

Synthetic Division: Just divide and list the remainder (if you have one)

1. $(3x^2 + 4x - 12) \div (x + 5)$

$3x - 11$ rem 43

2. $(x^2 - 5x - 12) \div (x - 3)$

$x - 2$ Rem 78

3. $(x^4 - 3x^2 + 12) \div (x + 1)$

$x^3 - x^2 - 2x + 2$ rem 10

4. $(2x^3 + 3x^2 - 8x + 3) \div (x + 3)$

$2x^2 - 3x + 1$

No remainder
b/c $x+3$ is
a factor

Finding Roots using Synthetic Division: You may use your calculator for ONE!

1. $x^3 - x^2 - 8x + 12 = 0$ $x = -3$

$-3 \mid 1 \quad -1 \quad -8 \quad 12$
 $\downarrow \quad -3 \quad 12 \quad -12$
 $\hline 1 \quad -4 \quad 4 \quad 0$

$(x^2 - 4x + 4) = 0$
 $(x - 2)(x - 2)(x + 3)$

$x = -3$
 $x = 2$
multiplicity 2

2. $2x^3 - 3x^2 - 2x + 3 = 0$ $x = -1$

$-1 \mid 2 \quad -3 \quad -2 \quad 3$
 $\downarrow \quad -2 \quad 5 \quad -3$
 $\hline 2 \quad -5 \quad 3 \quad 0$

$2x^2 - 5x + 3$
 $(2x - 3)(x - 1)$
 $x = \frac{3}{2}$ $x = 1$

$x = -1$
 $x = \frac{3}{2}$
 $x = 1$

3. $36x^4 - 13x^2 + 1 = 0$

$\frac{1}{2} \mid 36 \quad 0 \quad -13 \quad 0 \quad 1$
 $\downarrow \quad 18 \quad 9 \quad -2 \quad -1$
 $\hline 36 \quad 18 \quad -4 \quad -2 \quad 0$

$36x^3 + 18x^2 - 4x - 2$
 $(9x^3 - 1)(4x + 2)$
 $(3x - 1)(3x + 1)$

$x = \frac{1}{2}$
 $x = \frac{1}{3}$
 $x = -\frac{1}{3}$
 $x = -\frac{1}{2}$

3. $36x^4 - 13x^2 + 1 = 0$

(Factor this time) $(9x^2 - 1)(4x^2 - 1)$
 $(3x - 1)(3x + 1)(2x - 1)(2x + 1)$
 $x = \frac{1}{3}$ $x = -\frac{1}{3}$ $x = \frac{1}{2}$ $x = -\frac{1}{2}$

4. $x^3 + 3x^2 - 6x - 8 = 0$ $x = 2$

$2 \mid 1 \quad 3 \quad -6 \quad -8$
 $\downarrow \quad 2 \quad 10 \quad 8$
 $\hline 1 \quad 5 \quad 4 \quad 0$

$x^2 + 5x + 4 = 0$
 $(x + 4)(x + 1) = 0$
 $x = -4$ $x = -1$

$x = 2$
 $x = -1$
 $x = -4$

6. $x^4 + x^2 - 2 = 0$

$1 \mid 1 \quad 0 \quad 1 \quad 0 \quad -2$
 $\downarrow \quad 1 \quad 1 \quad 2 \quad 2$
 $\hline 1 \quad 1 \quad 2 \quad 2 \quad 0$

$x^3 + x^2 + 2x + 2$
 $(x^2 + 2)(x + 1)$
square root method

$x = 1$
 $x = -1$
 $x = \pm i\sqrt{2}$

5. $x^4 - 3x^3 - 11x^2 + 3x + 10 = 0$ $x = -1$

$-1 \mid 1 \quad -3 \quad -11 \quad 3 \quad 10$
 $\downarrow \quad -1 \quad 4 \quad 7 \quad -10$
 $\hline 1 \quad -4 \quad -7 \quad 10 \quad 0$

$x = -1$ $x = 1$
 $x = -3$
 $x = 5$

$x^3 - 4x^2 - 7x + 10$ ← doesn't factor

$5 \mid 1 \quad -4 \quad -7 \quad 10$
 $\downarrow \quad 5 \quad 5 \quad -10$
 $\hline 1 \quad 1 \quad -2 \quad 0$

$x = 5$
is factor of cubic

7. $x^3 + 4x^2 - 2x + 15 = 0$

$-5 \mid 1 \quad 4 \quad -2 \quad 15$
 $\downarrow \quad -5 \quad 5 \quad -15$
 $\hline 1 \quad -1 \quad 3 \quad 0$

$x = -5$
 $x = \frac{1 \pm i\sqrt{11}}{2}$

quadratic form $x = \frac{1 \pm i\sqrt{11}}{2}$ → 1 real 2 imaginary