Follow these steps to solve polynomial equations:

1) Get everything on one side of the equal sign and 0 on the other side
2) Completely factor the side with all the stuff
3) Set each factor equal to 0 and solve
4) Make sure your answers are real numbers
5) Remember to list all your solutions

Keep these tips in mind as well…

OK to factor out a variable (you will set it equal to 0 later)

OK to divide both sides of the equation by a **number**
(0 divided by your number $= 0$)

DO NOT divide both sides of the equation by a **variable** (you will lose solutions!!!)

Let's look at some examples…

<u>Example 1</u>

$$x^4 + 7x^3 - 8x - 56 = 0$$

1) Get everything on one side of the equal sign and 0 on the other side
   This is already done.

2) Completely factor the side with all the stuff
   Since there are four terms, we will use factoring by grouping.

$$x^4 + 7x^3 - 8x - 56 = 0$$
$$(x^4 + 7x^3) + (-8x - 56) = 0$$
$$x^3(x + 7) - 8(x + 7) = 0$$
$$(x^3 - 8)(x + 7) = 0$$

$$(x - 2)(x^2 + 2x + 4)(x + 7) = 0$$

3) Set each factor equal to 0 and solve

$x - 2 = 0$ $x^2 + 2x + 4 = 0$ $x + 7 = 0$
$x = 2$ This will produce imaginary $x = -7$

solutions. If you look at
$b^2 - 4ac$, you'll get
$$2^2 - 4(1)(4) = 4 - 16 = -12$$

4) Make sure your answers are real numbers
   This was covered in the blue text of Step 3.

5) Remember to list all your solutions

$$x = -7, 2$$

Example 2

$$4x^4 + 20x^2 = -25$$

1) Get everything on one side of the equal sign and 0 on the other side

$$4x^4 + 20x^2 = -25$$
$$4x^4 + 20x^2 + 25 = 0$$

2) Completely factor the side with all the stuff
   This looks like a binomial square

$$4x^4 + 20x^2 + 25 = 0$$
$$(2x^2 + 5)^2 = 0$$

3) Set each factor equal to 0 and solve
   There's only one factor to consider

$$2x^2 + 5 = 0$$
$$2x^2 = -5$$
$$x^2 = -\frac{5}{2}$$
$$x = \pm\sqrt{-\frac{5}{2}}$$

4) Make sure your answers are real numbers
   There is no need to continue. We can see that the only solution we are getting will involve the imaginary number i.

5) Remember to list all your solutions
   The only solution we have isn't real!

No solution

Example 3

$$2x^5 - 12x^3 = -16x$$

1) Get everything on one side of the equal sign and 0 on the other side

$$2x^5 - 12x^3 = -16x$$
$$2x^5 - 12x^3 + 16x = 0$$

2) Completely factor the side with all the stuff
   Look for the GCF (greatest common factor first)

OK to divide by 2; not OK to divide by x

$$2x^5 - 12x^3 + 16x = 0$$
$$2x(x^4 - 6x^2 + 8) = 0$$
$$x(x^4 - 6x^2 + 8) = 0$$
$$x(x^2 - 4)(x^2 - 2) = 0$$

$$x(x + 2)(x - 2)(x^2 - 2) = 0$$

3) Set each factor equal to 0 and solve

$x = 0$	$x + 2 = 0$	$x - 2 = 0$	$x^2 - 2 = 0$
$x = 0$	$x = -2$	$x = 2$	$x^2 = 2$
$x = 0$	$x = -2$	$x = 2$	$x = \pm\sqrt{2}$

4) Make sure your answers are real numbers
   Looks good!

5) Remember to list all your solutions

$$x = 0, \pm\sqrt{2}, \pm 2$$