A close-up photograph of a hand holding a black pen, writing on a piece of paper. The background is blurred, showing a warm, reddish-brown color. The text is overlaid on the image in a white, serif font.

**Chang Learning Center**  
**SAT: Studying for the SAT Mathematics Section**  
**Lesson #5: Linear Functions**  
**July 16th, 2024**

By Joshua Weiner

Provided by Chang Learning



# SAT Quiz #4

## Review

Questions {#1, #2, #3, #4 and #5}

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Chang Learning

SAT Class Quiz

## Scholastic Achievement Test (SAT) QUIZ #4

5 QUESTIONS: Multiple Choice (Show your work)

<p>1) (Easy Level)</p> <p>What is the value of the formula below when <math>a = 10</math> and <math>b = 2</math> ?</p> $(a - b)(a^2 + ab + b^2)$	<p>A) 1024 B) 992 C) 976 D) 912</p>
<p>2) (Easy Level)</p> <p>Linus made 8 gallons of Lemonade for his summer sale. It cost him \$3 per gallon to make the lemonade. If he sells the lemonade in 8 ounce bottles for \$1 each, how much profit will he make if he sells all the lemonade ?</p> <p>(Use <i>One gallon</i> =128 ounces)</p>	<p>A) \$130 B) \$104 C) \$64 D) \$52</p>
<p>3) (Mid Level)</p> <p>Triangular numbers are numbers that pack into equilateral triangles (Think of packing circles, or oranges, into equal sided triangles.)</p> <p>What is the sum of the first 6 triangular numbers ?</p> <p>The first few triangular numbers are: {1, 3, 6, 10, 15...}.</p>	<p>A) 43 B) 60 C) 35 D) 56</p>
<p>4) (Mid Level)</p> <p>What is the "x" value to the intersection of the two linear equations below:</p> $3x + 2y = 12$ $2x - 2y = 18$	<p>A) + 6 B) - 3 C) + 3 D) - 6</p>
<p>5) (Challenge Level)</p> <p>A farmer buys a square of land that is 40 ACRES in area. (1 ACRE is equal to a 208.7ft by 208.7ft square.)</p> <p>To the nearest hundred feet, how many feet fence is needed to fence all 4 sides of his property.</p>	<p>Grid In</p>

JW2542 for CHANG LEARNING 2022

1) (Easy Level)

What is the value of the formula below when  $a = 10$  and  $b = 2$ ?

$$(a - b)(a^2 + ab + b^2)$$

A) 1024

B) 992

C) 976

D) 912

2) (Easy Level)

Linus made 8 gallons of Lemonade for his summer sale. It cost him \$3 per gallon to make the lemonade. If he sells the lemonade in 8 ounce bottles for \$1 each, how much profit will he make if he sells all the lemonade ?

(Use *One gallon* =128 ounces)

A) \$130

B) \$104

C) \$64

D) \$52

3) (Mid Level)

Triangular numbers are numbers that pack into equilateral triangles  
(Think of packing circles, or oranges, into equal sided triangles.)

What is the sum of the first 6 triangular numbers ?

The first few triangular numbers are:

{1, 3, 6, 10, 15...}.

A) 43

B) 60

C) 35

D) 56

4) (Mid Level)

What is the “x” value to the intersection of the two linear equations below:

$$3x + 2y = 12$$

$$2x - 2y = 18$$

A) + 6

B) - 3

C) + 3

D) - 6

5) (Challenge Level)

Grid In

A farmer buys a square of land that is 40 ACRES in area.  
(1 ACRE is equal to a 208.7ft by 208.7ft square.)  
To the nearest hundred feet, how many feet fence is needed  
to fence all 4 sides of his property.

SAT Homework #4  
Review  
Questions {#, # and #}

**Question 1****1 pts**

If  $4x - 7 < 5$ , which of the following describes the range of possible values of  $x$ ?

(A)  $x < -3$

(B)  $x > -3$

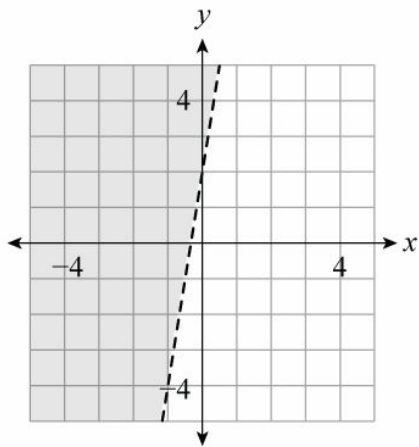
(C)  $x < 3$

(D)  $x > 3$



## Question 2

1 pts



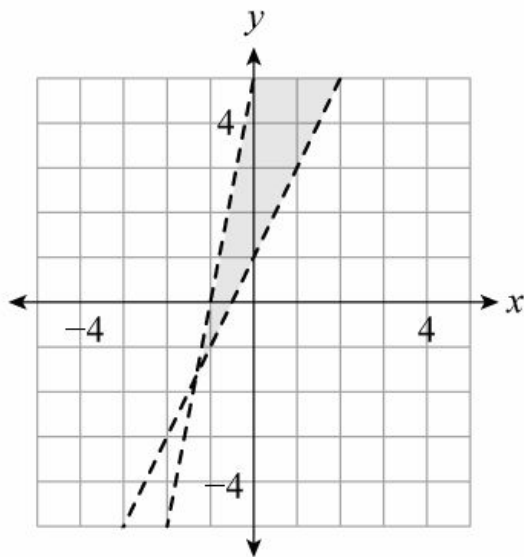
Which of the following inequalities describes the solution set shown in the graph?

- (A)  $y < 2x + 6$
- (B)  $y > 2x + 6$
- (C)  $y < 6x + 2$
- (D)  $y > 6x + 2$



### Question 3

1 pts



The graph shows the solution to a system of inequalities. If  $(a, b)$  is a solution to the system of inequalities shown in the graph, what is the smallest positive integer value of  $b$ ?

**Question 4****1 pts**

$$\begin{aligned}x &> 2 \\ x - 4y &< 8\end{aligned}$$

Which of the following describes the range of all possible values of  $y$  for the given system of inequalities?

---

(A)  $-\frac{3}{2} < y$

---

(B)  $-\frac{2}{3} < y$

---

(C)  $\frac{2}{3} < y$

---

(D)  $\frac{3}{2} < y$



### Question 5

1 pts

Ralph wants to gain at least 30 new subscribers this week. Basic subscribers,  $b$ , pay \$1, while premium subscribers,  $p$ , pay \$5. If Ralph wants to earn more than \$60 this week from his new subscribers, which of the following systems of inequalities correctly models this goal?

(A)  $\begin{cases} b + p \leq 30 \\ b + 5p < 60 \end{cases}$

(B)  $\begin{cases} b + p \geq 30 \\ b + 5p > 60 \end{cases}$

(C)  $\begin{cases} b + p \geq 30 \\ b + 5p < 60 \end{cases}$

(D)  $\begin{cases} b + p \leq 30 \\ b + 5p > 60 \end{cases}$



### Question 6

1 pts

$$x + 2y < 3$$

$$4x - 5 > -6y$$

Which of the following points satisfies the given system of inequalities?

(A) (0, 0)

(B) (0, 1)

(C) (1, 0)

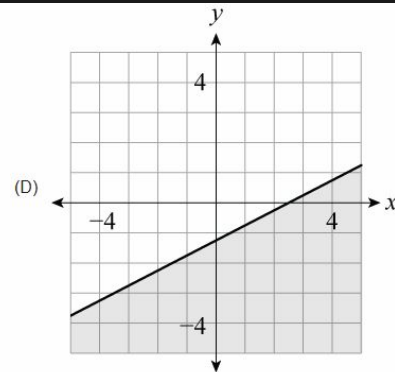
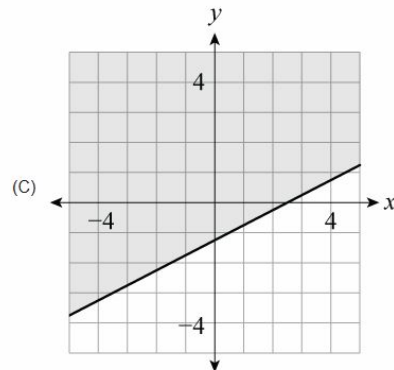
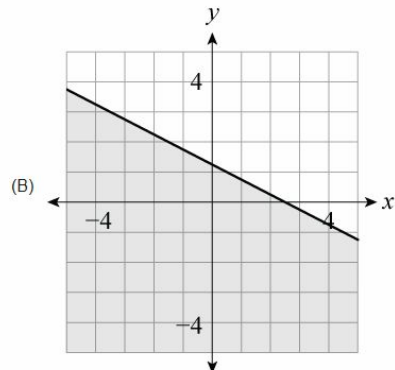
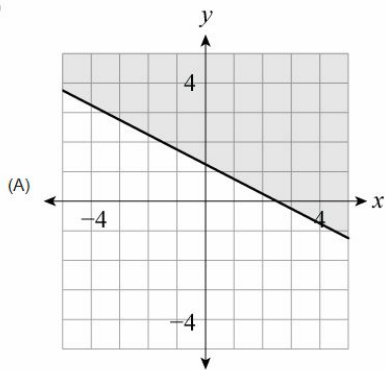
(D) (1, 1)



Question 7

1 pts

Which of the following graphs represents the solution set for  $4x + 8y \geq 10$ ?





### Question 8

1 pts

If  $2b + 15 \leq 34$ , what is the greatest possible value of  $4b + 2$ ?



### Question 9

1 pts

Vicky spends \$200 to buy pots, seeds, and soil to start a garden. Once she begins harvesting, she estimates that it will lower her vegetable grocery bill from \$30 a week to \$22 a week. Which of the following inequalities can be used to find  $w$ , the number of weeks after harvesting that her vegetable cost savings will be at least as much as the cost of starting the garden?

- (A)  $200 \geq (30 - 22)w$
- (B)  $200 \geq 22w$
- (C)  $200 \leq (30 - 22)w$
- (D)  $200 \leq 22w$



**Question 10****1 pts**

The variable  $x$  is an integer. If  $2(3x - 6) < 5$  and  $5(-2x + 1) < 2$ , how many possible values are there for  $x$ ?

(A) 0

(B) 1

(C) 2

(D) 3

# SAT Lesson #5 Linear Functions

# LINEAR FUNCTIONS

## LEARNING OBJECTIVES

After completing this chapter, you will be able to:

- Apply function notation
- Define the domain and range of a linear function
- Evaluate the output of a linear function for a given input
- Interpret the graph of a linear function
- Write a linear function to describe a rule or data set

## Function Notation

### LEARNING OBJECTIVES

After this lesson, you will be able to:

- Apply function notation
- Define the domain and range of a linear function
- Evaluate the output of a linear function for a given input

### To answer a question like this:

$$h(x) = 2x + 7$$

Which of the following must be true about  $h(x)$ ?

- A)  $h(3) = 15$
- B)  $h(14) = 35$
- C) The domain of  $h(x)$  consists only of integers
- D)  $h(x)$  may only be positive

**You need to know this:**

A **function** is a rule that generates one unique output for a given input. In function notation, the  $x$ -value is the input and the  $y$ -value, designated by  $f(x)$ , is the output. (Note that other letters besides  $x$  and  $f$  may be used.)

A linear function is a function that describes a line; as such, it is generally expressed in slope-intercept form with  $f(x)$  equivalent to  $y$ :

$$f(x) = mx + b$$

In questions that describe real-life situations, the  $y$ -intercept will often be the starting point for the function. You can think of it as  $f(0)$ , or the value of the function where  $x = 0$ .

The set of all possible  $x$ -values is called the **domain** of the function, while the set of all possible  $y$ -values is called the **range**. For most linear functions, the range and domain consist of all real numbers, since lines are infinitely long. However, a constant function, such as  $f(x) = 4$ , produces a horizontal line, since every  $x$ -value produces the same  $y$ -value, and thus has a range consisting of just that one number.

**You need to do this:**

- To find  $f(x)$  for some value of  $x$ , substitute the concrete value in for the variable and do the arithmetic.
- For questions that ask about a function of a function, for example,  $g(f(x))$ , start on the inside and work your way out.

**Explanation:**

Check each answer choice, plug in 3 for  $x$ :

$$h(3) = 2(3) + 7 = 6 + 7 = 13$$

This doesn't match. Eliminate choice (A).

Check answer choice (B), plug in 14 for  $x$ :

$$h(14) = 2(14) + 7 = 28 + 7 = 35$$

That is true, so choice **(B)** is correct.

On test day, you would select **(B)** and move on to the next question, but for the record: Since  $h(x)$  is a linear function, any possible  $x$ -values, not just integers, will correspond with points along the line. Choice (C) is incorrect.

Choice (D) is also incorrect. Any non-horizontal line will cross the  $x$ -axis at some point, which means that it has both positive and negative  $y$ -values. The given equation for  $h(x)$  is already in  $y = mx + b$  form, so you can see that it has a positive slope. So,  $h(x)$  can be either positive or negative.

## Graphs of Linear Functions

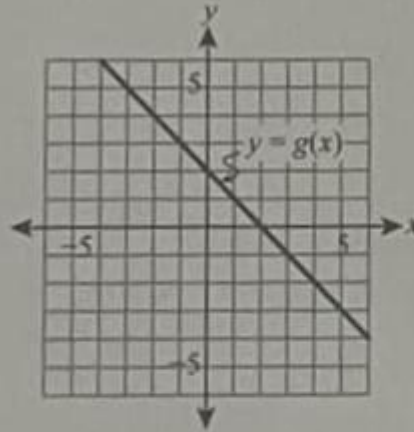
### LEARNING OBJECTIVE

After this lesson, you will be able to:

- Interpret the graph of a linear function

To answer a question like this:

$x$	$h(x)$
-2	-5
-1	-4
0	-3
1	-2
2	-1



The graph shows  $g(x) = mx + b$ , where  $m$  and  $b$  are constants. table. What is the value of  $h(m)$ ?

- A) -4
- B) -2
- C) 1
- D) 2

**Explanation:**

The linear function  $g(x)$  is given in slope-intercept form, so  $m$  represents the function's slope. You can determine the slope by visually inspecting the graph: for every unit the line moves to the right, it also goes down one, so  $m = -1$ . You could also plug two points from the graph of  $g(x)$ , such as  $(1, 1)$  and  $(0, 2)$  into the slope formula:  $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - 1}{0 - 1} = \frac{1}{-1} = -1$ . Next, use the table to find  $h(-1)$ , which is the  $y$ -value of function  $h$  when  $x = -1$ . According to the table, when  $x = -1$ ,  $h(x) = -4$ . **(A)** is correct.

## Describing Real-Life Situations with Linear Functions

### LEARNING OBJECTIVE

After this lesson, you will be able to:

- Write a linear function to describe a rule or data set

To answer a question like this:

COOKIE VARIETY	NUMBER OF COOKIES PER BOX	PRICE PER BOX (DOLLARS)
Walnut	22	1.26
Pecan	20	1.10
Butterscotch	24	1.42
Mint	18	0.94
Macadamia	12	0.46
Hazelnut	16	0.78

The number of cookies per box and the price per box for the different varieties of cookies sold by a cookie company are shown in the table. The relationship between the number of cookies per box and the price, in dollars, per box can be represented by which of the following linear functions?

- A)  $p(n) = 0.11n - 0.25$   
B)  $p(n) = 0.1n - 0.35$   
C)  $p(n) = 0.09n - 0.45$   
D)  $p(n) = 0.08n - 0.5$

**You need to know this:**

Modeling real-life situations using functions is the same as modeling them using equations; the only difference is the function notation and a function's rule that each input has only one output.

For example, suppose a homeowner wants to determine the cost of installing a certain amount of carpet in her living room. Say that the carpet costs \$0.86 per square foot, the installer charges a \$29 installation fee, and sales tax on the total cost is 7%. Using your algebra and function knowledge, you can describe this situation in which the cost,  $c$ , is a function of square footage,  $f$ . The equation would be  $c = 1.07(0.86f + 29)$ . In function notation, this becomes  $c(f) = 1.07(0.86f + 29)$ , where  $c(f)$  is shorthand for "cost as a function of square footage." The following table summarizes what each piece of the function represents in the scenario.

ENGLISH	Overall cost	Square footage	Material cost	Installation fee	Sales tax
MATH	$c$	$f$	$0.86f$	29	1.07

**You need to do this:**

For word problems involving function notation, translate the math equations exactly as you learned in the Word Problems lesson in the Linear Equations and Graphs chapter, but substitute  $f(x)$  for  $y$ .

**Explanation:**

Note that the question asks for the relationship between the number of cookies per box and the price per box and that the answer choices all start with  $p(n)$ . Given the context, this translates to the relationship "price as a function of the number of cookies." All the choices express a linear relationship, so you can't rule out any of them on that basis.

There are several approaches you could take to find the correct answer. One would be to recognize that all the choices are in the form  $p(n) = mn + b$  (a variation of the slope-intercept form  $y = mx + b$ ) and that you can set up a system of linear equations using the data from any two rows, such as "walnut" ( $p(n) = 1.26$  and  $n = 22$ ) and "pecan" ( $p(n) = 1.10$  and  $n = 20$ ), to solve for  $m$  and  $b$ . That approach would look like this:

$$\begin{array}{r} 1.26 = 22m + b \\ - (1.10 = 20m + b) \\ \hline 0.16 = 2m \\ 0.08 = m \\ 1.10 = 20(0.08) + b \\ 1.10 = 1.60 + b \\ b = -0.5 \end{array}$$

Because  $m = 0.08$  and  $b = -0.5$ , the correct function is  $p(n) = 0.08n - 0.5$ , so **(D)** is correct.

Another approach would be to use two of the pairs of data points from the table to calculate a slope; for example, using the "walnut" and "pecan" rows would yield  $\frac{1.26 - 1.10}{22 - 20} = \frac{0.16}{2} = 0.08$ . Because only one answer has a slope of 0.08, you can pick **(D)**.

Finally, you could pick numbers from the table. Plug any one of the rows of data, such as "pecan," from the table into all four answer choices to check which equation will produce a price of \$1.10 per box given 20 cookies per box:

- A)  $0.11(20) - 0.25 = 1.95 \neq 1.10$
- B)  $0.1(20) - 0.35 = 1.65 \neq 1.10$
- C)  $0.09(20) - 0.45 = 1.35 \neq 1.10$
- D)  $0.08(20) - 0.5 = 1.10$

Choice **(D)** is confirmed as the only one that works. It is correct.

# SAT Classwork #4

**#1 to #5      Page 78**

**#6 to #10     Page 81**

**#11 to #15    Page 85**

1

HINT: For Q1, replace  $x$  in the function definition with  $(x-2)$ .

If  $g(x) = 7x - 3$ , what is  $g(x - 2)$ ?

(A)  $7x - 17$

(B)  $7x - 11$

(C)  $7x - 5$

(D)  $7x - 1$

2

If  $k(x) = 5x + 2$ , what is the value of  $k(4) - k(1)$ ?

HINT: For Q3, work from the inside parentheses out.

$x$	$g(x)$
-6	-3
-3	-2
0	-1
3	0
6	1

$x$	$h(x)$
0	6
1	4
2	2
3	0
4	-2

Several values for the functions  $g(x)$  and  $h(x)$  are shown in the tables. What is the value of  $g(h(3))$ ?

(A) -1

(B) 0

(C) 3

(D) 6

4

If  $p(x) = 2x + 8$  and  $q(x) = x - 3$ , what is the value of  $\frac{q(p(5))}{p(q(5))}$ ?

(A) 0

(B) 0.8

(C) 1

(D) 1.25

$n$	$f(n)$	$g(n)$
2	11.6	1.5
3	13.9	1
4	16.2	0.5

The table shows some values of the linear functions  $f$  and  $g$ . If  $h(n) = 2 \times f(n) - g(n)$ , what is the value of  $h(6)$ ?

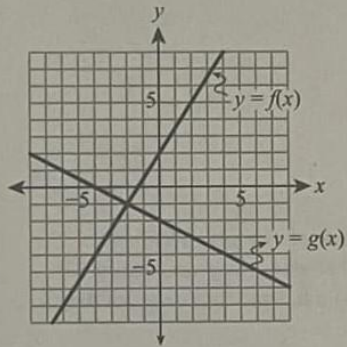
(A) 21.3

(B) 35.0

(C) 41.1

(D) 42.1

HINT: For Q6, at the point where the graphs of  $f$  and  $g$  intersect, both graphs have exactly the same  $x$  and  $y$  values.



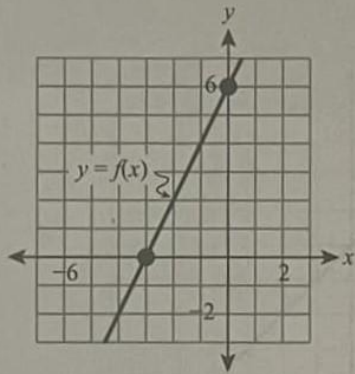
The graphs of functions  $f$  and  $g$  are shown in the figure. At what value of  $x$  does  $f(x) - g(x) = 0$ ?

(A) -2

(B) -1

(C) 0

(D) 2



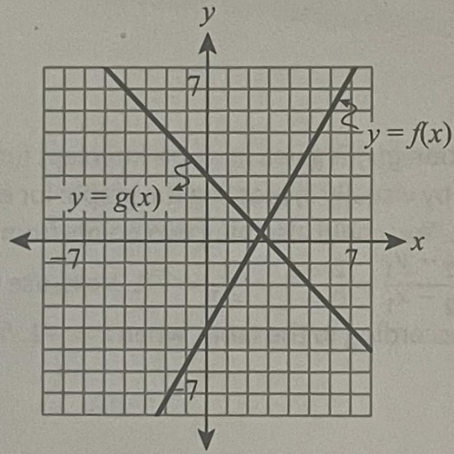
The graphs of linear functions  $f$  (shown) and  $g$  (not shown) are parallel. The graph of  $g$  passes through the point  $(1, 1)$ . What is the value of  $g(0)$ ?

(A)  $-3$

(B)  $-1$

(C)  $3$

(D)  $6$

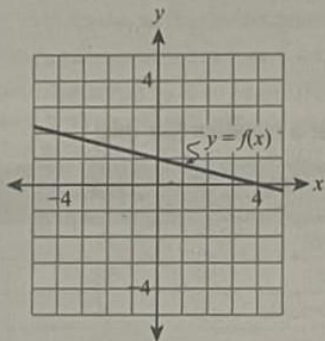


The graphs of the linear functions  $f$  and  $g$  are shown in the  $xy$ -plane. What is  $f(6) - g(-3)$ ?

The graph of the linear function  $f$  has intercepts at  $(c, 0)$  and  $(0, d)$  in the  $xy$ -plane. If  $2c = d$  and  $d \neq 0$ , which of the following is true about the slope of the graph of  $f$ ?

- (A) It is positive.
- (B) It is negative.
- (C) It equals zero.
- (D) It is undefined.

HINT: For Q10, first determine  $f(0)$ .



The graph of function  $f$  is shown in the  $xy$ -plane.

The equation for function  $g$  (not shown) is  $g(x) = 2f(x) - 9$ . What is the value of  $g(0)$ ?

(A) -9

(B) -7

(C) -1

(D) 1

HINT: For Q11, pick the easiest number of days from the chart, plug that into the choices, and eliminate any that don't give you the correct vote count. Repeat if necessary until only one choice is left.

Day	Vote Count
3	21
4	28
5	35
6	42
7	49

Paulo is running for class president. He recorded his vote count for each day. Data for five days are in the table. Which of the following represents Paulo's vote count,  $v$ , as a function of time,  $t$ , in days?

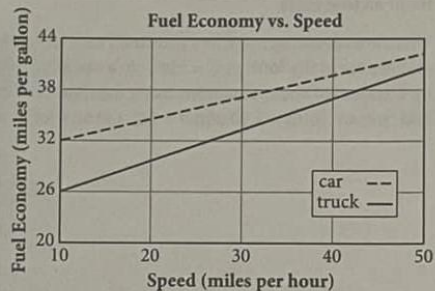
(A)  $v(t) = \frac{t}{7}$

(B)  $v(t) = \frac{t}{7} + 21$

(C)  $v(t) = 7t$

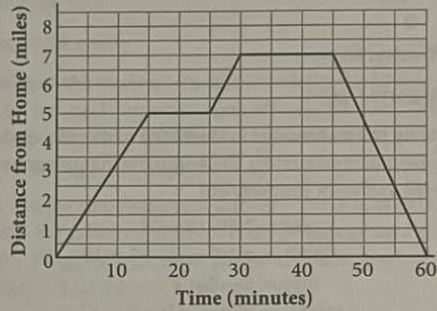
(D)  $v(t) = 7t + 21$

HINT: For Q12, the faster the rate of change, the steeper the slope.



The graph shows a car's and a truck's fuel economy as a function of speed. Which of the following is true?

- (A) The rate of increase in fuel economy of the car is greater than the rate of increase in fuel economy of the truck.
- (B) The rate of increase in fuel economy of the car is equal to the rate of increase in fuel economy of the truck.
- (C) The rate of increase in fuel economy of the car is less than the rate of increase in fuel economy of the truck.
- (D) Nothing can be said about the rates of change in fuel economy.



The graph shows Carmel's distance from home over a one-hour period, during which time she first went to the library, then went to the grocery store, and then returned home. Which of the following statements must be true?

- (A) The grocery store is 5 miles from Carmel's house.
- (B) Carmel traveled a total of 7 miles from the time she left home until she returned.
- (C) The grocery store is 7 miles farther from Carmel's house than the library is.
- (D) Carmel spent 10 minutes at the library and 15 minutes at the grocery store.

HINT: For Q14, which two readings will be easiest to use to find the number of visitors admitted every 15 minutes?

Time	Total Number of Visitors for the Day
10:10 a.m.	140
12:30 p.m.	420
2:00 p.m.	600
2:50 p.m.	700

The gates at a museum allow a constant number of visitors to enter every 15 minutes. The cumulative number of visitors at various times are shown in the table. The museum does not admit any visitors after 4:45 p.m. What is the projected total number of visitors for the day, assuming that the same number of visitors are granted entrance each 15-minute period throughout the day?

# SAT Classwork #5: Linear Functions

1st Set  
Function  
Notation

1)	A
2)	15
3)	A
4)	D
5)	D

2nd Set  
Graphing  
Functions

6)	A
7)	B
8)	0
9)	B
10)	B

3rd Set  
Real World  
Problems

11)	C
12)	C
13)	D
14)	930

# SAT Section 2 - Math Module 1

No calculators allowed

43 minutes to complete 27 questions



# SAT Section 2 - Math Module 2

Use your calculator

43 minutes to complete 27 questions





# A few Test-Taking Strategies

- Prepare in an organized way: Focus on ALGEBRA, GEOMETRY, COORDINATE PLANE, CHARTS & GRAPHS and STATISTICS lessons from Grades 9-10
- Be comfortable with the SAT Level of questions by exposure to as many practice questions as possible. The SAT is a patterned exam.
- Work on Time Management. Be sure to complete “easy to mid” level questions first.
- Some multiple choice questions can be solved by PLUG IN of the answer choices.
- Some multiple choice questions can be simplified by PLUG IN A VALUE for the variable (Plug in “1,2,3,4 or 5”)
- ESTIMATE the answer to save procedural time on questions.
- Study and MEMORIZE FORMULAS and SOLUTION METHODS before the exam.
- Look for SHORTCUTS

# Chang Learning Center

## SAT Preparation

Mathematics

Quiz

Lesson

Homework

