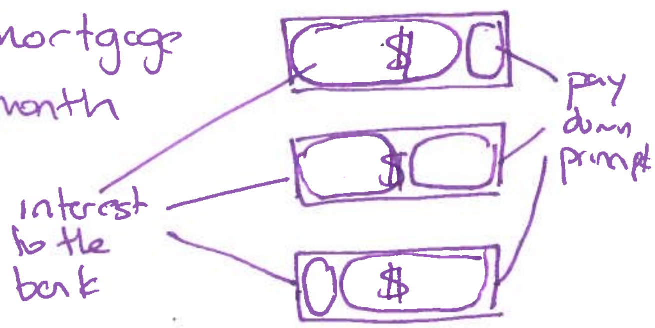
# Section 13.1 Review of Graphing

Most fundamental approach to graphing a function.

**Ex** Suppose you have a mortgage ... spanning 30 years, with a 3.6% annual interest rate.

Pay mortgage every month




Let $n$ be some number of months since loan started...

$f(n)$ to be the portion of ~~loan~~ payment that goes to lower principal.

$$f(n) = 1.003^{n-360}$$

Make a graph of $f$...

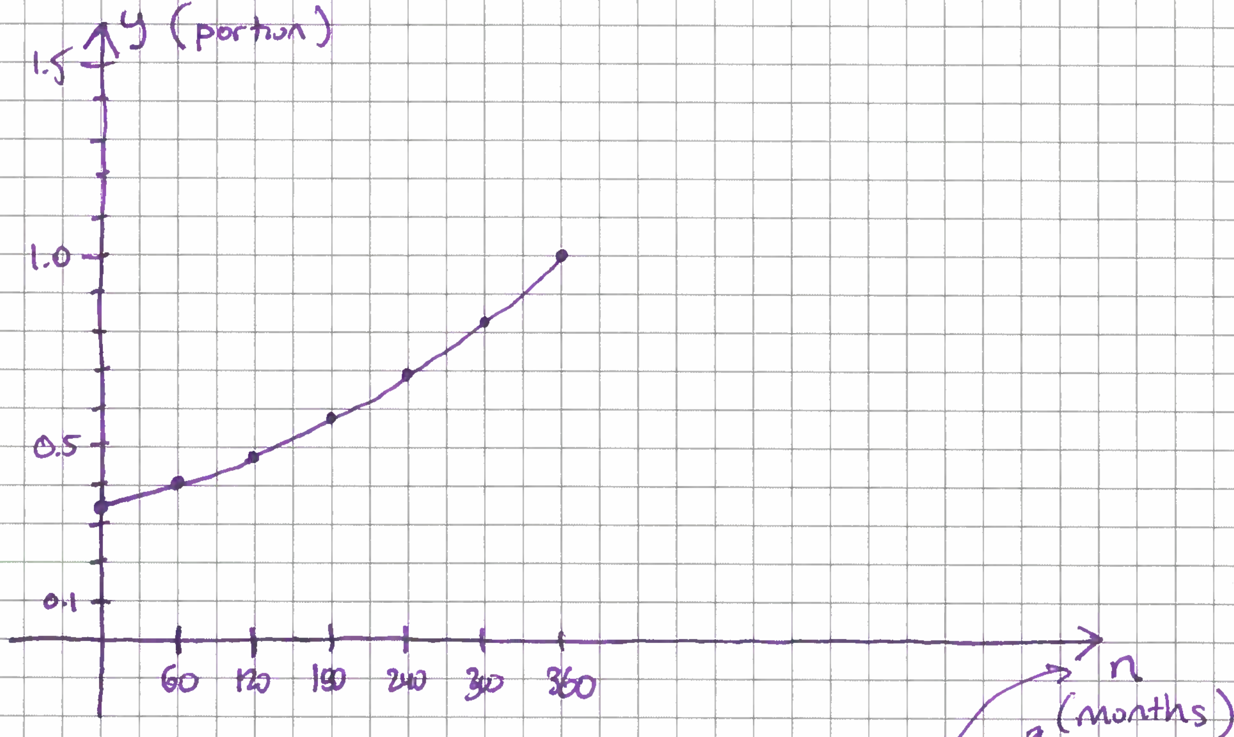
| $n$ | $f(n)$ |
|---|---|
| 0 | 0.3401 |
| 60 | 0.4071 |
| 120 | 0.4873 |
| 180 | 0.5832 |
| 240 | 0.6981 |
| 300 | 0.8355 |
| 360 | 1.000 |

60 months
5 years

$$f(0) = 1.003^{0-360} = 1.003^{-360} \approx 0.3401$$

$(\approx 34.01\%)$

$$f(60) = 1.003^{60-360} = 1.003^{-300} \approx 0.4071$$




ticks and labels

variable

units

Some function formulas have "special" recognizable patterns where there's a "shortcut" for graphing.

<u>Ex</u> Rent a scooter, charges \$1 right away. Then you are charged \$.25 per minute.

Let $x$ be how many minutes ridden, and let $C(x)$ be the total charge induced to your bank card.

Formula: $C(x) = 0.25x + 1$

Graph this using slope-intercept...

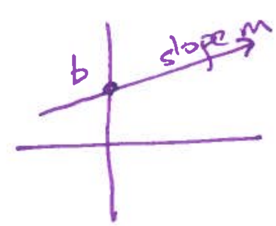
Reminds us of

$y = mx + b$

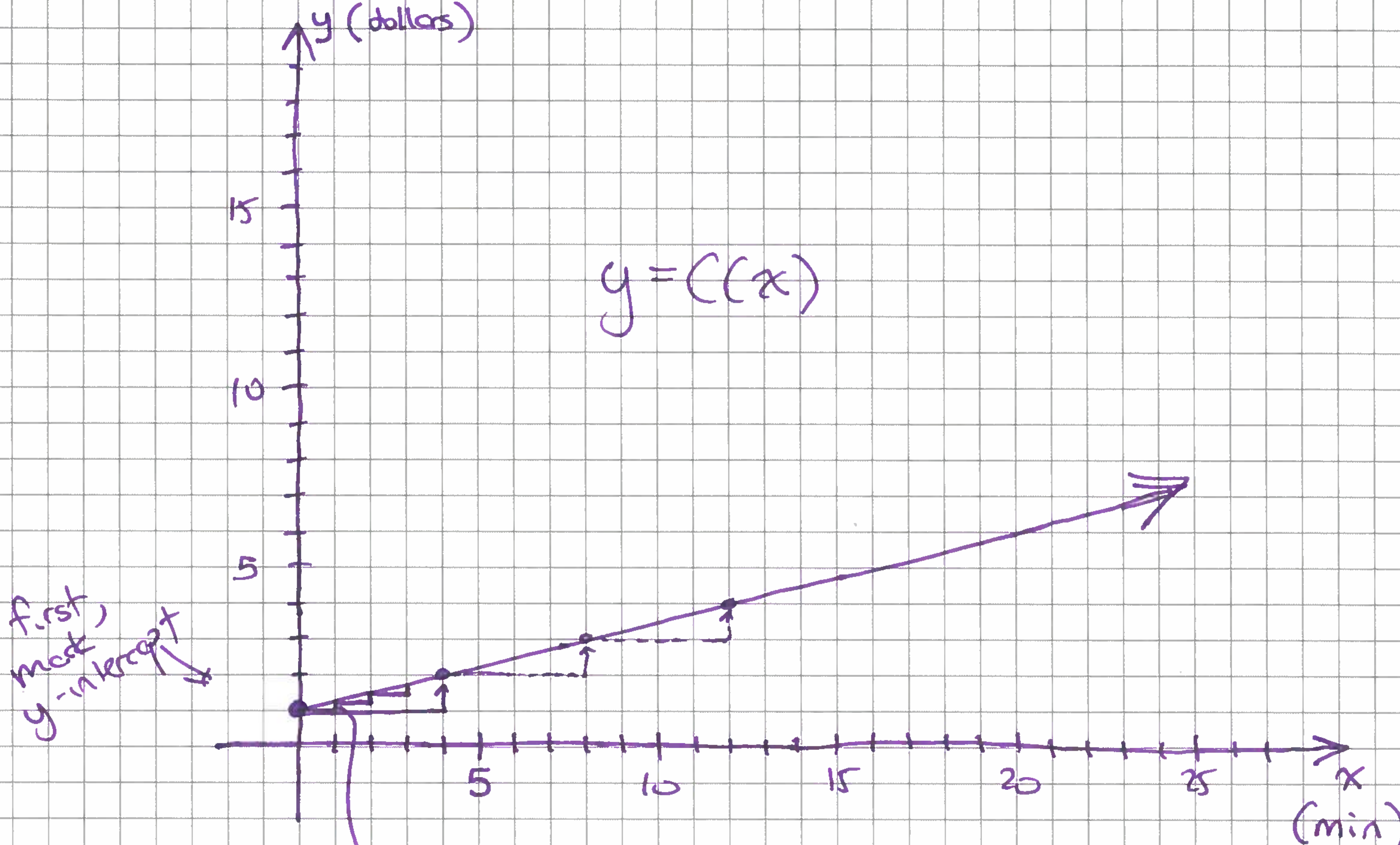
"slope-intercept" form of a line equation

slope

$(0, b)$ is the y-intercept



$$C(x) = \underbrace{0.25}_{\text{slope } 0.25}x + \underbrace{1}_{\substack{\text{y-intercept} \\ \text{at } (0,1)}}$$




1 minute forward,
0.25 up.
(one way to illustrate slope)

Alternatively,

$$m = 0.25 = \frac{25}{100} = \frac{1}{4}$$

$$\frac{1}{4}$$

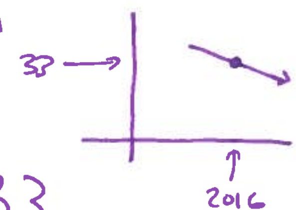
1 ← rise of 1 dollar

4 ← run of 4 minutes

Ex In 2016, 33% of adult German males smoked tobacco regularly. This has been decreasing by 0.4% per year.

Let $t$ be the year (like 2010, 2016, 2020, ...) and let $f(t)$ be the percent of adult German males who regularly smoke tobacco.

$$[\, f(2016) = 33 \,]$$




Formula: $f(t) = -0.4(t - 2016) + 33$

Reminds us of $y = m(x - x_0) + y_0$

(point-slope form of a line equation)

Graph f.

slope

$(x_0, y_0)$ is one point on the line.

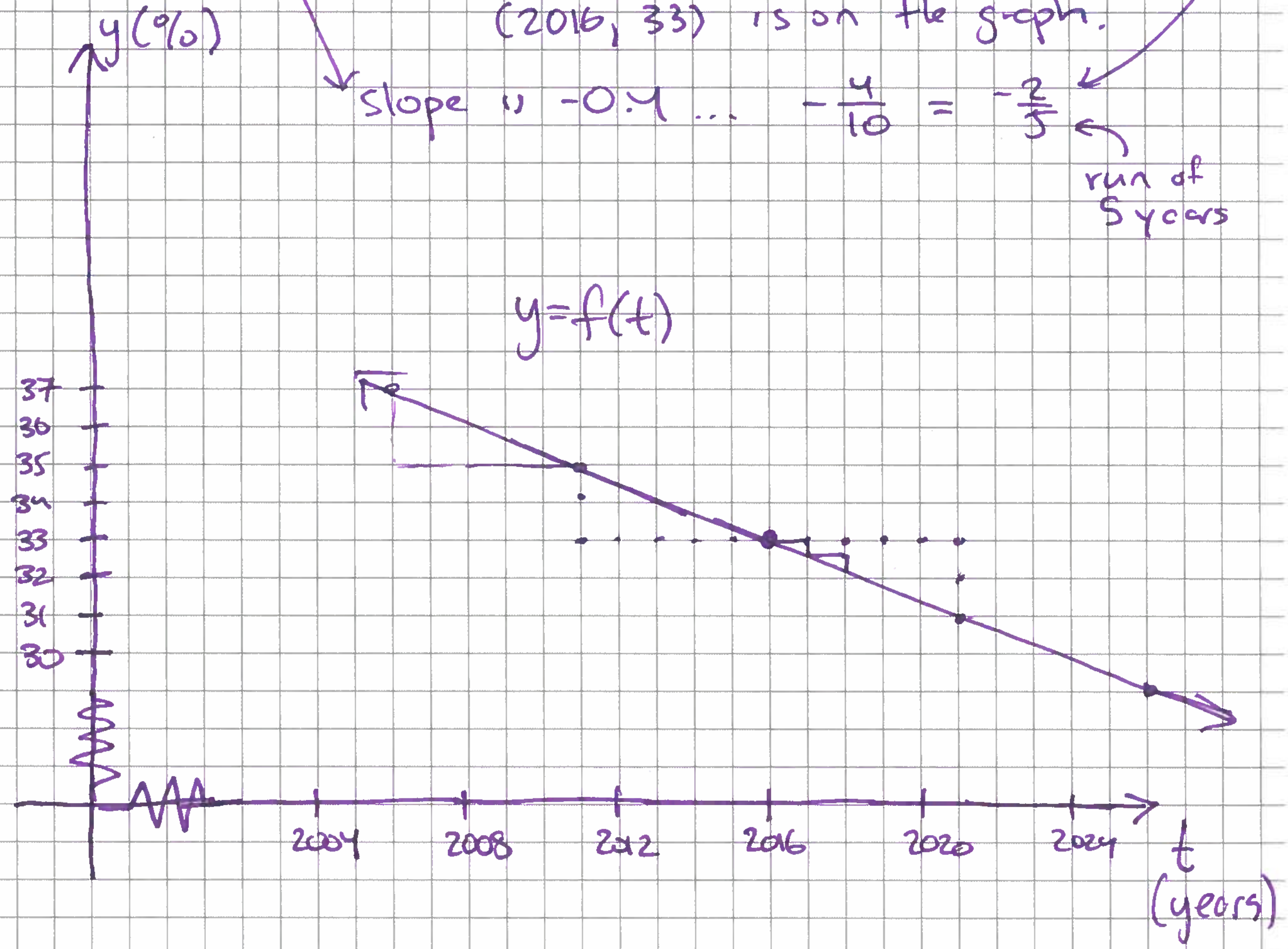
$f(t) = -0.4(t-2016)+33$

"rise" of $-2\%$

(2016, 33) is on the graph.

slope is $-0.4 \ldots \; -\frac{4}{10} = -\frac{2}{5}$

run of 5 years



EX I have \$100 to spend on Halloween candy.

Only buying Bags of Skittle packets
and Bags of Hershey's minis.

- One bag Skittle packets costs \$2.50.
- One bag of H minis cost \$2.00.

To study what combos are possible...
let $x$ be how many Skittle bags you buy,
$y$ be how many H mini bags...

$$\underbrace{2.50x}_{\text{spent on Skittles}} + \underbrace{2.00y}_{\text{spent on H minis}} = 100$$

$$2.5x + 2y = 100$$

Standard form of a line equation:

$$Ax + By = C$$

Graph this equation.

$$2.5x + 2y = 100$$

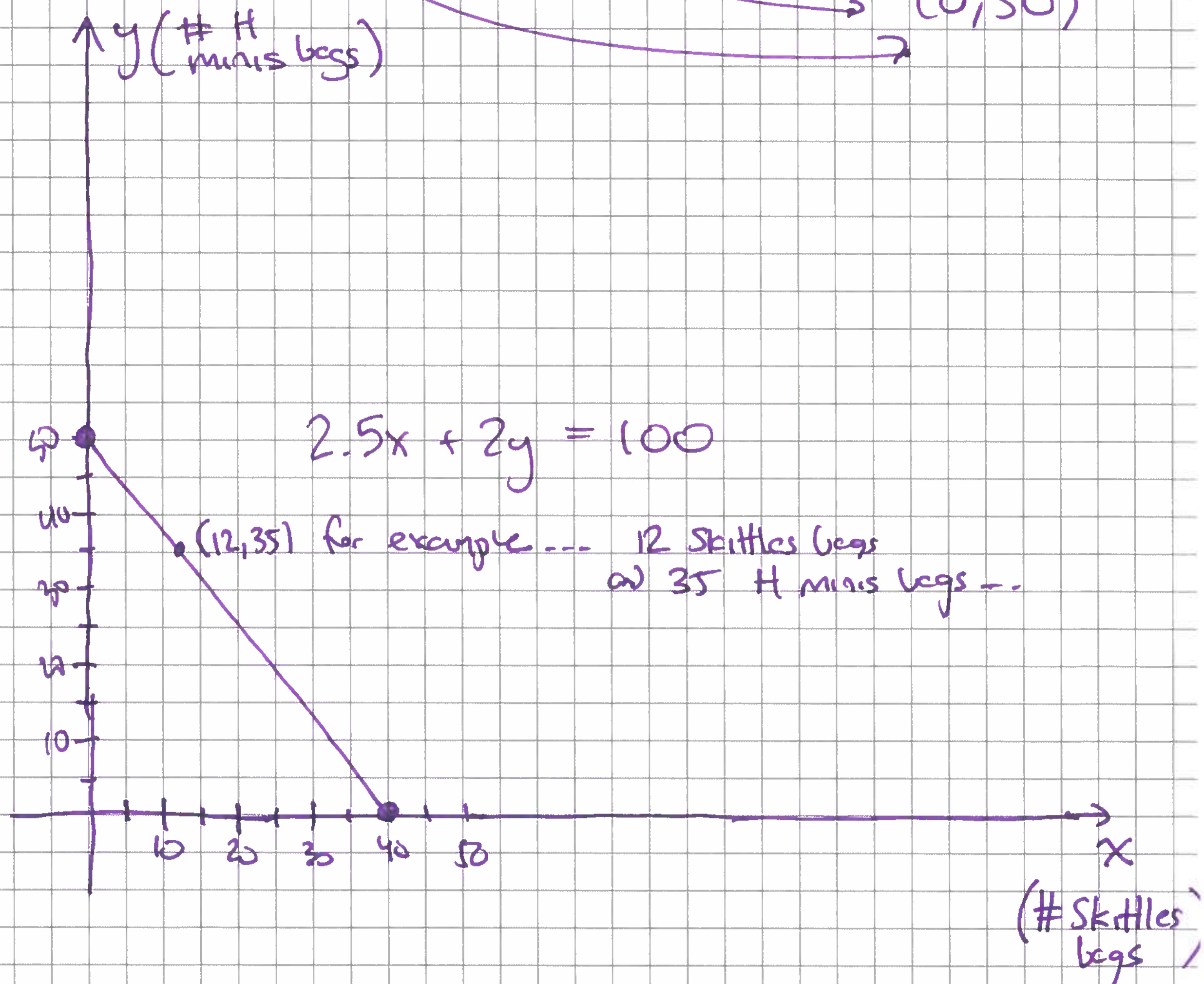
Imagine if $y = 0$ $\Longrightarrow$ $2.5x = 100$
(nothing on H, all on Skittles)

$$x = \frac{100}{2.5}$$

$$x = 40 \longrightarrow (40, 0)$$

Imagine if $x = 0$ $\Longrightarrow$ $2y = 100$
(no Skittles, all H)

$$y = 50 \longrightarrow (0, 50)$$



$f(x) = m \cdot x + b$

$f(x) = m(x-h) + k$

$A \cdot x + B \cdot y = C$

we have "shortcut" methods for making graphs.

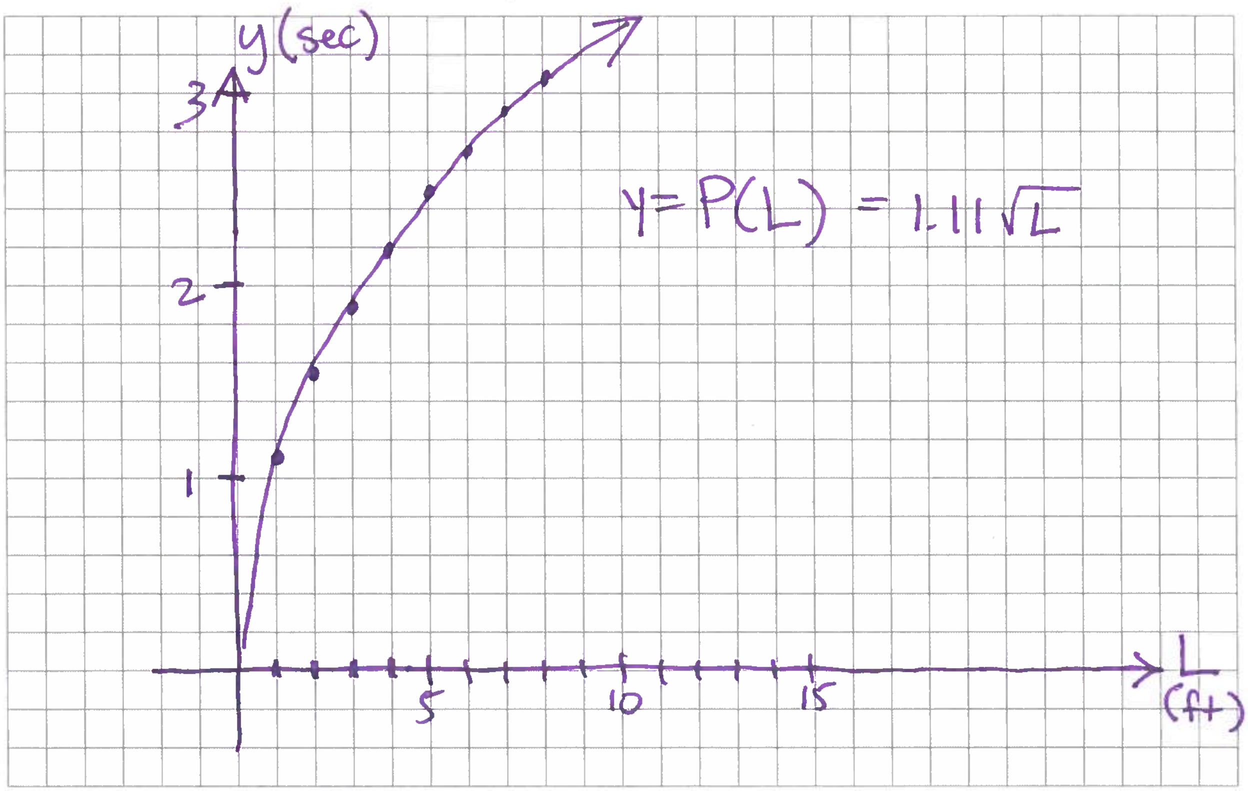
# Graphing Review

1. The period of a swinging pendulum is how much time it takes for the pendulum to complete a fill swing. On Earth, if the pendulum is $L$ feet long, then the period can be modeled by the function $P$, where $P(L) = 1.11\sqrt{L}$. Make a graph of the function $P$. Do this by making a table with at least 8 decimal approximation values.

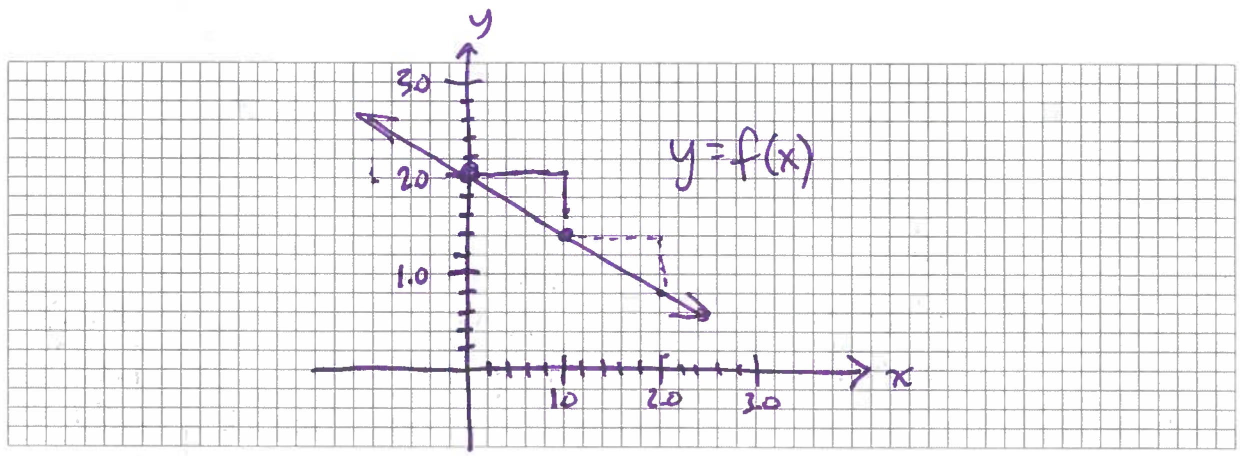
"seconds"

P: length is input (horizontal axis will be L (ft)) ⟶ time amounts (sec.)

| $L$ | $P(L)$ |
|---|---|
| 1 | 1.11 |
| 2 | 1.5697... |
| 3 | 1.9 |
| 4 | 2.2 |
| 5 | 2.5 |
| 6 | 2.7 |
| 7 | 2.9 |
| 8 | 3.1 |



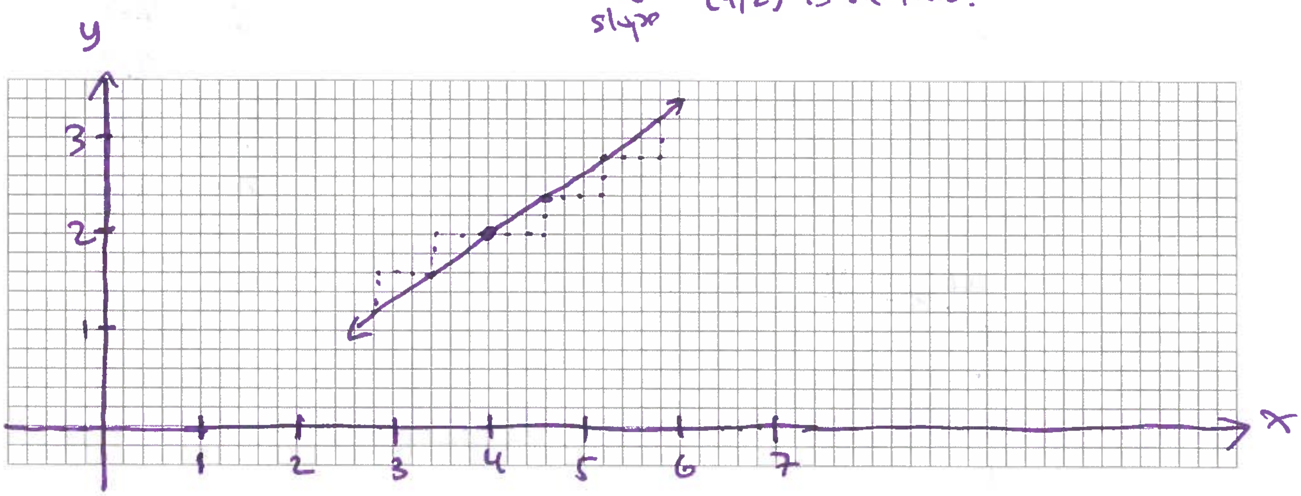
2. Make a graph of the function $f$, where $f(x) = -0.6x + 2$. (Try to recognize slope-intercept form, and how that helps with graph sketching.) forward 1, down 0.6




3. Make a graph of the function $f$, where $f(x) = \frac{2}{3}(x-4)+2$. (Try to recognize point-slope form, and how that helps with graph sketching.)

slope

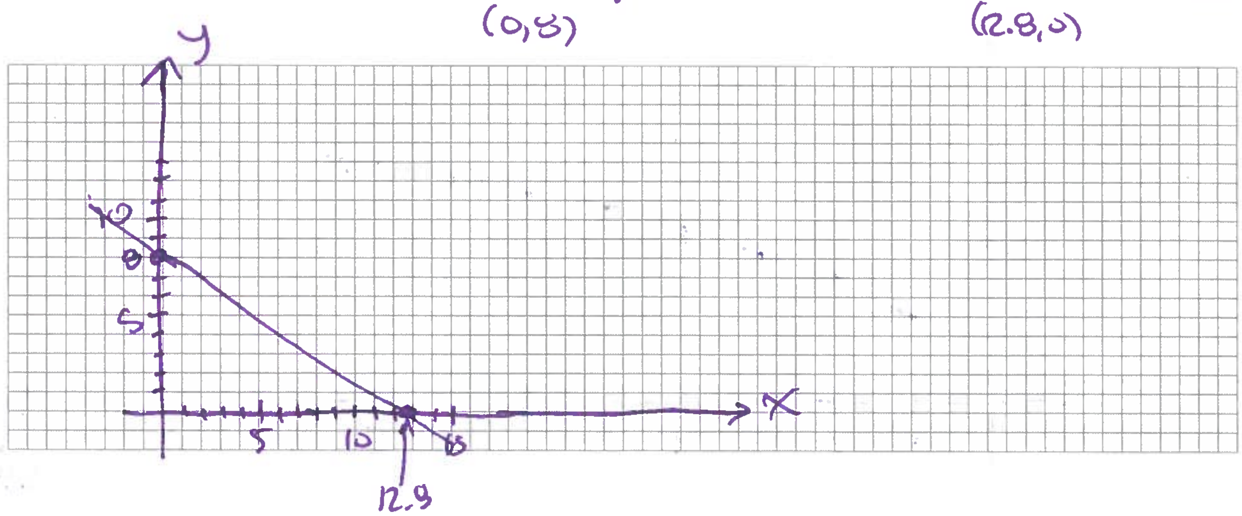
(4,2) is on this!




4. Make a graph of the equation $5x + 8y = 64$. (Try to recognize standard form, and how that helps with graph sketching.)

$x=0 \implies 8y=64$
$y=8$
$(0,8)$

$y=0 \implies 5x=64$
$x=12.8$
$(12.8,0)$

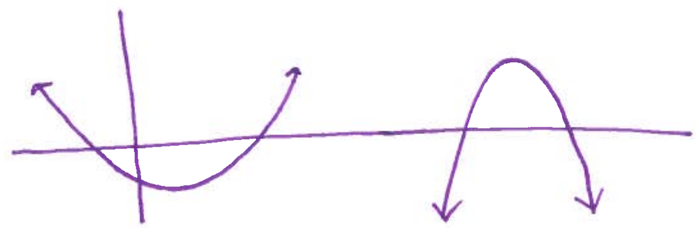


# Section 13.2 Quadratic Functions

when $f(x) = a\cdot x^2 + bx + c$

$a, b, c$ are specific numbers, with $a \neq 0$

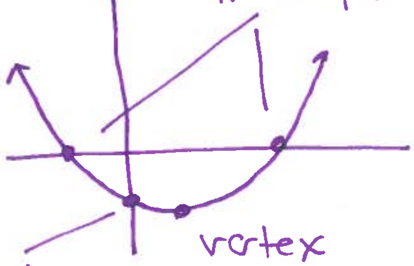
Graphs are "parabolas"



"opens upward" when $a$ is pos.

"opens downward" when $a$ is neg.

x-intercepts



y-intercept

$(0, c)$

$f(0)$

vertex

$(h, k)$

$f(h)$

Q.F. $x = \dfrac{-b \pm \sqrt{b^2-4ac}}{2a}$

Memorize:

$$h = \frac{-b}{2a}$$

$$k = f(h)$$

Ex Explore f where $f(x) = x^2 + 2x - 8$ and graph it.

$a=1$ (open upward) $\quad b=2 \quad c=-8$

y-intercept

$(0,-8)$

vertex

$$h = \frac{-b}{2a} = \frac{-2}{2\cdot 1} = \frac{-2}{2} = -1$$

$$k = f(-1) = (-1)^2 + 2(-1) - 8$$
$$= 1 - 2 - 8$$
$$= -9$$

$(-1,-9)$

Start sketching...

x-intercepts...

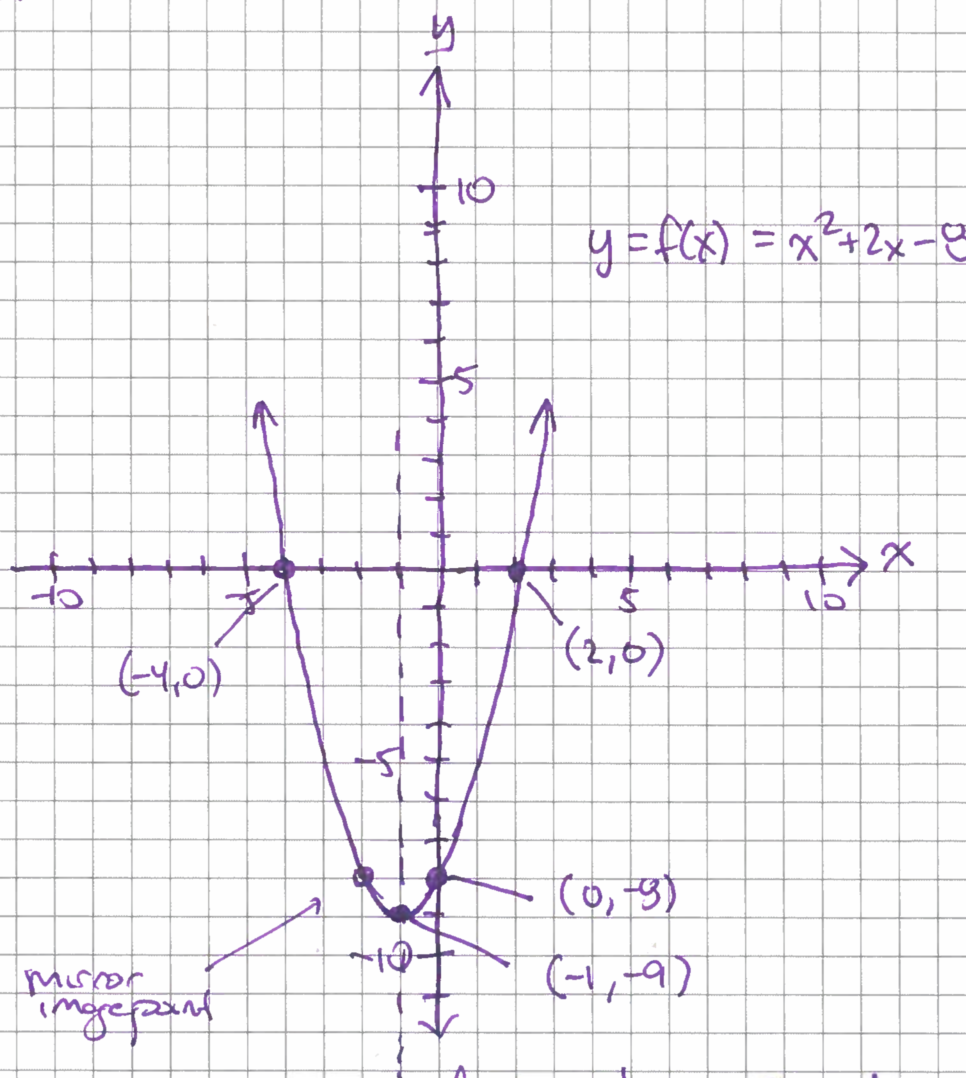
$f(x) = 0$

$x^2+2x-8 = 0$

$(x+4)(x-2) = 0$

$\{-4, 2\}$

x-intercepts at $(-4,0)$ and $(2,0)$




axis of symmetry: $x=-1$

**Ex** Let $f(x) = \frac{1}{2}x^2 + 2x + 9$ Graph it.

y-intercept

$(0, 9)$

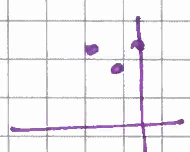
vertex $(h, k)$, $h \xrightarrow{f} k$

$$h = \frac{-b}{2a}$$

$$h = \frac{-2}{2 \cdot \frac{1}{2}} = \frac{-2}{1} = -2 \longrightarrow (-2, 7)$$

$$\begin{aligned} k = f(-2) &= \frac{1}{2}(-2)^2 + 2(-2) + 9 \\ &= \frac{1}{2}(4) - 4 + 9 \\ &= 2 - 4 + 9 \\ &= 7 \end{aligned}$$

Note



means no x-intercepts

don't hunt x-intercepts