

Find the equation of line.

// parallel same slope

⊥ perpendicular $\frac{a}{b} \perp -\frac{b}{a}$ $\frac{a}{b} \times \frac{-b}{a} = \frac{-ab}{ab} = -1$

Eg 1) Find the slope of the line $2x + y - 4 = 0$
Hence find the **equation of the line** through the point $(2, 4)$ which is parallel to the given line.

When given the equation of the line use the $y = mx + c$ to find the slope.

$m = \text{slope}$

$$\begin{array}{r|l} -2x & 2x + y - 4 = 0 \\ & y - 4 = -2x \\ +4 & y = -2x + 4 \\ & y = mx + c \end{array}$$

Slope = -2

Point (x_1, y_1)
 $(2, 4)$

Equation of line

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

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

$$y - 4 = -2x + 4$$

$$\begin{array}{r|l} +2x & 2x + y - 4 = 4 \\ -4 & 2x + y - 8 = 0 \end{array}$$

$$\text{Ans} = 2x + y - 8 = 0$$

C/W Pg 219 Q2 + Q5



Section 11.5 Parallel and perpendicular lines**Example 1**

Find the equation of the line through the point $(-2, 3)$ which is perpendicular to the line $2x - y + 5 = 0$.

Exercise 11.5

1. Find the slope of the line $2x + y - 4 = 0$.

Now find the equation of the line through the point $(2, 4)$ and which is parallel to the line $2x + y - 4 = 0$.

2. Find the equation of the line through the point $(1, -6)$ and which is parallel to the line $3x - y + 4 = 0$.

Slope = $y = mx + c$

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

$$+y \quad | \quad 3x + 4 = y \quad | \quad +y$$

$m = 3$ slope

Equ of line

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

$$y - (-6) = 3(x - 1)$$

$$y + 6 = 3x - 3$$

$$-y \quad | \quad 3x - y - 3 \quad | \quad -y$$

$$-6 \quad | \quad 0 = 3x - y - 9 \quad | \quad -6$$

$$3x - y - 9 = 0$$

Perpendicular Slopes finding the equation of the Line.

3. Find the slope of the line $2x - 3y + 1 = 0$.

What is the slope of any line perpendicular to $2x - 3y + 1 = 0$?

Now find the equation of the line through the point $(4, -1)$ and which is perpendicular to the line $2x - 3y + 1 = 0$.

Step 1: Find the slope

$$y = mx + c$$

$$2x - 3y + 1 = 0$$

$$+3y \quad | \quad 2x + 1 = 3y \quad | \quad +3y$$

$$\therefore \quad | \quad 2x + 1 = 3y \quad | \quad \div 3$$

$m = \frac{2}{3} \perp -\frac{3}{2}$

Equ of Line
 $y - y_1 = m(x - x_1)$

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

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

multiply

Eg $m = 2$

$2 \perp$

$\frac{2}{1} \perp -\frac{1}{2}$

$$\begin{array}{l} +3y \mid 2x+1 = 3y \mid +3y \\ \div 3 \mid \frac{2x+1}{3} = y \mid \div 3 \end{array}$$

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

multiply

$$2y+2 = -3x+12$$

$$\begin{array}{l} +3x \mid 3x+2y+2 = 12 \mid +3x \\ -12 \mid 3x+2y-10 = 0 \mid -12 \end{array}$$

$$\text{Ans} = 3x+2y-10=0$$

$$\frac{2}{1} \perp -\frac{1}{2}$$

C/W
Pg 219
Q 4+6

4. Find the equation of the line through $(-2, 1)$ and which is perpendicular to the line $3x + 2y - 4 = 0$.

$$y = mx + c$$

$$3x + 2y - 4 = 0$$

$$\begin{array}{l} -3x \mid +2y - 4 = -3x \mid \\ +4 \mid 2y = -3x + 4 \mid +4 \\ \div 2 \mid y = \frac{-3x+4}{2} \mid \div 2 \end{array}$$

$$\text{Ans} = 2x - 3y + 7 = 0$$

$$m = \frac{-3}{2} \perp \frac{2}{3}$$

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

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

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

$$\begin{array}{l} -3y \mid -3 = 2x - 3y + 4 \mid -3y \\ +3 \mid 0 = 2x - 3y + 7 \mid +3 \end{array}$$

5. Find the equation of the line through $(-4, 0)$ and which is parallel to the line $y = 3x - 5$.

$$y = mx + c$$

$$y = 3x - 5$$

$$\text{Slope} = 3(m)$$

Equ of line

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

$$y - 0 = 3(x + 4)$$

$$y = 3x + 12$$

$$y = mx + c$$

$$\begin{array}{l} -y \mid 0 = 3x - y + 12 \mid -y \end{array}$$

$$3x - y + 12 = 0 \quad ax + by + c = 0$$

H/W

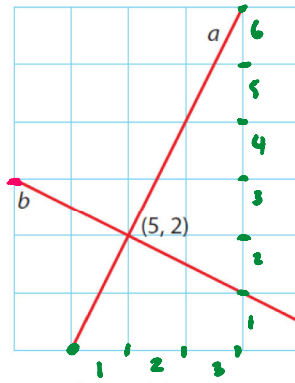
6. The given diagram shows the lines a and b intersecting at the point $(5, 2)$

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$$B = \frac{2}{4} \quad \frac{\text{Rise}}{\text{Run}}$$

$$\text{Slope of } B = \frac{1}{2}$$

$$A = \frac{6}{3} - \frac{2}{1} = 2$$



$$(11) \quad -\frac{1}{2} \times \frac{2}{1} = \frac{-2}{2} = -1 \quad \checkmark$$

- (i) Use the grid to find the slopes of a and b .
- (ii) Investigate if a and b are perpendicular to each other.
- (iii) Find the equation of the line a .

Slope 2 Point $(5, 2)$ $y - y_1 = m(x - x_1)$

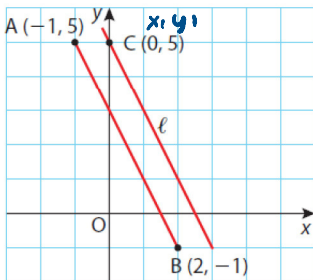
$$y - 2 = 2(x - 5)$$

$$\begin{array}{l} y - 2 = 2x - 10 \\ +2 \quad | \quad y = 2x - 8 \quad | \quad +2 \\ -y \quad | \quad 0 = 2x - y - 8 \quad | \quad -y \end{array}$$

7. The given diagram shows the points $A(-1, 5)$, $B(2, -1)$ and $C(0, 5)$.

The line ℓ is parallel to AB and contains the point C .

Find the equation of ℓ .



$$\text{Slope } [AB] \quad m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1 - 5}{2 - (-1)} = \frac{-6}{3} = -2$$

$$\text{Slope } \ell = -2$$

$$\text{Equation of } \ell \quad y - y_1 = m(x - x_1) \quad m = -2 \quad C(0, 5)$$

$$y - 5 = -2(x - 0)$$

$$\begin{array}{l} y - 5 = -2x \\ +2x \quad | \quad 2x + y - 5 = 0 \quad | \quad +2x \end{array}$$

8. Which one of the following lines is parallel to $3x + y - 4 = 0$?

A: $y = 3x - 2$

B: $y = \frac{1}{3}x + 4$

C: $6x + 2y + 7 = 0$

D: $x + 3y + 2 = 0$

9. The point A has coordinates $(1, 7)$ and the point B has coordinates $(3, 1)$.

The midpoint of [AB] is P.

Find the coordinates of P.

Now find the equation of the line which passes through P and which is perpendicular to the line $x + 5y - 7 = 0$.

Midpoint $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right) = \left(\frac{1+3}{2}, \frac{7+1}{2}\right) = \left(\frac{4}{2}, \frac{8}{2}\right) = (2, 4)$ P

Equ of line $y = mx + c$

Slope $(m) = -\frac{1}{5}$

$-\frac{1}{5} \perp \frac{5}{1} = 5$

$$\begin{array}{l} \cancel{x} + 5y - 7 = 0 \\ \cancel{x} \quad | \quad 5y - \cancel{x} = -x \quad | \quad -x \\ \cancel{x} \quad | \quad 5y = -x + 7 \quad | \quad +7 \\ \div 5 \quad | \quad y = \frac{-x+7}{5} \quad | \quad \div 5 \end{array}$$

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

$m = 5$
 (x_1, y_1)
 $(2, 4)$

$y - 4 = 5(x - 2)$

$y - 4 = 5x - 10$

$-y \quad | \quad -4 = 5x - y - 10 \quad | \quad -y$
 $+4 \quad | \quad 0 = 5x - y - 6 \quad | \quad +4$

HVV

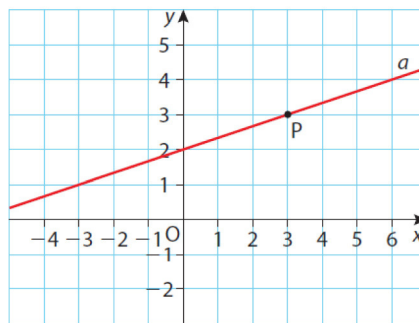
10. The line $y = 2x + 5$ intersects the y-axis at the point P.

(i) Write down the slope of the line and the coordinates of P.

(ii) Find the equation of the line through P and which is perpendicular to $y = 2x + 5$.

10. The line $y = 2x + 5$ intersects the y -axis at the point P.
- Write down the slope of the line and the coordinates of P.
 - Find the equation of the line through P and which is perpendicular to $y = 2x + 5$.

11. Use the grid in the given diagram to write down the slope of the line a .
Now write down the equation of a in the form $y = mx + c$.
- Write down the coordinates of the point P and hence find the equation of the line through P which is perpendicular to a .



12. The equation of the line AB is $5x - 3y = 26$.

(i) Find the slope of AB.

(ii) The point A has coordinates $(4, -2)$ and a point C has coordinates $(-6, 4)$.

(a) Prove that AC is perpendicular to AB.

(b) Find the equation of the line AC, expressing your answer in the form $ax + by = c$.

Answers

Exercise 11.5

1. $-2; 2x + y - 8 = 0$

2. $3x - y - 9 = 0$

3. $\frac{2}{3}; -\frac{3}{2}; 3x + 2y - 10 = 0$

4. $2x - 3y + 7 = 0$

5. $3x - y + 12 = 0$

6. (i) Slope $a: 2$, Slope $b: -\frac{1}{2}$

(ii) Yes, perpendicular

(iii) $2x - y - 8 = 0$

7. $2x + y - 5 = 0$

8. C

9. $(2, 4); 5x - y - 6 = 0$

10. (i) Slope: 2, $P(0, 5)$ (ii) $x + 2y - 10 = 0$

11. $\frac{1}{3}; y = \frac{1}{3}x + 2; P(3, 3); y = -3x + 12$

12. (i) $\frac{5}{3}$ (ii) (b) $3x + 5y = 2$