1. Find an equation of a line that has slope -2 and passes through the point $(3, -5)$. Write the equation of the line in point-slope form **and** then again in y-intercept form.

$m = -2$

point $(3, -5)$

line: $y - (-5) = -2(x - 3)$

or

$y = 5 - 2(x - 3)$ ← point-slope

or

$y = -2x + 11$ ← y-intercept form

2. Suppose the average surface temperature of the earth is modeled by the linear function

$$T = 0.02t + 8.50$$

where T is temperature in C° and t represents years since 1900.

(a) What units do the slope and the T-intecept have?

Slope is °C/year ; T-intercept is in °C

(b) What do the slope and T-intercept represent in physical terms?

Slope is how much temperature changes over a change in time. (a rate)

T-intercept is the temperature in 1900, when measurements started.

(c) Use the equation to predict the average global surface temperature in 2100.

$t = 2100 - 1900 = 200$ yrs. So $T = 0.02(200) + 8.5 = 12.5°C$

(d) Rewrite the formula for temperature above in point-slope form where the point is determined by the the temperature in the year 2100.

Slope : 0.02

point : (200, 12.5)

line: $T - 12.5 = 0.02(t - 200)$

point-slope: $T = 12.5 - 0.02(t - 200)$ ← answer

Quadratic Functions

3. A ball is dropped from the upper observation deck of the CN Tower 450 m above the ground. The height above the ground h after t seconds is given by the equation $h(t) = -4.9t^2 + 0.96t + 449.36$.

(a) When does the ball hit the ground?

Want t when $h=0$.

So $0 = -4.9t^2 + 0.96 + 449.36$

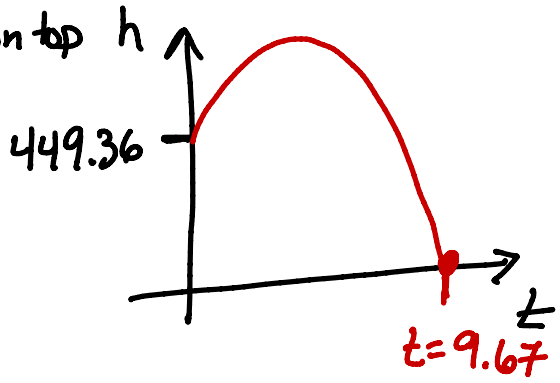
So $t = \dfrac{-0.96 \pm \sqrt{(0.96)^2 - 4(-4.9)(449.36)}}{2(-4.9)}$

use calculator! $= -9.47\ldots$ or $= 9.67$

answer: hits ground in 9.67 s.

(b) Sketch a rough picture of the graph $h(t)$. Given the physical understanding of the problem, what would be a reasonable domain for the function $h(t)$?

$h(0) = 449.36$ ← on top of building



domain $[0, 9.67]$

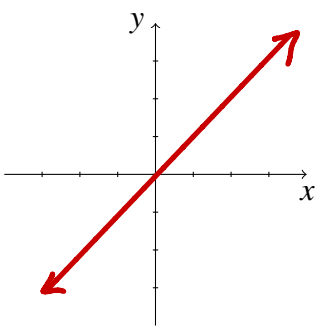
Essential Graphs

Set your calculator/computer aside. You should know the graphs the following functions in this section by heart. In your sketches, clearly indicate any asymptotes and intercepts.

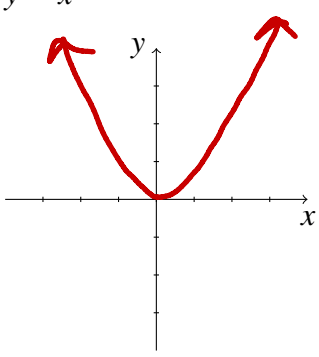
4. Sketch the graphs of the following functions:

↑ in green.

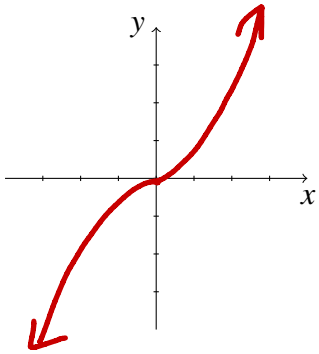
(a) $y = x$



(b) $y = x^2$

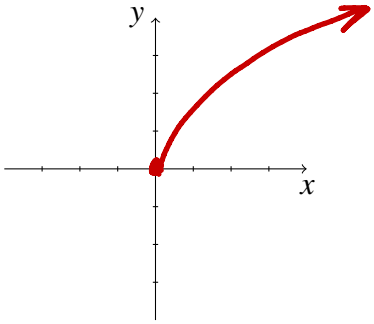


(c) $y = x^3$

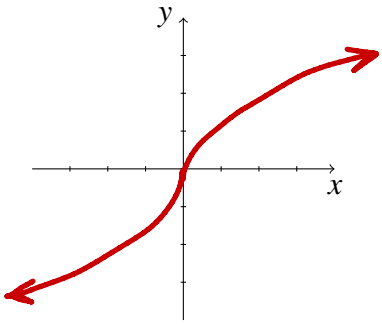


5. Sketch the graphs of the following functions:

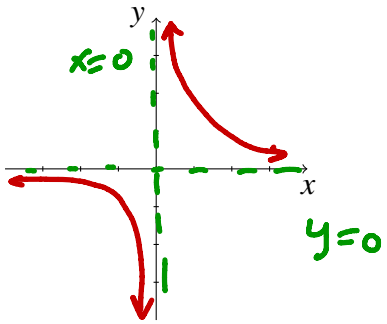
(a) $y = \sqrt{x}$



(b) $y = \sqrt[3]{x}$

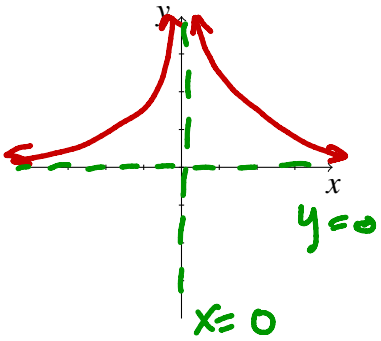


(c) $y = \dfrac{1}{x}$

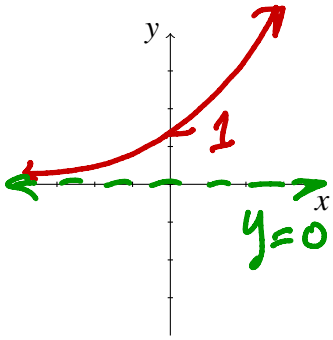


6. Sketch the graphs of the following functions:

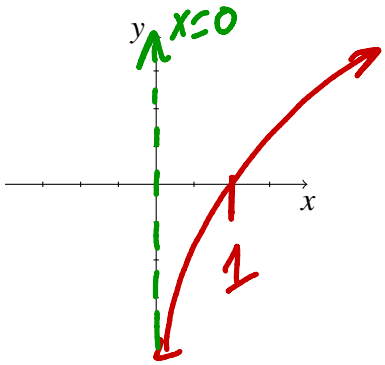
(a) $y = \dfrac{1}{x^2}$



(b) $y = e^x$

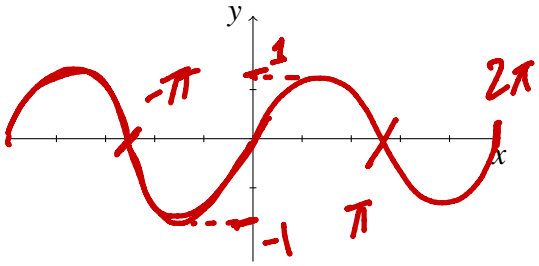


(c) $y = \ln x$

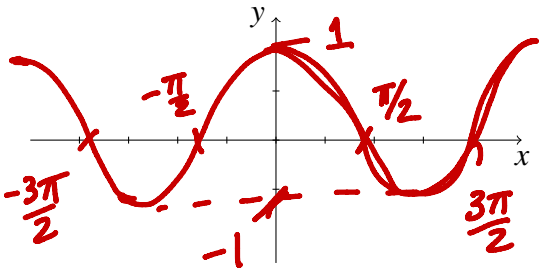


7. Sketch the following functions on $[-2\pi, 2\pi]$

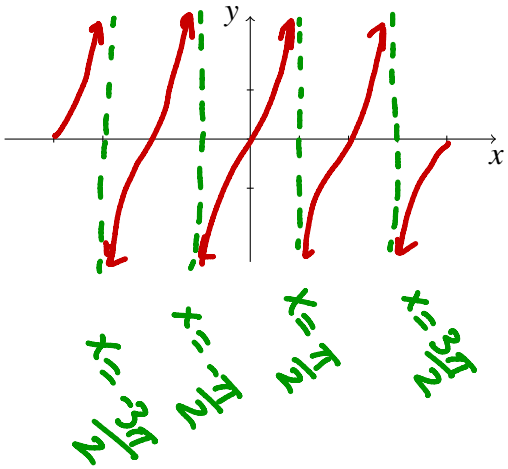
(a) $y = \sin x$



(b) $y = \cos x$



(c) $y = \tan x$

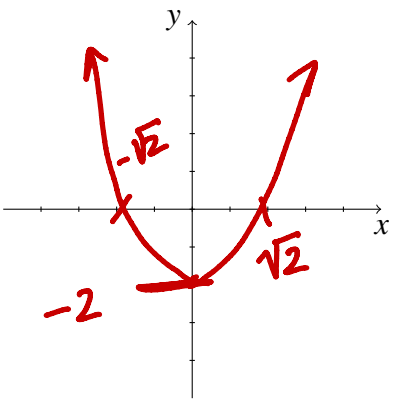


Graphs of Functions Related by Transformations

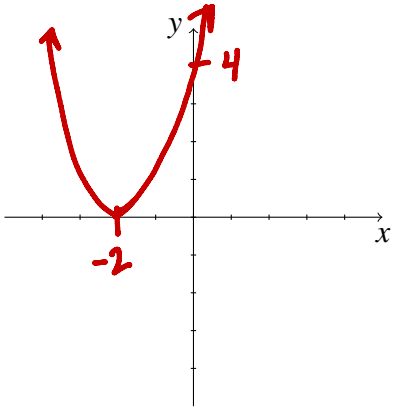
Once you know the graph of one function, it's easy to sketch the graphs of other functions that related to it by certain simple transformations. Again, set technology aside and sketch these the old-fashioned way.

8. Translations. Graph the following functions.

a) $y = x^2 - 2$

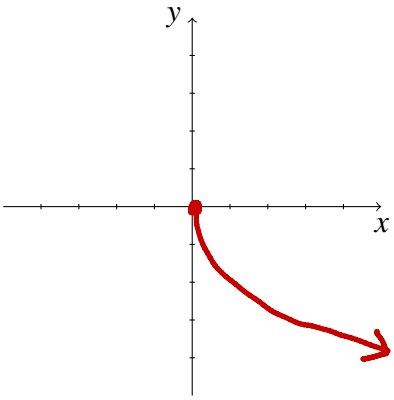


b) $y = (x + 2)^2$

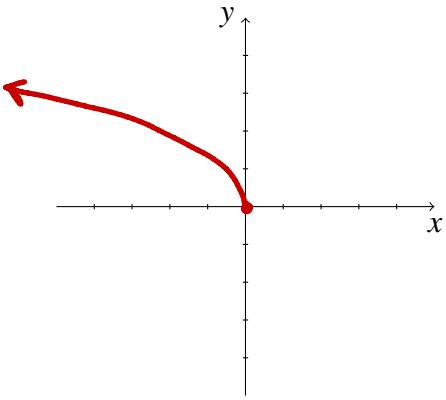


9. Refections. Sketch the graphs of the following functions.

a) $y = -\sqrt{x}$

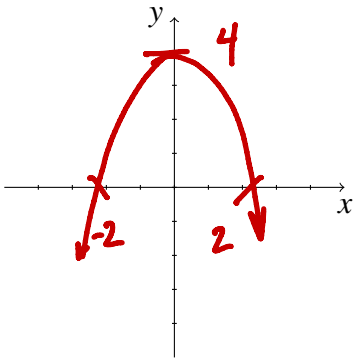


b) $y = \sqrt{-x}$

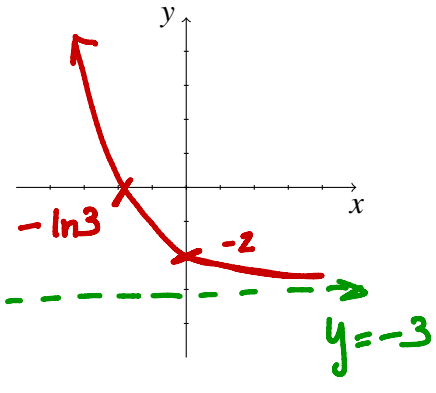


10. Graph the following functions.

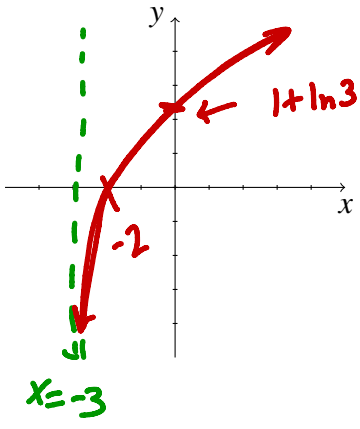
(a) $f(x) = 4 - x^2$



(b) $f(x) = e^{-x} - 3$



(c) $f(x) = \ln(x + 3) + 1$



11. (bonus question) Explain the difference between a *linear* function and a *nonlinear* function. Give both a graphical explanation and an algebraic explanation.

A linear function has the form $f(x)=mx+b$ and its graph is a line.

A nonlinear function cannot be written as $f(x)=mx+b$.
Examples are $f(x)=x^2$, $f(x)=\sqrt[3]{x}$ or $f(x)=\sin x$.

The graph of a nonlinear function is not a line.