Sum and Difference of Cubes

A binomial whose two terms are both perfect cubes can be factored using special formulas (memorize).

Sum of Cubes

$a^3 + b^3 = (a + b)(a^2 – ab + b^2)$

Difference of Cubes

$a^3 – b^3 = (a – b)(a^2 + ab + b^2)$

Factor the expression.

$4x^4 + 108x$

$4x(x^3 + 27)$ — *Factor out the GCF, 4x.*

a = x, b = 3 — *Identify a and b*

$4x(a + b)(a^2 - ab + b^2)$ — *Use the rule $a^3 + b^3 = (a + b) \times (a^2 - ab + b^2)$.*

$4x(x + 3)(x^2 - 3x + (3)^2)$ — *Simplify*

$4x(x + 3)(x^2 - 3x + 9)$

Factor the expression.

$125d^3 - 8$

$a = 5d, b = 2$ *Identify a and b*

$(a - b)(a^2 + ab + b^2)$ *Use the rule $a^3 - b^3 = (a - b) \times (a^2 + ab + b^2)$.*

$(5d - 2)((5d)^2 + (5d)(2) + (2)^2)$ *Simplify*

$(5d - 2)(25d^2 + 10d + 4)$

Factor the expression.

$81y^3 - 24x^9$

$3(27y^3 - 8x^9)$ *Factor out the GCF, 3.*

$a = 3y,\ b = 2x^3$ *Identify a and b*

$3(a - b)(a^2 + ab + b^2)$ *Use the rule $a^3 - b^3 = (a - b) \times (a^2 + ab + b^2)$.*

$3(3y - 2x^3)((3y)^2 + (3y)(2x^3) + (2x^3)^2)$ *Simplify*

$3(3y - 2x^3)(9y^2 + 6x^3y + 4x^6)$

Factor the expression.

$16 + 2z^6$

$2(8 + z^6)$ *Factor out the GCF, 2.*

$a = 2, b = z^2$ *Identify a and b*

$2(a + b)(a^2 - ab + b^2)$ *Use the rule $a^3 + b^3 = (a + b) \times (a^2 - ab + b^2)$.*

$2(2 + z^2)((2)^2 - (2)(z^2) + (z^2)^2)$ *Simplify*

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