



Factoring Sum/Difference of Cubes



I can factor the sum and difference of cubes.

Opp.

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



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

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



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



Opp

Always
PO5

What are the similarities? Differences?

= bi . tri



Factoring Sum/Difference of Cubes



I can factor the sum and difference of cubes.

Sum of cubes: $a^3 + b^3 = (a + b)(a^2 - \underline{ab} + b^2)$

Annotations: "same sign" points to the plus sign in $(a + b)$; "opposite sign" points to the minus sign in $(a^2 - ab + b^2)$; "always +" points to the plus sign in b^2 .

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

1. $x^3 - 8 =$

Handwritten annotations: x^2 above x^3 , 2^2 above 8 , x above x^3 , 2 above 8 . An arrow points from x^2 to x^2 in the quadratic factor.

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

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

2. $8x^3 + 27 =$

Handwritten annotations: $(2x)^2$ above $8x^3$, $(3)^2$ above 27 , $2x$ above $8x^3$, 3 above 27 . An arrow points from $2x \cdot 3$ to the $-6x$ term in the quadratic factor.

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

4. $27a^3 + 1 =$

Handwritten annotations: $(3a)^2$ above $27a^3$, $(1)^2$ above 1 , $3a$ above $27a^3$, 1 above 1 . An arrow points from $3a \cdot 1$ to the $-3a$ term in the quadratic factor.

3. $(3a + 1)(9a^2 - 3a + 1)$

3. $64a^3 - b^3 =$

Handwritten annotations: $4a$ above $64a^3$, b above b^3 , $(4a)^2$ below $64a^3$, $(b)^2$ below b^3 . An arrow points from $4a \cdot b$ to the $4ab$ term in the quadratic factor.

3. $(4a - b)(9a^2 + 4ab + b^2)$

Unit 5 Lesson 1: Operations and Composition of Functions



Learning Targets: I can add, subtract, multiply and divide functions.



I can determine the composition of functions.

Operations on Functions

Example: Given $f(x) = 3x^2 - 2x + 1$ and $g(x) = x - 4$, find each function.

a. $(f + g)(x) = \overset{f}{3x^2 - 2x + 1} + \overset{g}{x - 4} \Rightarrow$ add like terms
 $= \boxed{3x^2 - x - 3}$

b. $(f - g)(x) = 3x^2 - 2x + 1 - (x - 4)$
 $3x^2 - 2x + 1 - x + 4 = \boxed{3x^2 - 3x + 5}$

c. $(f \cdot g)(x) = \overset{\text{use } ()}{(3x^2 - 2x + 1)(x - 4)} =$
 $3x^3 - 12x^2 - 2x^2 + 8x + x - 4 = \boxed{3x^3 - 14x^2 + 9x - 4}$

d. $\left(\frac{f}{g}\right)(x) = \frac{3x^2 - 2x + 1}{x - 4}, x \neq 4$
 $\frac{x - 4 \neq 0}{+4 \quad +4}$
 $x \neq 4$

Unit 5 Lesson 1: Operations and Composition of Functions



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I can determine the composition of functions.

Function Composition

$$[f \circ g](x) = f(g(x))$$

$$[g \circ f](x) = g(f(x))$$

$$[h \circ g](x) = h(g(x))$$

Steve Phelps @giohio · Jan 22

Function composition.



Unit 5 Lesson 1: Operations and Composition of Functions



Learning Targets: I can add, subtract, multiply and divide functions.



I can determine the composition of functions.

Examples: Given $f(x) = 3x^2 - x + 4$, $g(x) = 2x - 1$, and $h(x) = 5x$, find each.

1. $[f \circ g](x) = 3(2x-1)^2 - (2x-1) + 4$

replace every x in the f function with the g function

$$= 3(4x^2 - 2x - 2x + 1) - 2x + 1 + 4 =$$
$$= 12x^2 - 12x + 3 - 2x + 1 + 4 =$$
$$12x^2 - 14x + 8$$

Unit 5 Lesson 1: Operations and Composition of Functions



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I can determine the composition of functions.

Examples: Given $f(x) = 3x^2 - x + 4$, $g(x) = 2x - 1$, and $h(x) = 5x$, find each.

$$\begin{aligned} 2. [g \circ f](x) &= 2(3x^2 - x + 4) - 1 \\ &= 6x^2 - 2x + 8 - 1 = \\ &= 6x^2 - 2x + 7 \end{aligned}$$

$$3. [h \circ g](x) = 5(2x - 1) = 10x - 5$$

$$h(g(x))$$

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Examples: Given $f(x) = 3x^2 - x + 4$, $g(x) = 2x - 1$, and $h(x) = 5x$, find each.

4. $[f \circ g](2) = \textcircled{28}$ 5. $[g \circ f](2) = \textcircled{27}$

$f(g(2))$

$$\begin{aligned}
 & 4-1 \\
 & 3 \\
 f(3) &= 3 \cdot 3^2 - 3 + 4 \\
 & 3 \cdot 9 - 3 + 4 \\
 & 27 - 3 + 4 \\
 & 24 + 4 \\
 & \textcircled{28}
 \end{aligned}$$

$$\begin{aligned}
 f(2) &= 3 \cdot 2^2 - 2 + 4 \\
 & 3 \cdot 4 - 2 + 4 \\
 & 12 - 2 + 4 \\
 & 10 + 4 = 14
 \end{aligned}$$

$$\begin{aligned}
 g(14) &= 2(14) - 1 \\
 & 28 - 1 \\
 & \textcircled{27}
 \end{aligned}$$

6. $[h \circ g \circ f](1) = \textcircled{55}$ $\textcircled{28}$

$$\begin{aligned}
 f(1) &= 3 \cdot 1^2 - 1 + 4 \\
 & 3 \cdot 1 - 1 + 4 \\
 & 3 - 1 + 4 \\
 & 2 + 4 \\
 & 6
 \end{aligned}$$

$$\begin{aligned}
 g(6) &= 2(6) - 1 \\
 & 12 - 1 \\
 & 11
 \end{aligned}$$

$$\begin{aligned}
 h(11) &= 5 \cdot 11 \\
 & \textcircled{55}
 \end{aligned}$$

CONCEPT CHECK: Operations and Composition of Functions



Learning Targets: I can add, subtract, multiply and divide functions.



I can determine the composition of functions.

Given $f(x) = 3x$, $g(x) = x + 7$ and $h(x) = x^2 + 2x + 5$, find each.

1. $(f + g)(x)$

2. $(h - g)(x)$

3. $\left(\frac{f}{g}\right)(x) =$

4. $[g \circ h](x)$

5. $[h \circ g](-9)$

6. $[f \circ (g \circ h)](1)$

CONCEPT CHECK: Operations and Composition of Functions



Learning Targets: I can add, subtract, multiply and divide functions.



I can determine the composition of functions.

**Given $f(x) = 3x$, $g(x) = x + 7$ and
 $h(x) = x^2 + 2x + 5$, find each.**

1. $(f + g)(x)$ $4x + 7$ **2. $(h - g)(x)$** $x^2 + x - 2$

3. $\left(\frac{f}{g}\right)(x) =$

$$\frac{x^2 + 2x + 5}{x + 7}, x \neq -7$$

4. $[g \circ h](x)$ $x^2 + 2x + 12$

5. $[h \circ g](-9)$ 5

6. $[f \circ (g \circ h)](1)$ 45