

Synthetic division

Terms in descending order by degree

[EX1] divide  $3x^4 - 2x^3 + x^2 - 5x + 1$  by  $x + 2$

coefficients of terms →

$$\begin{array}{r|rrrrr} & 3 & -2 & 1 & -5 & 1 \\ \downarrow & & -6 & 16 & -34 & 79 \\ \hline & 3 & -8 & 17 & -39 & 79 \end{array}$$

$\underline{-2}$  } divide by  $x+2$ ,  
so  $-2$  here

Quotient =  $3x^3 - 8x^2 + 17x - 39$

Remainder = 79

} degree of quotient is one less than degree dividend

[EX2]

$2x^4 + x^2 + 1$  divided by  $x + 2$

$$\begin{array}{r|rrrrr} & 2 & 0 & 1 & 0 & 1 \\ \downarrow & & -4 & 8 & -18 & 36 \\ \hline & 2 & -4 & 9 & -18 & 37 \end{array}$$

$\underline{-2}$

} zeros inserted for missing terms.

Quotient =  $2x^3 - 4x^2 + 9x - 18$

Remainder = 37

[EX3]

$2x^4 + x^3 - x^2 + 3x + 1$  divide by  $x - 2$

$$\begin{array}{r|rrrrr} & 2 & 1 & -1 & 3 & 1 \\ \downarrow & & 4 & 10 & 18 & 42 \\ \hline & 2 & 5 & 9 & 21 & 43 \end{array}$$

$\underline{2}$

}  $+2$  here since divide by  $x-2$

Quotient =  $2x^3 + 5x^2 + 9x + 21$

Remainder = 43

[EX4]

$16x^4 - 12x^2 + 4x + 3$  divide by  $x - \frac{1}{2}$

$$\begin{array}{r|rrrrr} & 16 & 0 & -12 & 4 & 3 \\ \downarrow & & 8 & 4 & -4 & 0 \\ \hline & 16 & 8 & -8 & 0 & 3 \end{array}$$

$\underline{\frac{1}{2}}$



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[EX5]  $4x^3 + x - 1$  divide by  $2x - 1$

$$2x - 1 = 2(x - \frac{1}{2})$$

divisor must be of form  $x - k$ ,  
coef. of  $x$  must be 1.  
So, we divide by  $x - \frac{1}{2}$  then  
divide the quotient by 2

$$\begin{array}{r|rrrr} & 4 & 0 & 1 & -1 \\ \downarrow & 2 & 1 & 1 & \\ \hline & 4 & 2 & 2 & 0 \end{array} \quad \left[ \frac{1}{2} \right]$$

So the quotient is

$$2x^2 + x + 1$$

The remainder is zero, so both divisor and quotient are factors of dividend. I.e.

$$4x^3 + x - 1 = (2x^2 + x + 1)(2x - 1)$$

} remainder is zero,  
So know we have found factors.

[EX6]  $2x^4 + x^3 - x^2 + 3x + 1$  by  $2x - 3$

$$2x - 3 = 2(x - \frac{3}{2})$$

$$\begin{array}{r|rrrrr} & 2 & 1 & -1 & 3 & 1 \\ \downarrow & 3 & 6 & \frac{15}{2} & \frac{63}{4} & \\ \hline & 2 & 4 & 5 & \frac{21}{2} & \frac{67}{4} \end{array} \quad \left[ \frac{3}{2} \right]$$

Quotient is  $x^3 + 2x^2 + \frac{5x}{4} + \frac{21}{4}$

Remainder is  $\frac{67}{4}$

} remember to divide by 2.