A cubic equation has the form

$ax^3 + bx^2 + cx + d$ It must have the term in x^3 or it would not be cubic (and so a cannot be equal to 0), but any or all of b, c and d can be zero.

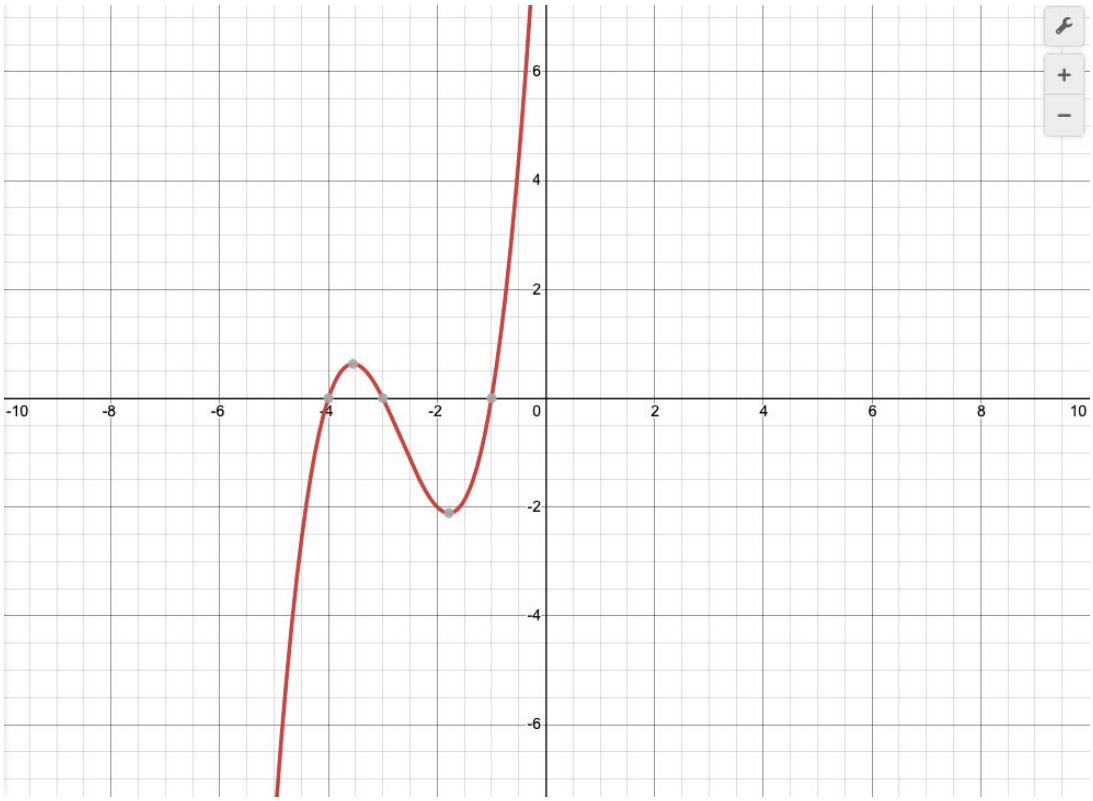
For instance, $8x^3 + 2x^2 + 3x + 5$, $5x^3 + 2x + 6$, and $9x^3 + 7$ are all cubic equations. Just as a quadratic equation may have two real roots, so a cubic equation has possibly three. But unlike a quadratic equation which may have no real solution, a cubic equation always has at least one real root.

If a cubic does have three roots, two or even all three of them may be repeated.

Suppose we wish to solve the equation $x^3 + 8x^2 + 19x + 12$ This equation can be factorized to give (x +1)(x +3)(x +4) = 0

This equation has three real roots, all different - the solutions are x = -1, x = -3 and x = -4.

Here is the graph of our equation



Notice how the graph is touching the x-axis when x = -4, -3, and -1.
Which explains the roots.

HOW TO SOLVE CUBIC EQUATIONS!!

There are many ways to solve a cubic equation

1) Factor out an x
2) Long division

INTRODUCE Quartic equations

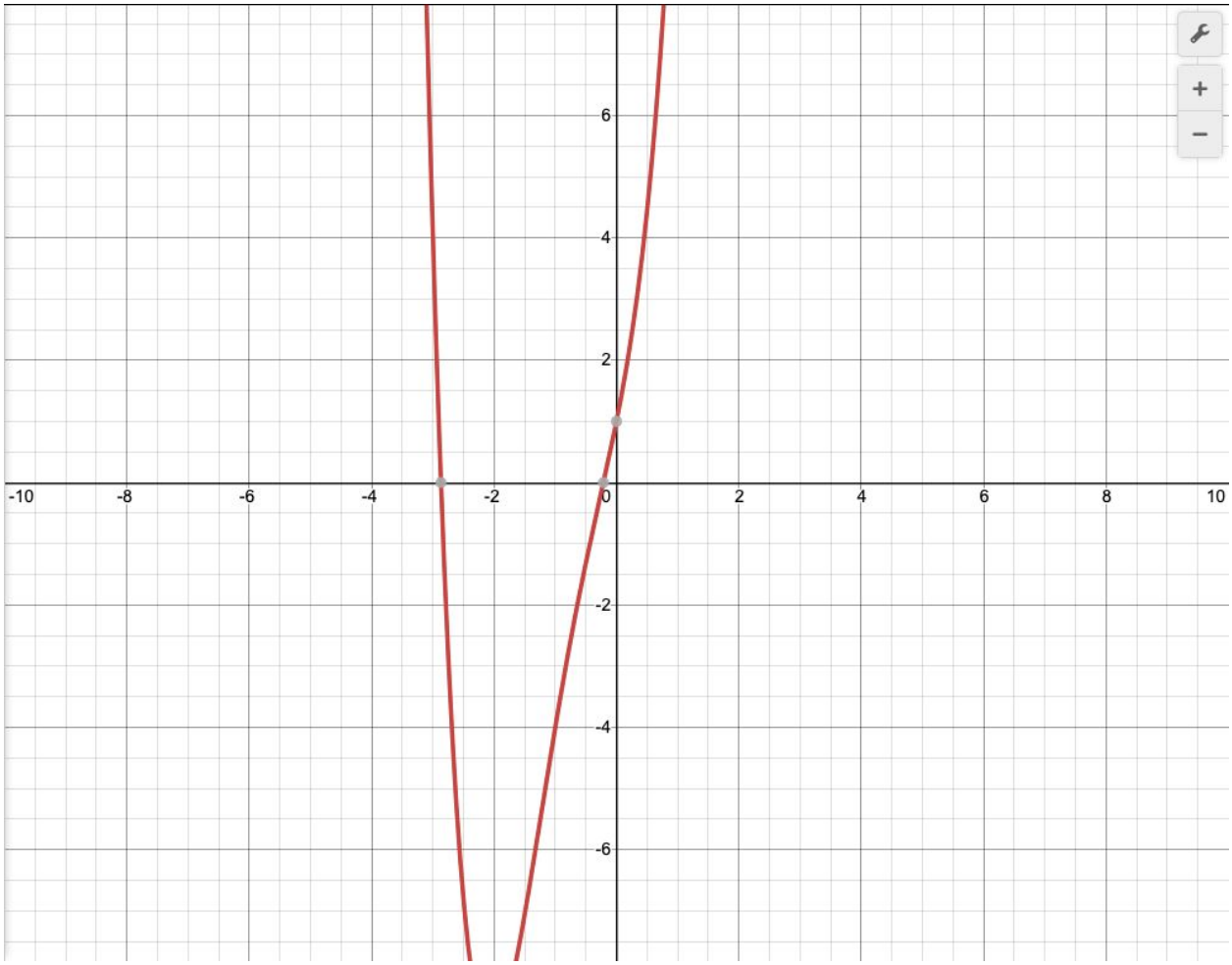
A **quartic equation**, or equation of the fourth degree, is an equation that equates a quartic polynomial to zero, of the form

$$ax^4 + bx^3 + cx^2 + dx + e$$

where $a \neq 0$.

Here is a graph that illustrates a quartic equation

$$x^4 + 3x^3 + 2x^2 + 5x + 1$$



In the powerpoint, we have created, we will go into details on how to graph and solve cubic and quartic equations.