Is this linear? If so, find the equation.

x	−3	0	3	6
y	7	5	3	1

+3 +3 +3

−2 −2 −2   (y-int)

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

negative can be overlooked

$$y = -\frac{2}{3}x + 5$$

What if we add an extra point, is it still linear?

x	−3	0	3	6	12
y	7	5	3	1	−3

+3 +3 +3 +6

−2 −2 −2 −4

$$\frac{\Delta y}{\Delta x} = \frac{-2}{3} \qquad \frac{\Delta y}{\Delta x} = \frac{-4}{6} = \frac{-2}{3}$$

Yes! The slope is still $-\frac{2}{3}$ between all points.

Take Away: A table of data represents a linear model IF the slope is the same between ALL points.
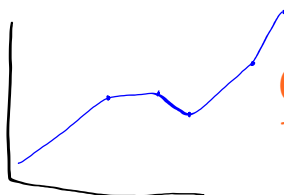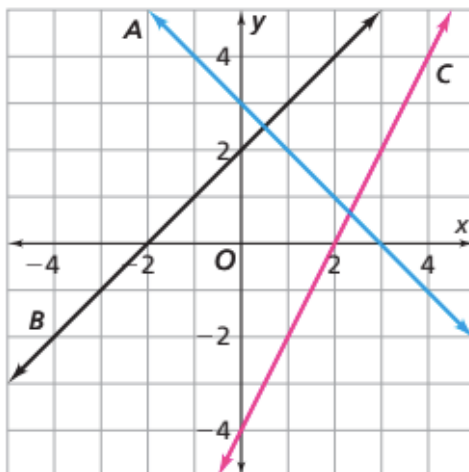

Clearly not linear.
The slope keeps changing!

Page 47, #'s 6 and 7

6. Here is a graph of three lines.

a. Complete the table.

Line	Constant Rate of Change	y-intercept	x-intercept
A	■	■	■
B	■	■	■
C	■	■	■

b. Here are the equations of the three lines. Match each line with its equation.

equation D: $y = 2 + x$ equation E: $y = -4 + 2x$ equation F: $y = 3 - x$

line A $y = x + 2$ line B   line C

What is the slope?

slope = 2   slope = -1

1

7. Two points determine a line.

    a. Which of these points are on the line that passes through $(0, 3)$ and $(2, 5)$?

       $(4, 7)$ $(4, 8)$ $(4, 10)$

[handwritten, red: this is a solution for the line — pointing to (4,7), which is circled in green]

[handwritten, blue/green:]
$+2 \left\langle \begin{array}{c} 0, 3 \\ 2, 5 \end{array} \right\rangle +2$

$+2 \left\langle \begin{array}{c} 2, 5 \\ 4, 7 \end{array} \right\rangle +2$

    b. Which of these points are on the line that passes through $(-2, 10)$ and $(1, 4)$?

       $(2, 0)$ $(2, 2)$ $(2, 10)$

[handwritten, (2,2) circled in green]

[handwritten, blue/green:]
$+3 \left\langle \begin{array}{c} -2, 10 \\ 1, 4 \end{array} \right\rangle -6$

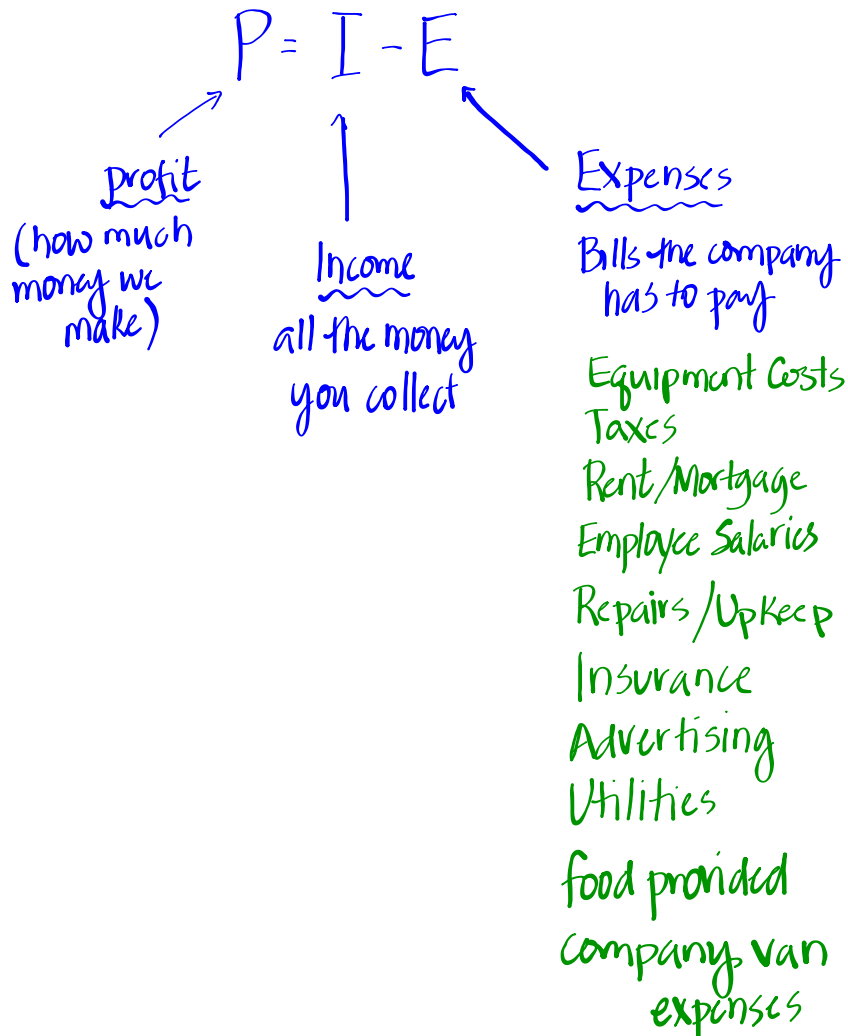$+1 \left\langle \begin{array}{c} 1, 4 \\ 2, 2 \end{array} \right\rangle -2$

$\dfrac{\Delta y}{\Delta x} = \dfrac{-6}{3} = \dfrac{-2}{1}$

2.3 Tree Top Fun
Equations for Linear Functions

Tree Top Fun (TTF, for short) runs adventure sites with zip lines, swings, rope ladders, bridges, and trapezes. The company uses mathematical models to relate the number of customers, prices, costs, income, and profit at its many locations.

$$P = I - E$$

profit
(how much money we make)

Income
all the money you collect

Expenses
Bills the company has to pay

Equipment Costs
Taxes
Rent/Mortgage
Employee Salaries
Repairs/Upkeep
Insurance
Advertising
Utilities
food provided
Company van expenses

Complete A-C and E

When finding an equation, it may help to calculate values of the dependent variable for some specific values of the independent variable. Then you can look for a pattern in those calculations. You can use the information given in words, tables of data, and graphs.

A Use what you know about linear equations to work out models for the Tree Top Fun business. Find an equation for each of the linear functions described below.

1. The standard charge per customer at TTF is $25. Write an equation that relates the daily income I to the number n of customers.

    $I = 25n$

2. Each TTF site has operating costs of $500 per day. Write an equation that relates daily profit P to the number n of customers.

3. One TTF site bought a new rope bridge for $4,500. TTF will make monthly payments of $350 until the bill is paid. Write an equation for the unpaid balance B after m monthly payments.

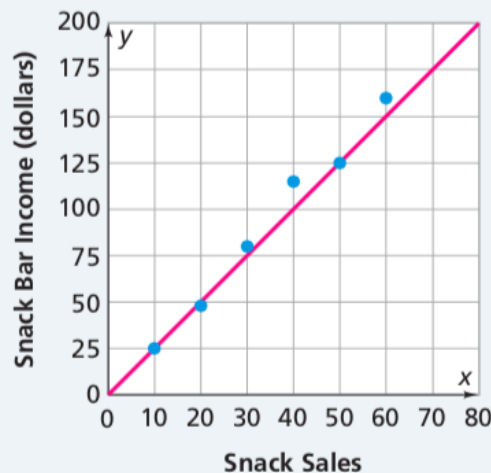## Complete A-C and E

B One operator of a Tree Top Fun franchise suggested the group admission fees in the table below.

Number in Group	1	2	3	4	5	10	15	20
Admission (dollars)	75	90	105	120	135	210	285	360

1. Explain how you know the relationship between the admission fee for a group and the number of people in the group is linear.

2. What are the slope and y-intercept of the graph of the data?

3. What equation relates admission fee A to the number n in the group?

C The owners of Tree Top Adventures opened a snack bar at one site. The graph below shows the income from snack sales for six different days. What is the equation of the linear model on the graph?

Complete A-C and E

E A state mathematics test asked students to find equations for linear functions. Two students, Dana and Chris, gave the answers below.

1. To find an equation for the line with slope -3 that passes through the point $(4, 3)$, Dana wrote the following steps. Is he correct? Explain.

$$y = -3x + b, \text{ so } 3 = -3(4) + b$$
$$\text{This means } b = 15 \text{ and } y = -3x + 15.$$

2. To find an equation for the line that passes through points $(4, 5)$ and $(6, 9)$, Chris wrote the following steps. Is she correct? Explain.

$$m = \frac{6-4}{9-5}, \text{ so } y = \frac{1}{2}x + b$$
$$\text{This means } 5 = \frac{1}{2}(4) + b, b = 3, \text{ and } y = \frac{1}{2}x + 3.$$

Homework

Finish Problem 2.3 A-C and E