Quadratics in Vertex Form – Unit 1

Tentative TEST date_____

Reflect – previous TEST mark _____, Overall mark now_____.
Looking back, what can you improve upon?

Learning Goals/Success Criteria

Use the following checklist to help you determine what you know well and where you need additional review.

DAYS & Pages	Can you…	No, I cannot. I need to learn this.	I kind of get it. I don't get the right answers very often.	I get it. I could work on being more consistent.	Yes, I can. I have perfected this!
Day 1 Pg 2-3	Recognize a quadratic relation from an equation?	☐	☐	☐	☐
	Recognize a quadratic relation from a graph ?	☐	☐	☐	☐
	Recognize a quadratic relation from a table of values?	☐	☐	☐	☐
Day 2 Pg 4-5 Day 3 Pg 6	Identify the key features of a quadratic (zeros, *y*-intercept, vertex, axis of symmetry and optimal value) from it's graph?	☐	☐	☐	☐
	Graph and summarize the key features of the basic parabola ($y = x^2$)	☐	☐	☐	☐
	Describe how transformations (reflection, vertical stretch/compression, horizontal or vertical translation) affect the basic parabola?	☐	☐	☐	☐
	Identify transformations applied to $y = x^2$ by looking at an equation in vertex form and/or it's graph.	☐	☐	☐	☐
	Create the equation of a quadratic in vertex form given information about the transformations applied to $y = x^2$.	☐	☐	☐	☐
	Create the equation of a quadratic in vertex form given the graph of the parabola.	☐	☐	☐	☐
Day 4 Pg 7 Day 5 Pg8-9	Recognize the equation of a quadratic in vertex form?	☐	☐	☐	☐
	Identify the vertex, axis of symmetry and optimal value of a quadratic from it's equation (in vertex form)?	☐	☐	☐	☐
	Sketch a parabola in vertex form (a transformed parabola)?	☐	☐	☐	☐
Day 6 Pg10-11	Use the equation of a quadratic relation which models a real-life situation to answer questions in the context of the problem?	☐	☐	☐	☐
	Use information from a real-life situation to model a quadratic relation (create an equation or graph or table of values)?	☐	☐	☐	☐
Day 7 Pg12-15	REVIEW				

DAY 1 – Modelling Quadratic Relations

1. Use the mathematical models to determine whether the relation is linear, quadratic or neither (circle the appropriate answer). Give a reason for each answer.

a.

$$y = 9x^2 + 6x - 7$$

linear or *quadratic* or *neither*?

Reason: _____

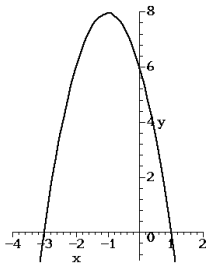
b.

x	*y*	1st	2nd
4	5		
2	2		
0	1		
-2	4		
-4	7		

linear or *quadratic* or *neither*?

Reason: _____

c.



linear or *quadratic* or *neither*?

Reason: _____

d.

$$y = 6x$$

linear or *quadratic* or *neither*?

Reason: _____

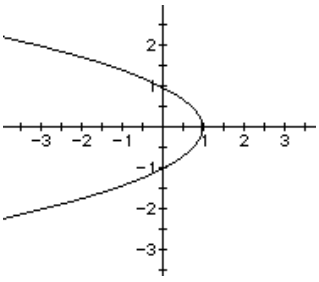
e.

x	*y*	1st	2nd
2	12		
1	3		
0	0		
-1	3		
-2	12		

linear or *quadratic* or *neither*?

Reason: _____

f.



linear or *quadratic* or *neither*?

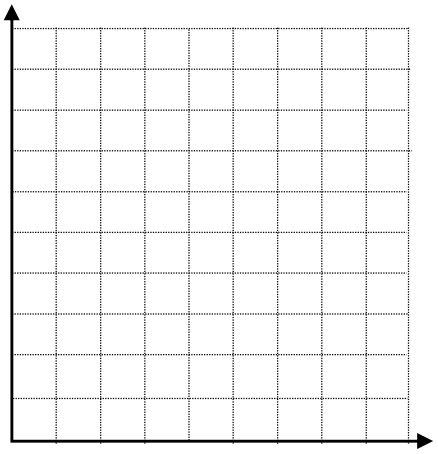
Reason: _____

2. Last year a clothing boutique sold 1200 t-shirts for $10 each. Market research suggests that for every $5 increase in price, 200 fewer t-shirts will be sold.

   a. Complete the table until the price is $40 in the table below.

   b. Graph the data below. Plot *Price* against *Income*. Label axes and give graph a title.

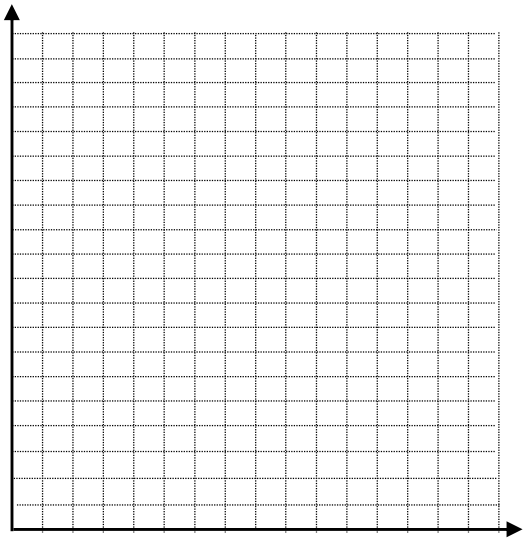
Price	Number of T-shirts Sold	Income
$10	1200	$12 000
$15	1000	
$20		
$25		
$30		
$35		
$40		



   c. Which price results in the maximum income? _____

3. A cannonball is shot horizontally from the top of a cliff. Its path can be modelled by the relation , where *h* is the cannonball's height above the ground, in metres, and *t* is the time, in seconds.
   a. Complete the table below.

time	$h = 150 - 5t^2$	*height*	1st	2nd
0				
1				
2				
3				
4				
5				



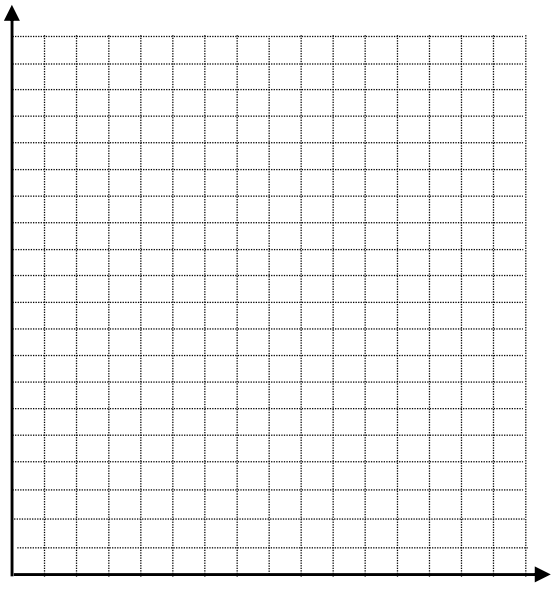
   b. Is the relation quadratic? How do you know?

   _____

   c. Graph the relation in the grid above. Label axes and give graph a title.

4. A craft store sold 800 ornaments for $2 each. A survey suggests that every $1 increase in price will reduce sales by 100.
   a. Complete the table below until no ornaments are sold.
   b. Graph the data Price versus Income. Label axes and give graph a title.

Price	Number of Ornaments Sold	Income

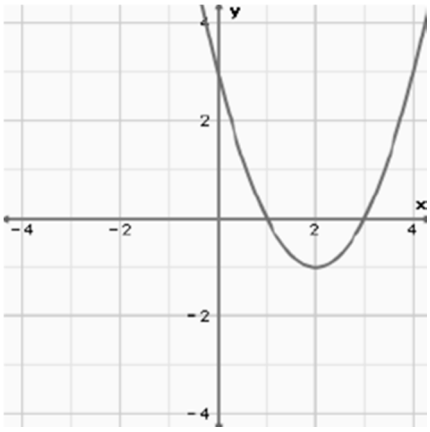


   c. Which price results in the maximum income? _____

DAY 2 – Changing Quadratic Relations: The Value of 'a'

1. State the vertex and the maximum or minimum value for each parabola.

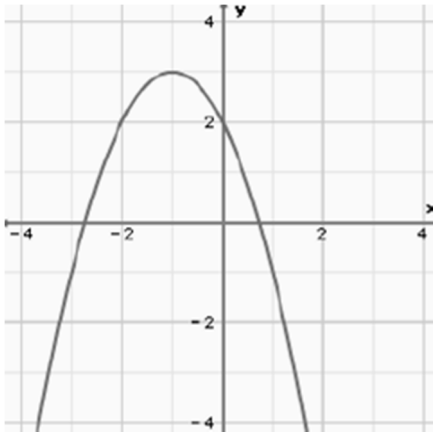
a.



Vertex: _____

max or *min*?: _____

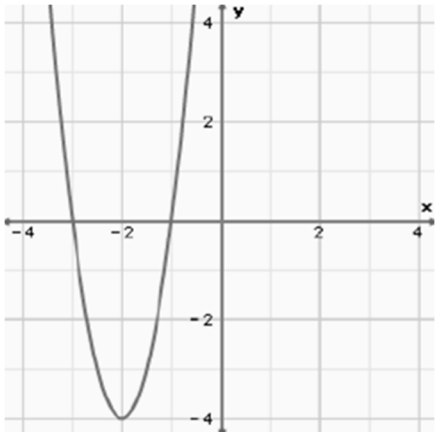
b.



Vertex: _____

Max or Min?: _____

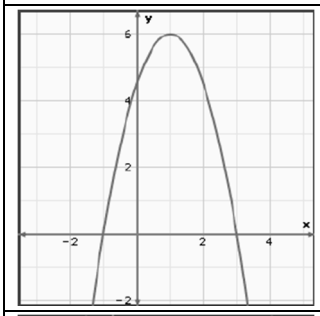
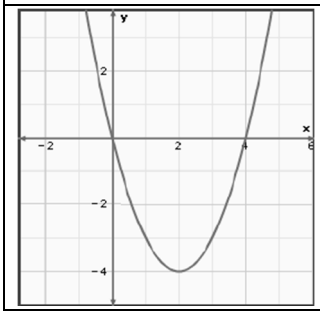
c.



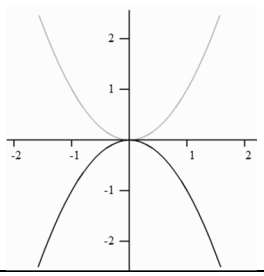
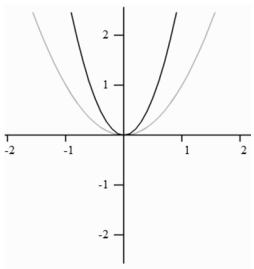
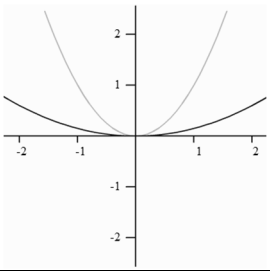
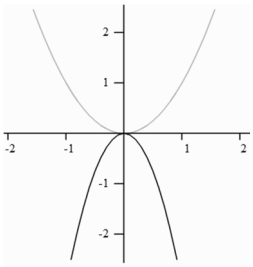
Vertex: _____

Max or Min?: _____

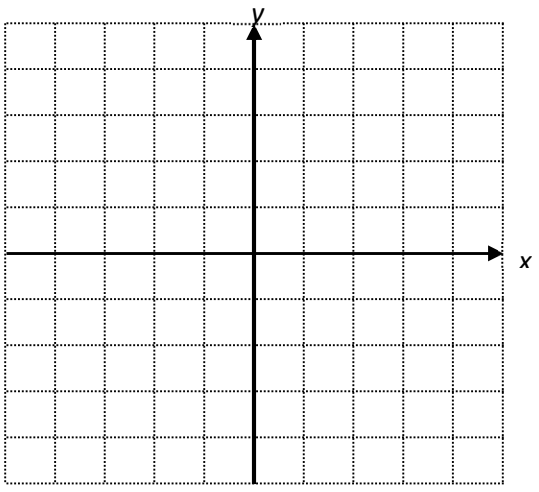
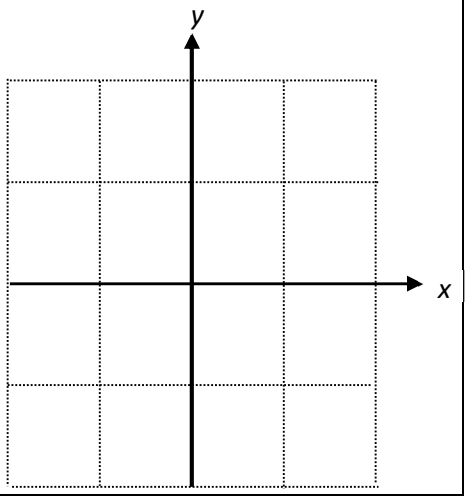
2. State the key features of each graph.

	zeros	*y*-intercept	vertex	axis of symmetry	optimal value
					
					

3. For each of the following, state how the value of *a* is affecting the basic parabola (*compression, stretch and/or reflection*). The basic parabola, $y = x^2$, is shown with a dotted line.

a.	b.	c.	d.
			

4. State the transformations and graph each of the following parabolas.

	a. $y = 2x^2$	b. $y = -\frac{1}{3}x^2$
(I) TRANSFORMATIONS		
(II) GRAPH		

5. For each set of quadratics, circle the one that is wider

a. $y = 0.2x^2$ $y = 5x^2$

b. $y = 3x^2$ $y = -0.4x^2$

c. $y = 5x^2$ $y = 2x^2$

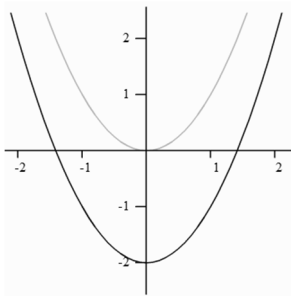
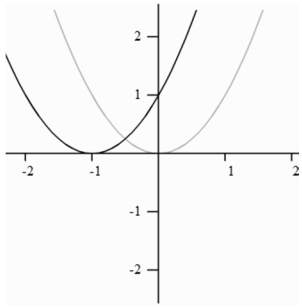
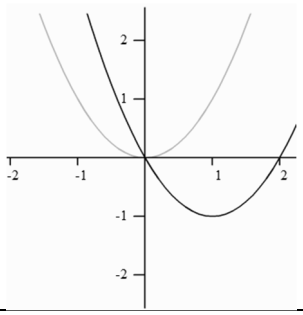
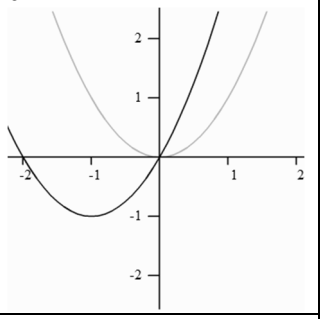
d. $y = 0.1x^2$ $y = 0.25x^2$

e. $y = -0.2x^2$ $y = 0.03x^2$

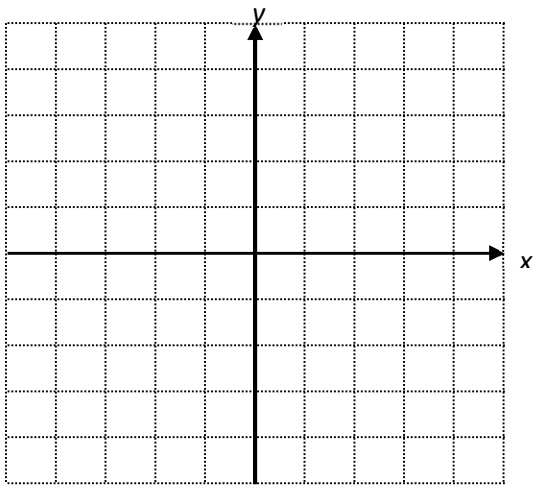
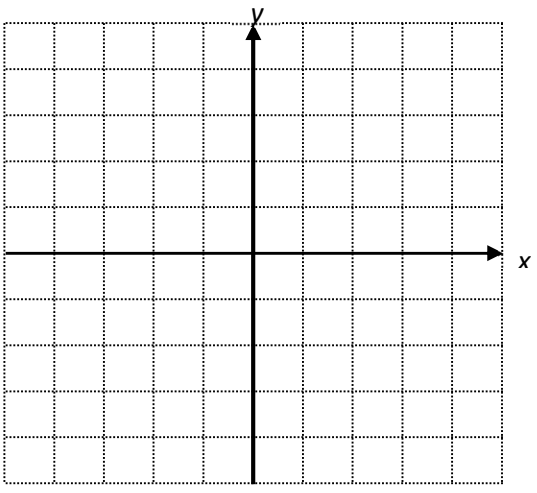
f. $y = 0.9x^2$ $y = -0.4x^2$

DAY 3 – Changing Quadratic Relations: The Values of 'h' and 'k'

1. For each of the following, state how the value of *h* and/or *k* is affecting the basic parabola *horizontal (left/right) or vertical (up/down) translation*. The basic parabola, $y = x^2$, is shown with a dotted line.

a.	b.	c.	d.
			

2. State the transformations and graph each of the following parabolas.

	a. $y = (x - 1)^2 + 2$	b. $y = (x + 3)^2 - 4$
(I) TRANSFORMATIONS		
(II) GRAPH		

3. For each set of quadratics, circle the one that has it's vertex farther from the *x*-axis.

   a. $y = x^2 + 5$ $y = x^2 - 4$ b. $y = x^2 + 2$ $y = x^2 - 3$

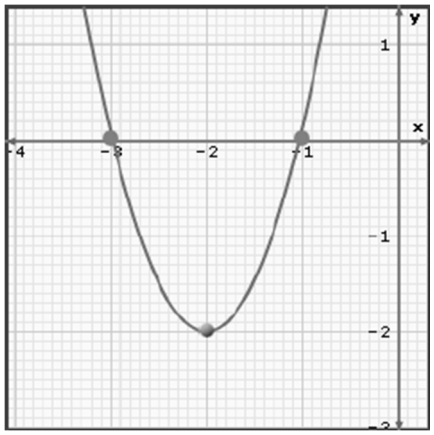
4. For each set of quadratics, circle the one that has it's vertex farther from the *y*-axis.

   a. $y = (x + 3)^2$ $y = (x - 2)^2$ b. $y = (x - 1)^2$ $y = (x - 2)^2$

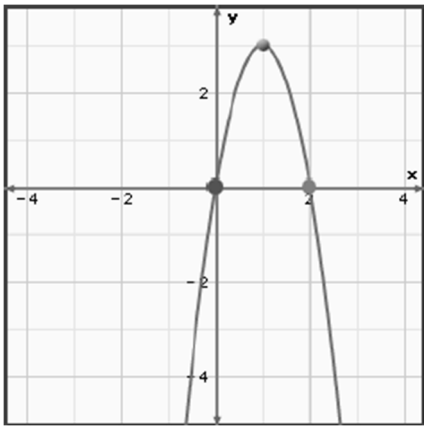
DAY 4 – Creating an Equation in Vertex Form

1. State the equation for each of the following parabolas.

a.



b.

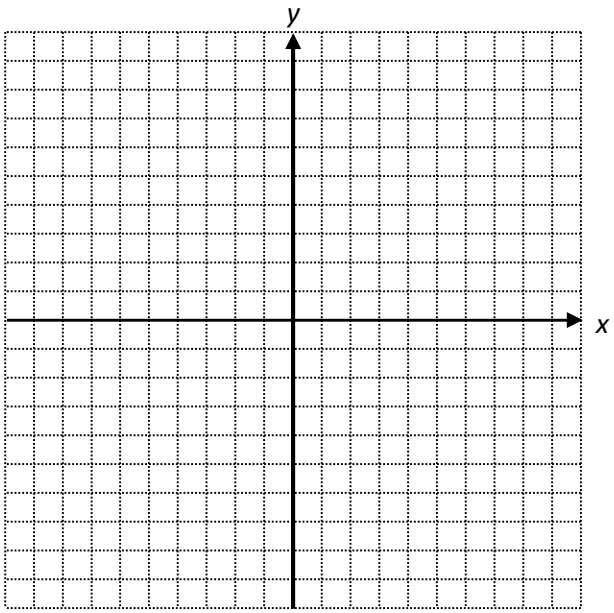
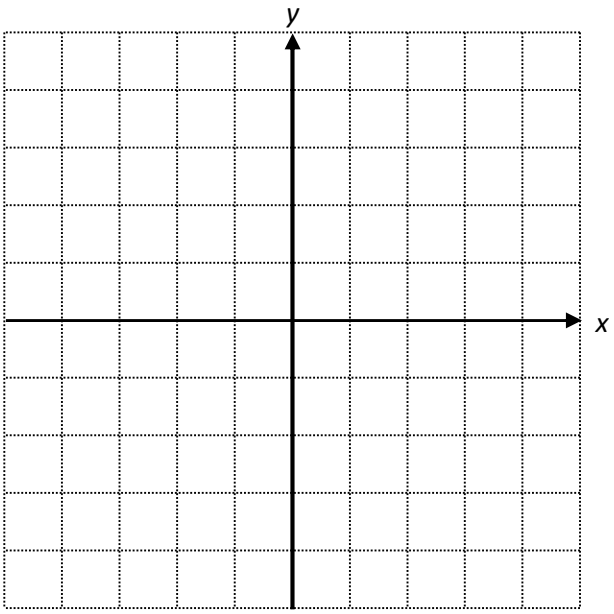


c. A parabola has a vertex (5, 2) and passes through the point (1, 4).

d. A parabola has a vertex (–3, 6) and a *y*-intercept of 1.

DAY 5 – Vertex Form of Quadratic Relations: $y = a(x - h)^2 + k$

1. For each of the following quadratic relations in vertex form, (i) state the transformations, (ii) graph the parabola, and (iii) state the key features.

<table>
<tr><th></th><th>$y = -2(x - 4)^2 + 5$</th><th>$y = {}^1/_3(x + 2)^2 - 4$</th></tr>
<tr><td>(I) TRANSFORMATIONS</td><td></td><td></td></tr>
<tr><td>(II) GRAPH</td><td> 
</td><td> 
</td></tr>
<tr><td>(III) KEY FEATURES</td><td><table>
<tr><td>zeros</td><td></td></tr>
<tr><td>y-intercept</td><td></td></tr>
<tr><td>vertex</td><td></td></tr>
<tr><td>axis of symmetry</td><td></td></tr>
<tr><td>optimal value</td><td></td></tr>
</table></td><td><table>
<tr><td>zeros</td><td></td></tr>
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<tr><td>vertex</td><td></td></tr>
<tr><td>axis of symmetry</td><td></td></tr>
<tr><td>optimal value</td><td></td></tr>
</table></td></tr>
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2. Collect the following information for each quadratic in vertex form. The first one is done.

	Transformations					
Equation	**a**	**h**	**k**	**vertex**	**axis of symmetry**	**optimal value**
$y=-7(x+4)^2+10$	• reflection • stretch by 7	• left 4	• up 10	(–4, 10)	$x = -4$	y=10, max
$y=2(x-3)^2-5$						
$y=-3(x-5)^2-1$						
$y=-(x+1)^2+6$						
$y=\frac{1}{3}(x+5)^2-3$						
$y=0.75(x-3)^2+1$						
$y=-(x+1)^2-5$						
$y=4(x-2)^2-3$						
$y=-3(x+5)^2+2$						
$y=-2(x-4)^2+1$						
$y=\frac{1}{2}(x-4)^2+3$						

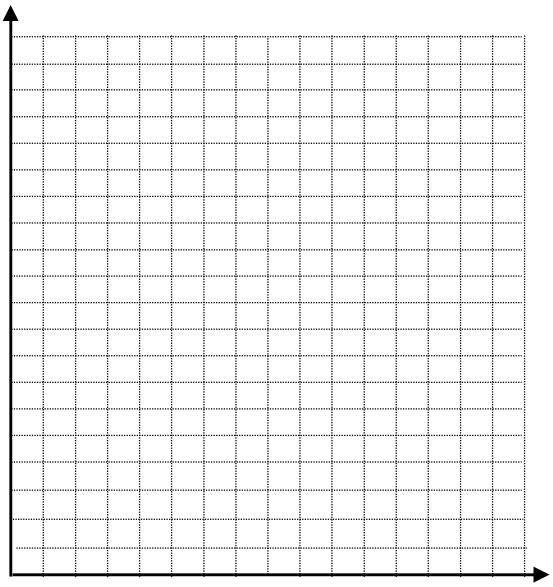
DAY 6 – Understanding Problems Involving Quadratic Relations

1. The manager of a hockey arena is pricing tickets for an upcoming game. She knows that if she increases the ticket price she will sell fewer tickets. The situation is modelled by the relation $R = -100(P-15)^2 + 22500$, where *R* is the total revenue and *P* is the ticket price, both in dollars.

   a. Create a table of values and graph the relation. Label axes and give graph a title.

x	$-100(x-15)^2+22500$	y

place vertex in middle →



   b. What is the vertex of the parabola? _____

   c. What do the coordinates of the vertex represent in this situation?

2. The Windsor-Detroit International Freedom Festival hosts one of the largest fireworks displays in the world. The fireworks are set off over the Detroit River. The path of a particular firework rocket is modelled by the relation $h = -4.9(t-2)^2 + 169.6$, where *h* is the rocket's height above the water, in metres, and *t* is the time, in seconds.

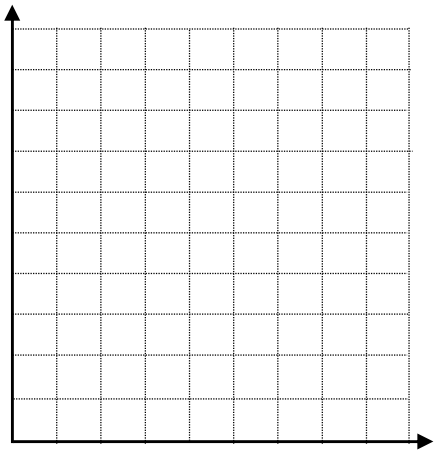
   a. How long will the rocket take to reach its maximum height? _____

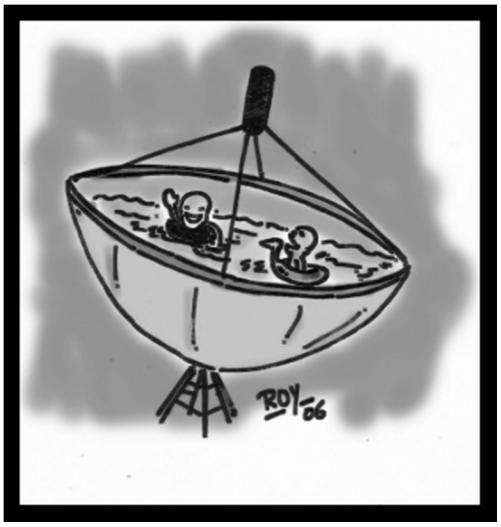
   b. What is the maximum height? _____

   c. A firework rocket will stay lit for an average of 5 s. What will the height of a rocket be 5 s after it is launched?

3. The shape of a satellite dish is parabolic. the dish is 5 cm deep and 40 cm wide.

   a. Sketch the parabola opening up. Label axes and give graph a title.

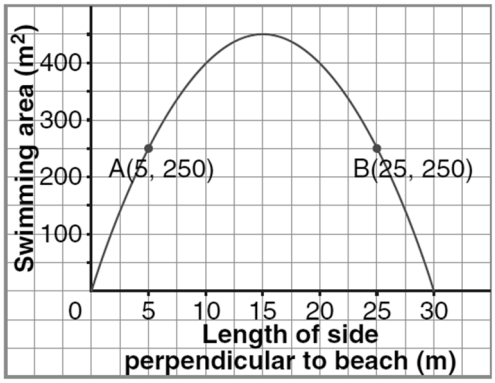




   b. Write a relation of the form $y = a(x-h)^2 + k$ that models the shape of this dish. The point (21, 0.0125) is also on the parabola.

REVIEW

1. A rectangular swimming area is to be enclosed by 60 m of rope. One side of the swimming area is along the shore so the rope will only be used on three sides. The graph shows how the swimming area is related to the length of the side perpendicular to the beach.



a. Interpret what the vertex represents. Draw a sketch this swimming area and label it.

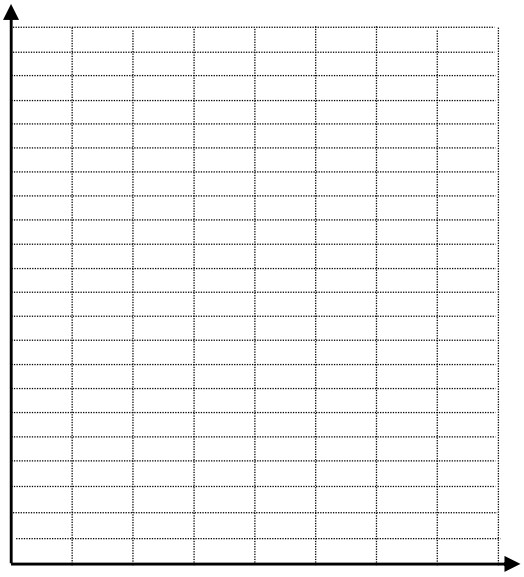
b. What are the dimensions of the largest swimming area?

c. Draw the swimming areas that correspond to points A and B, and label their dimensions. What is the same about these swimming areas? Which would you prefer, and why?

2. The stopper in a bathtub is released and the water begins to drain. The volume of water, *V* litres, in the tub *t* minutes after the stopper is pulled is given by the equation $V = -5t^2 - 8t + 120$.

   a. Complete the table to graph the relation. Label axes and give graph a title.

t	$-5t^2 - 8t + 120$	***V***
0		
1		
2		
3		
4		
5		



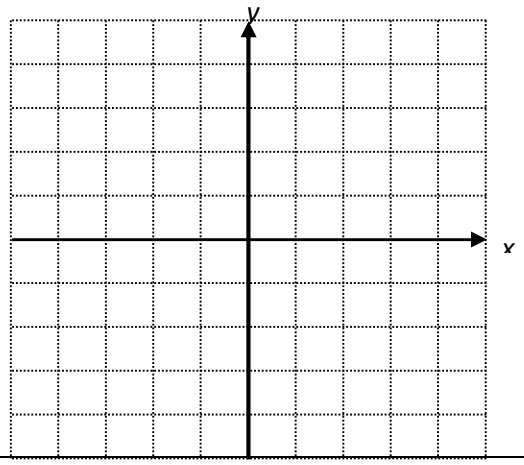
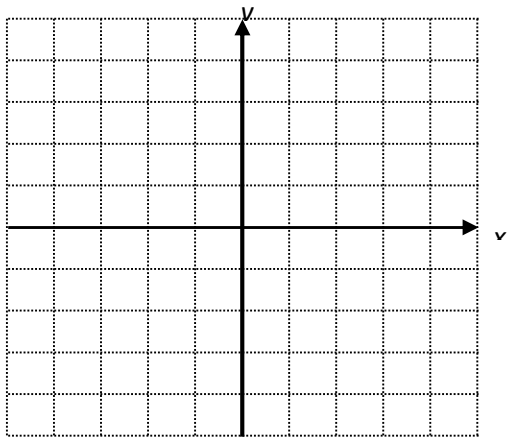
Why do we only need to use the first quadrant?

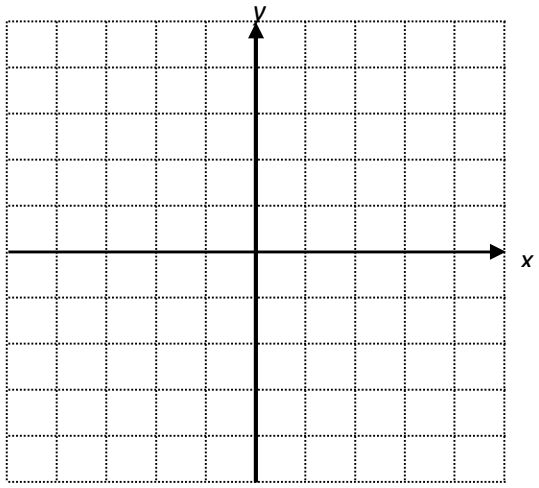
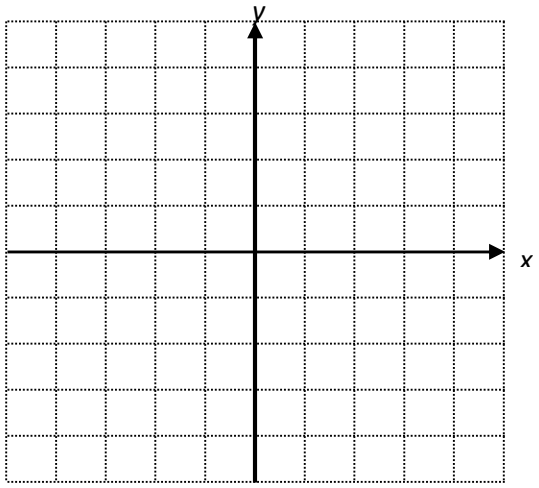
_____

   b. How many litres of water are in the tub when it begins to drain? _____

   c. How much time does it take for all the water to drain? _____

3. (i) State the transformations to $y = x^2$ for each of the following and (ii) sketch each graph.

	a. $y = (x-2)^2$	b. $y = x^2 - 2$
(I) TRANSFORMATIONS		
(II) GRAPH		

	a. $y = -2x^2$	b. $y = -x^2 + 2$
(I) TRANSFORMATIONS		
(II) GRAPH		

a. How are the graphs the same?

_____

_____

_____

b. How are they different?

_____

_____

_____

4. In each case, the parabola $y = x^2$ is transformed as described. Write the equation of the new parabola in the form $y = a(x-h)^2 + k$.

a. The parabola is translated 2 units up and 5 units right. _____

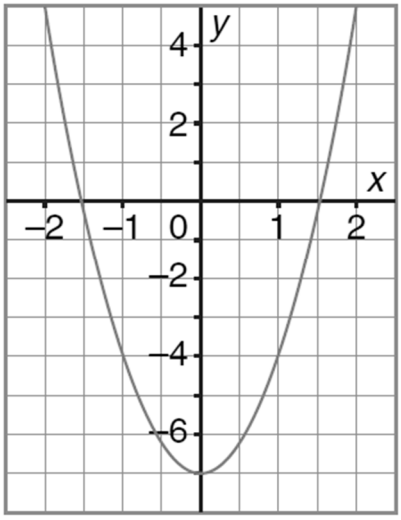
b. The parabola is stretched vertically by a factor of 4. _____

c. The parabola is translated 2 units right, then reflected in the *x*-axis. _____

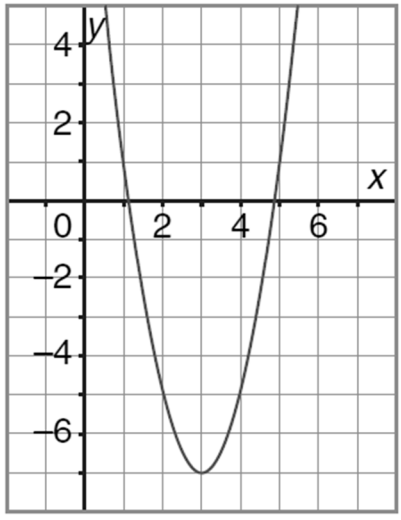
d. The parabola is compressed vertically by a factor of 0.5. _____

5. Match each parabola with its equation. Explain your answers.

①



②



Equation	Matches Graph Number	Because . . .
$y = 2(x-3)^2 - 7$		
$y = 2x^2 - 7$		

6. Use the graph of a quadratic relation below to determine it`s equation.