

2.1: Polynomial Long Division

Ex 1) $(m^2 - 7m - 11) \div (m - 8)$

- * polynomial must be written in standard form
- * polynomial must have every exponent down from the highest exponent

$$\begin{array}{r}
 \underline{m-8} \overline{) m^2 - 7m - 11} \\
 \underline{-m^2 + 8m} \\
 m - 11 \\
 \underline{-m + 8} \\
 -3
 \end{array}$$

$$\begin{aligned}
 \frac{m^2}{m} &= m \\
 \frac{m}{m} &= 1
 \end{aligned}$$

- Step 1) divide 1st term by 1st term
- 2) multiply
 - 3) subtract
 - 4) bring down next term
 - 5) repeat

$m + 1 - \frac{3}{m-8}$

Ex 2) $(13x^2 + 3x^3 + 2x - 8) \div (3x - 2)$
 $(3x^3 + 13x^2 + 2x - 8) \div (3x - 2)$

$$\begin{array}{r}
 \underline{3x-2} \overline{) 3x^3 + 13x^2 + 2x - 8} \\
 \underline{-3x^3 + 2x^2} \\
 15x^2 + 2x \\
 \underline{-15x^2 + 10x} \\
 12x - 8 \\
 \underline{-12x + 8} \\
 0
 \end{array}$$

$$\begin{aligned}
 \frac{3x^3}{3x} &= x^2 \\
 \frac{15x^2}{3x} &= 5x \\
 \frac{12x}{3x} &= 4
 \end{aligned}$$

$x^2 + 5x + 4$

* If remainder = 0, then divisor is a factor!

Ex 3) $(x^2 - 28) \div (x + 5)$

$(x^2 + 0x - 28) \div (x + 5)$

$$\begin{array}{r} \overline{x+5} \overline{) x^2 + 0x - 28} \\ \underline{-x^2 + 5x} \\ -5x - 28 \\ \underline{+5x + 25} \\ -3 \end{array}$$

$$\frac{x^2}{x} = x$$

$$\frac{-5x}{x} = -5$$

$$\boxed{x - 5 - \frac{3}{x+5}}$$

Ex 4) $(x^3 + 3x^2 - 4x - 12) \div (x^2 + x - 6)$

$$\begin{array}{r} \overline{x^2+x-6} \overline{) x^3 + 3x^2 - 4x - 12} \\ \underline{-x^3 + x^2 - 6x} \\ 2x^2 + 2x - 12 \\ \underline{-2x^2 + 2x + 12} \\ 0 \end{array}$$

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

$$\frac{2x^2}{x^2} = 2$$

$$\boxed{x + 2}$$

Ex 5) One factor of $2x^3 + 5x^2 - 37x - 60$ is $x+5$.
 Completely factor $2x^3 + 5x^2 - 37x - 60$.

$$\begin{array}{r}
 \overline{2x^2 - 5x - 12} \\
 x+5 \overline{) 2x^3 + 5x^2 - 37x - 60} \\
 \underline{-2x^3 + 10x^2} \\
 -5x^2 - 37x \\
 \underline{+5x^2 + 25x} \\
 -12x - 60 \\
 \underline{+12x + 60} \\
 0
 \end{array}$$

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

$$\frac{-5x^2}{x} = -5x$$

$$\frac{-12x}{x} = -12$$

$$\begin{array}{ccc}
 2x^2 & -5x & -12 \\
 \uparrow & \uparrow & \uparrow \\
 a & b & c
 \end{array}$$

Quadratic Formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(2)(-12)}}{2(2)}$$

$$x = \frac{5 \pm \sqrt{121}}{4}$$

$$x = \frac{5 \pm 11}{4}$$

$$\begin{array}{l}
 x = 4 \\
 -4 -4 \\
 (x-4) = 0
 \end{array}$$

$$\begin{array}{l}
 x = \frac{-3}{2} \\
 +\frac{3}{2} + \frac{3}{2} \\
 (x + \frac{3}{2}) = 0
 \end{array}$$

$$\boxed{(x+5)(x-4)(x + \frac{3}{2})}$$