



Introducing Polynomials

Year 10 Mathematics

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Learning Objectives

By the end of the lesson, I would hope that you have an understanding and be able to apply to questions the following concepts:

- To know the general form of a polynomial
- To know the meaning of the degree of a polynomial and the names of common polynomials
- To be able to use function notation for a polynomial



Recap of past learning

Let's take a break, for a short while, from logarithms and look at what Polynomials are. This is another very important section of the Mathematical methods course in Years 11 and 12.

Believe it or not, you've already been looking at polynomials when you looked at Parabolas and Quadratics. A quadratic is one example of a polynomial.

There are lots of them ... and it's really important to now start asking the following:

“When given an equation or expression what does it **look like**”.

When you start to think like this (and use the CAS to start graphing them) you will make massive leaps in understanding.



What is a polynomial

It's really important to understand what is and what is NOT a polynomial.

I have seen questions try and trick students with this exact concept.

A polynomial is an expression which has a number of the same pronumeral raised to **positive integer powers** (or zero).

Examples of polynomials include:

$$x^3 + 2x^2 - 3x + 4 \quad \checkmark$$

$$2x^5 + x^3 - 3 \quad \checkmark$$

$$x^2 - 7 \quad \checkmark$$

The following are NOT polynomials

$$\sqrt{x} + x^2 \quad \times$$

$$\frac{2}{x} + 3 = 2x^{-1} + 3 \quad \times$$

$$4x^{\frac{1}{3}} + 2x^2 + 1 \quad \times$$



Naming the parts of a polynomial

As we get more and more into the work we are going to be looking at, we find that the easiest way to trick you will be to use the “official names” of things. So, understand the **language of mathematics** is going to see you smash many more questions and get less confused.

This polynomial has degree 8

Leading term

Coefficient

Pronumeral

Constant

$$3x^8 - 4x^5 + x - 3$$



Names of polynomials

Let's make sure we use the correct names for the correct polynomials:

Linear	$x + 9$
Quadratic	$x^2 + x - 4$
Cubic	$x^3 \dots$
Quartic	x^4
Quintic	x^5
Degree 9 ..	x^9



Function notation: Really important!

Have you noticed that we tend to write a lot of graphs in the same way? They all seem to begin with $y =$. This is all well and good, but there is another way we can write these equations of graphs.

Using function notation. We say that the expression is a function of the pronumeral.

An example of using function notation is shown below:

$$P(x) = x^3 - 3x^2 - x + 2$$

$$y = x^3 - 3x^2 - x + 2$$



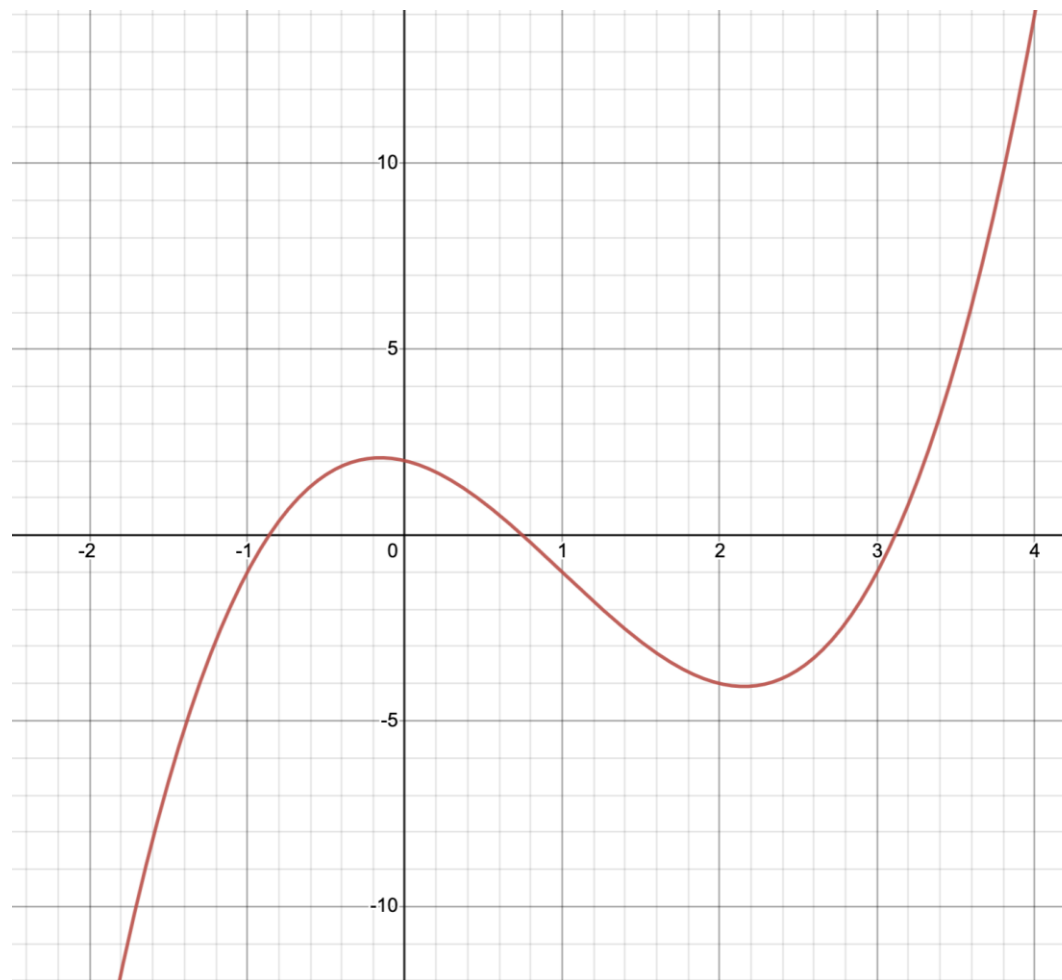
Graphing functions

What does the following look like on a graph?

We can think of $P(x)$ being interchangeable with y

$$P(x) = x^3 - 3x^2 - x + 2$$

$$y = x^3 - 3x^2 - x + 2$$



What does $P(3)$ mean then?

If we look at the function again and compare:

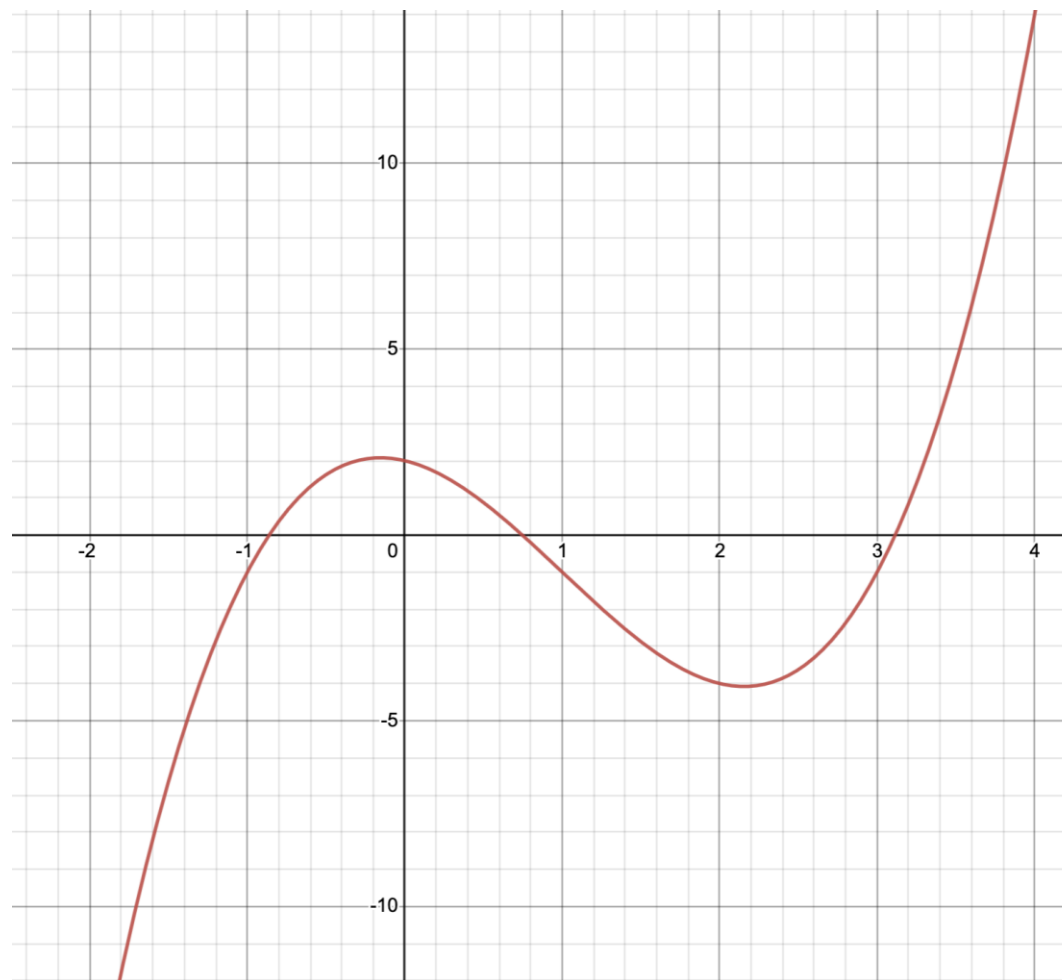
$$P(x) = x^3 - 3x^2 - x + 2$$

We can see that we seem to have replaced the x in the $P(x)$ with the number 3.

What we do on the left, we must do on the right.

$$P(3) = 3^3 - 3 \times 3^2 - 3 + 2$$

We would then work out the answer. But what does $P(3)$ mean?



Example: Deciding if an expression is a polynomial

Decide if the following expressions are polynomials.

a $4x^2 - 1 + 7x^4$



$$7x^4 + 4x^2 - 1$$

b $2x^2 - \sqrt{x} + \frac{2}{x}$



Example: Thinking

There is a difference between regurgitating content and thinking about it.

What would be the maximum number of terms in a polynomial of degree 7?

$$\begin{array}{lll} \textcircled{1} & x^1 + 1 & \Rightarrow 2 \\ \textcircled{2} & x^2 + x + 4 & \Rightarrow 3 \\ \textcircled{3} & x^3 - 2x^2 + 4x - 6 & \Rightarrow 4 \end{array}$$



Example: Doing things backwards

Maths teachers can be bad at showing you how things work in both directions.

Remember, what we can do forwards, we can do backwards too. So, how would you solve the following:

If $p(x) = x^3 - 2x^2 + bx + 3$ and $P(1) = 4$ find the value of b .

$$\begin{aligned} p(x) &= x^3 - 2x^2 + bx + 3 \\ x = 1 \quad P(1) &= 1^3 - 2 \times 1^2 + b \times 1 + 3 \\ 4 &= 1 - 2 + b + 3 \\ 4 &= 2 + b \\ b &= \underline{\underline{2}} \end{aligned}$$

$$P(1) = 4$$



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