Sum and Difference of Cubes

LEVEL 1: The Basics

Instructions: Factor each binomial using the Sum or Difference of Cubes formula.

- $x^3 + 1$
- $8x^3 + 1$
- $y^3 - 1$
- $27y^3 - 1$
- $a^3 + 27$
- $64a^3 + 27$
- $b^3 - 8$
- $125b^3 - 8$
- $m^3 + 64$
- $x^3 + y^3$
- $p^3 - 125$
- $a^3 - b^3$
- $q^3 + 216$
- $1 - 64z^3$
- $r^3 - 1000$
- $27 - 64x^3$

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LEVEL 2: Dive Deeper

Instructions: Factor each expression completely. Remember to check for a GCF first, and factor again if possible!

- $2x^3 + 16$
- $108m^3 - 4$
- $3y^3 - 24$
- $16p^3 + 54$
- $5a^3 + 5$
- $250q^3 - 2$
- $4b^3 - 32$
- $y^6 - 27$
- $x^4 + 8x$
- $a^9 + 1$
- $y^5 - y2$
- $b^{12} - 8$
- $a^4 + 27a$
- $x^3y^3 + 125$
- $x^6 - 64$ (Hint: Can be done as Difference of Squares or Sum of Cubes first. Try both and see!)

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LEVEL 3: Mastering the Concept

Instructions: Factor each expression completely. These might combine multiple factoring techniques or have more complex terms.

- $x^6 - 64$
- $y^6 - 729$
- $x^3 + 27y^3$
- $125a^3b^3 - 8c^3$
- $x^7 + x^4$
- $y^5 - 27y^2$
- $(x + y)^3 + 1$
- $8 - (a - b)^3$
- $x^3 + y^3 + x^2 - xy + y^2$
- $m^3 - n^3 - m^2 - mn - n^2$
- $16x^4y + 2xy^4$
- $24a^4b - 81ab^4$
- $x^9 - y^9$
- $1000 - 8z^6$
- $a^3b^6c^9 + 27d^3$
- $(m - n)^3 - 8$

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Challenge Problems

Q1: Factor the following expression completely: $x^6 - y^6$. (Hint: There are two ways to start this! Try factoring it as a Difference of Squares first and then factor the resulting terms. What happens if you try to factor it as a Difference of Cubes first?)

Q2: prove: $a^3 + b^3 + c^3 - 3abc = (a + b + c)(a^2 + b^2 + c^2 - ab - ac - bc)$

Q3: Factor: $(x - y)^3 + (x + y)^3$

Q4: Factor: $27a^3 - 8b^3 + 54a^2b - 36ab^2$

Q5: If $x^3 + 8 = 0$, solve for x by factoring first.

Q6: Factor: $64x^3 + 27y^3 - 144x^2y - 108xy^2$

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