Factoring you know...

● **Common factoring** ●

$$4x^3 - 6x^2 + 12x$$
$$= 2x(2x^2 - 3x + 6)$$

simple $x^2 + 7x + 12$
$$= (x + 4)(x + 3)$$

◉ **Trinomial factoring** ●

perfect square $4x^2 - 12x + 9$
$$= (2x - 3)(2x - 3)$$
$$= (2x - 3)^2$$

not-so-simple
$$\underbrace{12x^2 + 1x - 6}_{-72}$$

$a \cdot c$

$$\underline{9} \cdot \underline{-8} = -72$$
$$\underline{9} + \underline{(-8)} = 1 \leftarrow \quad b$$

$(12x^2 + 9x) + (-8x - 6)$

difference of squares

$x^4 - 81$

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

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

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

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

↑
NOT a
difference

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

Factor by grouping

$$(x^3 + 2x^2) + (3x + 6)$$
$$= x^2(x + 2) + 3(x + 2)$$
$$= (x + 2)(x^2 + 3)$$

Factoring Sum and Differences of Cubes

difference

Recall: $x^2 - 25$ $= (x-5)(x+5)$

perfect
squares

⚠ $x^2 + 25$ CANNOT be factored

Sum of Cubes: $a^3 + b^3 = (a+b)(a^2 - ab + b^2)$

distribute

$= a^3 - a^2b + ab^2 + a^2b - ab^2 + b^3$

$= a^3 + b^3$

Difference of Cubes: $a^3 - b^3 = (a-b)(a^2 + ab + b^2)$

expand to check !

Example 1: Factor $x^3 - 8$

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

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

$a = x$
$b = 2$

Example 2: Factor $27a^3 + 125$

$a = 3a$
$b = 5$

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

$= (3a+5)(9a^2-15a+25)$

Example 3: Factor $7x^4 - 448x$

$(a-b)(a^2+ab+b^2)$
$a = x$
$b = 4$

$= 7x(x^3-64)$

$= 7x(x-4)(x^2+4x+16)$

Example 4: Factor $x^9 + 512$

$a = x^3$
$b = 8$

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

$= (x^3+8)(x^6-8x^3+64)$
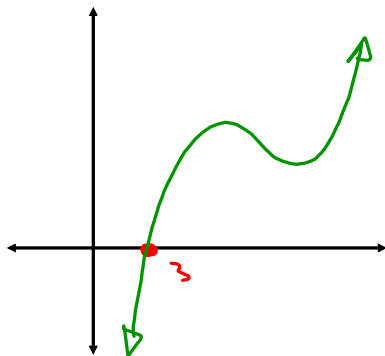
but $\underline{\quad}$ can be factored

$a = x$
$b = 2$

$= (x+2)(x^2-2x+4)(x^6-8x^3+64)$

Note: the trinomial factor NEVER has real roots

ex// $P(x) = x^3 - 27$

$= (x-3)(\underbrace{x^2+3x+9})$

no other real roots

Homefun:

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