# -- Quadratic Functions and Complex Numbers --

## Equation → Graph

### Standard Form

1. use the formula $\frac{-b}{2a}$ to find the x-value of the vertex
2. plug the x-value into the equation to find the y-value of the vertex
4. let y = 0 and solve for x-intercepts (see next table for review on this)
5. let x = 0 and solve for y-intercept
6. plot your points and sketch. remember that
   a > 0 = ∪ = smiley face
   and
   a < 0 = ∩ = frowny face

$y = -4x^2+8x+5$

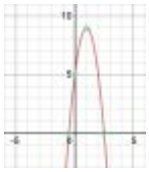
$x_{vertex} = \frac{-8}{2(-4)} = 1$

$y_{vertex} = -4(1)^2+8(1)+5 = 9$

vertex = ( 1 , 9 )

x-int: (-.5 , 0) (2.5, 0)

if x=0, y=5: y-int=(0,5)



### Vertex Form

(see next table to review converting)

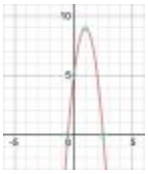
1. find the vertex by multiplying the numbers right next to the two variables by -1
2. let y = 0 and solve for x-intercepts. (remember to use both the positive and negative solution when you take the $\sqrt{}$ of something)
3. let x = 0 and solve for y-intercept
4. plot your points and sketch. remember that
   a > 0 = ∪ = smiley face
   and
   a < 0 = ∩ = frowny face

$y - 9 = -4(x-1)^2$

vertex = ( 1 , 9 )

x-int: (-.5 , 0) (2.5, 0)

y-int : ( 0 , 5 )



## Manipulating Equations

### Factoring

1. multiply the first and last numbers together. then find two numbers that you can multiply to get that number and that you can add to get the middle number. split the middle term into those two numbers
2. factor out the gcf from the first and last two terms
3. make sure the stuff in the parentheses is the same. if not, redo the problem. if yes, rewrite the equation by factoring out the stuff in the ( )

$y = -4x^2+8x+5$

$y = -4x^2 - 2x + 10x + 5$

$y = -2x(2x+1) + 5(2x+1)$

$y = (2x+1)(-2x+5)$

### Quadratic Formula

$y = -4x^2+8x+5$

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

$x = \frac{-8 \pm \sqrt{8^2-4(-4)(5)}}{2(-4)}$

$x = \frac{-8 \pm 12}{-8}$

$x = \frac{-8+12}{-8}$ $x = \frac{-8-12}{-8}$

$x = -.5$ $x = 2.5$

### Completing the Square

1. Isolate the x-terms on one side of the equation, then factor so that the $x^2$ term has no coefficient
2. divide the second term in the parenthesis by 2, then square it. add this number to the stuff in the parenthesis. then multiply that number by the red number in step two, and add that answer to the other side of the equation
3. factor the stuff in the parenthesis and simplify the terms on the other side

$y = -4x^2+8x+5$

$y - 5 = -4(x^2 - 2x)$

$y - 5 + (-4) = -4(x^2-2x+1)$

$y - 9 = -4(x-1)^2$

*if you are solving for zeros, set each set of parentheses equal to 0 and solve for x. the zeroes here are x = -.5 and x = 2.5

* the discriminant is all the stuff inside the $\sqrt{}$. if it is +, there are 2 solutions. if it is -, there are 0 solutions. if it is 0, there is one solution

*if you wanna find the vertex, multiply the numbers right next to the two variables by -1. The vertex here is: vertex: ( 1 , 9 )

## Complex Numbers

### Explanation

* a complex number is any number that has the variable i in it
* $i = \sqrt{-1}$
* this means that $i^2 = -1$, $i^3 = -i$, $i^4 = 1$, and then the cycle repeats

### Adding/Subtracting

$(3i^2 + 5i + 6) - (4i - 2)$

$-3 + 5i + 6 - 4i + 2$

$i + 5$

### Multiplying

$i(5i+6)(4i-2)$

$i(20i^2 - 10i + 24i - 12)$

$20i^3 - 10i^2 + 24i^2 - 12i$

$-20i + 10 - 24 - 12i$

$-32i - 14$

## Division

* remember that you are not allowed to have an i in the denominator
* if there is only one term in the denominator, you can multiply by i/i to get rid of the i in the denominator (situation 1 → )
* if there are two terms in the denominator, you have to multiply the fraction by $\frac{conjugate\ of\ denominator}{conjugate\ of\ denominator}$ (situation 2 → )
* The conjugate basically means to switch the sign in between the two terms (+ ↔ -)

1: $\frac{5i^2+6}{2i} \cdot \frac{i}{i} = \frac{5i^3+6i}{2i^2} = \frac{-5i+6i}{-2} = \frac{i}{-2}$

2: $\frac{6i+2}{2i+3} \cdot \frac{2i-3}{2i-3} = \frac{12i^2-18i+4i-6}{4i^2-6i+6i-9} = \frac{-12-14i-6}{-4-9} = \frac{-18-14i}{-13}$