Parallel Lines

The symbol for "parallel" is $\parallel$ (think of the two "l"s in "parallel"). $\parallel$ lines NEVER cross each other.

Like this:

$\parallel$ lines have the EXACT SAME m, including sign.

For example, if we're given some line $y=-6x-7$, all lines $\parallel$ to this one will have the same m of -6.

To find the eqn. of a line $\parallel$ to, say, $y=-6x-7$ and passing through $(\underset{x_1}{0}, \underset{y_1}{-2})$, do the following:

- Determine what the $\parallel$ slope is. Thankfully this is very easy, since nothing changes: if $m=-6$, m still $=-6$.
- Plug m, y_1 and x_1 into the Point-Slope formula:

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

$$y-(-2)=-6(x-0)$$

$y-(-2)=y+2 \longrightarrow$ $y+2=-6x-(0)(-6)$ ← anything times $\phi=\phi$.

$$y+2=-6x+0$$

$$-2 \qquad -2$$

$$\boxed{y=-6x-2}$$

- Compare these eqns.: $y=-6x-7$ vs. $y=-6x-2$. Are the ms the same? Yes. These lines are $\parallel$ to each other. The y-intercepts (b) do not matter. (over)

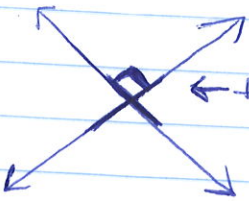
To summarize:

- Keep m the EXACT SAME (sign and all)
- Plug m, x_1, and y_1 into the Point-Slope formula and solve.

Perpendicular Lines

The symbol for "perpendicular" is $\perp$. It symbolizes how two lines intersect (cross) each other at a 90° angle.

Like so:



← the box also indicates a 90° angle

Lines that are $\perp$ to each other have m that are "negative reciprocals" of each other. In other words, the slope number and signs are flipped.

For example, we are given the line $y = -\frac{3}{4}x + 2$.
We know that $m = -3/4$.
The negative reciprocal of this m is $+\frac{4}{3}$.

↳ $-3/4$ flips (including sign) and becomes $+4/3$.

To find the eqn. of a line $\perp$ to, say, $y = \frac{3}{4}x + 2$, and passing through $(\underset{x_1}{3}, \underset{y_1}{1})$, do the following:

- Determine what the $\perp$ m is. Flip $\frac{3}{4}$ and it becomes $+4/3$.
- Use the eqn. $y - y_1 = m(x - x_1)$. Plug in the new m, x_1, and y_1:

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

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- Rearrange $y-1=\frac{4}{3}(x-3)$ to be in Slope-Intercept form:

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

$$=\frac{4}{3}x-\frac{3}{1}\left(\frac{4}{3}\right) \leftarrow 3\text{s cancel out}$$

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

$$+1 \qquad +1$$

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

- Compare our original eqn. with our new one:

$$y=-\frac{3}{4}x+2 \quad \text{vs.} \quad y=\frac{4}{3}x-3$$

Are the ms negative reciprocals of each other?
$-\frac{3}{4}$ flipped $\xrightarrow{\text{becomes}}$ $+\frac{4}{3}$, so YES.

Do the y-intercepts (b) matter? No. Only the slopes matter.

And we're done.

- To summarize:
  - Flip original m, including sign, to get a new m.
  - Plug in new m, y_1 and x_1 (from given coordinate) into the Point-Slope formula ($y-y_1=m(x-x_1)$).
  - Solve to get your eqn. $\perp$ to the original line.