Quadratic Functions (Section 3-2)

* Graphing quadratics in the form: $y = ax^2 + bx + c$

STEPS: ① Find the axis of symmetry using: $x = \frac{-b}{2a}$

② Find the y-value that goes w/ the x-coordinate in step #1.

③ Find two other points on the graph. Use symmetry! Try to use $x = 0$ (it usually the easiest)

④ Graph the vertex (found in step #1 & #2). Graph the two other pts. Connect w/ a parabola.

ex: $y = -x^2 + 4x - 2$ (opens downward)

$a = -1$, $b = 4$, $c = -2$

$x = \frac{-4}{2(-1)} = \frac{-4}{-2} = 2$

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

$= -4 + 8 - 2$

$y = 2$

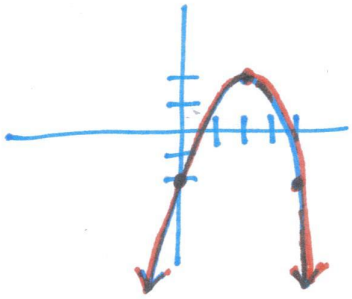
vertex: $(2, 2)$

if $x = 0$

$y = -(0)^2 + 4(0) - 2$

$y = -2$

$(0, -2)$ so... $(4, -2)$



ex: $y = -2x^2 + 8x + 9$ (opens downward)

$a = -2$, $b = 8$, $c = 9$

$x = \frac{-8}{2(-2)} = \frac{-8}{-4} = 2$

$y = -2(2)^2 + 8(2) + 9$

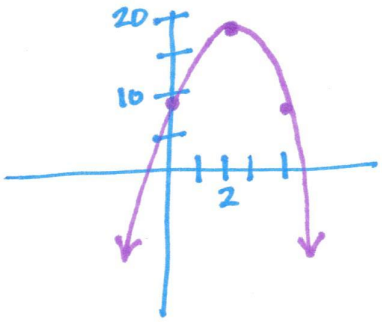
$= -8 + 16 + 9$

$y = 17 \rightarrow$ vertex $(2, 17)$

if $x = 0$

$y = 9$ $(0, 9)$

so... $(4, 9)$



ex: $y = 2x^2 - 6x + 1$ (opens upward)

$a = 2$, $b = -$, $c = 1$

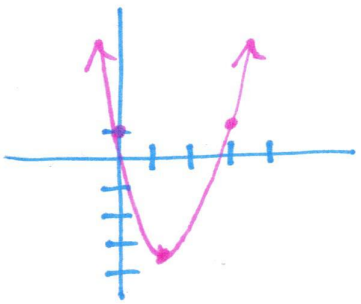
$x = \frac{-(-6)}{2(2)} = \frac{6}{4} = 1.5$

$y = 2(1.5)^2 - 6(1.5) + 1$

$y = -3.5 \rightarrow$ vertex $(1.5, -3.5)$

if $x = 0$, $y = 1$ $(0, 1)$

so... $(3, 1)$



* Using the Vertical Motion Model: $h = -16t^2 + c$ (falling object)

height, time, initial height

If the initial velocity is not zero, then we must change the equation to:

$$h = -16t^2 + vt + c$$

height, time, initial velocity, initial height

#3

ex: baseball → $v = 30$ ft/sec

$h = -16t^2 + 30t + 6$

max height?

time to reach max?

range?

* Much easier to do in the calc!

$y_1 = -16x^2 + 30x + 6$

graph: z-standard

Change window to: $x: [0,5]$, $y: [-1,50]$

2nd, Trace, #4 (calculate max) scroll L, scroll R, enter → $x = 0.9375$, $y = 20.0625$

max height → @ vertex!

$t = \frac{-b}{2a} = \frac{-30}{2(-16)} = \frac{-30}{-32} = \frac{15}{16}$ sec ≈ 0.9375

$h = -16(15/16)^2 + 30(15/16) + 6$

$h = 20.0625$ ft

max height: 20.0625 ft
time to reach max: 0.9375 sec
range: $[0, 20.0625]$

#4

ex: 100 ft of rope

$A = -x^2 + 50x$ (width)

$y_1 = -x^2 + 50x$

window: $x: [0,60]$, $y: [0,800]$

* calculate a max, or find x algebraically & calculate a value.

$x = \frac{-50}{2(-1)} = 25$

$A = -(25)^2 + 50(25) = 625$

Max width: $x = 25$
max area: 625 ft^2
range: $[0, 625]$