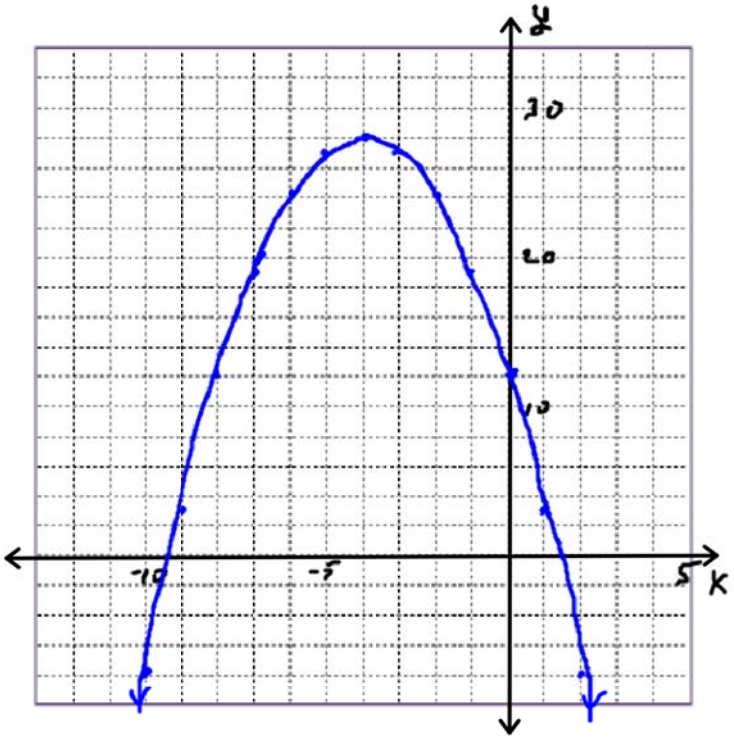
$y = -x^2 - 8x + 12$

x	y	
-8	12	
-7	19	-1
-6	24	-3
-5	27	-5
-4	28	-7
-3	27	-9
-2	24	
-1	19	
0	12	
1	3	



Axis of symmetry

$a = -1$, $b = -8$

$x = \frac{-b}{2a}$

$x = \frac{-(-8)}{2(-1)}$

Axis of symmetry: $x = -4$

Vertex (we just found that the x-coordinate is -4).

$y = -x^2 - 8x + 12$

$y = -(-4)^2 - 8(-4) + 12$

$y = 28$

vertex: $(-4, 28)$

y-intercept ($x = 0$): $(0, 12)$

x-intercept ($y = 0$)

$-x^2 - 8x + 12 = 0$

$x^2 + 8x - 12 = 0$

$a = 1, b = 8, c = -12$

$x = \frac{-8 \pm \sqrt{8^2 - 4(1)(-12)}}{2(1)}$

$x = \frac{-8 \pm \sqrt{112}}{2}$

$x = \frac{-8 \pm \sqrt{16 \cdot 7}}{2}$

$x = \frac{-8 \pm \sqrt{16}\sqrt{7}}{2}$

$x = \frac{-8 \pm 4\sqrt{7}}{2}$

$x = -4 \pm 2\sqrt{7}$

x-intercepts:

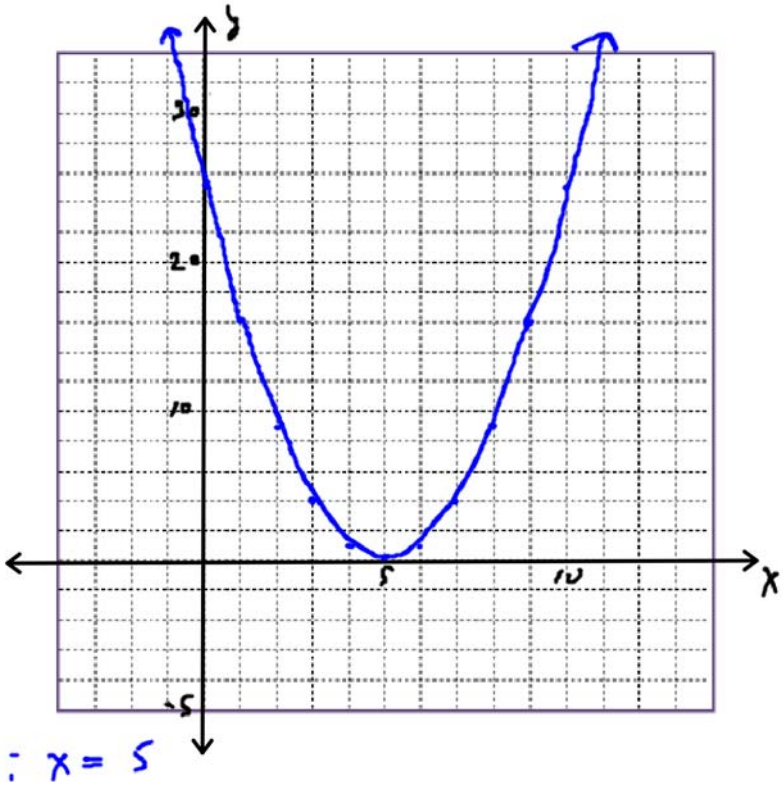
$(-4 + 2\sqrt{7}, 0)$

$(4 - 2\sqrt{7}, 0)$

$y = x^2 - 10x + 25$

x	y	
2	9	
3	4	
4	1	
5	0	+1
6	1	+3
7	4	+5
8	9	

$y = x^2 - 10x + 25$



axis of symmetry : $x = 5$

$x = \frac{-b}{2a}$; $a = 1, b = -10$

$x = \frac{-(-10)}{2(1)}$

$x = 5$

Vertex : $(5, 0)$

We just found that the x-coordinate is 5.

$y = 5^2 - 10(5) + 25$

$y = 0$

y-intercept : $(0, 25)$

x-intercept : $(5, 0)$

$x^2 - 10x + 25 = 0$

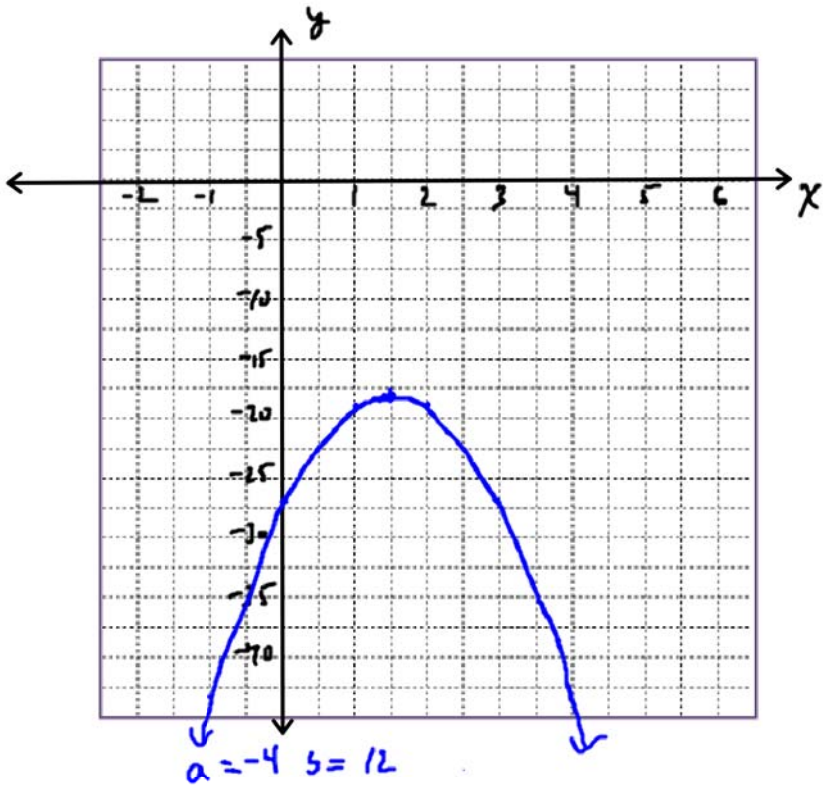
$(x-5)^2 = 0$

$x - 5 = 0$

$x = 5$

$y = -4x^2 + 12x - 27$

x	y	
-1	-43	
0	-27	
1	-19	
3/2	-18	
2	-19	
3	-27	-8
4	-43	-16
5	-67	-24



a = -4 b = 12

x-intercepts: y is 0

$-4x^2 + 12x - 27 = 0$

$4x^2 - 12x + 27 = 0$

$a = 4,\ b = 12,\ c = 27$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$x = \frac{-(-12) \pm \sqrt{(-12)^2 - 4(4)(27)}}{2(4)}$

$x = \frac{12 \pm \sqrt{-288}}{8}$ ← not a real number

There are no x-intercepts.

axis of symmetry: $x = \frac{3}{2}$

$x = -\frac{b}{2a}$

$x = -\frac{12}{2(-4)}$

$x = \frac{3}{2}$

Vertex: $(x = \frac{3}{2})$

$y = -4(\frac{3}{2})^2 + 12(\frac{3}{2}) - 27$

$= -9 + 18 - 27$

$= -18$

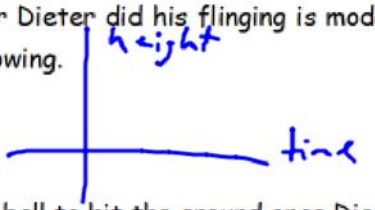
vertex: $(\frac{3}{2}, -18)$

y-intercept: $(0, -27)$

$y = -4x^2 + 12x - 27$

Dieter swiped his sister's lacrosse stick and ball and climbed to the roof of his granny's condo tower. Dieter stuck the ball in the net of the stick and flung the ball straight up with the stick exactly at roof level and the ball 3 feet past the edge of the roof.

The height above the ground of the ball (ft) t seconds after Dieter did his flinging is modeled by the function $h(t) = -16t^2 + 38t + 86$. Find each of the following.



a. The height of granny's condo tower.
b. The maximum height reached by the ball.
c. The time (to the nearest 10th of a second) it took for the ball to hit the ground once Dieter had flung the ball.

a. The height can be determined letting $t = 0$ (he flings from the roof so the position at $t=0$ is the elevation of the roof)

b. The maximum height is the y-coordinate of the vertex

c. We can determine when the ball hits the ground by solving $h(t) = 0$

c. $h(t) = 0$

$-16t^2 + 38t + 86 = 0$

$\frac{-16t^2 + 38t + 86}{-2} = \frac{0}{-2}$

$8t^2 - 19t - 43 = 0$

$a = 8, b = 79, c = -43$

$t = \frac{-(-19) \pm \sqrt{(-19)^2 - 4(8)(-43)}}{2(8)}$

$t = \frac{19 \pm \sqrt{19^2 + 4(8)(43)}}{2(8)}$

$t \approx \frac{19 \pm 41.68}{16}$

we can ignore the negative because the ball doesn't hit the ground before it's thrown!

$t \approx \frac{19 + 41.68}{16} \approx 3.79$

So it took about 3.79 s for the ball to hit the ground.

A few minutes later Dieter's granny has other uses in mind for her lacrosse stick.

a. $h(0) = 86$

The height of the tower is 86 ft.

b. $y = -16t^2 + 38t + 86$

$a = -16$

$b = 38$

axis of symmetry

$t = \frac{-b}{2a}$

$t = \frac{-38}{2(-16)}$ $\quad t = \frac{19}{16}$

Vertex: $(t = 19/16)$

$y = -16\left(\frac{19}{16}\right)^2 + 38\left(\frac{19}{16}\right) + 86$

≈ 108.6

So the max height reached by the ball was about 108.6 ft

Group work questions

1. Find the vertex of each parabola.

   a. $y = x^2 - 7x + 11$

   b. $y = -2x^2 - 12x - 50$

   c. $y = x^2 - 8x - 9$

   d. $y = (3x + 8)^2$

2. Find the intercepts of each parabola.

   a. $y = x^2 - 7x + 11$

   b. $y = -2x^2 - 12x - 50$

   c. $y = x^2 - 8x - 9$

   d. $y = (3x + 8)^2$

3. Graph each parabola. Make sure that you clearly show the symmetry of the parabola and that your axes are well labeled and scaled.

   a. $y = x^2 - 7x + 11$

   b. $y = -2x^2 - 12x - 50$

   c. $y = x^2 - 8x - 9$

   d. $y = (3x + 8)^2$

4. The next day Ricky ran into Abdou in the Subway shop on Capitol Highway. Ricky said "whaddup?" Abdou said "Check it out, fool. I took the tofu pita pocket my moms packed me for lunch and tossed it up in the air from the bleachers of the Wilson High athletic field. The height above the ground (ft) of the pita pocket t seconds after I tossed the nasty thing can be modeled by the function $h(t) = -16t^2 + 32t + 48$. I bet you can't figure out how high the pita was flung nor how long it took for the pita to hit the ground."

   Lucky Ricky just happened to have a notebook and pencil with him so he sat down in a booth and did some figuring. Ricky once again impressed Abdou by coming up with the correct answer to both of his questions.

   Recreate Ricky's calculations and find the correct answers to each of Abdou's stumpers.

5. The hypotenuse of a certain right triangle is 3 inches longer than twice the length of one of the legs. The other leg of the triangle is 11 inches long. Find, to the nearest 10^{th} of an inch, the length of the hypotenuse of the triangle.