Finding zero's is an important part of sketching graphs.

Before we attack this question, we need one more tool:

Long Division:

how many times does $\boxed{12}$ go into 12?

how many times does $\boxed{12}$ go into 9?

$$
\begin{array}{r|l}
 & \underline{\;\;1\;\;0\;\;7} \\
\boxed{12} & 1\;\;2\;\;9\;\;3 \\
\boxed{12}\cdot 1 & \underline{-1\;\;2}\;\;\;\;\;\; \\
 & 0\;\;9\;\;\;\; \\
\boxed{12}\cdot 0 & \underline{-\;\;0}\;\;\;\; \\
 & 9\;\;3 \\
 & \underline{-8\;\;4} \\
 & \boxed{9}
\end{array}
$$

Remainder

$$
\begin{array}{r}
12 \\
\underline{\times\;8} \\
96
\end{array}
\leftarrow \text{too big.}
\qquad
\begin{array}{r}
12 \\
\underline{\times\;7} \\
84
\end{array}
\leftarrow \text{this works}
$$

$$
\begin{array}{r}
{}^{8}\cancel{9}3 \\
\underline{-84} \\
9
\end{array}
$$

5

<u>So:</u> $\dfrac{107}{12} = 107 + \dfrac{9}{12}$

Polynomial Long Division

multiply $(x+2)$ by x^2 to match the leading term x^3

Don't need to do anything to match leading term of 0 new

multiply by 9 to match current leading term of $9x$

$$
\begin{array}{r}
x^2 \qquad\qquad\quad \\
+\ 0x + 9 \\
x+2 \overline{)\, x^3 + 2x^2 + 9x + 3} \\
-(x^2 + 2x^2) \qquad\quad \\
\hline
0 + 9x \qquad \\
-\quad 0 \qquad \\
\hline
9x + 3 \\
-(9x + 18) \\
\hline
\boxed{-15}
\end{array}
$$

Remainder

10

$3 - 18 = -18 + 3$

$= -15$

So: $\dfrac{x^3 + 2x^2 + 9x + 3}{x+2} = x^2 + 9 - \dfrac{15}{x+2}$

to keep things straight...

Add in spaces for missing terms

Eg: Divide $6x^3 - 1$ by $x^2 + x + 1$

think $\frac{6x^3}{x^2} = 6x$

think $(x^2)(-6) = -6x^2$

$$
\begin{array}{r}
6x + (-6) \\
x^2+x+1 \overline{\big)\, 6x^3 + 0x^2 + 0x - 1} \\
-(6x^3 + 6x^2 + 6x) \\
\hline
-6x^2 - 6x - 1 \\
-(-6x^2 - 6x - 6) \\
\hline
5
\end{array}
$$

$-1-(-6) = -1+6 = 5$

remainder

10

So: $$\frac{6x^3 - 1}{x^2 + x + 1} = 6x - 6 + \frac{5}{x^2 + x + 1}$$