



Division of 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 long division algorithm
- To be able to carry out the long division algorithm to divide polynomials
- To know how to express a polynomial using the quotient, divisor and remainder

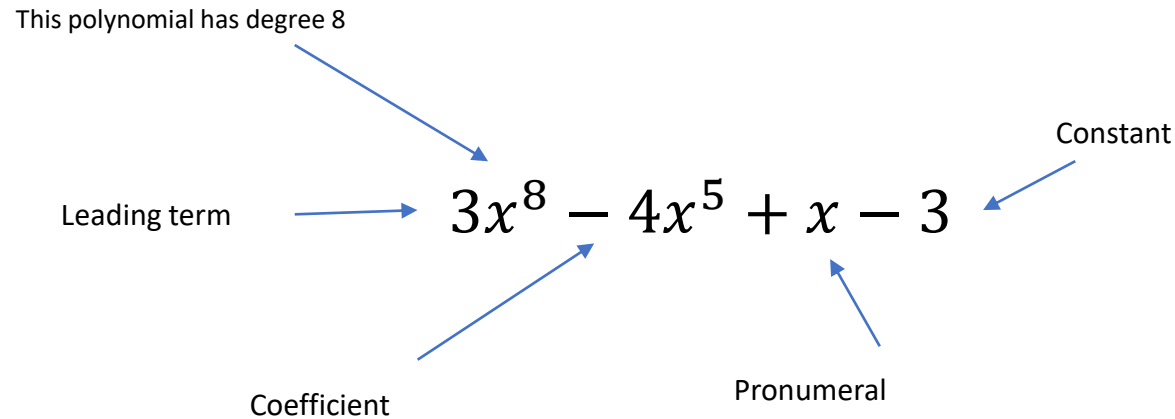


Recap of past learning

In the past lessons we have been looking at what polynomials are and how to expand (and simplify them) when they are in different forms.

Being able to divide polynomials is a really important skill for Mathematical Methods. Thankfully there is an algorithm which can be used (in fact there are a number of ways of doing it) but we are only going to look at one here.

Remember: The following is an example of a polynomial. We can write it in Factor Form if we need to.



Long division: A recap

I'm not really sure if you were ever shown how to do long division ... but the process is actually quite helpful in doing Polynomial Division.

Let's practice with the following question:

$$832 \div 3$$

$$\begin{array}{r} 277 \\ 3 \overline{) 832} \\ \underline{-6} \downarrow \\ 23 \\ \underline{-21} \downarrow \\ 22 \\ \underline{-21} \\ 1 \end{array} = 277 \text{ r } 1$$

Remember when in primary school you wrote r2?
What did this really mean?



The language of polynomial division

The following is really good for your summary books (or notes).

Once again, as we head deeper into the course (and the questions) the following language will be used over and over again. The more familiar you are with the language, the better!

The reason this format is nicer is clearer in Specialist Mathematics and Mathematical Methods

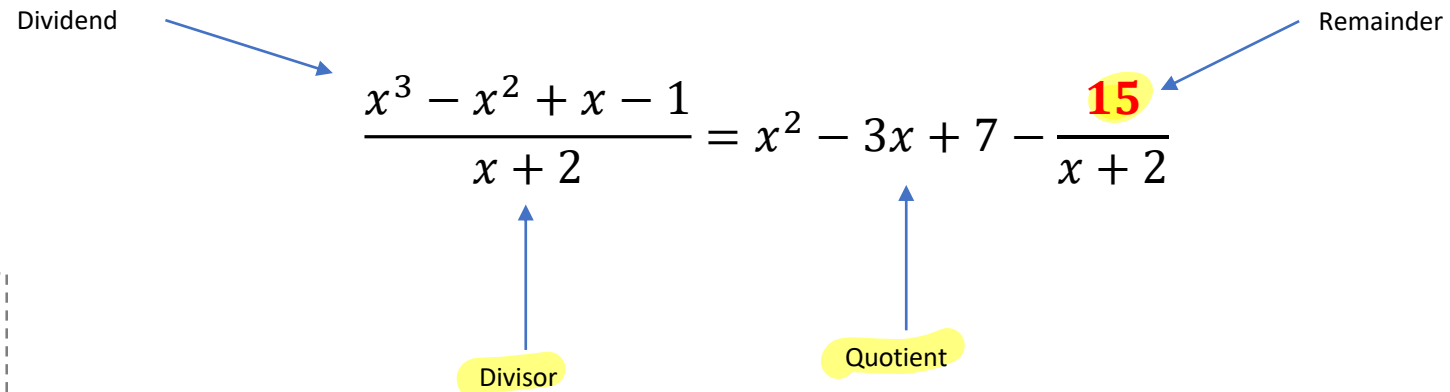
Dividend

Remainder

$$\frac{x^3 - x^2 + x - 1}{x + 2} = x^2 - 3x + 7 - \frac{15}{x + 2}$$

Divisor

Quotient





Example: Dividing polynomials

The best way to get proficient with these is to practice. Over and over again! So, let's look at some questions.

a Divide $P(x) = x^3 + 2x^2 - x + 3$ by $(x - 2)$ and write in the form $P(x) = (x - 2)Q(x) + R$, where R is the remainder.

b Divide $P(x) = 2x^3 - x^2 + 3x - 1$ by $(x + 3)$ and write in the form $P(x) = (x + 3)Q(x) + R$.

$$\begin{array}{r} x^2 + 4x + 7 \\ x-2 \overline{) x^3 + 2x^2 - x + 3} \\ \underline{-x^3 - 2x^2} \\ 4x^2 - x \\ \underline{-4x^2 - 8x} \\ 7x + 3 \\ \underline{-7x - 14} \\ 17 \end{array}$$

$$\begin{array}{r} x^3 + 2x^2 - x + 3 \\ \underline{x-2} \end{array} = x^2 + 4x + 7 + \frac{17}{x-2}$$

$$x^3 + 2x^2 - x + 3 = (x - 2)(x^2 + 4x + 7) + 17$$

$$P(x) = (x - 2)(x^2 + 4x + 7) + 17$$



Example: Dividing polynomials

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- b** Divide $P(x) = 2x^3 - x^2 + 3x - 1$ by $(x + 3)$ and write in the form $P(x) = (x + 3)Q(x) + R$.

$$\begin{array}{r} 24 \\ 3 \\ \hline 72 \\ 1 \end{array}$$

$$\begin{array}{r} \overline{2x^2 - 7x + 24} \\ x+3 \overline{) 2x^3 - x^2 + 3x - 1} \\ \underline{-(2x^3 + 6x^2)} \\ -7x^2 + 3x \\ \underline{-(7x^2 - 21x)} \\ 24x - 1 \\ \underline{-(24x + 72)} \\ -73 \end{array}$$

$$P(x) = (x + 3)(2x^2 - 7x + 24) - 73$$



Example: Dividing polynomials

Two more questions ... for me to show you how to do it. It's a process and needs to be practiced. The time you put into this now will be rewarded later!

- a** Divide $P(x) = x^3 + x^2 - 4x + 3$ by $(x - 1)$ and write in the form $P(x) = (x - 1)Q(x) + R$, where R is the remainder.
- b** Divide $P(x) = 3x^3 - 2x^2 + 5x - 2$ by $(x + 2)$ and write in the form $P(x) = (x + 2)Q(x) + R$.

$$\begin{array}{r} x^2 + 2x - 2 \\ x-1 \overline{) x^3 + x^2 - 4x + 3} \\ \underline{-(x^3 - x^2)} \\ 2x^2 - 4x \\ \underline{-(2x^2 - 2x)} \\ -2x + 3 \\ \underline{-(-2x + 2)} \\ 1 \end{array}$$

$$P(x) = (x - 1)(x^2 + 2x - 2) + 1$$



Example: Dividing polynomials

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- b** Divide $P(x) = 3x^3 - 2x^2 + 5x - 2$ by $(x + 2)$ and write in the form $P(x) = (x + 2)Q(x) + R$.

$$\begin{array}{r} \overline{) 3x^3 - 2x^2 + 5x - 2} \\ \underline{3x^3 + 6x^2} \\ -8x^2 + 5x \\ \underline{-8x^2 - 16x} \\ 21x - 2 \\ \underline{21x + 42} \\ -44 \end{array}$$

$$P(x) = (x+2)(3x^2 - 8x + 21) - 44$$



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