West Spring Secondary School
3E EMath: Assignment 1
Functions & Graphs

Name: ________________________ (   ) Class: ___________ Date: _________

Overview

This worksheet covers the following:

1. Recognizing shape of quadratic functions
2. Sketching quadratic functions of the form $y = (x-h)^2 + k$ **or** $y = -(x-h)^2 + k$

Introduction

Previously in Chapter 2, we learned about quadratic equations – the 4 methods of solving them, and using them in word problems. Today, we are going to investigate more about quadratic equations – the different forms and shapes, how to describe them etc.

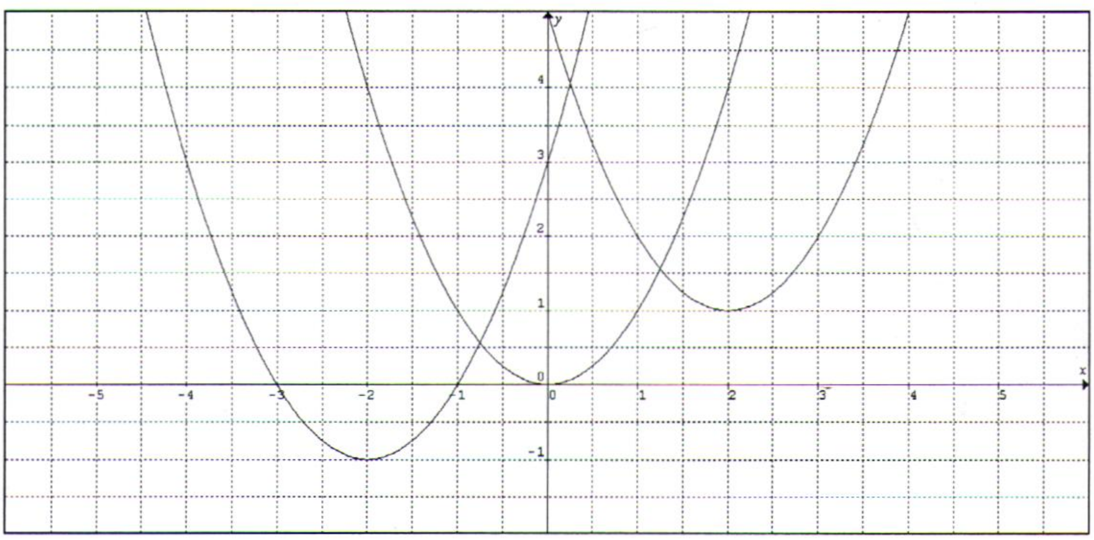
To begin, for any quadratic function $y = ax^2 + bx + c$

We can classify them into two types based on *a* (the coefficient of x^2):

1. *a* is +ve, or
2. *a* is -ve

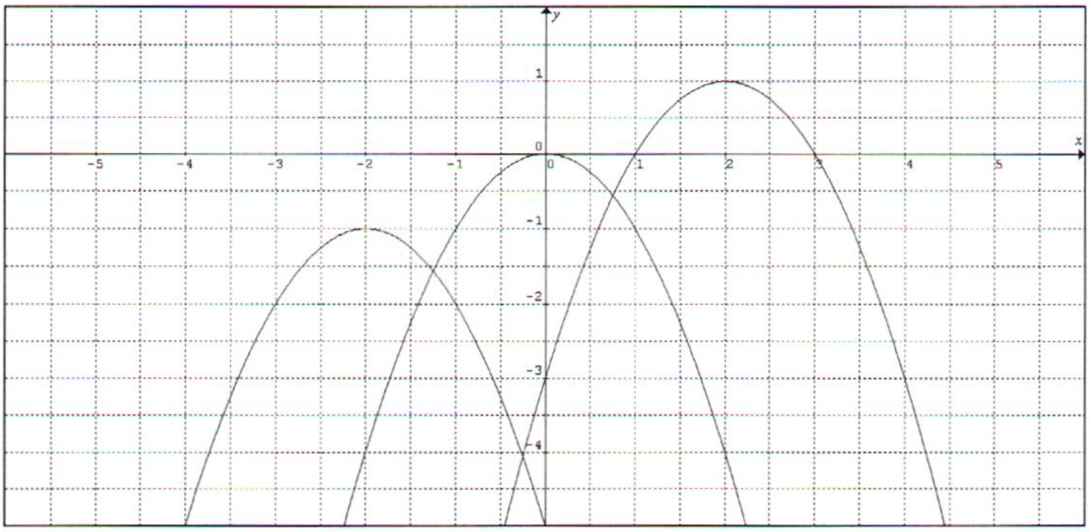
a is +ve

If a is +ve (e.g. $y = x^2, y = 2x^2 - 5x$), the quadratic functions will look like these:



a is -ve

If a is –ve (e.g. $y=-x^2, y=-3x^2+2x-1$), the quadratic functions will look like these:



What do you notice about their differences?

Complete the table below:

a is +ve ("Smiley Face")	*a* is -ve ("Sad Face")
Shape of graph:	Shape of graph:
Graphs will have: • <u>Minimum</u> point • Line of symmetry • Have a y-intercept • May or may not have x-intercepts	Graphs will have: • <u>Maximum</u> point • Line of symmetry • Have a y-intercept • May or may not have x-intercepts

Question: Given a quadratic function, can we sketch the graph quickly and accurately?

To sketch a graph quickly and accurately, we can transform the quadratic function into one of these two forms (with their negative counterparts):

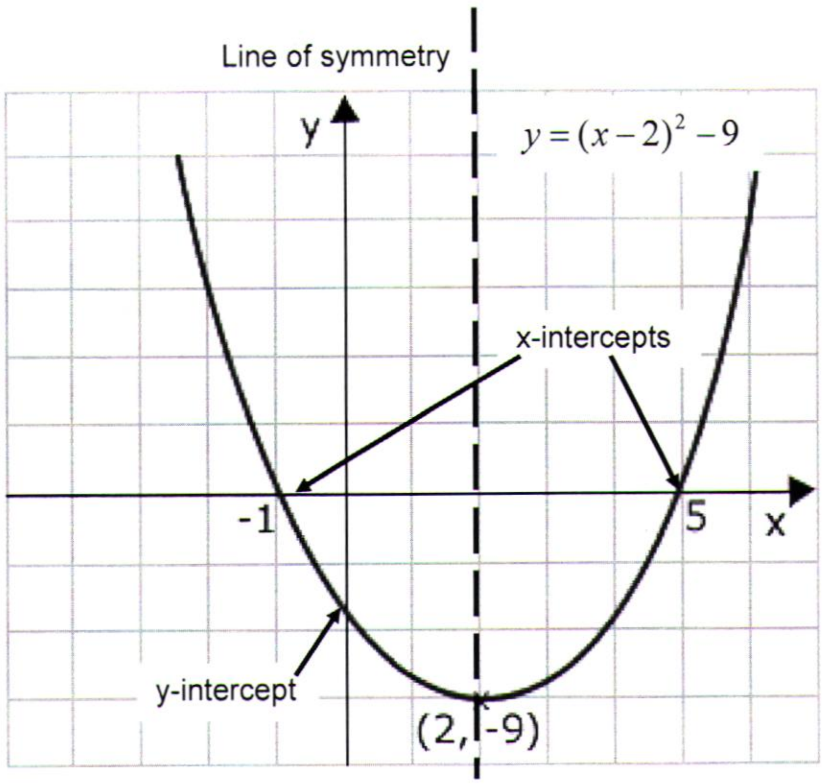
1. $y = (x-h)^2 + k$ **or** $y = -(x-h)^2 + k$
2. $y = (x-p)(x-q)$ **or** $y = -(x-p)(x-q)$

The difference between 1 and 2 is that the 2[nd] form means the graph has x-intercepts (i.e. it cuts the x-axis). Since this may not be true for all quadratic functions, not all quadratic functions can be expressed in the 2nd form.

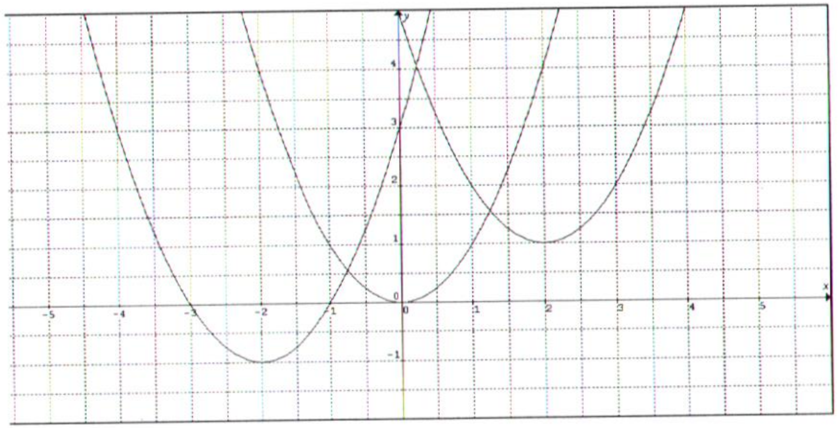
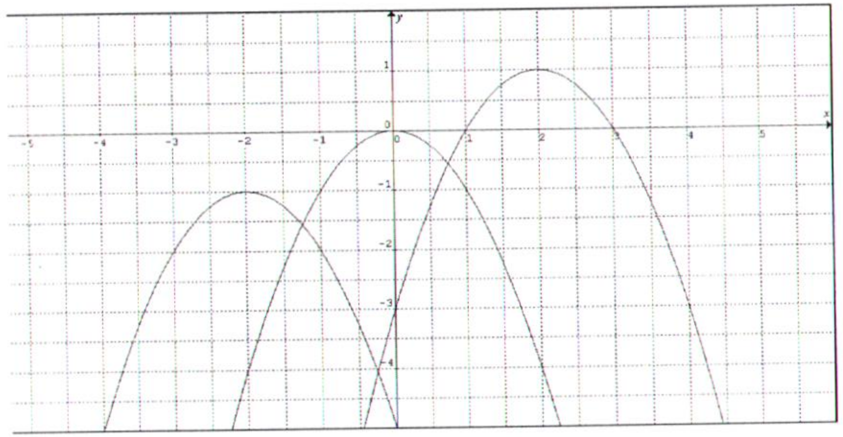
Now let's investigate each of these forms closer.

Example:

1. Smiley face or sad face? => Min or Max point? ____________
2. Coordinates of min point ____________
3. Line of symmetry? ____________
4. y-intercept? ____________



When a function is expressed as $y=(x-h)^2+k$ **or** $y=-(x-h)^2+k$, the graph will have a turning point at the point (*h*, *k*). This turning point is either a <u>minimum</u> or <u>maximum</u> point depending on the coefficient of x^2, i.e. *a*.

<table>
<tr><th>$y=(x-h)^2+k$</th><th>$y=-(x-h)^2+k$</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Important points to note:
• "Smiley Face" – <u>minimum</u> point
• Turning/Min point at (h, k)
• Line of symmetry at $x = h$
• Label where it cuts the y-axis</td><td>Important points to note:
• "Sad Face" – <u>maximum</u> point
• Turning/Max point at (h, k)
• Line of symmetry at $x = h$
• Label where it cuts the y-axis</td></tr>
</table>

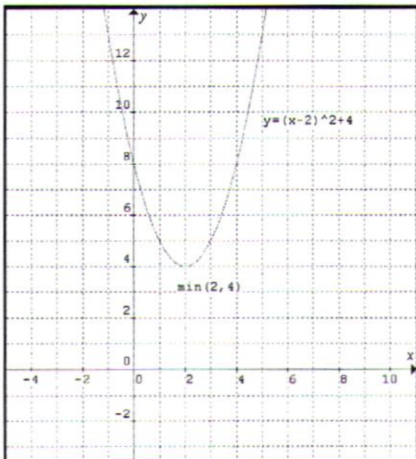
Example 1:

Sketch the graph of $y=(x-2)^2+4$

Steps:

5. Smiley face or sad face? => Min or Max point? min point
6. Coordinates of min point (2,4)
7. Line of symmetry? $x=2$
8. y-intercept? $y=8$

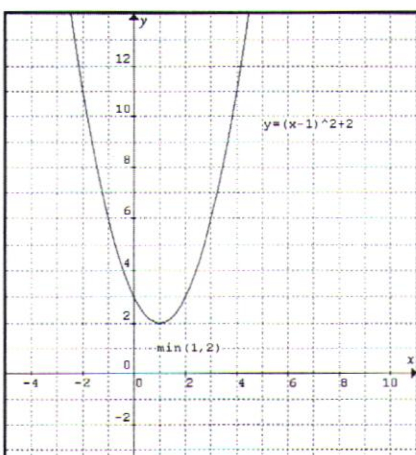
Once you have the above information, sketch the graph.
Make sure you label the important information clearly.



Example 2:

Sketch the graph of $y=(x-1)^2+2$

1. Smiley face or sad face? => Min or Max point? min point
2. Coordinates of min point (1,2)
3. Line of symmetry? $x=1$
4. y-intercept? $y=3$



Practice 1

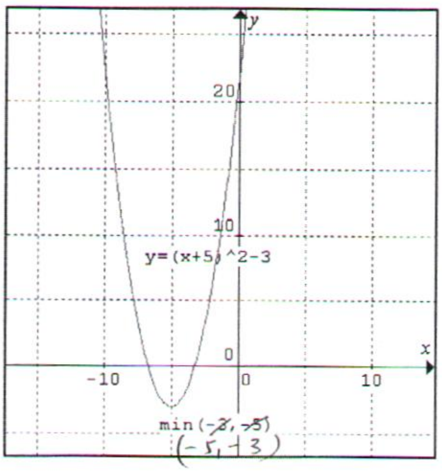
Sketch the graph of $y = (x-1)^2 + 2$

1. Smiley face or sad face? => Min or Max point? __________
2. Coordinates of min point __________
3. Line of symmetry? __________
4. y-intercept? __________

Practice 2

Sketch the graph of $y = (x+5)^2 - 3$

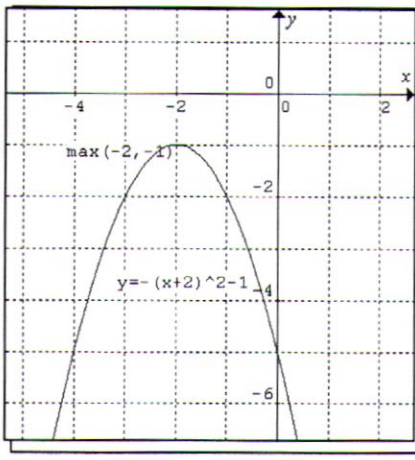
1. Smiley face or sad face? => Min or Max point? min point
2. Coordinates of turning point $(-5, -3)$
3. Line of symmetry? $x = -5$
4. y-intercept? $y = 22$



Example 3:

Sketch the graph of $y=-(x+2)^2-1$

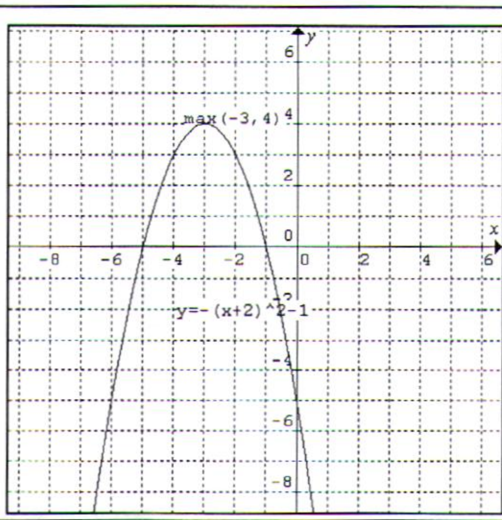
1. Smiley face or sad face? => Min or Max point? Max point
2. Coordinates of turning point $(-2,-1)$
3. Line of symmetry? $x=-2$
4. y-intercept? $y=-5$
5. x-intercept? no real roots



Practice 3:

Sketch the graph of $y=-(x+3)^2+4$

1. Smiley face or sad face? => Min or Max point? Max point
2. Coordinates of turning point $(-3,4)$
3. Line of symmetry? $x=-3$
4. y-intercept? $y=-5$
5. x-intercept? $x=-1$ or $x=-5$

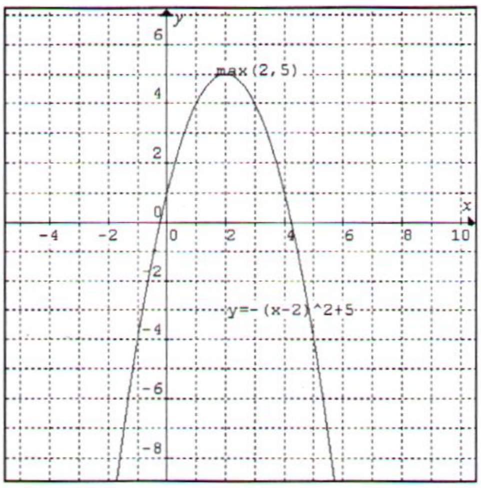


Practice 4

Sketch the graphs for the following quadratic equations, showing clearly:

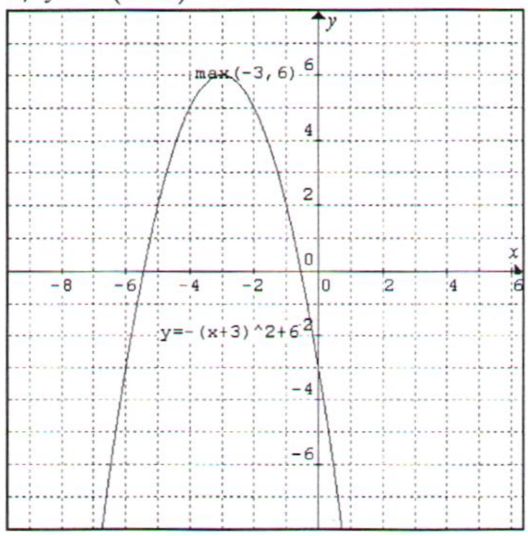
- min or max point
- line of symmetry (state the equation)
- y-intercept

a) $y = -(x-2)^2 + 5$



$x = 4.24$ or $x = -0.236$

b) $y = -(x+3)^2 + 6$



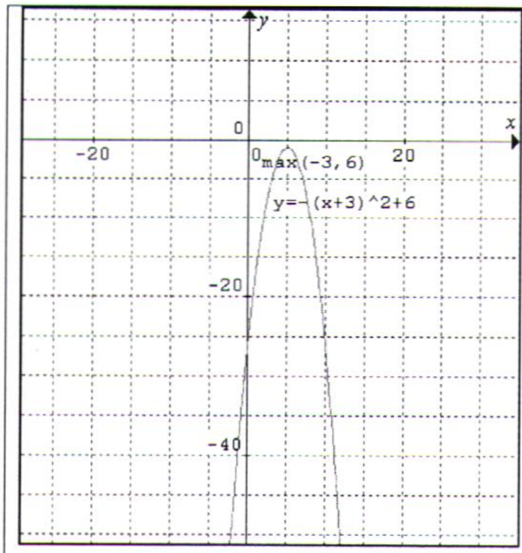
$x = -0.551$ or $x = -5.45$

c) $y = -(x-5)^2 - 1$

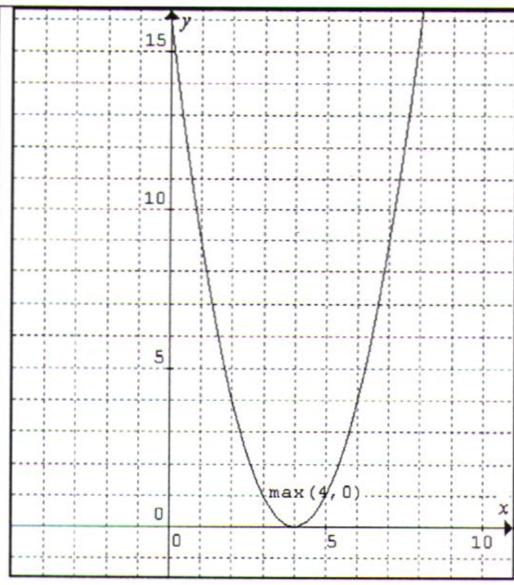
x no real roots

d) $y = (x-4)^2$

$x = 4$



y
x
0
-20
20
max(-3, 6)
y=-(x+3)^2+6
-20
-40

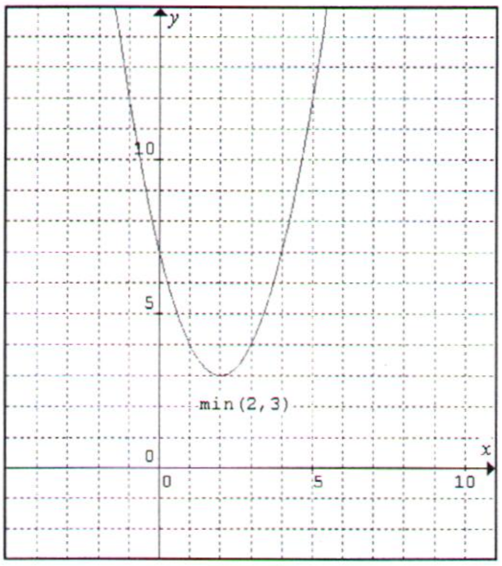


y
15
10
5
0
max(4, 0)
x
0
5
10

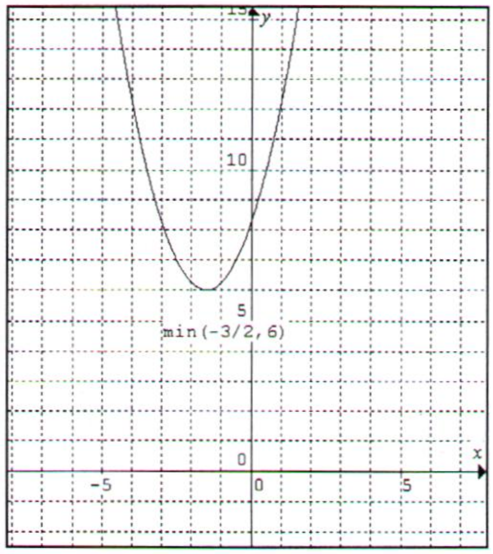
Homework

1. Sketch the graphs for the following quadratic equations, showing clearly:
   - min or max point
   - line of symmetry (state the equation)
   - y-intercept

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



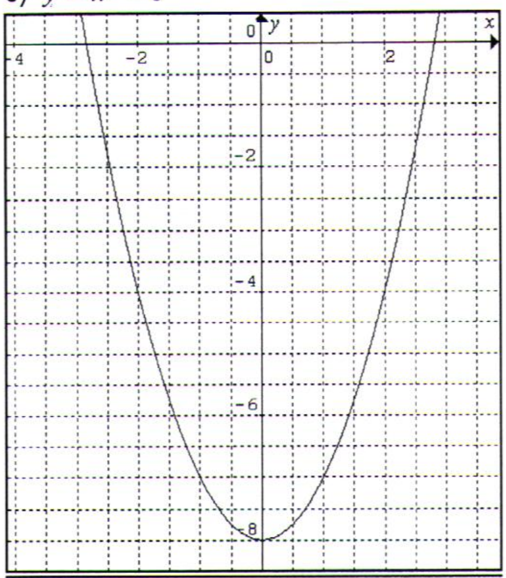
b) $y=\left(x+\frac{3}{2}\right)^2+6$



no real roots

· no real roots ·

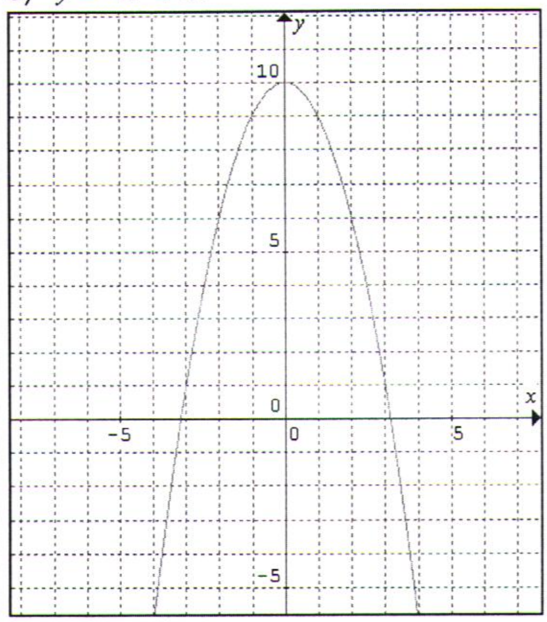
c) $y = x^2 - 8$



min $(0, -8)$

$x = 2.83$ or -2.83

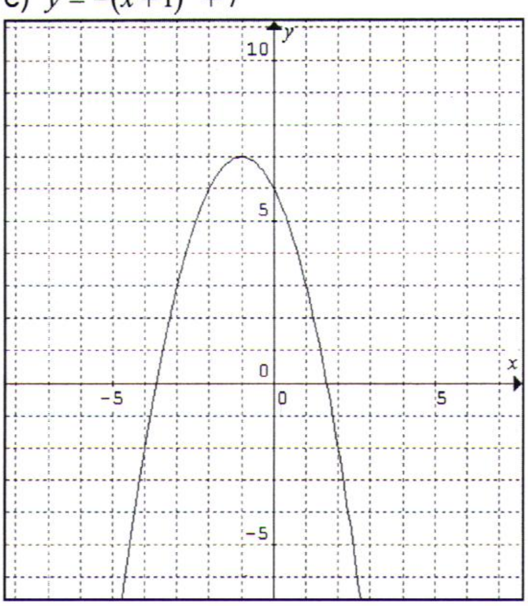
d) $y = -x^2 + 10$



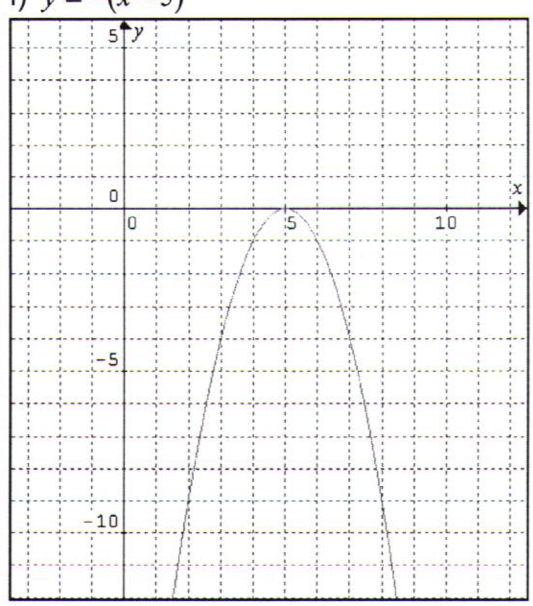
max $(0, 10)$

$x = 3.16$ or $x = -3.16$

e) $y = -(x+1)^2 + 7$



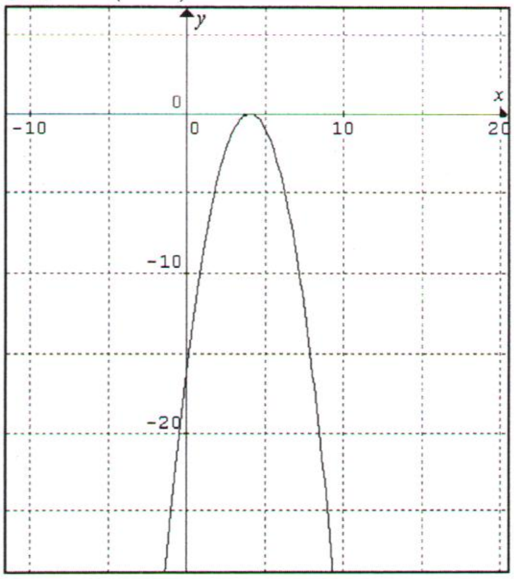
f) $y = -(x-5)^2$



$x = 1.65$ or $x = -3.65$

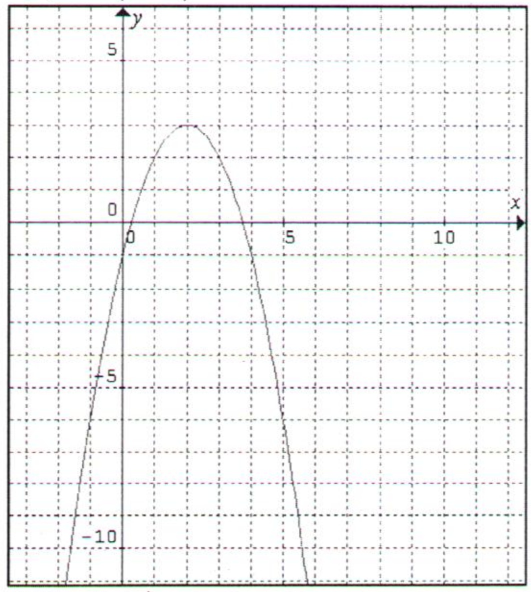
$x = 5$

g) $y = -(x-4)^2$



$x=4$

h) $y = -(x-2)^2 + 3$



$x = 3.73$ or $x = 0.268$

Dateline: Mar 2011

My Reflection