S 1.2 #s 1, 3, 4, 5, 7, 10, 12, 15, 17, 18, 19, 21, 23

1–2 Classify each function as a power function, root function, polynomial (state its degree), rational function, algebraic function, trigonometric function, exponential function, or logarithmic function

1. (a) $f(x) = \log_2 x$ (b) $g(x) = \sqrt[4]{x}$

(c) $h(x) = \dfrac{2x^3}{1-x^2}$ (d) $u(t) = 1 - 1.1t + 2.54t^2$

(e) $v(t) = 5^t$ (f) $w(\theta) = \sin\theta \cos^2\theta$

1 a) $\log_2(x)$ is logarithmic.

b) $\sqrt[4]{x}$ is root (power, if you think $\sqrt[4]{x} = x^{\frac{1}{4}}$)

c) $\dfrac{2x^3}{1-x^2}$ is rational $\left(\dfrac{\text{poly}}{\text{poly}}\right)$

d) $1 - 1.1t + 2.54t^2$ is polynomial.

e) 5^t is exponential $\left(\text{constant}^{\text{variable}}\right)$

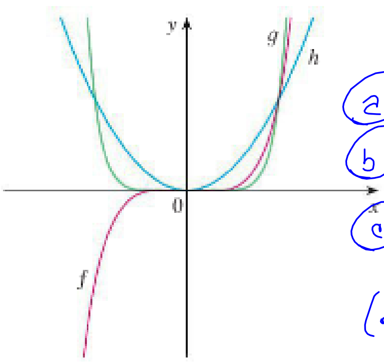
f) $\sin\theta \cos^2\theta$ is trigonometric.

Click on the Earth icon, to see a library of basic functions and properties from College Algebra.

http://harryzaims.com/121-all/videos/03-Writing-Projects/Writing-Project-2/

3–4 Match each equation with its graph. Explain your choices. (Don't use a computer or graphing calculator.)

3. (a) $y = x^2$ (b) $y = x^5$ (c) $y = x^8$



x^2

x^4

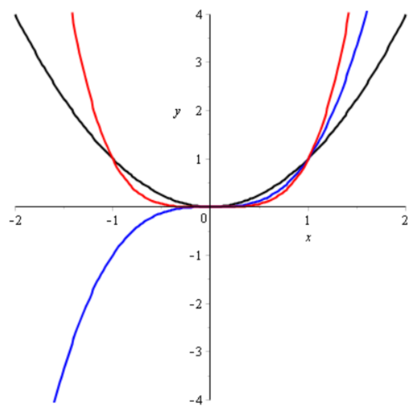
x^3

a) $y = x^2 = h(x)$

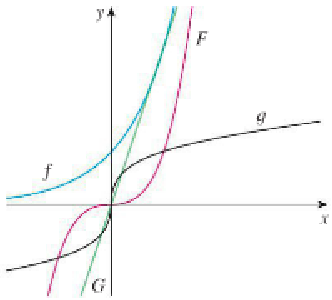
b) $y = x^5 = f(x)$

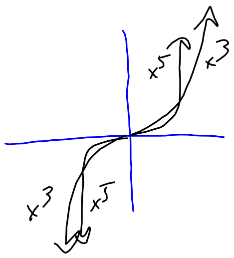
c) $y = x^8 = g(x)$

$(.1)^8 =$ small!



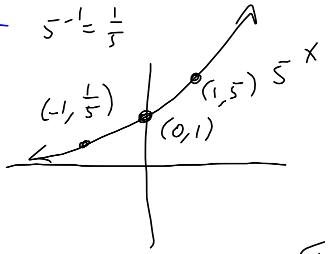
4. (a) $y = 3x$ (b) $y = 3^x$ (c) $y = x^3$ (d) $y = \sqrt[3]{x}$





See College algebra stuff.

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

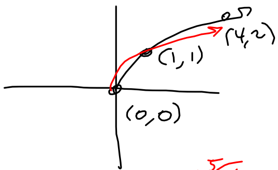


(a) $y = 3x = G(x)$

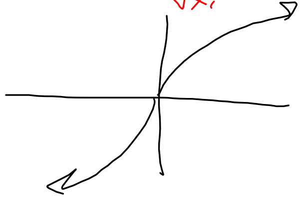
(b) $y = 3^x$ is $f(x)$

(c) $y = x^3$ is $F(x)$.

(d) $y = \sqrt[3]{x}$ or $x^{\frac{1}{3}} = g(x)$



$\sqrt[3]{x}, \sqrt[5]{x}, \ldots$



5–6 Find the domain of the function.

$\frac{\text{Stuff}}{0}$ BAD

$\sqrt[2n]{\text{negative}}$

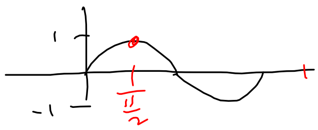
5. $f(x) = \dfrac{\cos x}{1 - \sin x}$

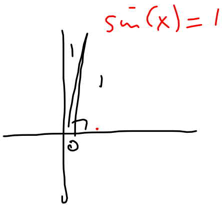
Need $1 - \sin x \neq 0$

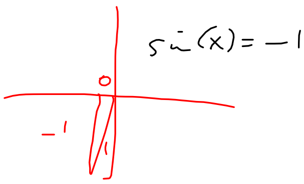
$\sqrt[2n]{\text{stuff}}$ need stuff ≥ 0

$1 \neq \sin x$

$\frac{\text{Junk}}{\text{stuff}}$ need stuff $\neq 0$







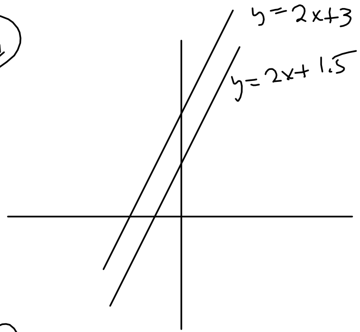
$x \notin \{ \frac{\pi}{2} + 2n\pi \mid n \in \mathbb{Z} \}$

$= A \Rightarrow \mathcal{D} = \mathbb{R} \setminus A$

$\{ x \mid x \neq \frac{\pi}{2} + 2n\pi, \ n \in \mathbb{Z} \}$

7. (a) Find an equation for the family of linear functions with slope 2 and sketch several members of the family.
(b) Find an equation for the family of linear functions such that $f(2) = 1$ and sketch several members of the family.
(c) Which function belongs to both families?

(a)



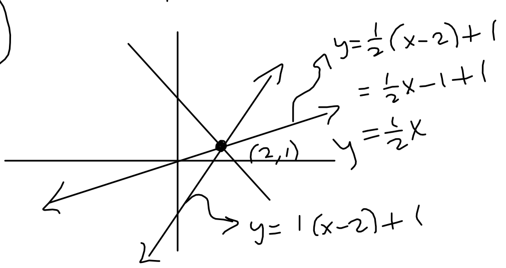
$f(x) = mx + b$ for linear.

Slope-Intercept. Slope $= m$
$(0,b) =$ point on graph

Point-Slope $f(x) = m(x - x_1) + y_1$
Slope $= m$
$(x_1, y_1) =$ point on graph

Important!

(b)



$f(x) = mx + b$ thru $(2,1)$

$f(2) = m(2) + b = 1 \implies$

$b = 1 - 2m \implies$

$f(x) = mx + (1-2m)$
$= mx + 1 - 2m$
$= mx - 2m + 1$
$= m(x-2) + 1$ → point-slope!

Instant, using point-slope.
$f(2) = 1$
Line:
$y = m(x-2)+1$

(c) To be in both families,
$m = 2$ & $(x_1, y_1) = (2, 1)$

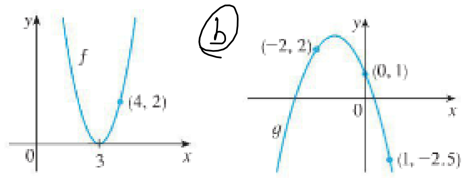
$\boxed{y = 2(x-2)+1}$ Book

wants $y = mx+b$ $= 2x - 4 + 1$

$\boxed{y = 2x - 3}$

10. Find expressions for the quadratic functions whose graphs are shown.

a b



a

$f(x) = a(x-h)^2 + k =$

$= a(x-3)^2 + 0$

$f(4) = a(4-3)^2 + 0 = 2$

$\Rightarrow a = 2$

$\Rightarrow \boxed{f(x) = 2(x-3)^2}$

b

$f(x) = ax^2 + bx + c$

$f(-2) = 2 : \quad a(-2)^2 + b(-2) + c = 2$

$4a - 2b + c = 2$

$f(0) = 1 : \quad a(0)^2 + b(0) + c = 1$

$c = 1$

$f(1) = -2.5 : \quad a(1)^2 + b(1) + c = -2.5 = -\frac{25}{10} = -\frac{5}{2}$

$a + b + c = -\frac{5}{2}$

$2a + 2b + 2c = -5$

$\boxed{c = 1} \Rightarrow 4a - 2b + c = 4a - 2b + 1 = 2 \Rightarrow 4a - 2b = 1$

$2a + 2b + c = 2a + 2b + 1 = -5 \Rightarrow 2a + 2b = -6$

$a + b = -3$

$a + b = -3 \Rightarrow a = -b - 3$

$4a - 2b = 1 \Rightarrow 4(-b-3) - 2b = 1$

$\Rightarrow -4b - 12 - 2b = 1$

$-6b = 11$

$\boxed{b = -\frac{11}{6}}$

$a + b = -3$

$a - \frac{11}{6} = -\frac{18}{6}$

$\boxed{a = \frac{-7}{6}}$

$\boxed{-\frac{7}{6}x^2 - \frac{11}{6}x + 1 = f(x)}$

12. Recent studies indicate that the average surface temperature of the earth has been rising steadily. Some scientists have modeled the temperature by the linear function $T = 0.02t + 8.50$, where T is temperature in °C and t represents years since 1900.

(a) What do the slope and T-intercept represent?

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

(a) $m = .02t$ is saying $.02^{\circ}C$ increase per year.

$b = 8.5$ says $8.5^{\circ}C$ = average surface temp in 1900.

(b) $2100 - 1900 = 200 = t$ in 2100!

$T(200) = .02(200) + 8.5 = 4 + 8.5 = \boxed{12.5^{\circ}C}$

15. The relationship between the Fahrenheit (F) and Celsius (C) temperature scales is given by the linear function $F = \frac{9}{5}C + 32$.

(a) Sketch a graph of this function.

(b) What is the slope of the graph and what does it represent? What is the F-intercept and what does it represent?

Recall: Build the model from

F	C	
32	0	Freeze
212	100	Boil

want F as func. of C,

so $x \to C$

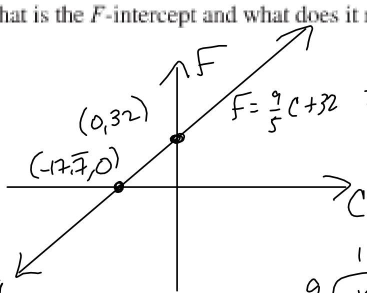
$y \to F$

$(x_1, y_1) = (0, 32)$

$(x_2, y_2) = (100, 212)$

etc.

a



$\frac{9}{5}C + 32 = 0$

$9C = -160$

$C = -17.\overline{7}$

$$\begin{array}{r} 17.7 \\ 9\overline{)160} \\ \underline{90} \\ 70 \\ \underline{63} \\ 70 \end{array}$$

b) $m = \frac{9}{5}$ means Fahrenheit increases $\frac{9}{5}°$ for every $1°$ increase in Celsius.

17. Biologists have noticed that the chirping rate of crickets of a certain species is related to temperature, and the relationship appears to be very nearly linear. A cricket produces 113 chirps per minute at 70°F and 173 chirps per minute at 80°F.

(a) Find a linear equation that models the temperature T as a function of the number of chirps per minute N.

(b) What is the slope of the graph? What does it represent?

(c) If the crickets are chirping at 150 chirps per minute, estimate the temperature.

a) T = Temp. (°F)

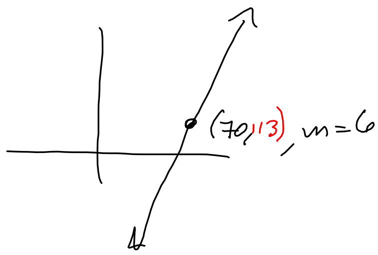
N = # chirps per min.

$N = N(T)$

$(x_1, y_1) = (T_1, N_1) = (70, 113)$

$(T_2, N_2) = (80, 173)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{N_2 - N_1}{T_2 - T_1} = \frac{173 - 113}{80 - 70} = \frac{60}{10} = 6$



So, $y = m(x - x_1) + y_1$

$N = m(T - T_1) + N_1$

$N = \boxed{N(T) = 6(T - 70) + 113}$

b) $m = 6 = \frac{6 \text{ chirps}}{1°F}$

c) Given $N = 150$, find T

$N(T) = 6(T - 70) + 113 = 150$

$= 6T - 420 + 113 = 115$

$6T = 422$

$T = \frac{422}{6} = \frac{211}{3} \approx \boxed{70.3°}$

$$\begin{array}{r} 420 \\ -113 \\ \hline 307 \\ +115 \\ \hline 422 \end{array}$$

18. The manager of a furniture factory finds that it costs \$2200 to manufacture 100 chairs in one day and \$4800 to produce 300 chairs in one day.

(a) Express the cost as a function of the number of chairs produced, assuming that it is linear. Then sketch the graph.

(b) What is the slope of the graph and what does it represent?

(c) What is the y-intercept of the graph and what does it represent?

(a) Want cost = C, as a function of the # of chairs, x, that are produced. (C is in \$)

$(x_1, C_1) = (100, 2200)$

$(x_2, C_2) = (300, 4800)$

$$m = \frac{C_2 - C_1}{x_2 - x_1} = \frac{4800-2200}{300-100} = \frac{2600}{200} = 13$$

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

$$\boxed{C(x) = 13(x - 100) + 2200} = 13x + 900$$

2200
−13

(b) $m = 13 = \dfrac{13 \text{ \$}}{1 \text{ chair produced}}$

(c) $C(0) = 900$ = Fixed Cost (Taxes, Bribes, Insurance)

19. At the surface of the ocean, the water pressure is the same as the air pressure above the water, 15 lb/in^2. Below the surface, the water pressure increases by 4.34 lb/in^2 for every 10 ft of descent.

(a) Express the water pressure as a function of the depth below the ocean surface.

(b) At what depth is the pressure 100 lb/in^2?

(a) $m = \dfrac{4.34 \text{ lb/in}^2}{10 \text{ ft descent}} = \dfrac{.434 \text{ lb/in}^2}{1 \text{ ft depth}}$

$(0, 15) = (d_1, P_1)$

d = depth in ft.

P = pressure in lbs/in^2

$$\boxed{P = P(d) = .434d + 15}$$

```
15/.434
      34.56221198
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(b) $P(d) \overset{\text{SET}}{=} 100$ & solve for d

$.434d + 15 = 100$

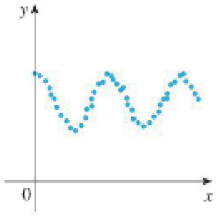
$.434d = 85$

$$\boxed{d = \frac{85}{.434} \approx 34.56221198 \text{ ft}}$$

21–22 For each scatter plot, decide what type of function you might choose as a model for the data. Explain your choices.

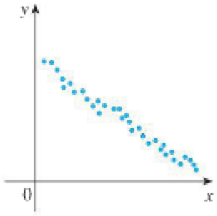
21.

(a)



sine or cosine

(b)

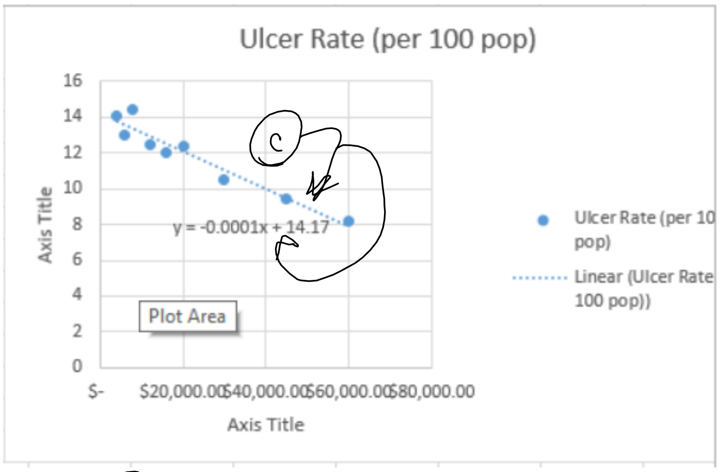


$y = mx + b$

23. The table shows (lifetime) peptic ulcer rates (per 100 population) for various family incomes as reported by the National Health Interview Survey.

Income	Ulcer rate (per 100 population)
$4,000	14.1
$6,000	13.0
$8,000	13.4
$12,000	12.5
$16,000	12.0
$20,000	12.4
$30,000	10.5
$45,000	9.4
$60,000	8.2

(a) Make a scatter plot of these data and decide whether a linear model is appropriate.
(b) Find and graph a linear model using the first and last data points.
(c) Find and graph the least squares regression line.
(d) Use the linear model in part (c) to estimate the ulcer rate for an income of $25,000.
(e) According to the model, how likely is someone with an income of $80,000 to suffer from peptic ulcers?
(f) Do you think it would be reasonable to apply the model to someone with an income of $200,000?



a ✓

b $(4, 14.1), (60, 8.2)$

x = income in 1000s of $

y = # of ulcers per 100

$m = \frac{8.2-14.1}{60-4} = \frac{-5.9}{56}$

-0.10535714285714285714285714285714285714285714285714...

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

$\approx \boxed{-.105357(x-4)+14.1 \approx y}$

e $y(80) \approx -.105357(80-4)+14.1$

$\approx$ 6.092868 ulcers

f $200000?

$y(200) \approx$ -6.549972, which makes no sense.