

1.3: Linear Fcts.

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Defn: A linear fct has the form $f(x) = mx + b$

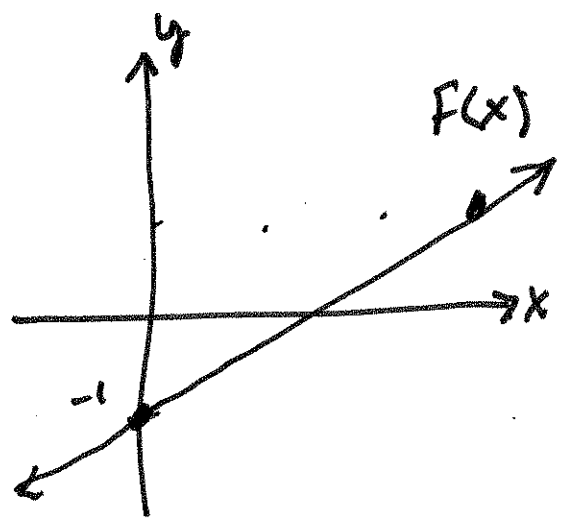
OR $y = mx + b$

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

$b = y\text{-intercept.}$

ex 1: Find the lin. fct w/ slope $\frac{2}{3}$ and $y\text{-int}$ -1 .

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



ex 2: Find the linear fct thru $(10, 2)$ and $(8, 7)$.

1st: symbolically.

$$m = \frac{7 - 2}{8 - 10} = -\frac{5}{2}$$

recall: pt-slope form

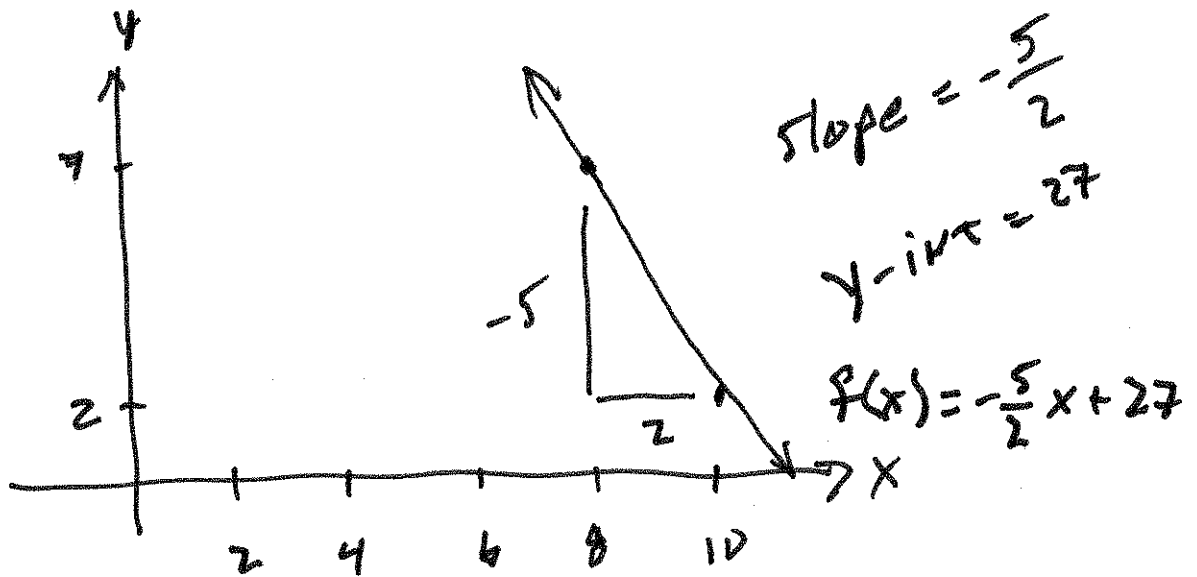
$$y - y_1 = m(x - x_1)$$

$$\Rightarrow y - 2 = -\frac{5}{2}(x - 10)$$

$$= -\frac{5}{2}x + 25$$

$$\Rightarrow y = -\frac{5}{2}x + 27 \text{ or } f(x) = -\frac{5}{2}x + 27.$$

2nd: graphically.



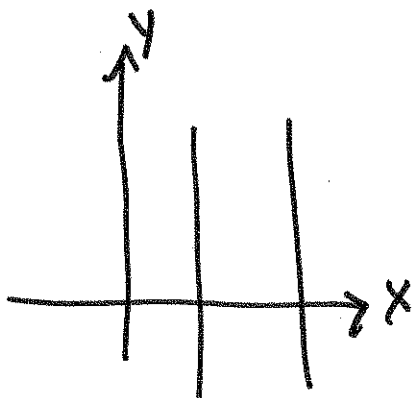
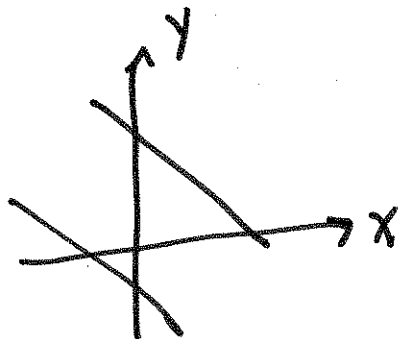
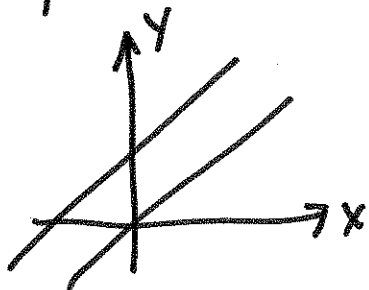
Domain: $(-\infty, \infty) \quad x \in \mathbb{R}$

Range: $(-\infty, \infty) \quad y \in \mathbb{R}$

Special Lines.

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① parallel lines



same slope.

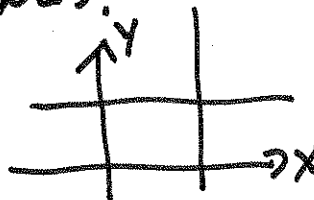
Ex. Find the eqn of the line parallel to $y = 3x + 24$ thru the pt $(25, 29)$

$$y - 29 = 3(x - 25)$$

$$\Rightarrow y = 3x - 75 + 29$$

$$= 3x - 46$$

② perpendicular lines.



slopes are negative reciprocals.

perp. slopes

$$\frac{2}{3} \text{ \& } -\frac{3}{2} \quad -\frac{7}{4} \text{ \& } \frac{4}{7}$$

$$3 \text{ \& } -\frac{1}{3} \quad -\pi \text{ \& } \frac{1}{\pi}$$

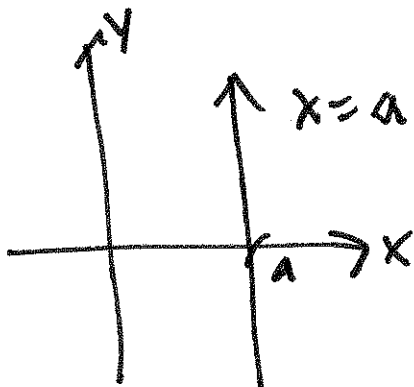
ex: Find the eqn of the line perpendicular to $y = 3x + 24$ thru $(20, 15)$

$$\Rightarrow y - 15 = -\frac{1}{3}(x - 20)$$

solve for y

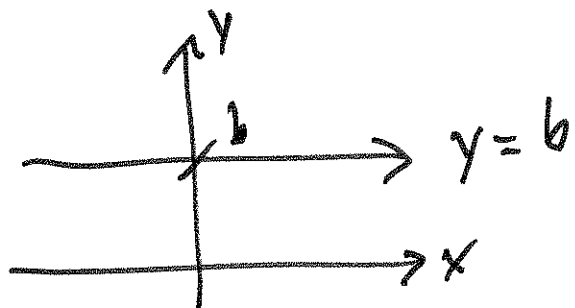
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vertical lines



slope is undefined

④ horizontal lines



slope = 0.

ex: marriage rates.

yr	# of marriages/1000 unmarried women
1975	66.4
1980	62.5
1985	58.6
1990	54.7

-3.9
 -3.9
 -3.9

1st: Define variables.
 $t = \text{yrs since 1975}$
 $w = \# \text{ of marriages}$

2nd: linear model.

$$\text{slope} = \frac{-3.9}{5}$$

$$w\text{-intercept} = 66.4$$

$$t = 0$$

$$w = 66.4$$

$$w = -\frac{3.9}{5}t + 66.4$$

3rd: interp the w-int.

In 1975 there were 66.4 marriages/1000 women

4th interp. the slope

every 5 yrs the # of weddings decreases by 3.9/1000 women.

5th: Find & interp the t-intercept.

$$w = -\frac{3.9}{5}t + 66.4$$

solve $0 = -\frac{3.9}{5}t + 66.4$

$$\Rightarrow \frac{3.9}{5}t = 66.4$$

$$\Rightarrow t = 66.4 \left(\frac{5}{3.9} \right) \approx 85$$

In 2060, there will be no weddings.

1.3 Linear Fcts

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Ex1: Marriage rates are declining (approx data)

This is approx data -
taken from the Index
of Leading Cultural
Indicators.

yr	lt of marriages 1000 unmarried women
1975	66.4
1980	62.5
1985	58.6
1990	54.7

construct a linear model.

- define variables.
- model.
- int. y-int.
- int. the slope.
- find & int. the x-int.
- reasonable domain & range.

Linear Fct: Of the form $f(x) = mx + b$ where
 m & b are constants.

ex2: Find the lin. fct. w/ slope = $\frac{2}{3}$ & y-int -1.

ex3: Eqn of the line thru (10, 2) & (8, 7)

parallel vs. perp. lines.

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slope = 0 vs. und. slope.

ex4: R-11 is $3\frac{1}{2}$ " thick

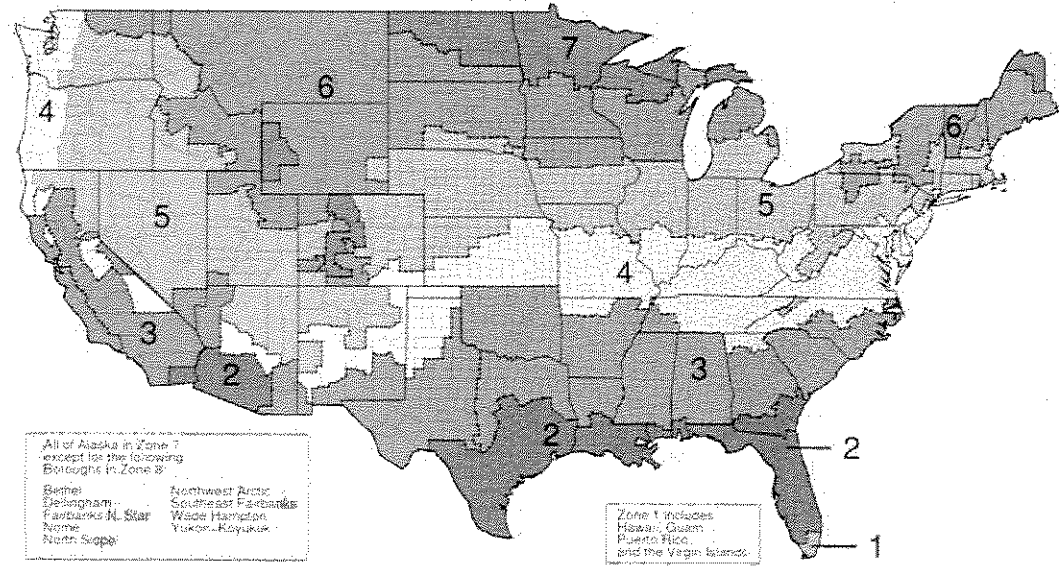
R-19 is $5\frac{1}{2}$ thick

How thick is R-51 if the relationship is linear?

(see picture)



Recommended insulation levels for retrofitting existing wood-framed buildings



Zone	Add insulation to Attic		Floor
	Uninsulated Attic	Existing 3-4 Inches of Insulation	
1	R30 to R49	R25 to R30	R13
2	R30 to R60	R25 to R38	R13 to R19
3	R30 to R60	R25 to R38	R19 to R25
4	R38 to R60	R36	R25 to R30
5 to 8	R49 to R60	R38 to R49	R25 to R30