$f(x) = x^4 - 10x^2 - 2x - 14$ divided by $(x-3)$

LONG DIVISION

solution: $x^3 + 3x^2 - x - 5$ R -29

$$
\begin{array}{r|l}
 & x^3 + 3x^2 - x - 5 \quad R\ -29 \\
x-3 & \cancel{x^4} + 0x^3 - 10x^2 - 2x - 14 \\
 & -(\cancel{x^4} + 3x^3) \\
 & \quad \cancel{3x^3} - 10x^2 \\
 & \quad -(\cancel{3x^3} + 9x^2) \\
 & \qquad -\cancel{x^2} - 2x \\
 & \qquad +\cancel{x^2} \mp 3x \\
 & \qquad\quad -\cancel{5x} - 14 \\
 & \qquad\quad +\cancel{5x} \mp 15 \\
 & \qquad\qquad -29 \text{ Remainder}
\end{array}
$$

$x-3$ ← divisor

SYNTHETIC DIVISION

3 ← opposite of # in divisor

	x^4	x^3	x^2	x	c
3	1	0	-10	-2	-14
	↓	3	9	-3	-15
	1	3	-1	-5	-29
	x^3	x^2	x	Constant	Remainder

← coefficients of $f(x)$

$x^3 + 3x^2 - x - 5$ R -29

1. $f(x)$ must be in exponent order
2. Must insert zero placeholders for any missing powers of x

Long vs. Synthetic Division

Synthetic Division may only be applied when your divisor is of the form $(x + \#)$ OR $(x - \#)$

Long Division must be applied for all other divisor forms

$x^2 - 4x + 1$	$x^2 - 8$	$x - 10$	$4x - 1$
LONG	LONG	SYNTHETIC	LONG

The Remainder Theorem:

When $f(x)$ is divided by $(x - \#)$, then the remainder is equal to $f(\#)$.

$f(x) = x^4 - 10x^2 - 2x - 14$ divide $(x-3)$ $\quad (x+2)$

$f(3) = (3)^4 - 10(3)^2 - 2(3) - 14 \qquad f(-2)$

$81 - 90 - 6 - 14$

$\boxed{-29}$