Unit 7-1 Activity Draft

Use Desmos for exploration/explanation?

If x = -b/2a gives the x-coordinate of the vertex of f(x)=ax62 + bx, what is the x-coordinate of the vertex of g(x)=ax^2 + bx + c?

**Active Reading**

5.1/5.2 = Vertical and Horizontal Shifts

6.1-6.3 = reflections and vertical stretches (no f(ax))

5.1.1: Given the function f(x)=x2+x, write a formula for each expression below.

f(x+6)=

f(x)+6=

3f(x)=

5.1.2: -3f(x-5), etc.

5.1.4: Beginning with the function y=g(t), write an equation which matches each description.

“We subtracted 5 from the input and added 4 to the output.”

y=

“We doubled the input and then subtracted 1 from the output.”

y=

“We multiplied the output by 7.”

y=

5.1.5-14 (Do all of these?): The Swimmer: In preparation for the swimming competition, a swimmer jumped off a diving board into a swimming pool below. Below is a graph of her height above the water as a function of time.

**Figure** **5.1.6.** h=g(t)h=g(t)

You can see some basic information from the graph:

How high was the diving board?

When did the swimmer reach the water?

What was her maximum height above the water?

5.1.7: The graph below shows the swimmer’s height above the water when she jumped off the regular diving board.

After this dive, she decided to jump off the high-dive board, which is 7 feet higher than the regular diving board. Click and drag the vertical intercept to move the graph to match this new situation.

What was the swimmer’s beginning height above the water?

Feet

Did anything change about the swimmer’s maximum height?

?

It stayed the same

It increased by 7 feet

Did anything change about the time she reached the water?

?

It increased slightly

It decreased slightly

5.1.12: The graph below shows

h=f(t)=−16t2+15t+3

which is the swimmer’s height above the water when she jumped off the regular diving board at time t=0 seconds.

At the competition, the swimmer missed the starting whistle and jumped 2 seconds late. Click and drag the starting point to move the graph to match this new situation.

Jumping late is a change in the:

?

input

outout

Which equation below makes sense for this change?

h=f(t+2) or h=f(t−2)

If you simplify each of these formulas, the results are:

f(t+2)=−16(t+2)2+15(t+2)+3

and

f(t−2)=−16(t−2)2+15(t−2)+3

Graph these two functions on your calculator. Which one matches the graph you made above?

(Followed by commentary on the “surprising” results).

5.1.13: Recall that the swimmer’s height above the water, after jumping off the regular diving board, was given by:

h=f(t)=−16t2+15t+3

Suppose the swimmer jumped off the high-dive board, which is 7 feet higher than the regular board, but she did so 3 seconds after the timer started. Alter the formula for f(t) in order to write the formula for her height above the water in this situation.

5.1.14: Recall that the swimmer’s height above the water, after jumping off the regular diving board, was given by:

h=f(t)=−16t2+15t+3

Suppose on a particular dive, her height above the water was given by the formula:

h=1+15(t+1)−16(t+1)2

Did she jump late or early?

She jumped 1 second

?

late

early

Did she jump off the *high-dive* board (7 feet higher than normal), the *Mega high-dive* board (25 feet higher than normal), or the *Nano* board (2 feet lower than normal)?

She jumped off the

?

high-dive

Mega high-dive

Nano

5.1.15-16 Geogebra: The graph starts by showing the parabola f(x)=x2. Moving the slider will change the function by adding a number k to the output (#16: f(x+h)+k (negatives allowed)).

Use the slider to change the value of k to the number 5. What happened to the graph as you changed the formula to f(x)+5=x2+5?

The graph moves right.  
 The graph moves left.  
 The graph moves up.  
 The graph moves down.  
 None of these

Notice that the graph shows the coordinates of the lowest point (the *vertex*). Which equation below would graph as a parabola with a vertex at the point (0,−3)?

y=f(x)−3=x2−3  
 y=f(x)+3=x2+3  
 None of these

5.1.17 (#19 does mx))The linear function

f(x)=4x

will graph as a line with slope 4, passing through the origin (0,0).

Now, using translations, it would be easy to write the equations of similar lines. For example:

The line with slope 4, passing through the point (7,15), may be thought of as the result of shifting f(x) to the *right* by 7 units, and *up* by 15 units.

What would be the equation of this new line?

5.2 (Formalizes 5.1 explorations)

5.2.2 Geogebra: Use the checkboxes to graph a function y=f(x). Then use the slider to add a number to the input of the function.

To move a graph to the *right*, you add a

?

positive

negative

number to the input.

To move a graph to the *left*, you add a

?

positive

negative

number to the input.

5.2.7: The function f(x)=x2+2xf(x)=x2+2x is graphed below.

**Figure** **5.2.8.** f(x)=x2+2xf(x)=x2+2x

If you wanted to move this graph so it had the same shape, but it was 33 units to the right and 22 units down, what would be its formula?

5.2.9: The function g(x)=x−x3g(x)=x−x3 is graphed below.

**Figure** **5.2.10.** g(x)=x−x3g(x)=x−x3

A different function, h(x)=(x+1)−(x+1)3+2,h(x)=(x+1)−(x+1)3+2, is a certain transformation of g(x).g(x).

Describe what transformations were done to g(x)g(x) to make h(x).h(x).

Then sketch a graph of h(x)=(x+1)−(x+1)3+2h(x)=(x+1)−(x+1)3+2 by hand.

5.2.13: The dashed green graph below shows f(x)=x2−x. The solid red graph shows g(x), which is some transformation of f(x).

Decide how f(x)=x2−x was transformed to make g(x). Then, choose the correct formula for g(x) below.

g(x)=(x+3)2−x  
 g(x)=x2−x+3  
 g(x)=(x+3)2−x+3  
 g(x)=x2−x−3  
 None of these

5.2.15: At 9:00 a.m., a cup of tea was heated to 200 degrees Fahrenheit and then left to sit in a 70 degree kitchen.

The graph of T=f(t) shows the temperature (in degrees Fahrenheit) of the cup of tea as it cooled down toward room temperature, where t is the number of minutes after 9:00 a.m.

By moving the slider, you can change the time at which the tea stopped heating and began to cool. For instance, if it began to cool at 9:20 a.m., then the graph would be exactly the same — just shifted to the *right* by 20 minutes.

This corresponds to subtracting 20 from the input of the function f.

5.2.16: Suppose this is the first week of the year, and T(d) describes the average daily temperature (in degrees) for this week, where d is the day of the year (d=1 for January 1st, etc.).

For each statement below, choose the correct translation which represents the temperature function for that week.

“Next week’s temperatures are expected to be an exact repeat of this week.”

Formula for temperature, one week from now:

?

T(d + 7)

T(d) + 7

T(d - 7)

T(d) - 7

“Two weeks from now, temperatures are expected to be just like this week, but about 5 degrees warmer.”

Formula for temperature, two weeks from now:

?

T(d + 14) + 5

T(d - 14) + 5

T(d + 14) - 5

T(d - 14) - 5

5.2.19: The graph of a function y=g(x) is shown below.

What would be the *domain* of y=f(x+3)?

Answer: ⩽

?

x

y

⩽

What would be the *range* of y=f(x−1)−2?

Answer: ⩽

?

x

y

⩽

5.2 HW #1: The function h(t)=−4.9t2+10t+40 will approximate the height of an object which was thrown straight upward at a speed of 10 meters per second at time t=0 seconds from a height of 40 meters. See the graph below.

You can move the point to see how high the object will be at a certain time, or when the object will hit the ground.

Now, we can use this function to describe other situations involving such an object. For example, suppose the person had waited until t=1 second before throwing the object.

Which graph below shows the height of the object if the person waited 1 second before throwing it?

Graph 1

Graph 2

Answer:

?

Graph 1

Graph 2

Since this is a *horizontal* translation of the original graph h(t), are we changing the *input* or the *output*?

?

Input

Output

In order to correctly shift the graph of h(t), what will we use for the *input* in the formula for the function h? Type your expression below.

5.2 HW #2: Again, the function f(t)=−4.9t2+10t+40 represents the height of an object which was thrown straight upward at a speed of 10 meters per second, from an initial height of 40 meters.

Suppose now that the person waited 3 seconds and also carried it an additional 12 meters higher in elevation before throwing it.

Waiting 3 seconds is a change to the input t, so the input of the function will now be:

Carrying the object an additional 12 meters upward before throwing it is a change to the output, so we will

?

add

subtract

the number 12 to the outside of the function.

Putting these transformations together, the formula will now be:

f()+

=−4.9()2+10()+40+

5.2 HW #3: Consider the graph of f(x) given below:

*(click on image to enlarge)*

Find a possible formula for the transformations of f(x) shown below:

5.2 HW #14: Consider the table of values for f(x) and g(x) given below:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| x | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| f(x) | -16 | -12 | 0 | 26 | 72 | 144 | 248 | 390 | 576 | 812 |
| g(x) | -9 | -8 | -1 | 12 | 31 | 56 | 87 | 124 | 167 | 216 |

(a) Using the table above, evaluate each of the following:

|  |  |  |
| --- | --- | --- |
| (i) | f(x) for x=6 |  |
| (ii) | f(5)−3 |  |
| (iii) | f(5−3) |  |
| (iv) | g(x)+6 for x=2 |  |
| (v) | g(x+6) for x=2 |  |
| (vi) | 3g(x) for x=0 |  |
| (vii) | f(3x) for x=2 |  |
| (viii) | f(x)−f(2) for x=8 |  |
| (ix) | g(x+1)−g(x) for x=1 |  |

(b) Solve the following:  
 (i) g(x)=31 has solution x=   
 (ii) f(x)=72 has solution x=   
 (iii) g(x)=124 has solution x=

5.2 HW #15

Describe a series of shifts which translates the graph y=(x+3)3−8 back onto the graph of y=x3.

Select the correct direction using the pulldown menus, and enter a number which identifies the amount of units for each shift.

We must shift the graph to the

?

left

right

by units, and shift the graph

?

up

down

units.

(Given (-9, 8) on g, write a formula for the transformation whose graph has (-6, 8), etc.

5.2 HW#20: (a) The graph of y=(x+4)2+10 is the graph of y=x2+10

|  |  |  |
| --- | --- | --- |
| shifted horizontally |  | choose the shifting amount  left 5 units  left 4 units  left 3 units  left 2 units  left 1 unit  no horizontal shift  right 1 unit  right 2 units  right 3 units  right 4 units  right 5 units  and |
| shifted vertically |  | choose the shifting amount  down 5 units  down 4 units  down 3 units  down 2 units  down 1 unit  no vertical shift  up 1 unit  up 2 units  up 3 units  up 4 units  up 5 units  . |

(b) The graph of y=x2+13 is the graph of y=x2+10

|  |  |  |
| --- | --- | --- |
| shifted horizontally |  | choose the shifting amount  left 5 units  left 4 units  left 3 units  left 2 units  left 1 unit  no horizontal shift  right 1 unit  right 2 units  right 3 units  right 4 units  right 5 units  and |
| shifted vertically |  | choose the shifting amount  down 5 units  down 4 units  down 3 units  down 2 units  down 1 unit  no vertical shift  up 1 unit  up 2 units  up 3 units  up 4 units  up 5 units  . |

(c) The graph of y=(x+4)3−5(x+4)−1 is the graph of y=x3−5x

|  |  |  |
| --- | --- | --- |
| shifted horizontally |  | choose the shifting amount  left 5 units  left 4 units  left 3 units  left 2 units  left 1 unit  no horizontal shift  right 1 unit  right 2 units  right 3 units  right 4 units  right 5 units  and |
| shifted vertically |  | choose the shifting amount  down 5 units  down 4 units  down 3 units  down 2 units  down 1 unit  no vertical shift  up 1 unit  up 2 units  up 3 units  up 4 units  up 5 units  . |

(d) The graph of y=3(x−4)2−(x−4)+12 is the graph of y=3x2−x+10

|  |  |  |
| --- | --- | --- |
| shifted horizontally |  | choose the shifting amount  left 5 units  left 4 units  left 3 units  left 2 units  left 1 unit  no horizontal shift  right 1 unit  right 2 units  right 3 units  right 4 units  right 5 units  and |
| shifted vertically |  | choose the shifting amount  down 5 units  down 4 units  down 3 units  down 2 units  down 1 unit  no vertical shift  up 1 unit  up 2 units  up 3 units  up 4 units  up 5 units  . |

5.2 HW #21: The graph of f(x) contains the point (−7,8). What point must be on each of the following transformed graphs? Enter points as (a,b) including the parentheses.

(a) The graph of f(x−5) must contain the point [help (points)](https://webwork-ptx.aimath.org/)

(b) The graph of f(x)−8 must contain the point [help (points)](https://webwork-ptx.aimath.org/)

(c) The graph of f(x+6)+5 must contain the point [help (points)](https://webwork-ptx.aimath.org/)

5.2 HW #23: g horizontal and vertical shifts. For each of the tables below find a possible formula by applying transformations to f(x).

*EXAMPLE:* if the values for a function k(x) are:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| x | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| k(x) | -1 | -0.5 | 1 | 3.5 | 7 | 11.5 | 17 | 23.5 |

then k(x)=f(x)−1.

(a)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| x | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| h(x) | -4 | -3.5 | -2 | 0.5 | 4 | 8.5 | 14 | 20.5 |

h(x)=

(b)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| x | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| g(x) | -1 | 0 | 0.5 | 2 | 4.5 | 8 | 12.5 | 18 |

g(x)=

(c)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| x | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| m(x) | -3 | -2 | -1.5 | 0 | 2.5 | 6 | 10.5 | 16 |

m(x)=

5.2 HW #24: At a jazz club, the cost of an evening is based on a cover charge of $15 plus a beverage charge of $8 per drink.

(a) Find a formula for t(x), the total cost for an evening in which x drinks are consumed.  
 t(x)=

(b) If the price of the cover charge is raised by $5, express the new total cost function, n(x), as a transformation of t(x).  
 n(x)=   
 ***Note****: Do not give an explicit formula. Using function notation, write an expression for n(x) by performing the necessary transformations to t(x). For example your answer should be of the form, n(x)=t(x−100)+180 and not of the form n(x)=80x+9.*

(c) The management increases the cover charge to $40, leaves the price of a drink at $8, but includes the first three drinks for free. For x≥3, express p(x), the new total cost, as a transformation of t(x).  
 p(x)=   
 (see note in (b) above for the correct way to express your answer)

5.2 HW #25: The table below gives values of T=f(d), the average temperature (in degrees Celsius) at a depth *d* meters in a borehole in Belleterre, Quebec.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| d, depth (m) | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 |
| T, temp (C) | 5.5 | 5.2 | 5.1 | 5.1 | 5.3 | 5.5 | 5.75 | 6 |

Consider the function g(d)=f(d+50) which describes another borehole near Belleterre.  
   
(a) Fill in all of the blanks in the table of values for g(d) for which you have sufficient information. If are unable to determine a value in the table, enter **NONE.** Do not leave any blanks in the table.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| d | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 |
| g(d) |  |  |  |  |  |  |  |  |

(b) Which of the statements below best describes in words what the function g(d) tells you about the borehole?  
   
A. Temperatures in this borehole are 50 degrees Celsius cooler than at the same depth in the Belleterre borehole.  
   
B. Temperatures in this borehole are 50 degrees Celsius warmer than at the same depth in the Belleterre borehole.  
   
C. If the temperatures in both boreholes are the same, then you will be 50 meters deeper in this borehole than if you were in the borehole in Belleterre.  
   
D. If the temperatures in both boreholes are the same, then you will be 50 meters closer to the top of this borehole than if you were in the borehole in Belleterre.  
   
E. None of the above

6.1.1; If f(3) means “the output when the input is 3”, what does 6⋅f(3) mean? 18  
 6 times the input of 3  
 6 times the output when x is 3

If f(3)=7, then what is 6⋅f(3)?

Answer:

6.1.6: Suppose h(−4)=5.

What point is on the graph of y=h(x)?

Answer:

?

(-4,5)

(-4,-5)

(4,5)

(4,-5)

What point is on the graph of y=−h(x)?

Answer:

?

(-4,5)

(-4,-5)

(4,5)

(4,-5)

6.1.9: Suppose h(5)=9 and h(−5)=13 for some function h.

What point must be on the graph of y=h(x)?

Answer:

?

(5, 9)

(5, 13)

What point must be on the graph of y=h(−x)?

answer:

?

(-5, 9)

(-5, 13)

6.1.10 Geogebra: The function y=g(x) is shown below.

Click to graph the transformation y=g(−x). Use it to complete each statement below.

To evaluate g(−x) when x=2, we are really evaluating:

?

g(2)

g(-2)

What is the value of g(−x) when x=2?

Answer:

To evaluate g(−x) when x=−1, we are really evaluating:

?

g(1)

g(-1)

What is the value of g(−x) when x=−1?

Answer:

The graphs of y=g(−x) and y=g(x) are reflections of each other over the

?

x-axis

y-axis

6.1.12: Complete the table below, using f(x)=x. If an expression cannot be evaluated, write *DNE* (“does not exist”) in that space.

|  |  |  |  |
| --- | --- | --- | --- |
| x | f(x) | −f(x) | f(−x) |
| −9 |  |  |  |
| −4 |  |  | 2 |
| −1 |  |  |  |
| 0 |  |  |  |
| 1 |  | -1 |  |
| 4 |  |  |  |
| 9 | 3 |  | DNE |

6.1.15 (16 does g(-x)) : To graph the transformation y=−f(x), it is helpful to begin with the graph of y=f(x) and select a few points on it. Then, reflect those points over the x-axis, and complete the sketch of the reflected function y=−f(x).

Move the slider on the graph above, and the graph will be reflected over the x-axis to make y=−f(x).

Notice that the point (−1,0) didn’t move as you changed the slider. Why not?

6.2: Vertical Stretches (No Horizontal stretches)

6.2.3: Suppose the function f(x) represents the price of your favorite whole bean coffee, where x represents how many pounds you buy.

Which expression below means “the coffee is only half the regular price”?

6.2.4: The graph shows a function y=f(x).

The first column of the table below shows output values for the function f.

Use those values to determine the values in the next two colums for 2⋅f(x) and 12⋅f(x). Remember that multiplying *outside* of a function by a number will change its *output* values.

|  |  |  |  |
| --- | --- | --- | --- |
| x | f(x) | 2f(x) | 12f(x) |
| 0 | 0 |  |  |
| 1 | 3 | 6 | 1.5 |
| 4 | 6 |  |  |
| 7 | 5 |  |  |
| 11 | 3 |  |  |

6.2.6 (#7: Negatives allowed): The graph below shows a function y=f(x).

Moving the slider allows you to also graph y=a⋅f(x), where you can change the value of a between 0 and 3.

Move the slider so a>1, and use what you observe to complete the statement below:

To graph y=af(x) when a>1, you would begin with y=f(x) and

?

stretch it away from

compress it toward

the x-axis.

Now, move the slider so that 0<a<1, and use what you observe to complete the statement below:

To graph y=af(x) when 0<a<1, you would begin with y=f(x) and

?

stretch it away from

compress it toward

the x-axis.

6.2.8: The function y=f(x)=x3 contains the points (0,0) and (2,8).

Suppose we want to vertically stretch our function so that it still contains the point (0,0), but now contains the point (2,12).

This means we have multiplied the outputs of our original function by some number k. What is the value of k?

Answer:

What is the formula for this new function?

Answer: y=

6.3: Formalizes 6.1-6.2

6.3.17: A function y=f(x) is graphed below, together with a transformation y=g(x).

Suppose g(x)=k⋅f(x) for some constant number k. What is k?

Answer: k =

6.3.19:

The graph of the function y=f(x) is shown below.

Four transformations of y=f(x) are shown. Use them to answer the questions that follow.

Which graph is y=−f(x)?

Answer:

?

A

B

C

D

Which graph is y=2f(x)?

Answer:

?

A

B

C

D

Which graph is y=−2f(x)?

Answer:

?

A

B

C

D

Which graph is y=f(x) +2?

6.3.20: In this problem, you will use an arbitrary function f(x). Write an expression using function notation to match each function transformation described below.

Shift the graph of y=f(x) to the right by 6 units, and then vertically compress it by a factor of 0.2.

Answer: y=

Vertically stretch the graph of y=f(x) by a factor of 6.5, and then vertically shift it downward by 11 units.

Answer: y=

Vertically shift the graph of y=f(x) downward by 11 units, and then vertically stretch it by a factor of 6.5.

Answer: y=

Reflect the graph of y=f(x) over the y-axis, and then shift it upward by 12 units.

Answer: y=

Shift the graph of y=f(x) to the left by 10 units, then compress it vertically by a factor of 0.7, and then reflect it over the x-axis.

Answer: y=

6.3 HW#1: Let C=f(n) represent the total cost (in dollars) for a carpenter when she builds n wooden chairs.

(a) If the carpenter currently builds k chairs per week, what do the following expressions represent? Pick one (if any) of the statements in each pull-down menu which best explains its significance.  
 (i) f(k+10)

?

The cost of building 10 more chairs per week.

An increase in weekly cost by 10 dollars.

The cost of building 10 chairs less each week.

A decrease in weekly cost by 10 dollars.

The number of chairs you can build per week if total cost is increased by 10 dollars.

The weekly cost if the cost per chair increases by 10 dollars.

None of the above

.  
 (ii) f(k)+10

?

The cost of building 10 more chairs per week.

An increase in weekly cost by 10 dollars.

The cost of building 10 chairs less each week.

A decrease in weekly cost by 10 dollars.

The number of chairs you can build per week if total cost is increased by 10 dollars.

The weekly cost if the cost per chair increases by 10 dollars.

None of the above

.  
 (iii) f(2k)

?

The cost of building two more chairs per week.

Double the weekly cost of building k chairs.

The cost of building twice as many chairs per week.

The weekly cost if the cost per chair is doubled.

The cost of building half as many chairs per week.

The number of chairs you can build in one week if the weekly cost is doubled.

None of the above

.  
 (iv) 2f(k)

?

The cost of building two more chairs per week.

Double the weekly cost of building k chairs.

The cost of building twice as many chairs per week.

The weekly cost if the cost per chair is doubled.

The cost of building half as many chairs per week.

The number of chairs you can build in one week if the weekly cost is doubled.

None of the above

.

b) If the carpenter sells her chairs at 70% above cost, plus an additional 4% sales tax on the sale price, write an expression for her gross income (including sales tax) each week.  
 Gross Income =

6.3 HW #2: Let A=f(r) be the area of a circle of radius r.

(a) Write a formula for f(r)= [help (formulas)](https://webwork-ptx.aimath.org/)

(b) Which expression represents the area of a circle whose radius is increased by 5%?  
   
A. f(r+0.05)  
 **B.** 0.05f(r)  
 **C.** f(r)+0.05  
 **D.** f(5+r)  
 **E.** f(1.05r)  
   
(c) By what percent does the area increase if the radius is increased by 5%?  
 % (round to the nearest 0.01%) [help (numbers)](https://webwork-ptx.aimath.org/)

6.3HW#6: (a) Complete the table below so that the function f(x) is EVEN. (f(x) should be defined for all values of the domain shown.)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| x | -3 | -2 | -1 | 1 | 2 | 3 |
| f(x) | -7 |  | 2 |  | 6 |  |

(b) Complete the table below so that the function g(x) is ODD. (g(x) should be defined for all values of the domain shown.)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| x | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| g(x) | -7 |  | 2 |  |  | 6 |  |

*(NOTE: There is now an extra value you need to determine when x=0)*

6.3HW# 12 Consider the function y=f(x) drawn below:

*(click on image to enlarge)*

On a separate piece of paper, sketch an accurate graph of the function y=−2f(−x) . Which (if any) of the graphs below matches the graph you drew?

6.3HW#13: The graph of y=f(x) is given below (in blue), along with several related graphs (which are in red).

**Note:** you can click on the graph to enlarge it.

For each equation, enter the letter of the corresponding graph.  
   
 y=−f(x+4)  
   
 y=f(x)+3  
   
 y=2f(x+6)  
   
 y=f(x−4)

6.3HW#14: Consider the graph of f(x) given below:

*(click on image to enlarge)*

Find a possible formula for the transformations of f(x) shown below:

*(click on image to enlarge)*

y=

6.3HW#18: Write a formula (in terms of the independent variable *w*) for the transformation of k(w)=2w given below.  
   
 y=k(−w)+7=

6.3HW#23: The point (−7,4) is on the graph of y=g(x). Give the coordinates of one point which must be on the graph of each of the following functions.

(a) 12g(x) must have the point ([help (points)](https://webwork-ptx.aimath.org/)) on its graph.

(b) g(12x) must have the point ([help (points)](https://webwork-ptx.aimath.org/)) on its graph.

(c) −2 g(x) must have the point ([help (points)](https://webwork-ptx.aimath.org/)) on its graph.

(d) −g(2x) must have the point ([help (points)](https://webwork-ptx.aimath.org/)) on its graph.

6.3HW#24 (also #35): Fill in all of the blanks in the table below for which you have sufficient information. If you do not have enough information to fill in a blank, type **NONE** in the blank space provided. Do not leave any blanks empty.

6.3HW#25: If the graph of the line y=mx+b is reflected over the x-axis, what will be the slope and intercepts of the new graph? (Your answers will depend on the parameters b and m.

(a) The slope will be

(b) The y-intercept will be y=

(c) The x-intercept will be x=

6.3HW#28: Starting with the graph of y=ln⁡x, find the equation of the graph that results from:

(a) shifting 2 units upward.  
 (b) shifting 2 units to the left.  
 (c) reflecting about the x-axis.  
 (d) reflecting about the y-axis.  
 (e) reflecting about the line y=x.  
 (f) reflecting about the x-axis and then the line y=x.  
 (g) reflecting about the y-axis and then the line y=x.  
 (h) shifting 2 units to the left and then reflecting about the line y=x.

(a) y=   
 (b) y=   
 (c) y=   
 (d) y=   
 (e) y=   
 (f) y=   
 (g) y=   
 (h)

6.3HW#30: Which of the following explains how to obtain the graph of y=3−ex from the graph of y=ex?  
   
(a) Reflect the graph of y=ex about the y-axis and then shift this result up 3 unit.  
 (b) Reflect the graph of y=ex about the y-axis and then shift this result to the right 3 units.  
 (c) Reflect the graph of y=ex about the x-axis and then shift this result up 3 unit.  
 (d) Reflect the graph of y=ex about the x-axis and then shift this result to the right 3 units.

6.3HW#31: Starting with the graph of y=2x, write the equation of the graph that results from  
   
(a) reflecting about the line y=4  
 (b) reflecting about the line x=2

(a) y=   
 (b) y=

6.3HW#34: The function f(x)=2x−x2 is given graphed below:

**Note: Click on graph for larger version in new browser window.**

(A) Starting with the formula for f(x), find a formula for g(x), which is graphed below:

**Note: Click on graph for larger version in new browser window.**

g(x) =

(B) Starting with the formula for f(x), find a formula for h(x), which is graphed below:

**Note: Click on graph for larger version in new browser window.**

h(x) =

6.3HW#37 (only time, with #38, a horiz. Stretch): Describe a function g(x) in terms of f(x) if the graph of g is obtained by reflecting the graph of f about the x-axis and if it is horizontally stretched by a factor of 2 when compared to the graph of f.  
 g(x)=Af(Bx)+C where  
 A=   
 B=   
 C=

6.3HW#38: Suppose that f(x) has a domain of [3,18] and a range of [2,18]. What are the domain and range of:

(a) **f(x)+5 Domain**  **Range**

(b) f(x+5) **Domain Range**

(c) f(5x) **Domain Range**

(d) 5f(x) **Domain Range**

6.3HW#39: Every day I take the same taxi over the same route from home to the train station. The trip is x miles, so the cost for the trip is f(x). Match each story in (a)-(d) to a function in (i)-(iv) representing the amount paid to the driver.

A. I received a raise yesterday, so today I gave my driver a five dollar tip.  
 B. The meter in the taxi went crazy and showed five times the number of miles I actually traveled.  
 C. I had a new driver today and he got lost. He drove five extra miles and charged me for it.  
 D. I haven't paid my driver all week. Today is Friday and I'll pay what I owe for the week.

(i) f(5x) matches statement

?

A

B

C

D

(ii) f(x+5) matches statement

?

A

B

C

D

(iii) f(x)+5 matches statement

?

A

B

C

D

(iv) 5f(x) matches statement

**Flipped Math**

4.1: Given parent function Write function vertical shift down of 5 and horizontal shrink by a factor of Write function horizontal shift right of 2, vertical shift up 3, and vertical stretch by factor of 4

Given parent function Describe scale Describe scale

Several: Name the parent function. Then describe the transformation (translation, scale, and reflection) of the function if it exists.

Several: Given the parent function , write the equation of the following transformation… 13. Reflect about the x-axis, horizontal shift right 2, vertical shrink of ½ 14. Horizontal shrink of , vertical shift down 6 15. horizontal shift left 4, vertical shift down 7, horizontal stretch of 8

Several: The graph of a parent function and a transformation of the parent function are given. Write the equation of the transformed function.

Several with SQRT: Match the function to its graph WITHOUT using a graphing calculator!

Describe the transformation (translation, scale, and/or reflection) that happens to the function

Given the (unfamous) h(x) is shown below: Sketch a graph of the following (several):

(Note: For order of transformations, have a problem to plug in a value and find which order will obtain the output.)

**S-Z:** 1.7- p. 120-139: Presentation by charts and reasoning

Example 1.7.1: p. 123: Graph f(x) = √ x. Plot at least three points. 2. Use your graph in 1 to graph g(x) = √ x − 1. 3. Use your graph in 1 to graph j(x) = √ x − 1. 4. Use your graph in 1 to graph m(x) = √ x + 3 − 2.

p. 135: “Order” summary table

p. 140 (HW): Suppose (2, −3) is on the graph of y = f(x). In Exercises 1 - 18, use Theorem 1.7 to find a point on the graph of the given transformed function.

p. 141 (similar through #49): The complete graph of y = f(x) is given below. In Exercises 19 - 27, use it and Theorem 1.7 to graph the given transformed function. x y (−2, 2) (0, 0) (2, 2) −4 −3 −2 −1 2 3 4 1 2 3 4 The graph for Ex. 19 - 27 19. y = f(x) + 1 20. y = f(x) − 2 21. y = f(x + 1) 22. y = f(x − 2) 23. y = 2f(x) 24. y = f(2x) 25. y = 2 − f(x) 26. y = f(2 − x) 27. y = 2 − f(2 − x).

HW #54-63 (includes horizontal stretches): Let f(x) = √ x. Find a formula for a function g whose graph is obtained from f from the given sequence of transformations.

HW#64: The graph of y = f(x) = √3 x is given below on the left and the graph of y = g(x) is given on the right. Find a formula for g based on transformations of the graph of f. Check your answer by confirming that the points shown on the graph of g satisfy the equation y = g(x).

HW#67 (etc.): . What happens if you reflect an odd function across the y-axis?

**APC:** 1.8

p. 85; Preview Activity 1.8.1. Open a new Desmos graph and define the function f (x) x 2 . Adjust the window so that the range is for −4 ≤ x ≤ 4 and −10 ≤ y ≤ 10. a. In Desmos, define the function 1(x) f (x)+a. (That is, in Desmos on line 2, enter g(x) = f(x) + a.) You will get prompted to add a slider for a. Do so. Explore by moving the slider for a and write at least one sentence to describe the effect that changing the value of a has on the graph of 1. b. Next, define the function h(x) f (x − b). (That is, in Desmos on line 4, enter h(x) = f(x-b) and add the slider for b.) Move the slider for b and write at least one sentence to describe the effect that changing the value of b has on the graph of h. c. Now define the function p(x) c f (x). (That is, in Desmos on line 6, enter p(x) = cf(x) and add the slider for c.) Move the slider for c and write at least one sentence to describe the effect that changing the value of c has on the graph of p. In particular, when c −1, how is the graph of p related to the graph of f ? d. Finally, click on the icons next to 1, h, and p to temporarily hide them, and go back to Line 1 and change your formula for f . You can make it whatever 85 Chapter 1 Relating Changing Quantities you’d like, but try something like f (x) x 2 + 2x + 3 or f (x) x 3 − 1. Then, investigate with the sliders a, b, and c to see the effects on 1, h, and p (unhiding them appropriately). Write a couple of sentences to describe your observations of your explorations.

Presents more theoretically: e.g., p. 87: This shows that for an input of x + b in h, the output of h is the same as the output of f that corresponds to an input of simply x. Hence, in Figure 1.8.3, the formula for h in terms of f is h(x) f (x − 2), since an input of x + 2 in h will result in the same output as an input of x in f . For example, h(2) f (0), which aligns with the graph of h being a shift of the graph of f to the right by 2 units. Again, it’s instructive to see the effects of horizontal translation dynamically

1.8 HW: p. 97: The figure above is the graph of the function m(t). Let n(t) m(t) + 2, k(t) m(t + 1.5),w(t) m(t − 0.5) − 2.5 and p(t) m(t − 1). Find the values of the following: 1. n(−3) 2. n(1) 3. k(2) 4. w(1.5) 5. w(−1.5)

1.8 HW #5: The graph of f (x) contains the point (9, 4). What point must be on each of the following transformed graphs? (a) The graph of f (x − 6) must contain the point (b) The graph of f (x) − 5 must contain the point (c) The graph of f (x + 2) + 7 must contain the point

1.8 HW #6: Let f (x) x 2 . a. Let 1(x) f (x) + 5. Determine AV[−3,−1] and AV[2,5] for both f and 1. What do you observe? Why does this phenomenon occur? b. Let h(x) f (x − 2). For f , recall that you determined AV[−3,−1] and AV[2,5] in (a). In addition, determine AV[−1,−1] and AV[4,7] for h. What do you observe? Why does this phenomenon occur? c. Let k(x) 3 f (x). Determine AV[−3,−1] and AV[2,5] for k, and compare the results to your earlier computations of AV[−3,−1] and AV[2,5] for f . What do you observe? Why does this phenomenon occur? d. Finally, let m(x) 3 f (x − 2) + 5. Without doing any computations, what do you think will be true about the relationship between AV[−3,−1] for f and AV[−1,1] for m? Why? After making your conjecture, execute appropriate computations to see if your intuition is correct.

1.8 HW #8: exploration of horizontal stretches: We have explored the effects of adding a constant to the output of a function, y f (x) + a, adding a constant to the input, y f (x + a), and multiplying the output of a function by a constant, y a f (x). There is one remaining natural transformation to explore: multiplying the input to a function by a constant. In this exercise, we consider the effects of the constant a in transforming a parent function f by the rule y f (ax). Let f (x) (x − 2) 2 + 1. a. Let 1(x) f (4x), h(x) f (2x), k(x) f (0.5x), and m(x) f (0.25x). Use Desmos to plot these functions. Then, sketch and label 1, h, k, and m on the provided axes in Figure 1.8.19 along with the graph of f . For each of the functions, label and identify its vertex, its y-intercept, and its x-intercepts. y x Figure 1.8.19: Axes for plotting f , 1, h, k, and m in part (a). y x Figure 1.8.20: Axes for plotting f , r, and s from parts (c) and (d). b. Based on your work in (a), how would you describe the effect(s) of the transformation y f (ax) where a > 0? What is the impact on the graph of f ? Are any parts of the graph of f unchanged? c. Now consider the function r(x) f (−x). Observe that r(−1) f (1), r(2) f (−2), and so on. Without using a graphing utility, how do you expect the graph of y r(x) to compare to the graph of y f (x)? Explain. Then test your conjecture by using a graphing utility and record the plots of f and r on the axes in Figure 1.8.20. d. How do you expect the graph of s(x) f (−2x) to appear? Why? More generally, how does the graph of y f (ax) compare to the graph of y f (x) in the situation where a < 0

**Calc-Medic** 1.5 #4: (Multiple Choice) Pilar’s parents give him an allowance amount , based on his age, *t*, in years. Which of the following expressions would give the allowance amount of Pilar’s younger sister, who is three years younger than he is?

b. c. d.

1.6: (orders): I took the graph and performed the four transformations shown on the cards below.

Unfortunately, I can’t remember the order in which I carried out the four transformations. All I know is that I ended up with the graph of .

Can you find an order in which I could have carried out the transformations? Is there more than one way of doing this? If so, can you find them all?

Can you explain why different orders can lead to the same outcome?

What other parabolas could I have ended up with if I had performed the four transformations in a different order?

**MFG:** 2.3

2.40: The graph of y=g(x) has a vertical asymptote at x=−4. What happens to the asymptote under a vertical translation?

Nothing.  
 It is compressed vertically.  
 It is translated vertically.  
 It is eliminated.

2.42: The function E=f(h)E=f(h) graphed at right gives the amount of electrical power, in megawatts, drawn by a community from its local power plant as a function of time during a 24-hour period in 2002. Sketch a graph of y=f(h)+300y=f(h)+300 and interpret its meaning.

2.43: An evaporative cooler, or swamp cooler, is an energy-efficient type of air conditioner used in dry climates. A typical swamp cooler can reduce the temperature inside a house by 15 degrees.

Figure (a) shows the graph of T=f(t), the temperature inside Kate’s house t hours after she turns on the swamp cooler. Write a formula in terms of f for the function g shown in figure (b), and give a possible explanation of its meaning.

g(t)=

g is the temperature in the house on a day that was 10∘ hotter.  
 g is the temperature in the house on a day that was 10∘ cooler.  
 g is the temperature in the house 10 hours after turning on the swamp cooler.

Presentation argues horizontal shifts with table.

2.48: The function N=f(p)N=f(p) graphed at right gives the number of people who have a given eye pressure level pp from a sample of 100 people with healthy eyes, and the function gg gives the number of people with pressure level pp in a sample of 100 glaucoma patients.

a.Write a formula for gg as a transformation of f.f. b. For what pressure readings could a doctor be fairly certain that a patient has glaucoma?

2.49: The function C=f(t) shown above gives the caffeine level in Delbert’s bloodstream at time t hours after he drinks a cup of coffee, and g(t) gives the caffeine level in Francine’s bloodstream. Write a formula for g in terms of f, and explain what it tells you about Delbert and Francine.

g(t)=

A) Francine drank her coffee 3 hours after Delbert drank his.  
 B) Delbert drank his coffee 3 hours after Francine drank hers.  
 C) Francine drank 3 time as much coffee as Delbert drank.  
 D) Francine drank 3 more cups of coffee than Delbert drank.

2.53: The graph of y=F(x) is symmetric about the y-axis. Which of the following graphs is also symmetric about the y-axis??

(a) y=−3F(x)  
 (b) y=F(x)−3  
 (c) y=F(x−3)  
 Both (a) and (b)

2.57: The function A=f(t)*A=f(t)* graphed below gives a person's blood alcohol level t*t* hours after drinking a martini. Sketch a graph of g(t)=2f(t)*g(t)=2f(t)* and explain what it tells you.

2.58: If the Earth were not tilted on its axis, there would be 12 daylight hours every day all over the planet. But in fact, the length of a day in a particular location depends on the latitude and the time of year.

The graph above shows H=f(t), the length of a day in Helsinki, Finland, t days after January 1, and R=g(t), the length of a day in Rome. Each is expressed as the number of hours greater or less than 12. Write a formula for f in terms of g.

f(t)=

What does this formula tell you?

On any given day, the number of daylight hours varies from 12 hours by about...

A) 2 hours more in Helsinki as in Rome.  
 B) 3 hours more in Helsinki as in Rome.  
 C) twice as much in Helsinki as in Rome.  
 D) half as much in Helsinki as in Rome.

HW: In Problems 1–6, identify the graph as a translation of a basic function, and write a formula for the graph.

HW: For Problems 7–18,

Describe how to transform one of the basic graphs to obtain the graph of the given function.

Using guidepoints, sketch the basic graph and the graph of the given function on the same axes. Label the coordinates of three points on the graph of the given function.

HW: For Problems 23–32,

Identify the scale factor for each function and describe how it affects the graph of the corresponding basic function.

Using guidepoints, sketch the basic graph and the graph of the given function on the same axes. Label the coordinates of three points on the graph of the given function. (Last one is -1/(3x))

HW: In Problems 35–38, the graph of a function is shown. Describe each transformation of the graph; then give a formula for each in terms of the original function.

HW; In Problems 39–42, each table in parts (a)–(d) describes a transformation of f(x).*f(x).* Identify the transformation and write a formula for the new function in terms of f.

HW: In Problems 63 and 64, each graph can be obtained by two transformations of the given graph. Describe the transformations and write a formula for the new graph in terms of f.

HW#71: The graph of f(x)*f(x)* shows the number of students in Professor Hilbert's class who scored x*x* points on a quiz. Write a formula for each transformation of f*f* ((a) and (b) of the figure below); then explain how the quiz results in that class compare to the results in Professor Hilbert's class.

HW#72: The graph of f(x)*f(x)* shows the number of men at Tyler College who are x*x* inches tall. Write a formula for each transformation of f*f* ; then explain how the heights in that population compare to the Tyler College men.

HW#73-74: Step function stories.

HW#75: The graph of g(t)g(t) shows the population of marmots in a national park tt months after January 1. Write a formula for each transformation of gg and explain how the population of that species compares to the population of marmots.

HW#76: The graph of f(x)*f(x)* is a dose-response curve. It shows the intensity of the response to a drug as a function of the dosage x*x* milligrams administered. The intensity is given as a percentage of the maximum response. Write a formula for each transformation of f*f* and explain what it tells you about the response to that drug