Synthetic Division of Polynomials

Recall the division algorithm: $\dfrac{P(x)}{d(x)} = q(x) + \dfrac{r(x)}{d(x)}$

There is a short cut for division, called Synthetic Division. However, it only works when your divisor is a linear factor in the form $x - k$.

Determine $\dfrac{P(x)}{d(x)}$. If $d(x)$ is not a factor express your answer using the division algorithm. If $d(x)$ is a factor, then rewrite $P(x)$ in completely factored form.

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1. $P(x) = 2x^3 + 5x^2 - 7x - 12$
   & $d(x) = x + 3$

ADD

coefficients of $p(x)$

root/zero of $d(x)$

$$\begin{array}{r|rrrr}
 & 2 & 5 & -7 & -12 \\
 & & -6 & 3 & 12 \\
\hline
-3 & 2 & -1 & -4 & \boxed{0}
\end{array}$$

MULTIPLY

← Remainder

Since the remainder is <u>0</u>, $x + 3$ <u>IS</u> a factor.

$p(x) = (x+3)(2x^2 - x - 4)$

$\cancel{\begin{array}{c}-8 \\ -4\end{array}}$ *cannot be factored further

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2. $P(x) = x^3 + 4x^2 - 9x - 36$
   & $d(x) = x - 3$

$$\begin{array}{r|rrrr}
 & 1 & 4 & -9 & -36 \\
 & & 3 & 21 & 36 \\
\hline
3 & 1 & 7 & 12 & \boxed{0}
\end{array}$$

$p(x) = (x-3)(x^2 + 7x + 12)$

$p(x) = (x-3)(x+3)(x+4)$

3. $P(x) = x^4 - 5x^2 - 10x - 12$
   & $d(x) = x + 2$

*If a term is MISSING, use a placeholder!

Remember to put in <u>0</u> for missing terms.

$$\begin{array}{r|rrrrr}
 & 1 & 0 & -5 & -10 & -12 \\
 & & -2 & 4 & 2 & 16 \\
\hline
-2 & 1 & -2 & -1 & -8 & \boxed{4}
\end{array}$$

x+2 is NOT a factor of p(x)!

$p(x) = (x+2)(x^3 - 2x^2 - x - 8) + 4$

* If possible, FACTOR COMPLETELY!