Pre-AP Algebra 2
Lesson 1-5 – Linear Functions

Objectives: Students will be able to graph linear functions, recognize different forms of linear functions, and translate linear functions. Students will be able to recognize the parent linear function and compare/contrast other parent functions

Materials: graphing calculator, Translating Graphs of Lines Discovery Worksheet

Time	Activity
10 min	**Homework Review** Students check their answers to hw #1-4 and discuss work with their group. Pass around a tally sheet for questions (one from each side of the room to speed it up).
5 min	**Homework Presentations** Review the top 2 or 3 questions from the tally sheet.
10 min	**DO NOW:** Compare & Contrast Parent functions
15 min	**Pairwork** o Practice using point-slope – this will lead into the discovery worksheet
35 min	• Translating Graphs of Lines Discovery Worksheet: ➢ On this worksheet the students will begin to learn a major focus of the Algebra II curriculum – translations, rotations, and transformations of graphs. They will use the equation of a line in the form $f(x) = m(x - x_1) + y_2$ to discover how $f(x \pm h)$ and $f(x) \pm k$ changes the graph. ➢ Distribute the Graphs of Lines Discovery Worksheet and have the students graph each set of three lines on the same screen on their graphing calculators. Then have students write an explanation of the changes in the equation and what effect the change has on the graph.

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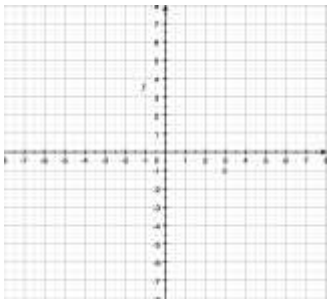
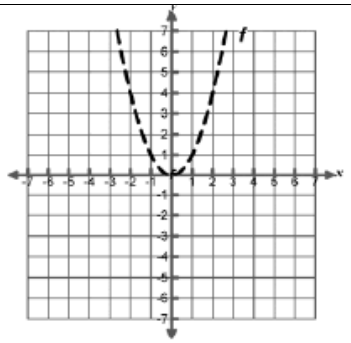
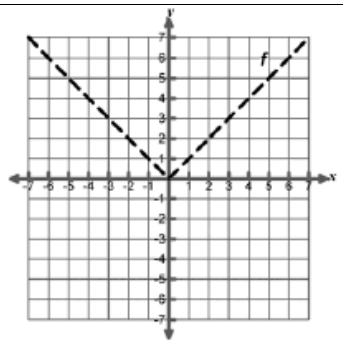
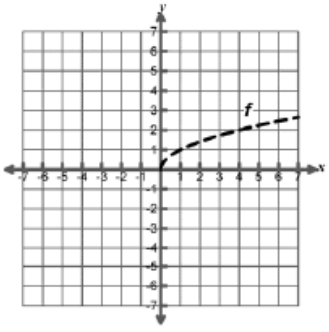
Lesson 1-5 – DO NOW

Each family of functions has a parent function. Here are a few parent functions.

Function Name	Parent Function	Graph
Linear	$f(x) = x$ Domain: Range: x-int: y-int:	
Quadratic	$f(x) = x^2$ Domain: Range: x-int: y-int:	
Absolute Value	$f(x) = \|x\|$ Domain: Range: x-int: y-int:	
Square Root	$f(x) = \sqrt{x}$ Domain: Range: x-int: y-int:	

What makes each of these a parent function? What do they have in common?

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Lesson 1-5 – Point-Slope Pairwork

Point-slope form of the equation of a line is one of the most important forms of the equation of a line for future mathematics courses such as Calculus. Let's look at where it came from. We all know the slope formula.

$$\frac{y_2 - y_1}{x_2 - x_1} = m$$

$$y_2 - y_1 = m(x_2 - x_1)$$

With x and y as our variables, m as our slope and (x_1, y_1) as any point on the line.

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

Write each of these in point slope and then solve for y.

(1) slope of 4 and goes through the point (2, –3)

(2) passes through the two points (4, 6) and (–5, 7)

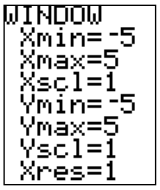
(3) passes through the point (6, –8) and is parallel to the line $y = 3x + 5$

(4) passes through the point (–7, 9) and is perpendicular to the line $y = \frac{1}{2}x + 6$

(5) passes through the midpoint of the segment whose endpoints are (4, 8) and (–2, 6) and is perpendicular to that segment

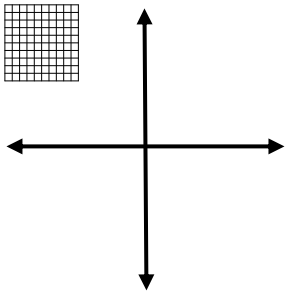
Pre-AP Algebra 2
Lesson 1-5 – Translating Graphs of Lines Discovery Worksheet

Name_____ Date_____

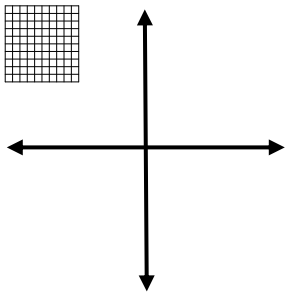


Translating Graphs of Lines The following graphs are transformations of the parent function $f(x) = x$ in the form $f(x) = a(x \pm h) \pm k$. Set your calculator window as shown and graph each set of lines on the same screen and sketch below. Discuss the changes in the equation and what affect the change has on the graph.

(1) $f(x) = 2(x - 0) + 0$
$g(x) = 2(x + 3) + 0$
$h(x) = 2(x - 4) + 0$



(2) $f(x) = 2(x - 0) + 0$
$g(x) = 2(x - 0) + 3$
$h(x) = 2(x - 0) - 4$

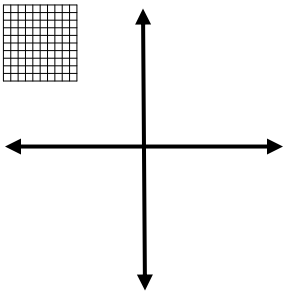


(3) What happens to the graph when you <u>add</u> a number *<u>in</u>* the function? (i.e. $f(x + h)$)

(4) What happens to the graph when you <u>subtract</u> a number *<u>in</u>* the function? (i.e. $f(x - h)$)

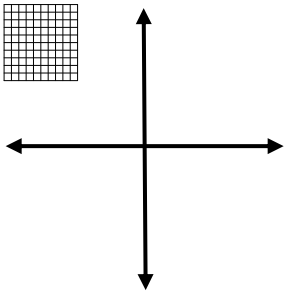
(5) What happens to the graph when you <u>add</u> a number to the function? (i.e. $f(x) + k$)

(6) What happens to the graph when you <u>subtract</u> a number from the function? (i.e. $f(x) - k$)



(7) $f(x) = 1(x - 0) - 2$
$g(x) = \frac{1}{4}(x - 0) - 2$
$h(x) = 4(x - 0) - 2$

(8) $f(x) = 2(x - 0) + 3$
$g(x) = 2(-x - 0) + 3$



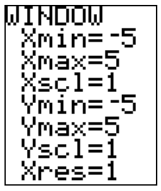
(9) What happens to the graph when the function is <u>multiplied</u> by a number between 0 and1? (i.e. $k\,f(x)$ where $0 < k < 1$)

(10) What happens to the graph when the function is <u>multiplied</u> by a number greater than 1? (i.e. $k\,f(x)$ where $k > 1$)

(11) What happens to the graph when you take the opposite of the x in the function? (i.e. $f(-x)$)

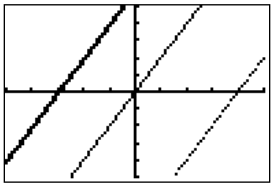
Pre-AP Algebra 2
Lesson 1-5 – Translating Graphs of Lines Discovery Worksheet (with Answers)

Name_____ Date_____

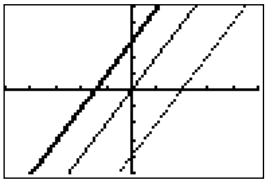


Translating Graphs of Lines The following graphs are transformations of the parent function $f(x) = x$ in the form $f(x) = a(x \pm h) \pm k$. Set your calculator window as shown and graph each set of lines on the same screen and sketch below. Discuss the changes in the equation and what affect the change has on the graph.

(1) $f(x) = 2(x - 0) + 0$
$g(x) = 2(x + 3) + 0$
$h(x) = 2(x - 4) + 0$



(2) $f(x) = 2(x - 0) + 0$
$g(x) = 2(x - 0) + 3$
$h(x) = 2(x - 0) - 4$



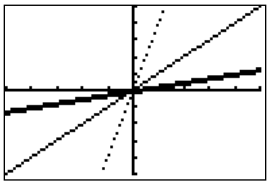
(3) What happens to the graph when you add a number *in* the function? (i.e. $f(x + h)$)
The graph moves to the left.

(4) What happens to the graph when you subtract a number *in* the function? (i.e. $f(x - h)$)
The graph moves to the right

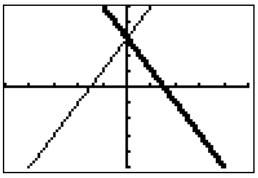
(5) What happens to the graph when you add a number to the function? (i.e. $f(x) + k$)
The graph moves up.

(6) What happens to the graph when you subtract a number from the function? (i.e. $f(x) - k$)
The graph moves down.

(7) $f(x) = 1(x - 0)$
$g(x) = \frac{1}{4}(x - 0)$
$h(x) = 4(x - 0)$



(8) $f(x) = 2(x - 0) + 3$
$g(x) = 2(-x - 0) + 3$



(9) What happens to the graph when the function is multiplied by a number between 0 and 1? (i.e. $k\,f(x)$ where $0 < k < 1$)
It becomes less steep.

(10) What happens to the graph when the function is multiplied by a number greater than 1? (i.e. $k\,f(x)$ where $k > 1$)
It becomes steeper.

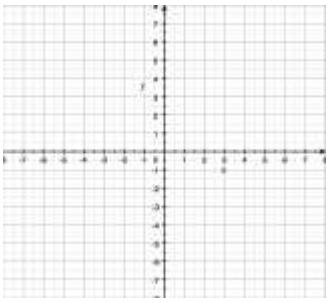
(11) What happens to the graph when you take the opposite of the x in the function? (i.e. $f(-x)$)
It rotates the graph on the y–axis.

Pre-AP Algebra 2
Lesson 1-5 – HOMEWORK

Check for Understanding

Can you complete these problems correctly by yourself?

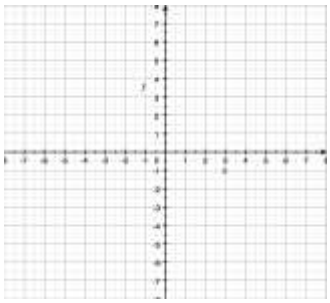
1. $f(x) = 3(x + 4) - 5$
   (1) Graph.
   (2) Discuss what types of translations were made to the parent graph.



   (3) Give the Domain and Range.

   (4) What is the inverse of $f(x)$?

2. $f(x) = -2(x - 1) + 3$
   (1) Graph.
   (2) Discuss what types of translations were made to the parent graph.



   (3) Give the Domain and Range.

   (4) What is the inverse of $f(x)$?

3. Consider the linear function *f(x)* = A(*x* – B) + C. Discuss all the changes in the graph as A, B, and C change from positive, negative, zero, as well as, grow smaller or larger. Discuss the domain and range of linear functions.

Pre-AP Algebra 2
Lesson 1-5 – HOMEWORK

Spiral

What do you remember from Algebra 1? (these are skills we will need in Algebra 2) You also need to remember what we have already learned in this unit.

Linear Equations

1. A hot air balloon is initially 20 feet above the ground. The burners are then turn on, causing the balloon to ascend at a rate of 150 feet per minute.
    a. Make a table showing the height h (in feet) of the balloon t minutes after the burners are turned on where $0 \leq t \leq 5$.

    b. Plot the points from the table in part a.

    c. Write an equation representing this situation.

2. Write the equation of the line passing through (4, 1) that is perpendicular to $x - 3y + 9 = 0$.

3. Write the equation of the line passing through (7, 1) that is parallel to $x = -2$.

4. Write the equation of the line passing through (-6, 2) that is perpendicular to $y = -2$.

Composition and Inverese of Functions

5. Let $f(x) = 3x + 2, g(x) = -x^2, h(x) = \frac{x-2}{5}$. Find the following
    a. $f\big(g(-3)\big)$
    b. $g\big(h(8)\big)$
    c. $f\big(g(x)\big)$
    d. $g\big(f(x)\big)$
    e. $h\big(f(x)\big)$
    f. $f\big(g(x)\big)$
    g. $f(g(h(x))$
    h. Find the inverse of $f(x)$.

6. Verify that $f(x) = 3x - 5$ and $g(x) = \frac{x+5}{3}$ are inverses.

Inequalities and Absolute Value

7. Solve the inequality, graph the solution on a number line, and then write the solution in interval notation.
    a. $-5x - 6 < 19$

    b. $x + 22 \geq -3x - 10$

    c. $5 < 2x + 3 < 11$

    d. $|x| = -2$

    e. $|x| < 2$

    f. $|x - 3| < 2$