Objective: Factor binomials of higher degree completely

Concept

Factoring Binomials

1. Factor out any GCF; (remember this can be a numerical and/or variable factor)
2. Check for a special pattern
    1. Difference of Two Squares: $(a)^2 - (b)^2$
    2. Sum of Two Cubes: $(a)^3 + (b)^3$
    3. Difference of Two Cubes: $(a)^3 - (b)^3$

Objective: Factor binomials of higher degree completely

Concept

Factoring Binomials with Special Patterns

Sum of Two Cubes

$$(x)^3+(y)^3$$

$$\downarrow$$

$$(x+y)\left((x)^2-xy+(y)^2\right)$$

Remember:

SOAP =

same sign,

opposite sign,

always positive!

Difference of Two Cubes

$$(x)^3-(y)^3$$

$$\downarrow$$

$$(x-y)\left((x)^2+xy+(y)^2\right)$$

Difference of Two Squares

$$(x)^2-(y)^2$$

$$\downarrow$$

$$(x-y)(x+y)$$

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Concept

In order to recognize special binomials you must know your perfect cubes and perfect squares. You must also know how to rewrite them as a power.

*First Ten Perfect Cubes

1^3 2^3 3^3 4^3 5^3 6^3 7^3 8^3 9^3 10^3

1 8 27 64 125 216 343 512 729 1000

*First Fifteen Perfect Squares

1^2 2^2 3^2 4^2 5^2 6^2 7^2 8^2 9^2 10^2

1 4 9 16 25 36 49 64 81 100

11^2 12^2 13^2 14^2 15^2 ... 25^2

121 144 169 196 225 625

Objective: Factor binomials of higher degree completely

Ex) Factor each polynomial completely.

$$3x^3 - 24$$

① gcf

$3(x^3 - 8)$

② Diff. of two cubes

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

"SOAP"

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

S O AP

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

check. $x^3 + 2x^2 + 4x$
$-2x^2 - 4x - 8$

Objective: Factor binomials of higher degree completely

Ex) Factor each polynomial completely.

$$54x^4 + 2x$$

① gcf

② Sum of two cubes

$2x(27x^3 + 1)$

$(3x)^3 + (1)^3$

"SOAP"

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

$3x \cdot 3x$

$1 \cdot 1$

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

Objective: Factor binomials of higher degree completely

Ex) Factor each polynomial completely.

$$x^3 + 343y^3$$

$(x)^3 + (7y)^3$

"SOAP"

① gcf = 1

↓

② sum of two cubes

$(x+7y)\left((x)^2 - (x)(7y) + (7y)^2\right)$

$7y \cdot 7y$

$$(x+7y)(x^2 - 7xy + 49y^2)$$

Objective: Factor binomials of higher degree completely

Ex) Factor each polynomial completely.

$x^3 + 46$

1) gcf = 1

2) not a special binomial

prime

Objective: Factor binomials of higher degree completely

Ex) Factor each polynomial completely.

$$64x^3y - 125y^4$$

① gcf

$y(64x^3 - 125y^3)$

② Diff. of two cubes

$(4x)^3 - (5y)^3$

"SOAP"

$y(4x-5y)((4x)^2 + (4x)(5y) + (5y)^2)$

$4x \cdot 4x$ $\quad$ $5y \cdot 5y$

$$y(4x-5y)(16x^2 + 20xy + 25y^2)$$

Objective: Factor binomials of higher degree completely

Ex) Factor each polynomial completely.

$$3x^5 - 27x$$

① gcf

$3x(x^4 - 9)$

② Diff. of two squares

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

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

③ check for another diff. of squares

Objective: Factor binomials of higher degree completely

Ex) Factor each polynomial completely.

$$x^4 - 625y^4$$

① gcf = 1

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

② Diff. of two squares

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

$(x)^2 - (5y)^2$

③ Another Diff. of two squares

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

Objective: Factor binomials of higher degree completely

Ex) Factor each polynomial completely.

$2x^4 + 8y^4$

① gcf $2(x^4 + 4y^4)$

② not a special binomial