Factoring Sum / Difference of Cubes

$\sqrt[3]{}$

$a^3 \pm b^3$

binomial

SOAP
Same
Opposite
Always
Positive

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

S O AP

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

Steps
** GCF?? Always check first
1) what's being cubed? Take $\sqrt[3]{}$ to find a & b
2) Plug in a & b → SOAP!!
3) ✓ yourself!!

Example: $64a^3 + 1$
$a = \sqrt[3]{64a^3} = 4a$ $\quad b = \sqrt[3]{1} = 1$
S O
$(4a+1)(16a^2 - 4a + 1)$

Example: $343m^3 - 64n^6$
$a = \sqrt[3]{343m^3} = 7m$ $\quad b = \sqrt{64n^6} = 4n^2$
S O AP
$(7m-4n^2)(49m^2 + 28mn^2 + 16n^4)$

Quick Check!

$1^3 = 1$
$2^3 = 8$
$3^3 = 27$
$4^3 = 64$
$5^3 = 125$
$6^3 = 216$
$7^3 = 343$
$8^3 = 512$
$9^3 = 729$
$10^3 = 1{,}000$
$11^3 = 1{,}331$
$12^3 = 1{,}728$
$13^3 = 2{,}197$
$14^3 = 2{,}744$
$15^3 = 3{,}375$

Example #3

No GCF!!

$27x^3 + 1$

$\sqrt[3]{a^3} = \sqrt[3]{27x^3}$

$a = \sqrt[3]{27} \cdot \sqrt[3]{x^3}$

$a = 3x$

$\sqrt[3]{b^3} = \sqrt[3]{1}$

$b = 1$

Rewrite in factored form

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

$a = 3x$

$a^2 = (3x)^2 = (3)^2(x)^2 = 9x^2$

$b = 1$

$b^2 = (1)^2 = 1$

$(a)(b) = (3x)(1) = 3x$

Don't forget S.O.A.P!

S O AP

$= (3x + 1)(9x^2 - 3x + 1)$

Example #4:

$125x^3 + 8$

$\sqrt[3]{a^3} = \sqrt[3]{125x^3}$

$a = \sqrt[3]{125} \cdot \sqrt[3]{x^3}$

$a = 5x$

$\sqrt[3]{b^3} = \sqrt[3]{8}$

$b = \sqrt[3]{8}$

$b = 2$

What is a^2 & b^2? $\Rightarrow$ $a^2 = (5x)^2$

$a^2 = (5)^2(x)^2$

$a^2 = 25x^2$

$b^2 = 2$

$b^2 = (2)^2$

$b = 4$

$a \cdot b = (25x^2)(4) = 100x^2$

Rewrite in factored form!

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

$= (5x + 2)(25x^2 - 100x^2 + 4)$

S O AP

Don't forget S.O.A.P!