

# Teaching Expressions

The table below defines some symbols as variables to represent certain quantities. For example,  $S$  stands for "the number of Students in a class."

A specific numerical value is provided for each variable. You should treat this value as constant for all cases. For example, assume that every class contains 30 students.

Symbol	Meaning	Numerical value
$S$	the number of Students in a class	30 students per class
$B$	the number of Boys in a class	14 boys per class
$G$	the number of Girls in a class	16 girls per class
$C$	the number of Classes per student in a day	6 classes per student
$P$	the number of Pages of homework per class per day	2 pages of hmwrk per cl per day
$D$	the number of Days in a marking period	45 days per marking period
$M$	the number of Marking periods in a year	4 marking periods per year
$T$	the number of Tests per class per marking period for each student	3 tests per class per mkg period
$N$	the number of miNutes in a class period	50 minutes per class

Using the given letters, it is possible to write many different algebraic expressions. Although you can always substitute numbers for the letters and do the arithmetic, most of the expressions you create will have no real meaning.

For example, for the expression  $MP$ , you can multiply the number of marking periods in a year by the number of Pages of homework per class per day, but the product you get doesn't have any useful application. In other words,  $MP$  doesn't really mean anything.

But some expressions do have a meaning. For example,  $B + G$ , the number of boys in a class plus the number of girls in a class, represents the number of students in a class. So the expression  $B + G$  has meaning.

The phrase "the number of students in a class" is a concise way to describe the number represented by  $B + G$ . We will call this the summary phrase.

The table tells you that there are 14 boys in a class, so  $B = 14$ , and that there are 16 girls in a class, so  $G = 16$ . Therefore,  $B + G = 14 + 16 = 30$ , and there are 30 students in a class. Even if the numbers were different,  $B + G$  would still represent the number of students in a class.

**Your Task** is to come up with **ten** meaningful algebraic expressions using the symbols above. For each expression, go through the steps listed below.

1. Write the expression.
2. Explain what the expression means, using a summary phrase.
3. Give the numerical value of the expression using the values of the variables given in the table.

# More Teaching Expressions

In this assignment you continue to work with algebraic expressions and summary phrases.

You will be given specific algebraic expressions and asked to write summary phrases for them; you also will be given specific summary phrases and asked to write algebraic expressions for them.

Reminder: The summary phrase for  $B + G$  is "the number of students in a class," not "the number of boys plus the number of girls in a class."

The symbols below are the same as those used in *Teaching Expressions*. Though no specific numerical values are assigned here, you should assume that each symbol represents a single number.

Symbol	Meaning
$S$	the number of Students in a class
$B$	the number of Boys in a class
$G$	the number of Girls in a class
$C$	the number of Classes per student in a day
$P$	the number of Pages of homework per class per day
$D$	the number of Days in a marking period
$M$	the number of Marking periods in a year
$T$	the number of Tests per class per marking period for each student
$N$	the number of miNutes in a class period

1. Write a summary phrase for the expression  $MT$ .
2. Write an algebraic expression for the number of minutes each student spends in class in a day.
3. Write a summary phrase for the expression  $MD$ .
4. Write an algebraic expression for the number of tests a student will take in a school year.
5. Write a summary phrase for  $S - G$ .
6. Write an algebraic expression for the number of tests a teacher will have to mark for each class in one marking period.
7. Write a summary phrase for  $PC$ .
8. Write an algebraic expression for the number of pages of homework a student will have in a school year.

# *Classroom Expressions*

In this assignment you continue to work with algebraic expressions and summary phrases.

## *Subscripts and Superscripts*

Mathematicians often use **subscripts** so that they can use similar symbols to represent related quantities. You can think of a subscripted symbol as a two-letter variable for a single quantity.

For example, the combined symbols  $P_B$  and  $P_G$  are used in this activity to represent the number of pencils that each boy in the classroom has and the number of pencils that each girl in the classroom has.

The subscript, such as  $B$ , is written below and to the right of the main symbol,  $P$ . The combined symbol  $P_B$  is usually read *P sub B*.

You need to exercise care in writing subscripted variables so that they don't look like the product of two separate variables.

*Note:* A symbol written above and to the right of the main symbol, the way we write exponents, is called a **superscript**.

## *Variables for the Classroom*

The list of variables for the classroom setting is shown below. You should assume that the values of the variables are constant in all cases. For example, assume that every boy has the same number of pencils.

<b>Symbol</b>	<b>Meaning</b>
$B$	the number of Boys in the classroom
$G$	the number of Girls in the classroom
$P_B$	the number of Pencils each Boy has
$P_G$	the number of Pencils each Girl has
$L$	the cost of Lunch for each student (in cents)
$S$	the cost of a Snack for each student (in cents)
$M$	the amount of time each student spends in Math class per day (in minutes)
$E$	the amount of time each student spends in English class per day (in minutes)
$H_M$	the amount of time that each student spends on Homework for Math per day (in minutes)
$H_E$	the amount of time that each student spends on Homework for English per day (in minutes)

1. What, if anything, does each of the following algebraic expressions represent?  
(Use a summary phrase, if possible.)
  - a.  $B+G$
  - b.  $GP_G$
  - c.  $BM + BH_M$
  - d.  $LS$
  
2. Write an algebraic expression for each of the phrases below.
  - a. The total number of pencils for the students in the class
  - b. The cost of lunch for the whole class
  - c. The total amount of time that the students in the class spend on English each day (both in class and on homework)
  
3. Make up some other meaningful expressions using the list of variables above.

## ***Variables of Your Own***

1. Make up a set of between five and ten variables for a situation, the way you did in *Teaching Expressions*.

You might choose something like Marching Band Expressions, Baseball Game Expressions, Dating Expressions, or Clothing Store Expressions, or you might prefer to make up a situation of your own.

On the front of a sheet of paper, write down your variables and what they stand for.

2. Below your list of variables, write three algebraic expressions using your variables for which someone can write a summary phrase.

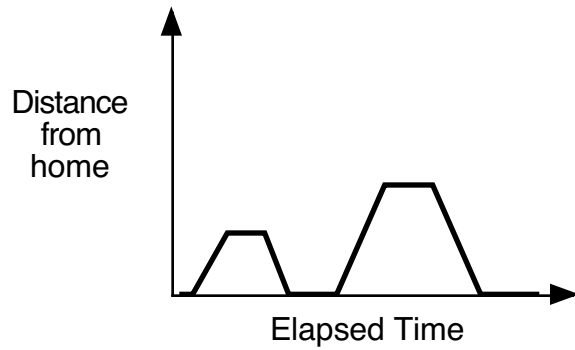
On the back of the same sheet of paper, write a summary phrase for each of your algebraic expressions.

3. On the front side of the paper, write three summary phrases for which someone can write an algebraic expression using your variables.

On the back side, write an algebraic expression for each of your summary phrases.

When you are ready, you will exchange papers with other students. Your task will then be to find summary phrases for each other's algebraic expressions and algebraic expressions for each other's summary phrases.

1. The following graph sketch illustrates a relationship between two quantities. Make up a story to fit the graph.

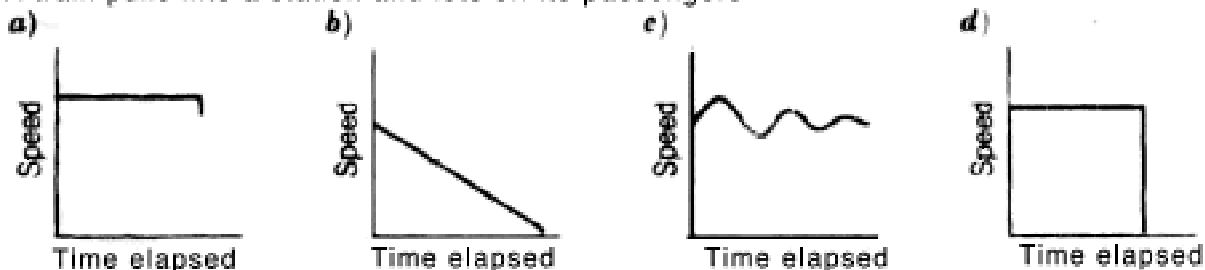


2. Draw a graph sketch with the vertical axis representing the amount of money you have with you and the horizontal axis represents elapsed time. Be sure to label each axis.

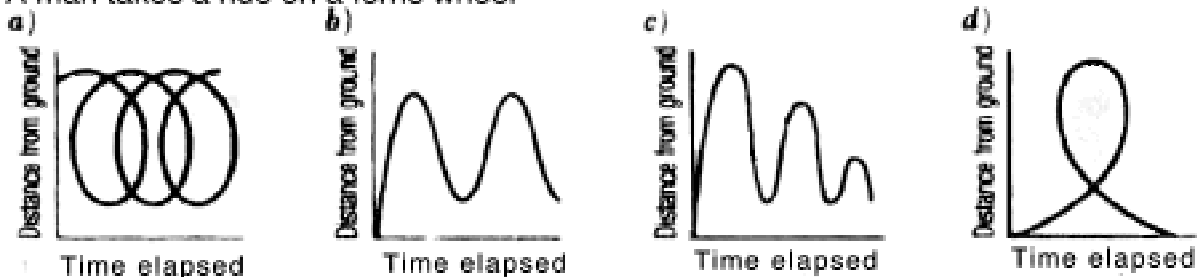
You get up, get dressed, eat, and then get your \$20 and leave home to go to school. At noon, you buy lunch. After school, you get \$50 from the bank. You go shopping, spend \$30, then go home.

Indicate which graph matches the statement

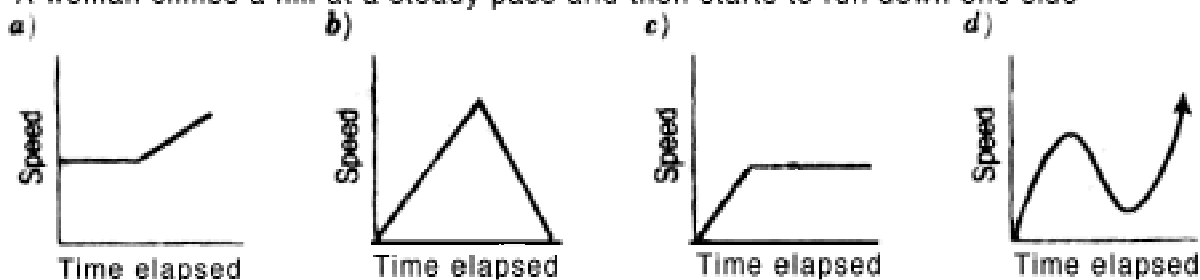
1. A train pulls into a station and lets off its passengers



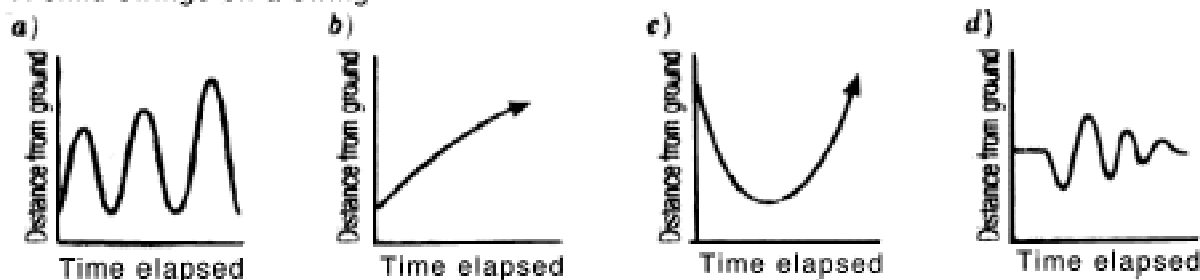
2. A man takes a ride on a ferris wheel



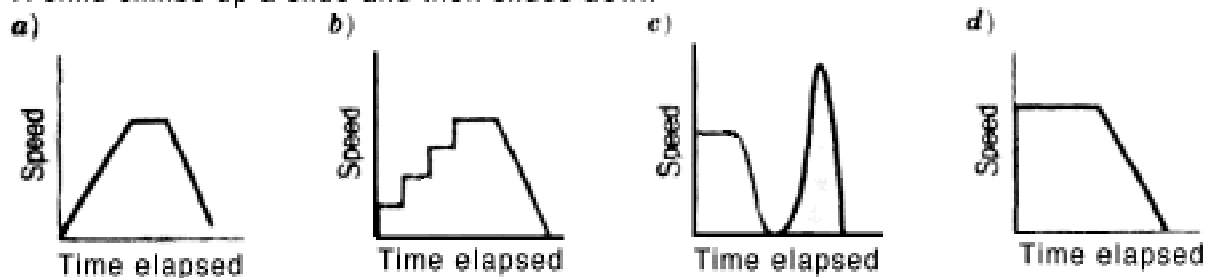
3. A woman climbs a hill at a steady pace and then starts to run down one side



4. A child swings on a swing



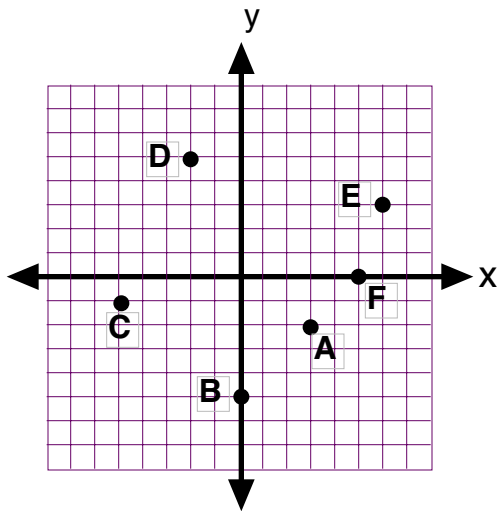
5. A child climbs up a slide and then slides down



From the *Mathematics Teacher*, September, 1994

## DRAWING GRAPHS

1. Sara walks from her home to the store. Halfway to the store, she realizes that she forgot to bring money, so she turns around, returns home, (gets her money, and then walks all the way to the store. Graph time on the horizontal axis and distance from home on the vertical axis.
  
2. Rashid is jumping on a trampoline. Graph time on the horizontal axis and his distance off the ground on the vertical axis.
  
3. Kendra is speeding along the highway and is stopped by a police officer. The officer gives her a ticket and then she continues on her way. Graph time on the horizontal axis and her speed on the vertical axis.
  
4. Carlos lives in a large city and travels to school on a local bus that stops at every block to let passengers on and off.
  - a) Graph time on the horizontal axis and the speed of the bus on the vertical axis.
  - b) Graph time on the horizontal axis and the distance Carlos has traveled on the vertical axis.



1. Give the coordinates of the labeled points.

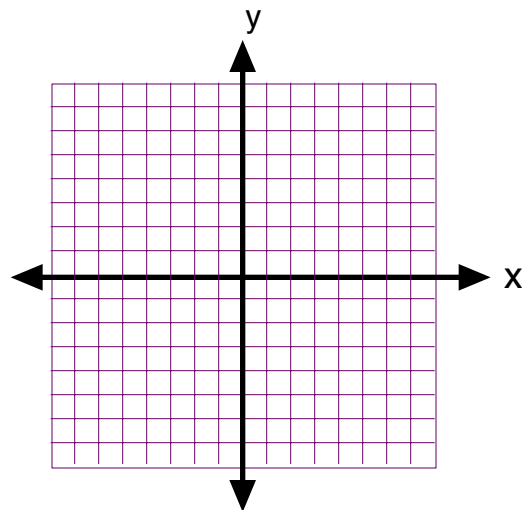
- A \_\_\_\_\_
- B \_\_\_\_\_
- C \_\_\_\_\_
- D \_\_\_\_\_
- E \_\_\_\_\_
- F \_\_\_\_\_

In which quadrant does each point lie?

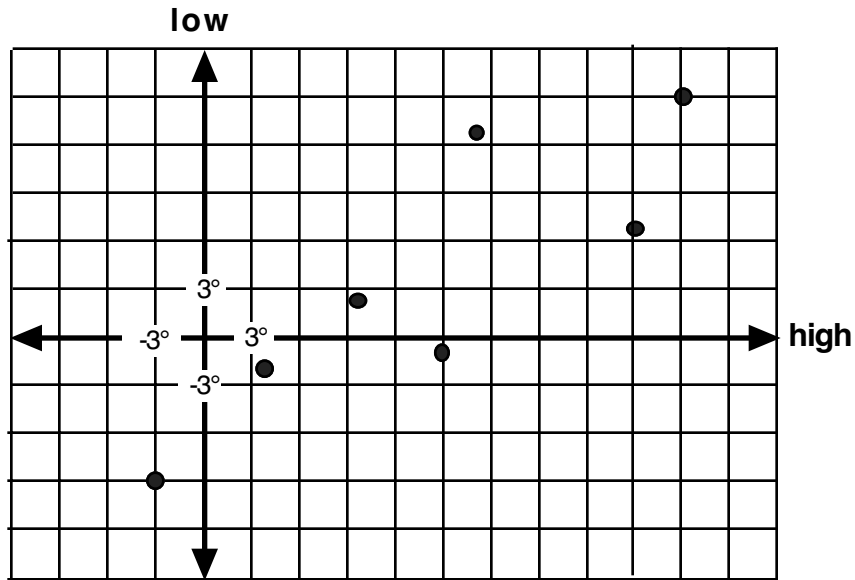
- 2.  $(-2, 5)$  \_\_\_\_\_
- 3.  $(3, 4)$  \_\_\_\_\_
- 4.  $(7, -1)$  \_\_\_\_\_
- 5.  $(0, -2)$  \_\_\_\_\_
- 6.  $(-1, -7.5)$  \_\_\_\_\_
- 7.  $(-9.1, 0)$  \_\_\_\_\_
- 8. The name given to the point  $(0, 0)$  is \_\_\_\_\_
- 9. Another name for the x-axis is the \_\_\_\_\_
- 10. The Cartesian coordinate system is also known as the \_\_\_\_\_

11. Graph and label each of the following points.

- G**  $(2, 5)$
- H**  $(-3, 1)$
- J**  $(4, 0)$
- K**  $(1, -5)$
- L**  $(0, -2)$

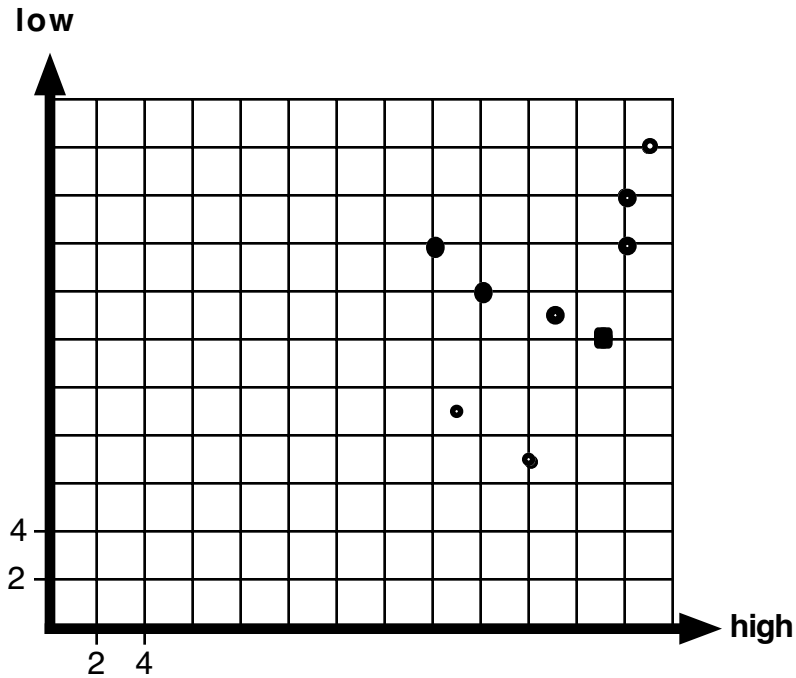


The daily high and low temperatures in °F for one week are shown in this scatter plot. Each point represents a high temperature and a low temperature for one day.



1. What was the median high temperature for the week?
2. What was the median low temperature for the week?

A 4th grade teacher plotted high and low scores for nine 25-question spelling tests. Each point represents the high score and the low score for one test. The results are shown in the graph below.



1. What was the median high score?
2. What was the median low score?
3. On one spelling test, the high score is the same as the low score. What was the score? What does this mean?

## *Spilling the Beans*

Three travelers met one night along the Overland Trail, and decided to have dinner together.

Sam had seven cans of beans to contribute and Kara contributed five cans of beans. Jock didn't have any beans, but the three cooked up what they had, and each ate the same amount.

After dinner, Jock offered the 84¢ in his pocket and said that the other two could divide it up in an appropriate way. They all agreed that in this way everyone would have contributed a fair share to the dinner.

Jock thought that Kara's share of the money should be 35¢, but Sam and Kara convinced him that this was wrong.

1. Explain why Jock might have thought that Kara's share was 35¢.
2. Then explain what Kara's correct share should be.

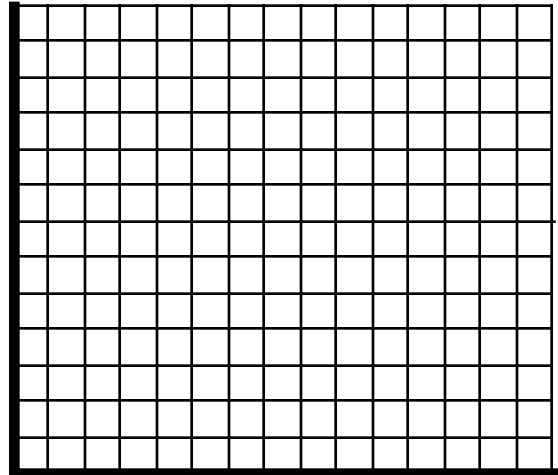
From Mathematics: Problem Solving Through Recreational Mathematics by Averbach and Chein. Copyright © 1980 by W.H. Freeman and Company. Adapted with permission.

# How Much?

For each problem,

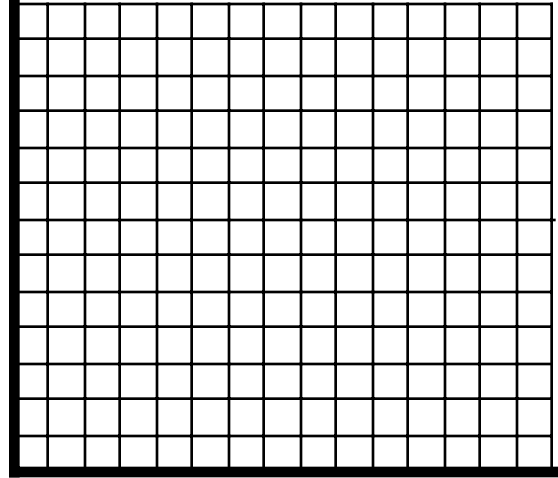
- 1) make an In-Out table showing the PATTERN stated in the problem
- 2) graph the information in the In-Out table (be sure to label the axes and use appropriate scales)
- 3) find the rule that describes the pattern
- 4) use the rule or the graph to answer the stated question

1. The *Movies to Go* video rental store charges \$3.00 for my first overnight video rental. The cost of each rental after that decreases by 5 cents. So the second rental is \$2.95 and the third rental is \$2.90 and so forth. How much would the 45th rental cost?

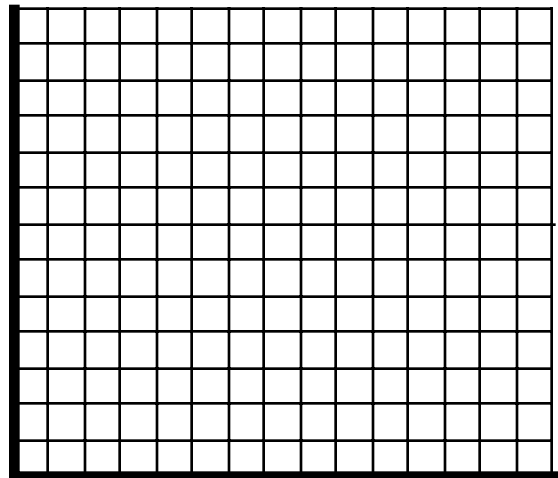


## ***How Much?*** (continued)

2. Martin has agreed to mow the lawn for Ms Gonzales every week this spring, summer, and fall. This week, Ms Gonzales paid Martin \$3.50. This is not much money, but Ms Gonzales wants a reliable worker and has agreed to increase Martin's pay by 35 cents each week he mows the lawn. How much will Martin earn the twentieth time he mows the lawn?



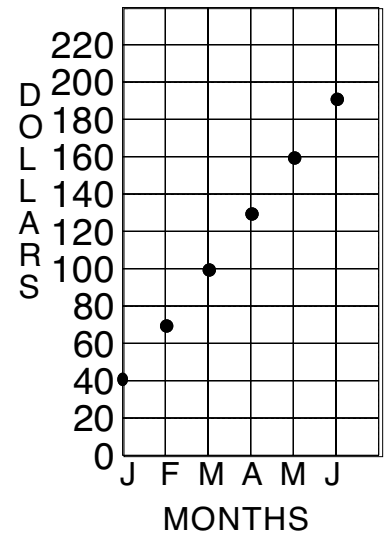
3. Armando ran an errand for Mrs. Schmidt and was paid 25 cents. Mrs. Schmidt told Armando that she would have an errand for him every day for thirteen days altogether and that she would double the preceding day's pay each time. How much did Armando earn on the thirteenth day?



## Graphs - Slopes - Situations

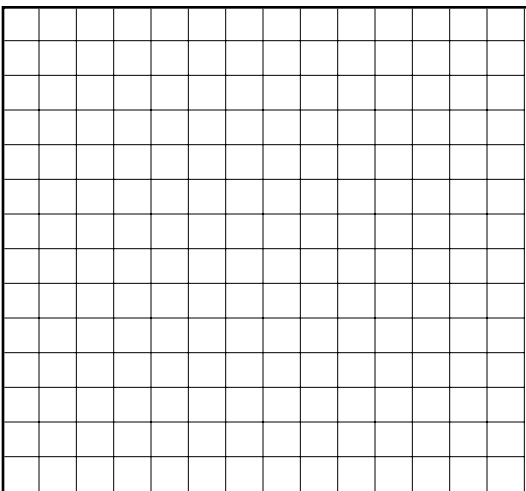
1. The graph below represents the money in Dave's savings account beginning January 1998.

- How much money did he have at the beginning of Jan?
- How much money did he have at the beginning of Feb?
- How much money did he have at the beginning of April?
- Is Dave saving money at a constant rate?
- Give an equation that would represent this graph.
- What is the slope of the line containing these points?

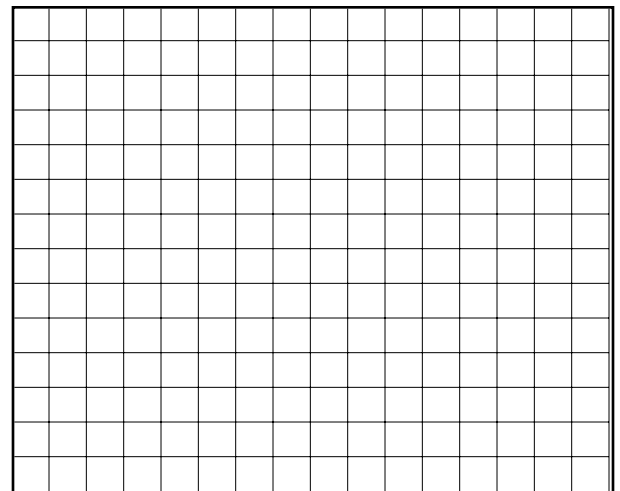


- The IMP class at Philly High is selling T-shirts. They ordered 300 shirts and sell approximately 25 each week.
  - Draw a graph that represents this situation.
  - Give an equation that represents this situation.
  - What is the slope of the line on the graph?
- Rob is an office manager in charge of ordering supplies. Two weeks after ordering 600 pencils, he noticed that there were 520 pencils left. After 5 weeks there were 400 pencils left.
  - Draw a graph representing this information.
  - How many pencils are being used each week?
  - Give an equation that represents this situation.
  - What is the slope of the line on the graph?
  - When should Rob order more pencils?

GRAPH FOR #2



GRAPH FOR #3



Find the equation of the given line.

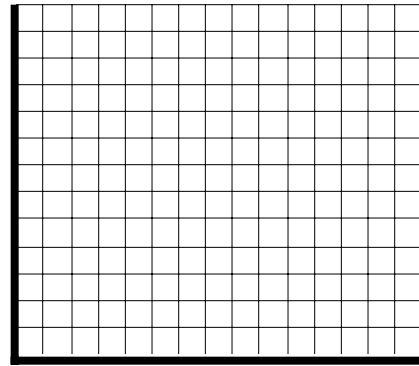
1. Joe's Buffet charges \$5 to get in plus \$1 for each plate of food you eat.

Graph the cost of eating at Joe's. (Be sure to use appropriate scales for your axes.)

Find the equation of the line you drew.

Cost  
(in dollars)

The Cost of Eating at Joe's



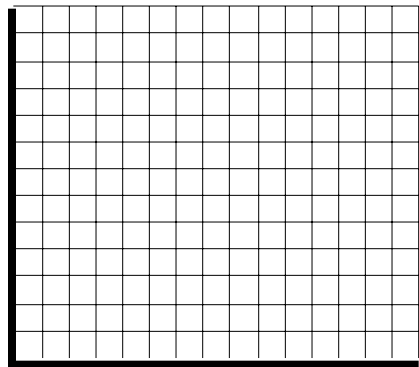
Number of plates

2. On Wednesday I bought 60 cans of Mountain Dew. I usually drink 4 cans of Dew each day.

Graph the number of cans that will remain as the days go by. (Be sure to use appropriate scales for your axes.)

Find the equation of the line you drew. Use the equation to determine how many cans will remain at the end of the thirteenth day.

Cans of  
Dew  
remaining.



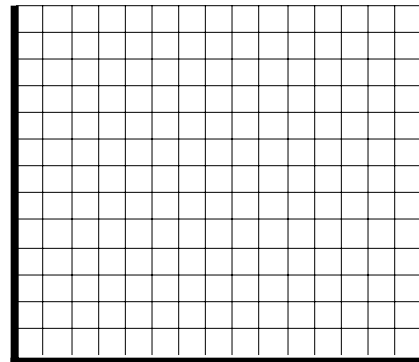
# of days that have passed

3. A glider is released from an airplane at an altitude of 5000 feet. The glider loses altitude at the rate of 3 feet per second.

Graph the altitude of the glider by the minute after it was released.

Find the equation of the line of descent.

altitude  
(in feet)



time (in minutes) after release

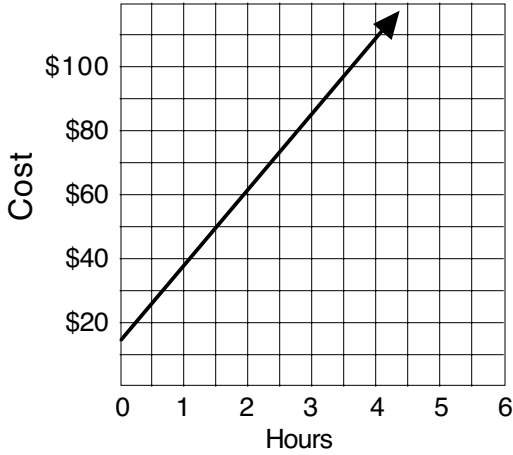
Which of the following graphs correctly represents the costs indicated in the advertisement?

**SCRUB-n-RUB**  
CLEANING SERVICES

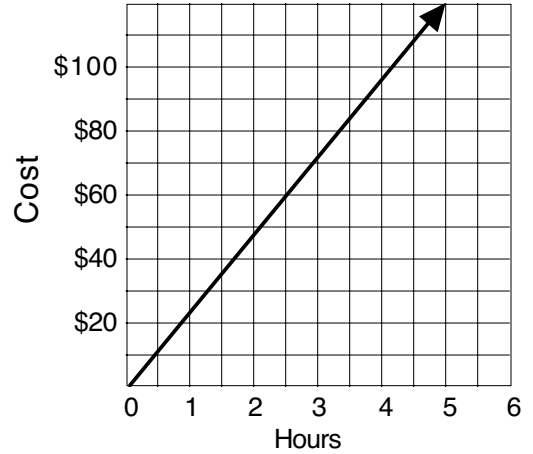
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**\$16 PER HOUR**  
**PLUS \$24 TRAVEL & SET-UP FEE**  
for all services

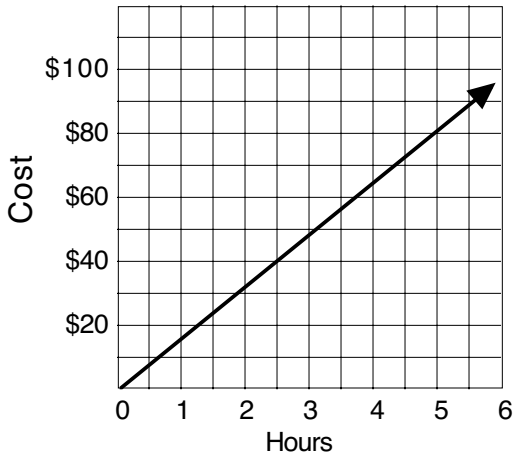
A.



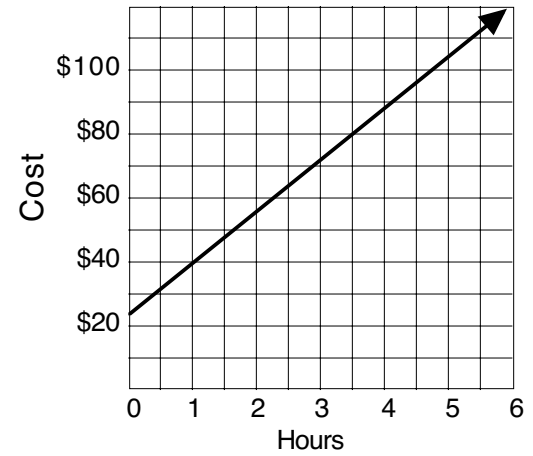
B.



C.



D.



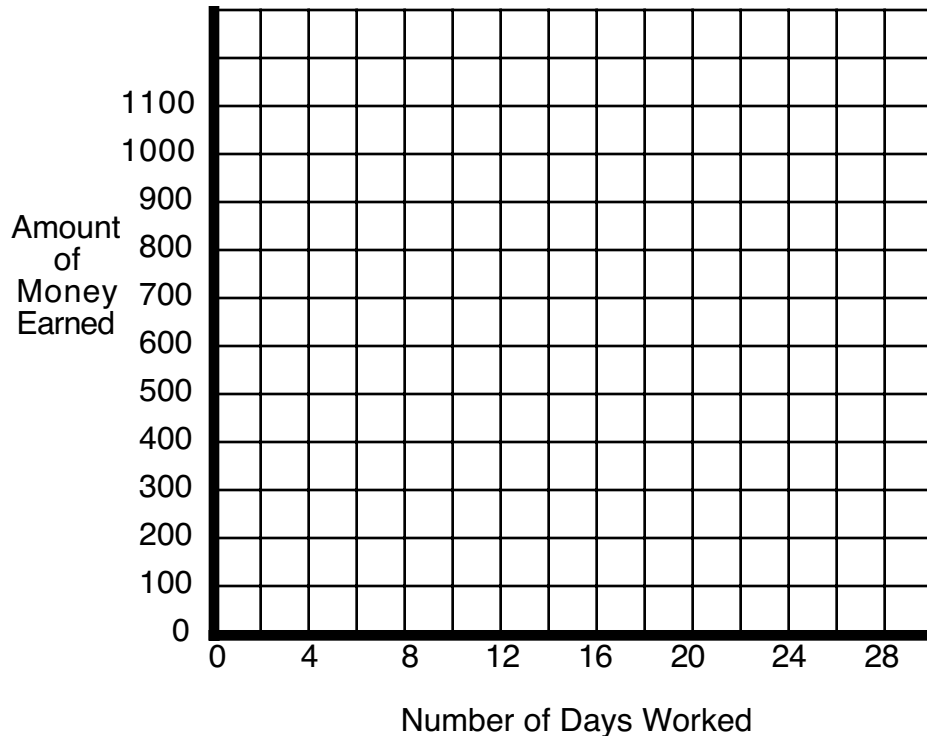
Another Cleaning Service charges \$20 per hour plus a \$16 fee. Draw the graph for its service on the grid you chose above. After how many hours is the cost the same for both cleaning services?

# Saving \$1000

Kyle and Kara each want to have \$1000 at the end of the summer. Kyle has been spending his money, so he only has \$40 saved so far. Kara has saved \$400. They have both agreed to save all of the money they earn until they each have \$1000.

Kyle works for a landscaper and makes \$60 per day. Kara works as a cashier and makes only \$40 per day. They will both work 7 days each week until they have both saved \$1000.

Use the grid below to graph and label their earnings and answer the following questions:



1. Who will get to \$1000 first?
2. How many days will it take?
3. How much money will the other person have when the first one gets to \$1000?
4. How many days would it take until they both have the same amount of money, assuming they both worked every day until that happened?

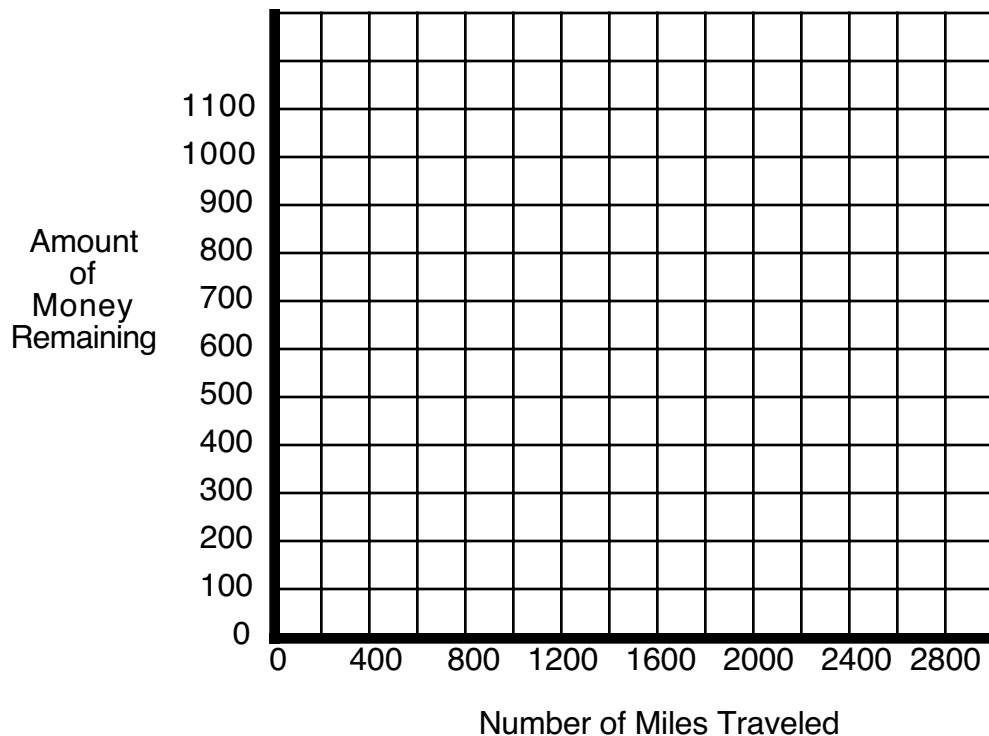
# Driving Across the Country

Three families from Philadelphia intend to drive to Los Angeles. The trip is 2800 miles. The Irvings are newly-weds and have no children. They have \$600 allocated to travel west. The Clarksons have three small children. They have \$1000 for the westward trip. The Butlers are traveling with their two-month old daughter. They have \$900.

The chart below shows their progress after traveling certain numbers of miles.

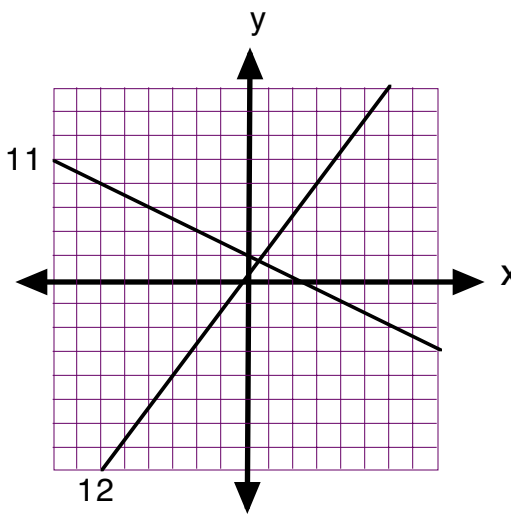
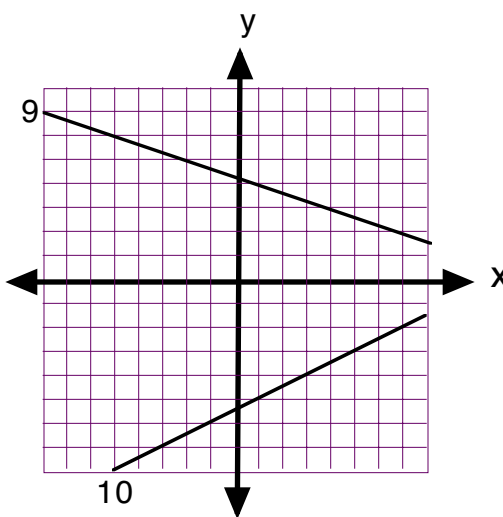
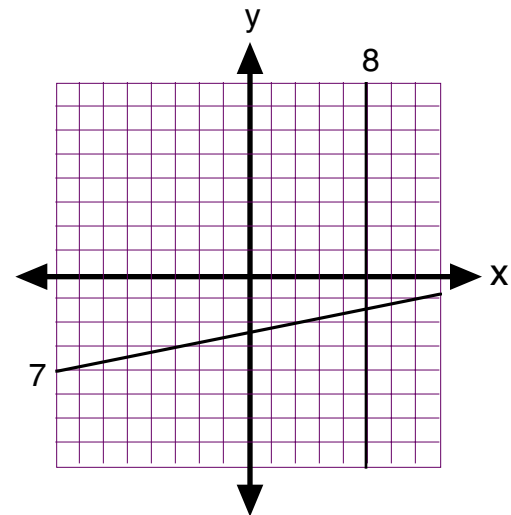
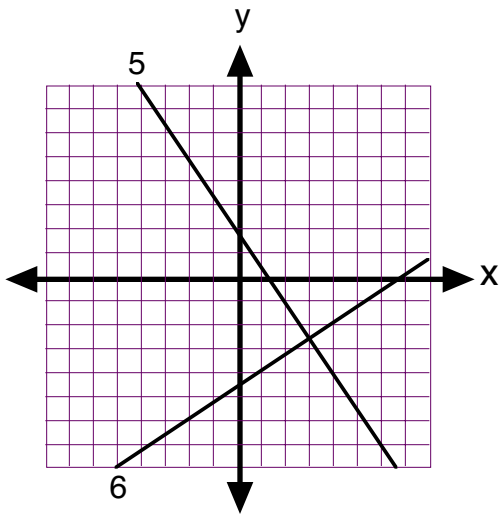
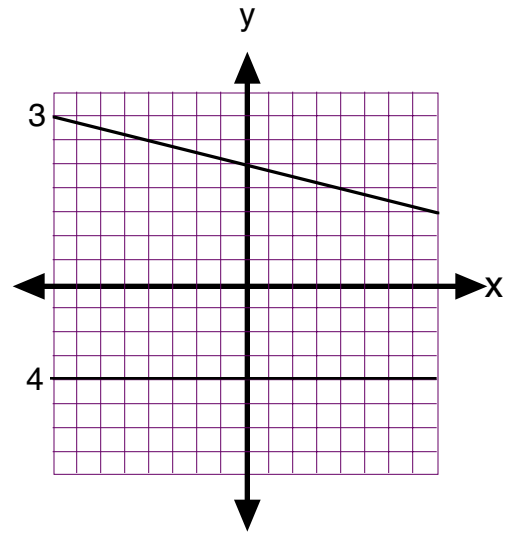
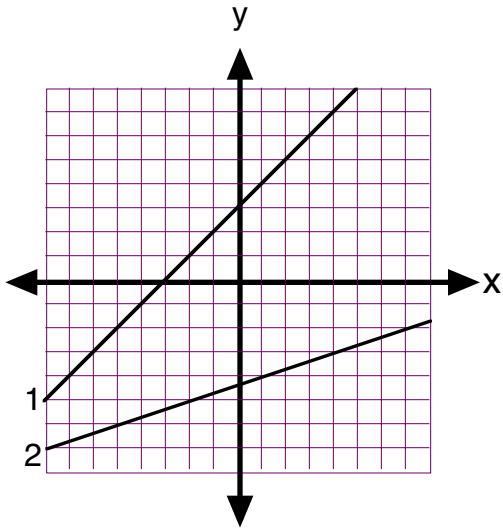
	Miles Traveled	Dollars Remaining	Miles Traveled	Dollars Remaining	Miles Traveled	Dollars Remaining
Irvings	450	\$520	850	\$440	1800	\$290
Clarksons	300	\$840	950	\$550	1300	\$380
Butlers	550	\$710	1000	\$530	1350	\$440

Use the grid below to graph the progress of the three families and draw the line of best fit for each..



1. Who will get to Los Angeles without running out of money?
2. Who will run out of money before reaching Los Angeles?
3. How far from Los Angeles will the family/families be when their money runs out?

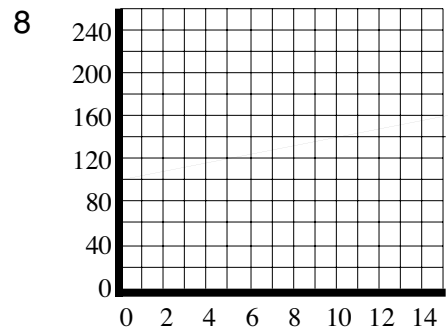
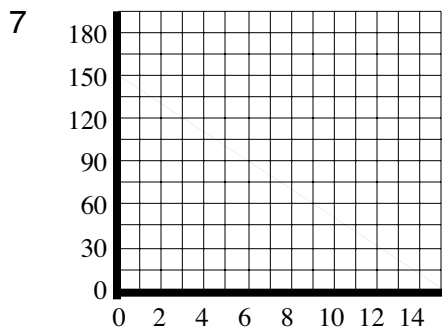
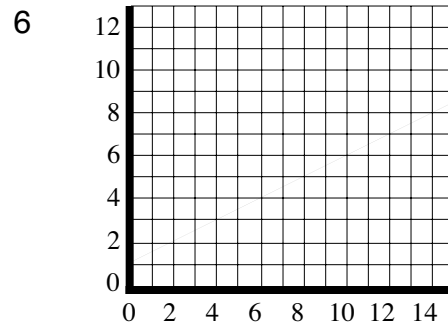
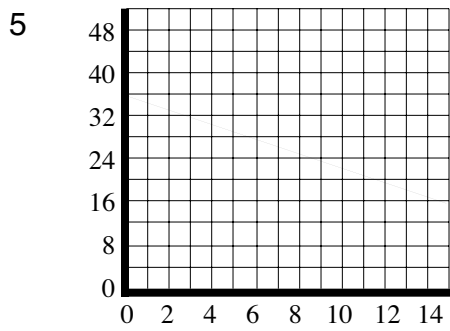
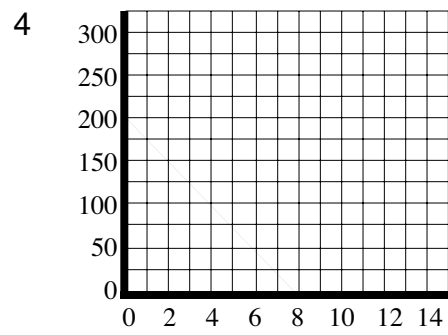
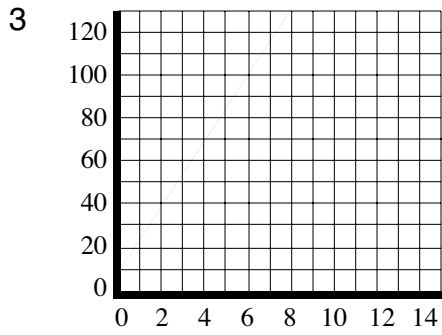
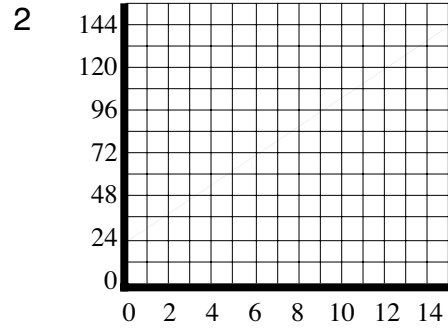
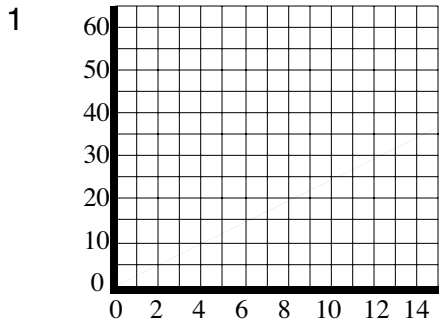
Find the slope of each numbered line.



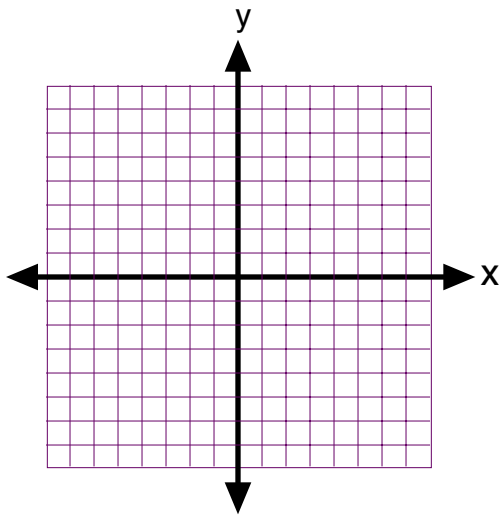
Find the slope and the y-intercept for each equation

1.  $y = 3x - 5$  slope: \_\_\_\_\_ y-intercept: \_\_\_\_\_
2.  $y = \frac{2}{3}x - 7$  slope: \_\_\_\_\_ y-intercept: \_\_\_\_\_
3.  $y = -\frac{3}{5}x - 9$  slope: \_\_\_\_\_ y-intercept: \_\_\_\_\_
4.  $y = -x - \frac{1}{2}$  slope: \_\_\_\_\_ y-intercept: \_\_\_\_\_
5.  $3x - 4y = 8$  slope: \_\_\_\_\_ y-intercept: \_\_\_\_\_
6.  $x - 3y = 6$  slope: \_\_\_\_\_ y-intercept: \_\_\_\_\_
7.  $4x + 5y = -3$  slope: \_\_\_\_\_ y-intercept: \_\_\_\_\_
8.  $5x + y = 8$  slope: \_\_\_\_\_ y-intercept: \_\_\_\_\_
9.  $2x - 4y = 12$  slope: \_\_\_\_\_ y-intercept: \_\_\_\_\_
10.  $3x - 4y = -12$  slope: \_\_\_\_\_ y-intercept: \_\_\_\_\_
11.  $7x + 3y = 7$  slope: \_\_\_\_\_ y-intercept: \_\_\_\_\_
12.  $2x - 3y = 0$  slope: \_\_\_\_\_ y-intercept: \_\_\_\_\_
13.  $2x = 8$  slope: \_\_\_\_\_ y-intercept: \_\_\_\_\_
14.  $-3y = 9$  slope: \_\_\_\_\_ y-intercept: \_\_\_\_\_

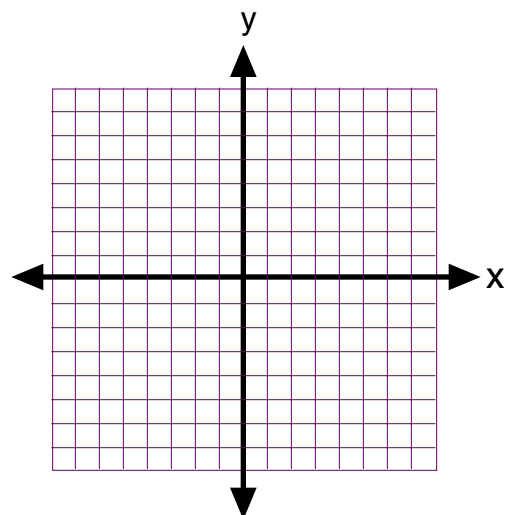
Find the equation of the given line



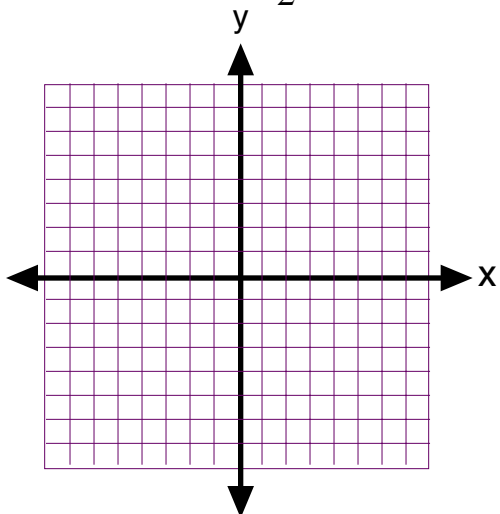
1. Graph  $y = 3x - 4$



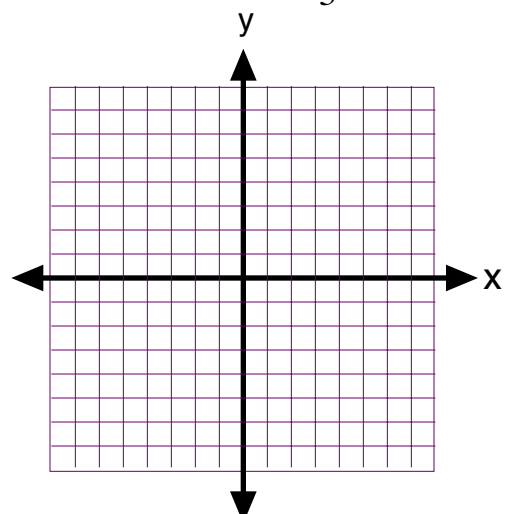
2. Graph  $y = -2x + 5$



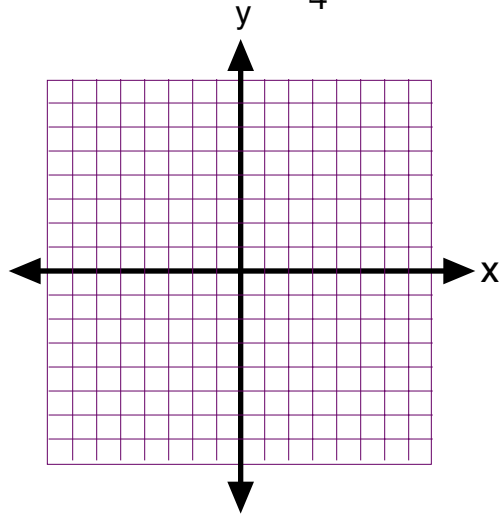
3. Graph  $y = \frac{1}{2}x - 1$



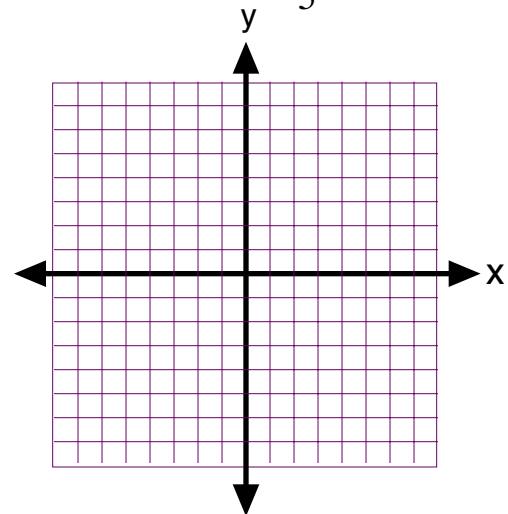
4. Graph  $y = -\frac{2}{3}x + 6$



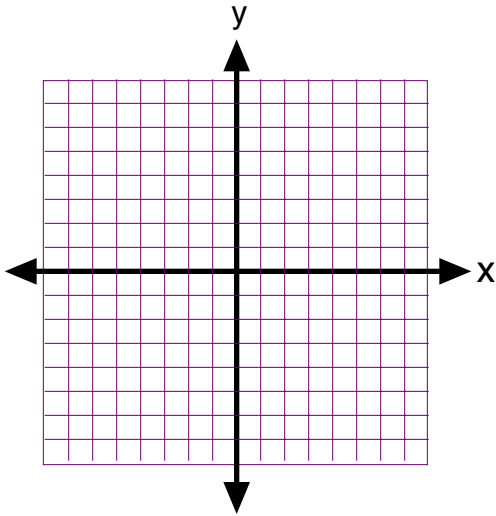
5. Graph  $y = -\frac{1}{4}x + 7$



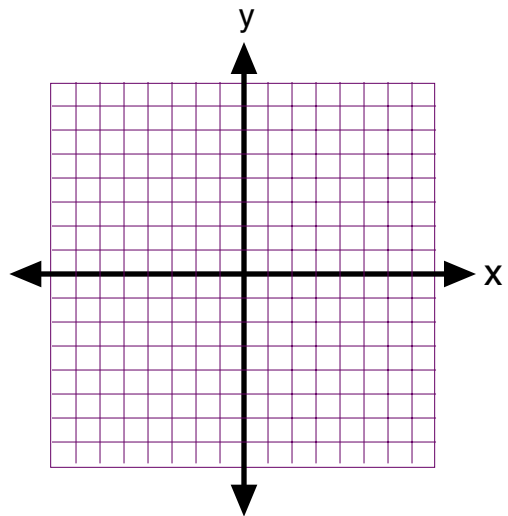
6. Graph  $y = \frac{4}{5}x$



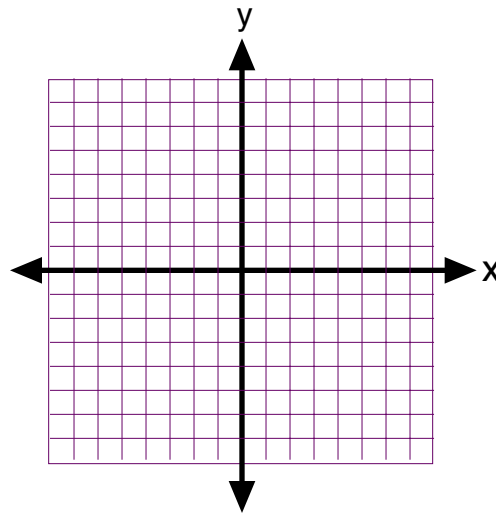
1. Graph  $y = -4$  and  $y = 2$



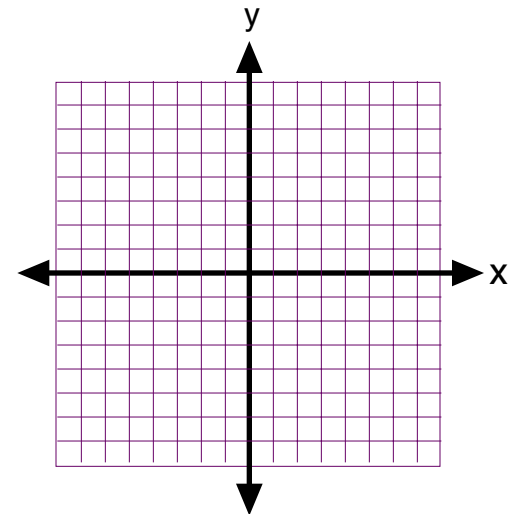
2. Graph  $y = x$  and  $y = x + 3$



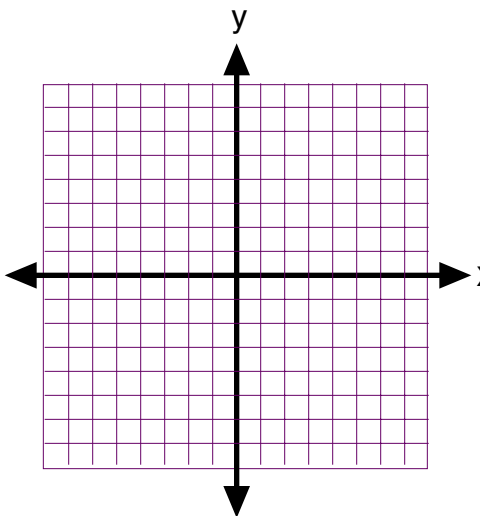
3. Graph  $y = -\frac{2}{3}x - 1$  and  $y = -\frac{2}{3}x + 2$



4. Graph  $y = \frac{1}{4}x + 3$  and  $y = \frac{1}{4}x - 3$



5. Graph  $y = -2x + 5$  and  $y = -2x$



6. Graph  $y = -\frac{2}{5}x + 3$  and  $y = -\frac{2}{5}x - 1$

