}$

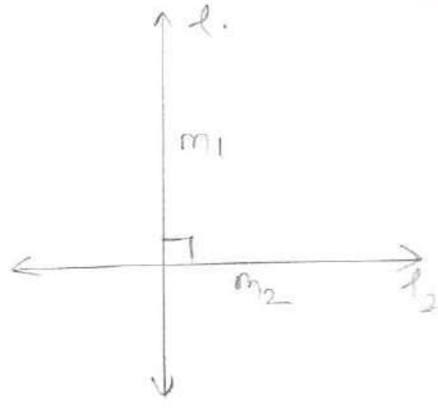
* condition for parallel lines:-

Two lines are parallel if their slopes are equal.



ie $m_1 = m_2$

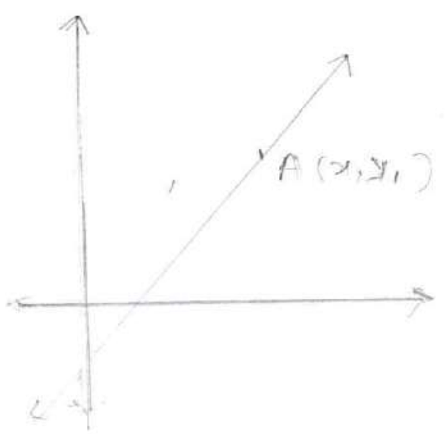
* condition for perpendicular lines:-



Two lines are perpendicular to each other if their product of slopes is -1

ie $m_1 \cdot m_2 = -1$

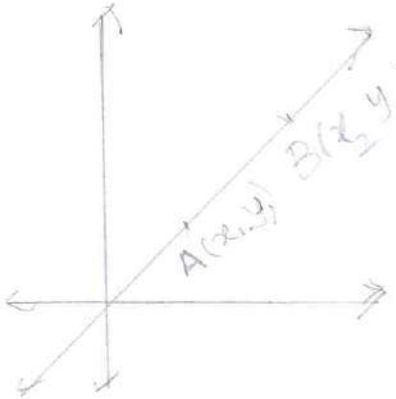
* Slope-point form:-



Equation of line having slope 'm' and passing through a point $A(x_1, y_1)$ is given by,

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

* Two point-form :-



Equation of line passing through the point $A(x_1, y_1)$ and $B(x_2, y_2)$ is given by,

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

* Intercept of a line :-

The General equation of straight line is,

$Ax + By + c = 0$ --- (1)

To find x-intercept, putting $y = 0$ in eqⁿ (1)

we get, $Ax + c = 0$

$$x = \frac{-c}{A}$$

$$\boxed{x\text{-intercept} = \frac{-c}{A}}$$

To find y-intercept, putting $x = 0$ in eqⁿ (1)

we get, $By + c = 0$

$$y = \frac{-c}{B}$$

$$\boxed{y\text{-intercept} = \frac{-c}{B}}$$

Examples on finding the slope of lines.

Example :- Find the slope of line whose inclination is 60°

Sol^n:- we know that

slope of line whose inclination is θ,

$$\text{slope} = m = \tan\theta$$

$$m = \tan 60^\circ$$

$\therefore \tan 60^\circ = \sqrt{3}$

$$\boxed{m = \sqrt{3}}$$

Example:- Find the slope of line passing through points $(-1,-2)$ and $(-3,8)$

Sol^n:- Given points $A(-1,-2) = A(x_1, y_1)$

$B(-3,8) = B(x_2, y_2)$

$$\text{Slope of line } AB = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{8-(-2)}{-3-(-1)}$$

$$= \frac{8+2}{-3+1}$$

$$= \frac{10}{-2}$$

$$\boxed{\text{slope of line } AB = -5 \text{ unit}}$$

Example:- Find the slope and y-intercept of the line $5x - 4y + 7 = 0$

sol^n:- Given eq^n of line is, $5x-4y+7=0$

$$\text{Slope} = m = \frac{-A}{B}$$

compair the eq^n $Ax+By+C=0$

where $A=5$, $B=-4$, $C=7$

$$\text{slope} = m = \frac{-5}{-4}$$

$$\boxed{\text{Slope} = m = \frac{5}{4} \text{ unit}}$$

Find y-intercept.

we know, $$\text{y-intercept} = \frac{-C}{B}$$

$$\text{y-intercept} = \frac{-7}{-4}$$

$$\boxed{\text{y-intercept} = \frac{7}{4} \text{ unit}}$$

Example:- Find the slope & intercepts of the line $\frac{x}{4} - \frac{y}{3} = 2$.

sol^n:- Given eq^n of line is,

$$\frac{x}{4} - \frac{y}{3} = 2$$

$$\frac{3x-4y}{12} = 2$$

$$3x - 4y = 24$$

$$\therefore \quad 3x - 4y - 24 = 0$$

compair the eq^n $Ax + By + C = 0$

where $A = 3$, $B = -4$, $C = -24$

$$\text{slope} = m = \frac{-A}{B} = \frac{-3}{-4} = \frac{3}{4}$$

$$\boxed{\text{Slope} = m = \frac{3}{4} \text{ unit}}$$

To find x-intercept

$$x\text{-intercept} = \frac{-C}{A}$$

$$= \frac{-(-24)}{3} = \frac{24}{8}$$

$$\boxed{x\text{-intercept} = 8}$$

To find y-intercept

$$y\text{-intercept} = \frac{-C}{B}$$

$$= \frac{-(-24)}{-4}$$

$$= \frac{24}{-4}$$

$$\boxed{y\text{-intercept} = -6 \text{ unit}}$$

Example:- Find the slope & intercepts of line

$$\frac{x}{2} - \frac{y}{3} = \frac{1}{4}$$

Sol^n:- Given eq^n of line, $\frac{x}{2} - \frac{y}{3} = \frac{1}{4}$

$$\frac{3x-2y}{6} = \frac{1}{4}$$

$$4(3x-2y) = 6 \times 1$$

$$12x - 8y = 6$$

ie $12x - 8y - 6 = 0$

compair the eq^n $Ax + By + C = 0$

where $A = 12$, $B = -8$, $C = -6$

$\therefore$ slope $= m = \frac{-A}{B} = \frac{-12}{-8} = \frac{3}{2}$

$$\boxed{\text{Slope} = m = \frac{3}{2} \text{ unit}}$$

x-intercept $= \frac{-C}{A} = \frac{-(-6)}{12} = \frac{6}{12} = \frac{1}{2}$

$$\boxed{x\text{-intercept} = \frac{1}{2}}$$

y-intercept $= \frac{-C}{B} = \frac{-(-6)}{-8} = \frac{6}{-8} = \frac{-3}{4}$

$$\boxed{y\text{-intercept} = \frac{-3}{4}}$$

Example:. Show that the lines $2x+3y+7=0$ and $4x+6y+2=0$ are parallel.

Sol^n:- Given eq^n of line 1 is,

$L_1 \Rightarrow 4x+6y+2=0$ and

eq^n of line 2 is,

$L_2 \Rightarrow 2x+3y+7=0$

slope of L_1 is $m_1 = \frac{-A}{B} = \frac{-4}{6} = \frac{-2}{3}$

ie $\boxed{m_1 = \frac{-2}{3} \text{ unit}}$

Slope of L_2 is $m_2 = \frac{-A}{B} = \frac{-2}{3}$

ie $\boxed{m_2 = \frac{-2}{3}}$

It is observed that slopes of both ~~lies~~ lines are equal ie $m_1 = m_2 = \frac{-2}{3}$

$\therefore$ This is condition for parallel lines.

$\therefore$ Given lines are parallel.

Examples:. Show that the lines $3x+4y+7=0$ and $28x-21y+50=0$ are perpendicular to each other.

Sol^n:- line $l_1 \rightarrow 3x+4y+7=0$

slope of l_1 is $m_1 = \frac{-A}{B} = \frac{-3}{4}$

ie $\boxed{m_1 = \frac{-3}{4}}$

line $l_2 \rightarrow 28x - 21y + 50 = 0$

Slope of l_2 is $m_2 = \frac{-A}{B} = \frac{-28}{-21} = \frac{4}{3}$

ie $\boxed{m_2 = \frac{4}{3}}$

we observed that, $m_1 \cdot m_2 = \frac{-\cancel{3}}{\cancel{4}} \times \frac{\cancel{4}}{\cancel{3}} = -1$

ie $m_1 \cdot m_2 = -1$ (this is condition for perpendicular)

$\therefore$ Given lines are perpendicular to each other.

Example:- Find the equation of line passing through the point $(3, -4)$ and having slope $\frac{3}{2}$.

sol^n:- Given slope $= \frac{3}{2}$

point $= P(x_1, y_1) = P(3, -4)$

By using slope-point form

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

$$y - (-4) = \frac{3}{2}(x - 3)$$

$$y + 4 = \frac{3}{2}(x - 3)$$

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

$$2y + 8 = 3x - 9$$

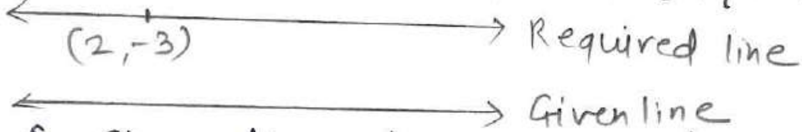
$$\therefore \quad 3x - 9 - 2y - 8 = 0$$

$$3x - 2y - 17 = 0$$

which is required equation of line.

Example:. Find the equation of line passing through $(2,-3)$ and parallel to the line $4x-y+7=0$

sol^n:- Given eq^n of line is, $4x-y+7=0$



Slope of Given line is $m_1 = \frac{-4}{-1} = 4$

Now required line is parallel to given line

$\therefore$ slope of required line also 4.

By slope-point Form,

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

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

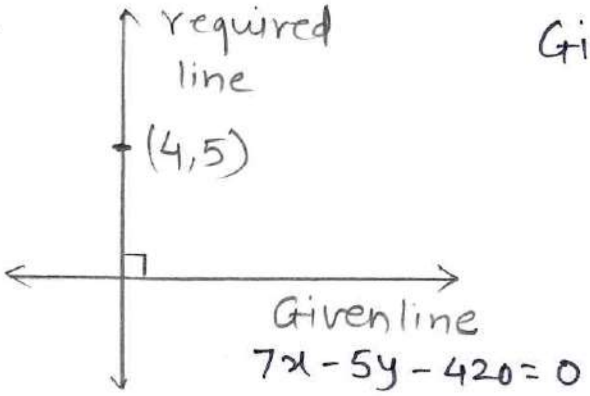
$$y+3 = 4x-8$$

$$\boxed{4x-y-11=0}$$

which is required line equation.

Ex. Find the equation of line passing through $(4,5)$ and perpendicular to line $7x-5y-420=0$

sol^n:-



Given line is $7x-5y-420=0$

It's slope is,

$$m_1 = \frac{-7}{-5} = \frac{7}{5}$$

let m_2 be the slope of required line

$$m_1 \cdot m_2 = -1 \quad \text{(condition for } \perp \text{ line)}$$

$$m_2 = \frac{-1}{m_1} = \frac{-1}{\frac{7}{5}} = \frac{-5}{7}$$

Now required line having a slope $\frac{-5}{7}$ and passing through points $(4,5)$ is given by. By using slope-point form.

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

$$y - 5 = \frac{-5}{7}(x - 4)$$

$$7(y-5) = -5(x-4)$$

$$7y - 35 = -5x + 20$$

$$\boxed{5x + 7y - 55 = 0}$$

which is required line equation.

Example:- Find the equation of line passing through the points $(3,4)$ and $(5,6)$

Sol^n:- Given pts $A(3,4) = A(x_1, y_1)$
$B(5,6) = B(x_2, y_2)$

By using two-point form

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

$$\frac{y-4}{4-6} = \frac{x-3}{3-5}$$

$$\frac{y-4}{\cancel{-2}} = \frac{x-3}{\cancel{-2}}$$

$$y - 4 = x - 3$$

$$\therefore \boxed{x - y + 1 = 0}$$

which is required line equation.

* Angle between two straight lines :-

If m_1 and m_2 are slope of two lines then, acute angle between two lines is given by,

$$\theta = \tan^{-1}\left|\frac{m_1 - m_2}{1 + m_1 \cdot m_2}\right|$$

* Examples on angle between two lines.

Example :- If slope of two lines are $-\frac{5}{6}$ & $\frac{1}{11}$ then Find angle between the lines.

Sol^n :- let $m_1 = -\frac{5}{6}$ and $m_2 = \frac{1}{11}$

Angle between two lines is,

$$\theta = \tan^{-1}\left|\frac{m_1 - m_2}{1 + m_1 \cdot m_2}\right|$$

$$= \tan^{-1}\left|\frac{-\frac{5}{6} - \frac{1}{11}}{1 + \left(-\frac{5}{6}\right)\left(\frac{1}{11}\right)}\right|$$

$$= \tan^{-1}\left|\frac{\frac{-55-6}{66}}{1 - \frac{5}{66}}\right|$$

$$= \tan^{-1}\left|\frac{\frac{-\cancel{61}}{\cancel{66}}}{\frac{\cancel{61}}{\cancel{66}}}\right| = \tan^{-1}|-1|$$

$$\theta = \tan^{-1}(1) \qquad \tan^{-1}|-x| = \tan^{-1} x$$

$$\boxed{\theta = \frac{\pi}{4}} \qquad \therefore \tan^{-1}(1) = \frac{\pi}{4}$$

Example:- Find acute angle between the lines $3x-2y+4=0$ and $2x-3y-7=0$

Sol^n:. Given equation of lines,

$L_1 \rightarrow 3x-2y+4=0$, $L_2 \rightarrow 2x-3y-7=0$

Slope of L_1 is $m_1 = \frac{-A}{B} = \frac{-3}{-2} = \frac{3}{2}$

$\therefore \boxed{m_1 = \frac{3}{2}}$

Slope of L_2 is $m_2 = \frac{-A}{B} = \frac{-2}{-3} = \frac{2}{3}$

$\therefore \boxed{m_2 = \frac{2}{3}}$

Acute angle between two lines,

$$\theta = \tan^{-1}\left|\frac{m_1 - m_2}{1 + m_1 \cdot m_2}\right|$$

$$= \tan^{-1}\left|\frac{\frac{3}{2} - \frac{2}{3}}{1 + \left(\frac{3}{2}\right)\cdot\left(\frac{2}{3}\right)}\right|$$

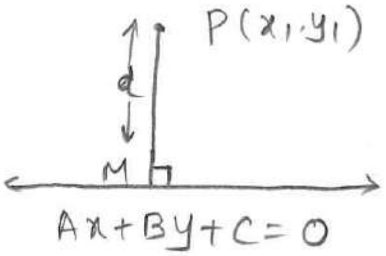
$$= \tan^{-1}\left|\frac{\frac{9-4}{6}}{1+1}\right|$$

$$= \tan^{-1}\left|\frac{\frac{5}{6}}{2}\right|$$

$$= \tan^{-1}\left|\frac{5}{12}\right|$$

$$\therefore \boxed{\theta = \tan^{-1}\left(\frac{5}{12}\right)}$$

* perpendicular Distance between point and line.



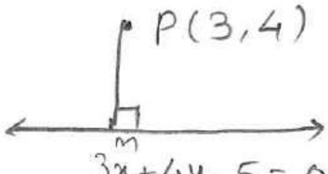
let $P(x_1, y_1)$ is any point and $Ax+By+C=0$ is a line, then perpendicular distance of a point P from the line $Ax+By+C=0$ is given by,

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

Examples on perpendicular Distance between point and line.

Example:- Find distance of the line $3x+4y-5=0$ From the point $(3, 4)$

sol^n:-



From Fig.

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

$$d(PM) = \left| \frac{3(3) + 4(4) - 5}{\sqrt{(3)^2 + (4)^2}} \right|$$

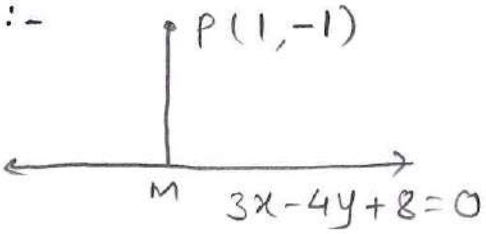
$$= \left| \frac{9+16-5}{\sqrt{9+16}} \right| = \left| \frac{20}{\sqrt{25}} \right|$$

$$= \left| \frac{20}{5} \right|$$

$$\boxed{d(PM) = 4 \text{ unit}}$$

Example:. Find distance of $(1,-1)$ from $3x-4y+8=0$

Sol^n:-



From Fig.

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

$$d(PM) = \left| \frac{3(1)-4(-1)+8}{\sqrt{(3)^2+(-4)^2}} \right|$$

$$= \left| \frac{3+4+8}{\sqrt{9+16}} \right|$$

$$= \left| \frac{15}{\sqrt{25}} \right|$$

$$= \frac{15}{5}$$

$$\boxed{d(PM) = 3 \text{ Unit}}$$

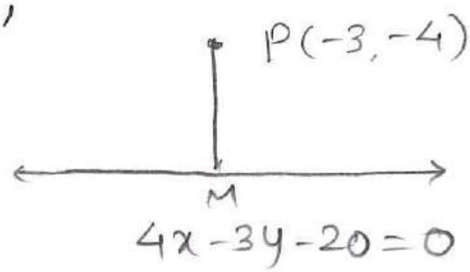
Example:- Find the length of perpendicular from the point $(-3,-4)$ on the line $4(x+2)=3(y-4)$

Sol^n:- Given line equation,

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

$$4x+8 = 3y-12$$

$$\therefore \quad 4x-3y-20=0$$



Distance between point and line is,

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

$$d(PM) = \left| \frac{4(-3) - 3(-4) + 20}{\sqrt{(4)^2+(-3)^2}} \right|$$

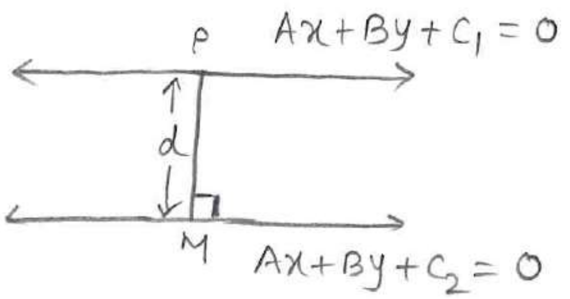
$$= \left| \frac{-12+12+20}{\sqrt{16+9}} \right|$$

$$= \left| \frac{20}{\sqrt{25}} \right|$$

$$= \frac{20}{5}$$

$$\boxed{d(PM) = 4 \text{ unit}}$$

* Perpendicular distance between two parallel lines :-

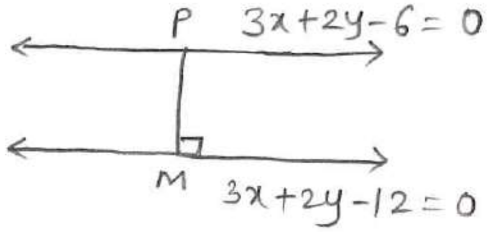


Perpendicular Distance between two parallel lines $Ax+By+C_1=0$ and $Ax+By+C_2=0$ is given by

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

Example:- Find the distance between two parallel lines $3x+2y-6=0$ and $3x+2y-12=0$

sol^n:-



compair the given eq^{ns}.

$A=3,\ B=2,\ C_1=-6,\ C_2=-12$

perpendicular distance between two parallel lines is given by,

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

$$= \left| \frac{-12-(-6)}{\sqrt{(3)^2+(2)^2}} \right|$$

$$= \left| \frac{-12+6}{\sqrt{9+4}} \right|$$

$$= \left| \frac{-6}{\sqrt{13}} \right|$$

$$\boxed{d(PM) = \frac{6}{\sqrt{13}} \text{ unit}}$$

distance is always positive.

Example:- Find the distance between the parallel lines $3x+4y+5=0$ and $6x+8y-25=0$

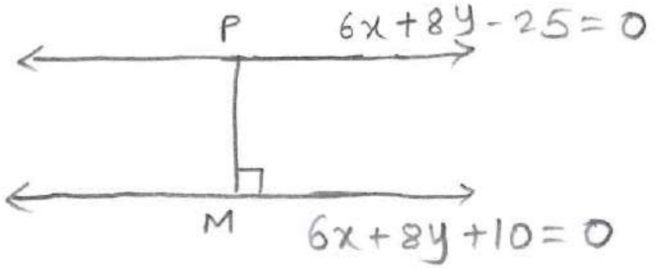
sol^n:- Given line equations,

$L_1 \rightarrow 3x+4y+5=0$ —(1)

$L_2 \rightarrow 6x+8y-25=0$ —(2)

multiply 2 by eq^n (1), we get,

$$6x + 8y + 10 = 0 \quad \text{---} (3)$$



From Fig.
distance between two lines,

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

compair Given eq^{ns}, $A = 6$, $B = 8$,
$C_1 = -25$, $C_2 = 10$

$$d(PM) = \left| \frac{10 - (-25)}{\sqrt{(6)^2 + (8)^2}} \right|$$

$$= \left| \frac{10 + 25}{\sqrt{36 + 64}} \right|$$

$$= \left| \frac{35}{\sqrt{100}} \right|$$

$$= \frac{35}{10}$$

$$= \frac{7}{2}$$

$$\boxed{d(PM) = 3.5 \text{ Unit}}$$

Subject :- Basic Mathematics (311302)
Question Bank
Unit-III - Straight line.

2 Mark Questions.

Q.1) Find the intercept of the line $2x+3y=6$ on both the axes. (Winter-2023)

Q.2) Find the acute angle between the lines whose slopes are $\sqrt{3}$ and $\frac{1}{\sqrt{3}}$ (Winter-2024)

Q.3) Find the slope and intercept of line $3x+4y=12$ (Summer-2025)

Q.4) Find the equation of line passing through $(3,-4)$ and having slope $\frac{3}{2}$. (Winter-2025)

Q.5) Find the value of K, if the lines $Kx-6y=9$ and $6x+5y=13$ are perpendicular to each other (Summer-26)

3 Mark Question

Q.6) Find distance between the parallel lines $3x+2y=5$ and $3x+2y=6$ (Winter-2023)

Q.7) Find acute angle between the lines, $3x=y-4$ and $2x+y+3=0$ (Winter-2023)

Q.8) Find the equation of straight line passes through the points $(-4,6)$ and $(8,-3)$ (Summer-2024)

Q.9) Find the perpendicular distance of the point $(-3,4)$ From the line $4(x+2)=3(y-4)$ (Summer-2024)

Q.10) Find the angle between the lines $x+5y=11$ and $5x-y=11$ (Summer-2024)

Q.11) Find the equation of straight line that passes through $(3,4)$ and perpendicular to the line $3x+2y+5=0$ (W-2024)

4-Mark Questions

Q.12) Find the equation of straight line passing through the point of intersection of lines $4x+3y=8$ and $x+y=1$ and parallel to the line $5x-7y=3$ (winter-2023)

Q.13) Find the equation of straight line passing through the point of intersection of $x+y=4$ and $2x+y=4$ and parallel to the x-axis (winter-2024)

Q.14) Find the equation of line passing through $(2,5)$ and the point of intersection of lines $x+y=0$ and $2x-y=9$ (winter-2025)

Q.15) Find the equation of line passing through the point of intersection of the lines $x+y=0$ and $2x-y=9$ and passing through the point $(2,5)$ (summer-2026)

8/6/26.