Long Division of Polynomials

For long division of polynomials, I'll work through an example and explain it as I go:

Suppose we were dividing $x^3 + x^2 - 5x - 2$ by $x - 2$. We would set it up just as with regular long division:

$$x - 2 \overline{\smash{)}\, x^3 + x^2 - 5x - 2}$$

Ignoring the rest of the equation for now, we look for at the *highest degree terms* in both the divisor ($x - 2$) and the dividend ($x^3 + x^2 - 5x - 2$). In this case, that would be the x^3 and x. We find that x^3 divided by x is x^2, and write this value on top, directly above the x^2 column.

$$\begin{array}{r} x^2 \phantom{{}- 5x - 2} \\ x - 2 \overline{\smash{)}\, x^3 + x^2 - 5x - 2} \end{array}$$

Now, we multiply x^2 by the divisor ($x - 2$) and write this result **under** $x^3 + x^2 - 5x - 2$ and subtract as follows:

$$\begin{array}{r} x^2 \phantom{{}- 5x - 2} \\ x - 2 \overline{\smash{)}\, x^3 + x^2 - 5x - 2} \\ \underline{x^3 - 2x^2} \phantom{{}- 5x - 2} \\ 3x^2 - 5x \phantom{{}- 2} \end{array}$$

Now, we repeat the process with $x-2$ and $3x^2-5x$. How many times does x go into $3x^2$? $3x$. So, we write this value next to the x^2 on top and continue the long division process as before.

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

Now, try these questions on your own:

1. $x-3\overline{\smash{\big)}\,x^2-x+6}$

2. $x-2\overline{\smash{\big)}\,x^2-4}$

3. $x+1\overline{)x^2+2x+1}$

4. $3x^3+x-9\overline{)3x^5-12x^4+0x^3-13x^2+36x}$

5. $x-2\overline{)x^3-4x^2+x+6}$

6. $x^2+2x-1\overline{)x^3-3x^2-11x+5}$

7. $2x^2-2x+3\overline{)2x^3-6x^2+7x-6}$

8. $x^2+2x+1\overline{)x^4+0x^3+2x^2+8x+5}$

9. $x+1\overline{)x^5+0x^4+0x^3+0x^2+0x+1}$

10. $x+1\overline{)x^4+4x^3+6x^2+4x+1}$