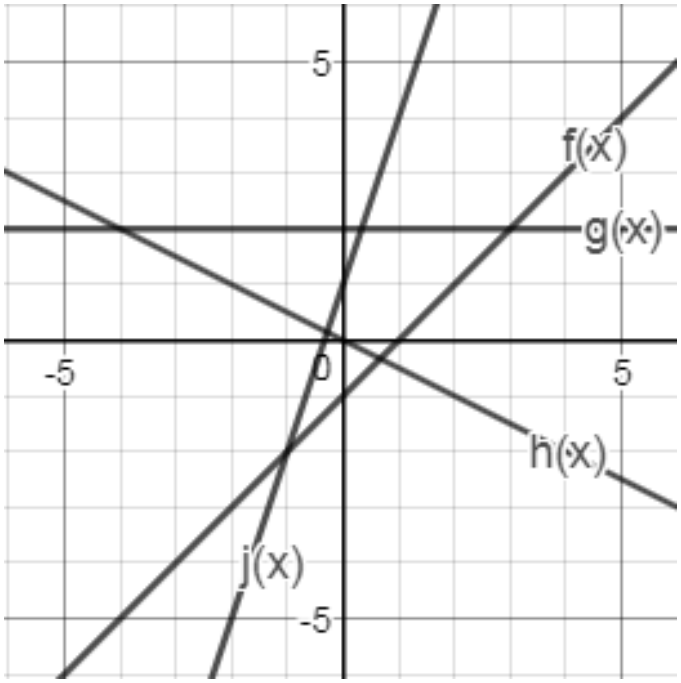
Chapter 1
Section 1.4
Warm-up Problem A. Consider the following graph of linear functions:



(a) Which function(s) has/have a negative slope?

h(x)

(b) Which function(s) has/have the highest magnitude slope?

j(x)

(c) Which function(s) has/have a slope of zero?

g(x)

(d) Which function(s) has/have the greatest vertical intercept?

g(x)

(e) Which function(s) has/have the smallest vertical intercept?

f(x)

Problem 1. Determine whether the following tables could represent a linear function. If it can, find a possible formula for the linear function. If not, explain why not.

(a)

x	0	100	200	300
$g(x)$	25	50	75	100

$\frac{25}{100}$ $\frac{25}{100}$ $\frac{25}{100}$

yes $y = \frac{25}{100}x + 25$

(b)

t	0	5	8	15
$f(t)$	10	20	26	40

yes $\frac{10}{5}$ $\frac{6}{3}$ $\frac{14}{7}$ $\frac{40-26}{14}$ $\frac{26-10}{16}$ $\frac{16}{8}$

$y = 2x + 10$

(c)

x	0	12	24	36
$h(x)$	20	40	50	55

$\frac{20}{12}$ $\frac{10}{12}$ $\frac{24-12}{12}$ NOPE

Problem 2. For each of the following situations, find *and interpret* the slope and vertical intercept.

a) An icicle grows according to the formula $W(t) = 0.2t + 0.15$, where t is the time in hours since the first measurement was taken, and $W(t)$ is the width of the icicle in centimeters.

the width is growing 0.2 cm/hr

and starts 0.15 cm

b) For an international travel data plan, a cell provider charges its customers according to the formula $C(n) = 10 + 2.05n$, where n is the number of megabytes (MB) of international data used, and $C(n)$ is the total charge in dollars for one month of international service.

\$10 just to have the service

2.05 \$/MB

Problem 3. Tim sells self-printed ~~Husker~~ Gamecock t-shirts outside Memorial Stadium on game days. He gets fined $100 per game for trademark infringement, but as long as we sells enough t-shirts, he doesn't care. It costs him $7.50 to make each shirt, and he sells his shirts for $20 each.

a) Let $R(x)$ represent Tim's revenue from selling x t-shirts on a particular game day, and let $C(x)$ represent Tim's costs for the day if he sells x shirts. Write formulas for $R(x)$ and $C(x)$.

$C(x) = 7.5x + 100$ $\quad R(x) = 20x$

b) Recall that profit is revenue minus cost. Write a formula for $P(x)$, Tim's profit after selling x shirts on game day.

$P(x) = 20x - 7.5x - 100$

c) Interpret the slope, x-intercept, and y-intercept of $P(x)$ in the context of the problem.

y-int → initial cost

Slope → how much tim makes per shirt

d) How many shirts must Tim sell in order to make a $50 profit?

$150 / (20 - 7.5) = x$

Problem 4. Find a formula for a line that

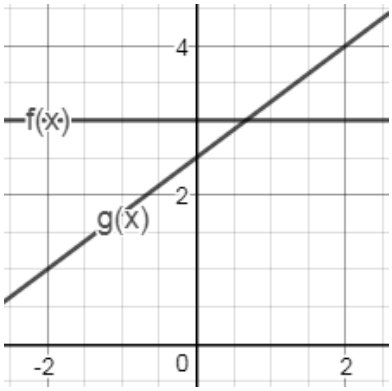
(a) has slope -2 and passes through the point $(-1, 4)$.

$y - 4 = -2(x+1) \Rightarrow y = -2x + 2$

(b) passes through the points $(1, 7)$ and $(3, 1)$.

$y - 1 = -4(x-3) \Rightarrow y = -4x + 11$

Problem 5. Find a formula for each of the following lines. Use any form you wish.



$g(x) = x + 2.5$

$f(x) = 3$

Problem 6. Suppose $h(t) = \frac{1}{t^2} + 7$. Find a formula for the line that intersects the graph of $h(t)$ at $t = -1$ and $t = 2$.

$(1, 8)$, $(2, \frac{29}{4})$

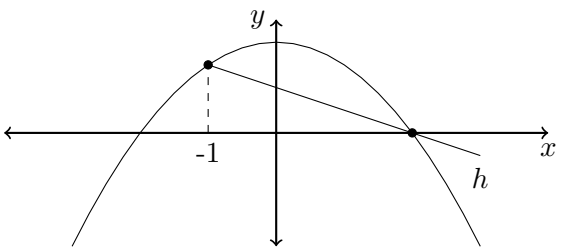
$y - 8 = (\frac{29}{4} - 8)(x - 1)$

$y = (\frac{29}{4} - 8)x - (\frac{29}{4} - 8) + 8$

Problem 7. Find an equation for the line h shown below, which passes through the two indicated points on the graph of $y = -x^2 + 4$.

$(-1, 3)$, $(2, 0)$

$\frac{3}{3}$ $\quad y = x - 2$



Problem 8. How can you tell if two lines intersect once, infinitely, or not at all? In particular, what can be said about their slopes in each situation? Explain by filling out the chart below.

# of intersections	0	1	∞
Slopes (Same? Different?)	same	diffent	same
y-int (Same? Different?)	Diff	either...	same

Draw a picture of each scenario.

Problem 9. What is ...

(a) the general point-slope equation for a line? (Label the parts of the equation.)

$y - P_2 = m(x - P_1)$ — m: slope; P_1: point

(b) the general slope-intercept equation for a line? (Label the parts of the equation.)

$y = mx + b$ — b: y-intercept; m: slope

(c) the general slope formula? (Label the parts of the equation.)

$\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$

(d) an equation of a line passing through the point $(4, -1)$ and parallel to $y = \frac{1}{2}x - \frac{5}{4}$?

$y + 1 = \frac{1}{2}(x - 4)$

(e) the slope of a line perpendicular to $y = 4.2(x - 3) + 1$?

$-\frac{1}{4.2}$

(f) an equation of a line perpendicular to the line defined by $(1, -3)$ and $(3, -7)$ and passing through the point $(1, -3)$?

$\frac{-7+3}{3-1} = \frac{-4}{2} = -2$ $\qquad y + 3 = \frac{1}{2}(x - 1)$

(g) the slope-intercept equation for a line with $m = -4$ and y-intercept $\left(0, \frac{3}{2}\right)$?

$y = -4x + \frac{3}{2}$

(h) an equation of the horizontal line passing through $(-4, 7.3)$?

$y = 7.3$

(i) an equation of the vertical line passing through $(-13, 5)$?

$x = -13$

(j) the linear function h such that $h(1) = 4$ and $h(-2) = 13$?

$\frac{4-13}{1+2} = \frac{-9}{3} = -3$ $\quad y-4 = -3(x-1)$

(k) the relationship between the two lines $y = 7 - x$ and $y = x + 3$?

perpindicular

(l) the relationship between the two lines $x = -3$ and $y = 5$?

perpindicular

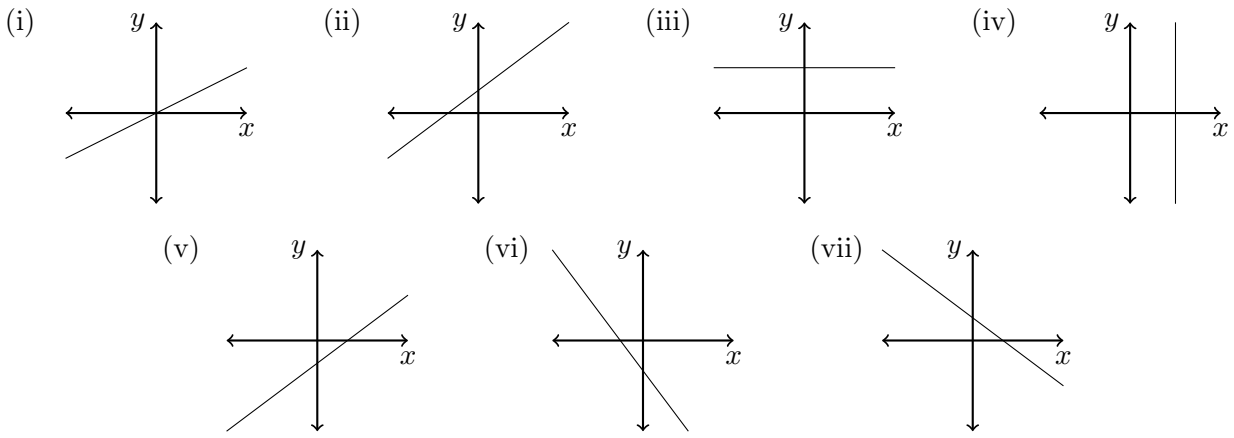
(m) the intersection of the lines $y = 2$ and $x = -\frac{3}{4}$?

$(-\frac{3}{4}, 2)$

Problem 10. Let a and b be positive numbers. Match each equation to its possible graph below.

(a) $y = \frac{a}{2}x$ (i) (c) $y = -bx - a$ (vi) (e) $y = -bx + a$ (vii) (g) $y = a + b$ (iii)

(b) $y = ax + b$ (ii) (d) $x = 2b$ (iv) (f) $y = ax - b$ (v)



Problem 11. Suppose a new MyPhone cellphone costs \$650, and depreciates in value by \$30 per month. A new Cyborg phone costs \$580, and depreciates in value by \$25 per month.

(a) Let $M(x)$ be the value of a MyPhone x months after it was purchased, and let $C(x)$ be the value of a Cyborg x months after it was purchased. Write formulas for $M(x)$ and $C(x)$.

$M(x) = -30x + 650$ $\quad C(x) = -25x + 580$

(b) If Carrie and Miranda buy phones at the same time, Carrie buying the Cyborg and Miranda buying the MyPhone, when will their phones have the same value?

$-30x + 650 = -25x + 580$ $\quad x = \frac{650 - 580}{5}$

(c) After how many months are each of the phones worth nothing?

My $\quad x = \frac{650}{30}$ $\quad$ Cy $\quad \frac{580}{25}$

Additional Problems

EP 1. Find a formula for a line that passes through the points $(-2, 4)$ and $(1, -5)$.

$\frac{-5-4}{1+2} = \frac{-9}{3} = -3 \quad y-4 = -3(x+2)$

EP 2. In 2001, a 256 MB USB flash drive cost \$157. In 2017, a pack of ten 256 MB USB flash drives can be purchased for \$23. Assuming the value of a flash drive has depreciated linearly with time, write a formula giving the cost of a single 256 MB USB flash drive as a function of the number of years since 2001. (For this problem you can assume that you don't get any special discount for purchasing ten instead of one.)

$y = 157 + \frac{23-157}{16}x$

EP 3. Find formulae for the linear functions in the following situations:

(a) $P = g(t)$ gives the population of a town that begins with 3,000 residents and grows by 27 people each year.

$P(t) = 27t + 3000$

(b) $j(50) = 17$ and $j(75) = -33$.

$j(x) = \frac{-33-17}{75-50}(x-50) + 17$

EP 4. To become a member of La-Mer-Hausse Golf Club, you must pay a one-time initiation fee, plus a fixed monthly fee for each month of membership.

(a) Suppose that belonging to the club for 3 months costs \$5,100, and the monthly membership fee is \$200. Write a linear function that models the cost, C, of belonging to La-Mer-Hausse for m months.

$y = 200(x-3) + 5{,}100$

(b) Interpret the slope and y-intercept of your equation from part (a) in the context of the problem.

monthly membership fee = 200

initiation fee = 5100 − 600