

$$x^3 + 27$$

$$(x \cdot x \cdot x) + (3 \cdot 3 \cdot 3)$$

$$(a+b)(a^2 - ab + b^2)$$

$a=x$ $b=3$

Same Sign
S

Opposite Sign
O

Always positive
AP

$$(x+3)(x^2 - 3x + 9)$$

$$x+5=0$$

$$\begin{matrix} -5 & -5 \\ \hline x = -5 \end{matrix}$$

$a=1$
 $b=-5$
 $c=25$

$$x^3 - 8$$

$$(x \cdot x \cdot x) - (2 \cdot 2 \cdot 2)$$

$$(a-b)(a^2 + ab + b^2)$$

$$(x-2)(x^2 + 2x + 4)$$

$$x^3 + 125$$

$$(x \cdot x \cdot x) + (5 \cdot 5 \cdot 5)$$

$$(x+5)(x^2 - 5x + 25)$$

$$1x^2 - 5x + 25 = 0$$

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

$$= \frac{-(-5) \pm \sqrt{(-5)^2 - 4(1)(25)}}{2}$$

$$= \frac{5 \pm \sqrt{-75}}{2}$$

$$= \frac{5 \pm i\sqrt{75}}{2}$$

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

$$x^3 - 64$$

$$(x-4)(x^2 + 4x + 16)$$

$$x-4=0$$

$$\begin{matrix} +4 & +4 \\ \hline x = 4 \end{matrix}$$

$$x = \frac{-4 \pm \sqrt{4^2 - 4(1)(16)}}{2}$$

$$= \frac{-4 \pm \sqrt{-48}}{2}$$

$$= \frac{-4 \pm i\sqrt{48}}{2}$$

$$x^2 + 7x + 10$$

$$(x+5)(x+2)$$

$$\begin{array}{r} 10 \\ 5 \quad 2 \\ 10 \quad 1 \end{array}$$

$$x^4 - 29x^2 + 100$$

$$x^2 - 29x + 100$$

$$(x^2 - 25)(x^2 - 4)$$

$$\begin{array}{r} 10 \quad 10 \\ -25 \quad -24 \\ 50 \quad 2 \\ 100 \quad 1 \end{array}$$

$$x^4 - 13x^2 + 36$$

$$(x^2 - 9)(x^2 - 4)$$

$$\begin{array}{r} -9 \quad -4 \\ 6 \quad 6 \\ 1 \quad 36 \\ 12 \quad 3 \end{array}$$

$$x^4 - 13x^2 - 48 = 0$$

$$-16 \cdot 3 = -48$$

$$(x^2 - 16)(x^2 + 3)$$

4 terms - Grouping

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

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

Group 2 highest
2 lowest powers of x

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

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

$$16x^3 + 32x^2 - 5x - 10 = 0$$

$$(16x^3 + 32x^2) + (-5x - 10) = 0$$

$$16x^2(x+2) + (-5)(x+2)$$

$$(x+2)(16x^2-5) = 0$$

check by FOIL

Review

Factor: $x^2 + 7x + 10$

$(x + 5)(x + 2)$

10
^
5+2=7

$x^2 + 12x + 32$
 $(x + 8)(x + 4)$

32
8x4
16x2
32x1

$x^2 - 6x - 27$
 $(x + 3)(x - 9)$

-27
-1 27
-27 1
-9 3
-3 9

$x^4 - 29x^2 + 100$

$(x^2 - 25)(x^2 - 4)$

100
100 1
20 5
-25 -4

$x^4 - 13x^2 + 36 = 0$
 $(x^2 - 9)(x^2 - 4)$

36
2 18
1 36

$x^4 - 13x^2 - 48 = 0$
 $(x^2 - 16)(x^2 - 3)$

-48

-1x48 -2x24 -3x16
-48x1 -24x2 -16x3

$x^4 - 98x - 200 = 0$
 $(x^2 - 100)(x^2 + 2)$

200

-200x1 -2x100 -50x4
-1x200 -100x2 -4x50

4 term polynomials

FACTORY BY GROUPING

Group the ^{2 highest} powers of x
 and the ^{2 lowest} powers of x

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

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

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

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

$$16x^3 + 32x^2 - 5x - 10 = 0$$

$$(16x^3 + 32x^2) + (-5x - 10) = 0$$

$$16x^2(x+2) + (-5)(x+2) \quad \text{FIND GCF'S}$$

$$(x+2)(16x^2-5)$$

$$4x^3 + 12x^2 - 8x - 24 = 0$$

$$(4x^3 + 12x^2) + (-8x - 24) = 0$$

$$4x^2(x+3) + (-8)(x+3)$$

$$\frac{12x^2}{4x^2} \quad (x+3)(4x^2-8)$$

$$\frac{-24}{-8} = 3$$

Factoring 3 term polynomials

Review: Factor $x^2 + 7x + 10$

WHAT
2 #s mult. = 10
 5×2
 $5 + 2 = 7$

$(x+5)(x+2)$

$x^2 + 12x + 32$
 $(x+8)(x+4)$

32
8 4
2 16
1 32

$x^4 - 29x^2 + 100 = 0$

$(x^2 - 25)(x^2 - 4)$

$(x+5)(x-5)(x+2)(x-2)$

10×10
 50×2
 -25×-4
 20×5

$x^4 - 13x^2 + 36 = 0$

$(x^2 - 9)(x^2 - 4)$

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

$-9 -4$
 $-18 -2$

$x^4 - 13x^2 - 48 = 0$

$(x^2 - 16)(x^2 + 3)$

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

48

~~1x48~~ ~~2x24~~
~~3x16~~ ~~4x12~~
~~6x8~~

$x^4 - 98x^2 - 200 = 0$

$(x^2 - 100)(x^2 + 2)$

$(x+10)(x-10)(x^2 + 2)$

$-100 \times 2 = -200$
 $-100 + 2 = -98$

4 terms:

Factor by GroupingGroup the ^{2 highest}
^{2 lowest} powers of x

$$\text{Ex: } 4x^3 + 8x^2 - 3x - 6 = 0$$

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

\uparrow FIND GCF \uparrow

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

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

$$16x^3 + 32x^2 - 5x - 10 = 0$$

$$(16x^3 + 32x^2) + (-5x - 10) = 0$$

$$16x^2(x+2) + (-5)(x+2)$$

FIND GCF

$$\boxed{(x+2)(16x^2-5)}$$

$$\frac{16x^3}{16x^2} = x$$

$$\frac{32x^2}{16x^2} = 2$$

$$4x^3 + 12x^2 - 8x - 24 = 0$$

$$(4x^3 + 12x^2) + (-8x - 24) = 0$$

$$4x^2(x+3) + (-8)(x+3) = 0$$

$$\frac{4x^3}{4x^2} = x \quad \frac{12x^2}{4x^2} = 3 \quad \frac{-8x}{-8} = x \quad \frac{-24}{-8} = 3$$

$$\boxed{(x+3)(4x^2-8)}$$