Super advanced factoring

$$f(x) = x^3 + 3x^2 - 24x - 80$$

divide ↑ by $x-5$

$$\begin{array}{r|cccc} 5 & 1 & 3 & -24 & -80 \\ & 0 & 5 & 40 & 80 \\ \hline & 1 & 8 & 16 & 0 \end{array}$$

$$1x^2 + 8x + 16 = (x+4)^2$$

quadratic!! factor!!

$$f(x) = x^3 + 3x^2 - 24x - 80$$
$$= (x+4)^2 (x-5)$$

Question: Factor 2

$$p(x) = x^6 - 9x^5 - 15x^4 + 293x^3 - 270x^2 - 2400x + 4000$$

some tips: $p(x)$ leaves rem $= 0$ ✓

when divided by $x+4$

$x-5$ ← w/ mult 3

$$\begin{array}{r|cccccc} -4 & 1 & -9 & -15 & 293 & -270 & -2400 & 4000 \\ & 0 & -4 & 52 & -148 & -580 & +3400 & -4000 \\ \hline & 1 & -13 & 37 & 145 & -850 & 1000 & 0 \\ 5 & 0 & 5 & -40 & -15 & 650 & -1000 & \\ \hline & 1 & -8 & -3 & 130 & -200 & 0 & \\ 5 & 0 & 5 & -15 & -90 & 200 & & \\ \hline & 1 & -3 & -18 & 40 & 0 & & \\ 5 & 0 & 5 & 10 & -40 & & & \\ \hline & 1 & 2 & -8 & 0 & & & \end{array}$$

$Q = x^2 + 2x - 8 = (x+4)(x-2)$

$P(x) = x^6 - 9x^5 - 15x^4 + 293x^3 - 270x^2 - 2400x + 4000$

$= (x+4)(x-2)(x-5)^3(x+4)$

factoring synthetic div.

Factor (fully)

$$f(x) = x^7 - x^6 - 6x^5 + 6x^4 + 9x^3 - 9x^2 - 4x + 4$$

$f(x)$ when divided by

- $x-2$ · mult 1
- $x+2$ · mult 1
- $x-1$ w/ mult. 3

leaves rem = 0

$$(x+1)^2(x-2)(x+2)(x-1)^3$$

$$f(x) = 9 + 3x - 2x^2 + 4x^{2023}$$

sussy # list

factors of no x : 1, 3, 9

factors of leading coeff : 1, 2, 4

Sussy list:

$$\pm\frac{1}{1}, \pm\frac{3}{1}, \pm\frac{9}{1}, \pm\frac{1}{2}, \pm\frac{3}{2}, \pm\frac{9}{2}$$

$$\pm\frac{1}{4}, \pm\frac{3}{4}, \pm\frac{9}{4}$$