February 5

Synthetic Division

Long Division:
works every time

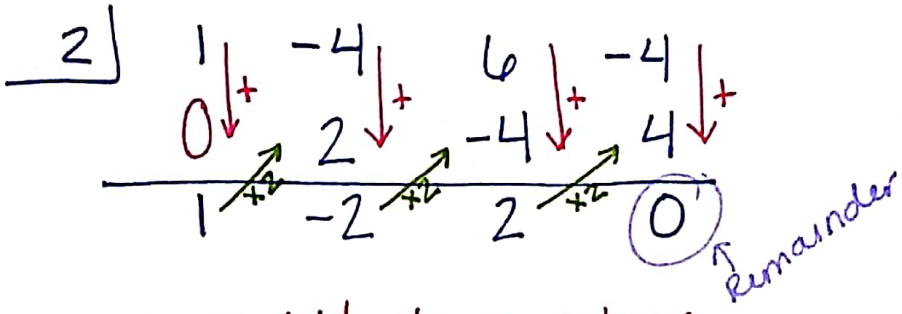
Synthetic Division:
ONLY works when what you are dividing by is $(x+\#)$ or $(x-\#)$

Ex1 $(1x^3-4x^2+6x-4)\div(x-2)$

Step 1: Set what you are dividing by equal to zero and solve. Put in box.

$x-2=0$
$+2\ \ +2$
$x=2$

Step 2: Line up coefficients of what you are dividing next to the box.



Step 3: Add down column.

Step 4: Multiply with box and put in next column.

Step 5: Repeat steps 3 and 4 until all columns are filled.

Step 6: Write answer. Numbers below line are coefficients. Variables start one exponent less than what you are dividing.

$1x^2-2x+2$

$\boxed{x^2-2x+2}$

Ex2 $(5b^4-2b^2+b^3+7)\div(b+6)$

$(5b^4+b^3-2b^2+7)\div(b+6)$

$(5b^4+b^3-2b^2+0b+7)\div(b+6)$

$b+6=0$

$-6 \quad -6$

$b=-6$

-6 | 5 | 1 | -2 | 0 | 7

0 | -30 | 174 | -1032 | 6192

5 | -29 | 172 | -1032 | 6199 ← R

$$5b^3-29b^2+172b-1032+\frac{6199}{b+6}$$

Ex3 $(m^3+4m^2-2m-9)\div(m+4)$

$m+4=0$

$-4 \quad -4$

$m=-4$

-4 | 1 | 4 | -2 | -9

0 | -4 | 0 | 8

1 | 0 | -2 | -1 ← R

$1m^2+0m-2-\frac{1}{m+4}$

$$m^2-2-\frac{1}{m+4}$$

Remainder Theorem

- When a polynomial $P(x)$ is divided by $(x-\#)$, the remainder is $P(\#)$.

Ex4 Determine the remainder when x^3+2x^2-5x-4 is divided by $x+3$.

$x+3=0$
$-3 \quad -3$
$x=-3$

$(-3)^3+2(-3)^2-5(-3)-4=\boxed{2}$

Factor Theorem

For a polynomial $P(x)$, $(x-\#)$ is a factor if the remainder is zero.

- **Ex5** Is $3x+2$ a factor of $3x^2+14x+8$?

$3x+2=0$
$-2 \quad -2$
$\frac{3x}{3}=\frac{-2}{3}$
$x=-\frac{2}{3}$

$3\left(-\frac{2}{3}\right)^2+14\left(-\frac{2}{3}\right)+8=0$ ☺ is zero

yes, $3x+2$ is a factor

Ex6 Is $x-1$ a factor of $3x^2+14x+8$?

$x-1=0$
$+1 \quad +1$
$x=1$

$3(1)^2+14(1)+8=25$ ☹ not zero

no, $x-1$ is not a factor