

## Do Now - Simplifying Exponential Expressions

<p>(a)</p> $\left(\frac{-12b^5a^{-2}}{3b^3a}\right)^{-4}$ $\left(\frac{-4b^2}{a^3}\right)^{-4}$ $\left(\frac{a^3}{-4b^2}\right)^4$ $\frac{(a^3)^4}{(-4)^4(b^2)^4}$ $\frac{a^{12}}{256b^8}$	<p>(b)</p> $(3x^2y)^3(9xy^{-3})^{-2}$ $27x^6y^3\left(\frac{9x}{y^3}\right)^{-2}$ $27x^6y^3\left(\frac{y^3}{9x}\right)^2$ $\frac{27x^6y^3}{1} \cdot \frac{y^6}{81x^2}$ $\frac{x^4y^9}{3}$	<p>(c)</p> $-125^{-\frac{2}{3}}$ $-1 \cdot 125^{-\frac{2}{3}}$ $\frac{-1}{125^{\frac{2}{3}}}$ $\frac{1}{(\sqrt[3]{125})^2}$ $-\frac{1}{(5)^2}$ $-\frac{1}{25}$
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### Function Notation

$$f(x) = 3x^2 - 4x + 1$$

$$f(-2) = 3(-2)^2 - 4(-2) + 1$$

$$= 3(4) + 8 + 1$$

$$= 12 + 9$$

$$= 21$$

$$g(x) = -\frac{3}{4}x - 9$$

$$g(-20) = -\frac{3}{4}(-20) - 9$$

$$= \frac{60}{4} - 9$$

$$= 15 - 9$$

$$= 6$$

### Operations with Functions

sum  $(f + g)(x) = f(x) + g(x)$

difference  $(f - g)(x) = f(x) - g(x)$

product  $(f \cdot g)(x) = f(x) \cdot g(x)$

quotient  $\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}$ , where  $g(x) \neq 0$

$$f(x) = x + 3$$

$$g(x) = x^2 - 25$$

$$\begin{aligned}(f + g)(x) &= x + 3 + x^2 - 25 \\ &= x^2 + x - 22\end{aligned}$$

$$\begin{aligned}(f - g)(x) &= x + 3 - (x^2 - 25) \\ &= -x^2 + x + 28\end{aligned}$$

$$\begin{aligned}(f \cdot g)(x) &= (x + 3) \cdot (x^2 - 25) \\ &= x^3 - 25x + 3x^2 - 75 \\ &= x^3 + 3x^2 - 25x - 75\end{aligned}$$

$$\begin{aligned}\left(\frac{f}{g}\right)(x) &= \frac{x + 3}{x^2 - 25} \\ &= \frac{x + 3}{(x + 5)(x - 5)}, \text{ D: } x \neq \pm 5\end{aligned}$$

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## Compositions of Functions

$$\begin{aligned}(f \circ g)(x) \\ \text{or} \\ f \circ g\end{aligned} = f(g(x))$$

$$\begin{aligned}(g \circ f)(x) \\ \text{or} \\ g \circ f\end{aligned} = g(f(x))$$

$$f(x) = x + 3$$

$$g(x) = x^2 - 25$$

$$\begin{aligned}(f \circ g)(4) &= f(g(4)) \\ &= f((4)^2 - 25) \\ &= f(-9) \\ &= -9 + 3 \\ &= -6\end{aligned}$$

$$\begin{aligned}(g \circ f)(-5) &= g(f(-5)) \\ &= g(-5 + 3) \\ &= g(-2) \\ &= (-2)^2 - 25 \\ &= -21\end{aligned}$$

$$\begin{aligned}(f \circ g)(x) &= f(g(x)) \\ &= g(x) + 3 \\ &= (x^2 - 25) + 3 \\ &= x^2 - 22\end{aligned}$$

$$\begin{aligned}(g \circ f)(x) &= g(f(x)) \\ &= (f(x))^2 - 25 \\ &= (x + 3)^2 - 25 \\ &= x^2 + 3x + 3x + 9 - 25 \\ &= x^2 + 6x - 16\end{aligned}$$

$$f(x) = x + 3$$

$$g(x) = x^2 - 25$$

$$\begin{aligned}(f \circ g)(4) &= (4)^2 - 22 \\ &= 16 - 22 \\ &= -6\end{aligned}$$

$$\begin{aligned}(g \circ f)(-5) &= (-5)^2 + 6(-5) - 16 \\ &= 25 - 30 - 16 \\ &= -21\end{aligned}$$

$$\begin{aligned}(f \circ f)(x) &= f(f(x)) \\ &= f(x) + 3 \\ &= x + 3 + 3 \\ &= x + 6\end{aligned}$$

$$\begin{aligned}(g \circ g)(x) &= g(g(x)) \\ &= (g(x))^2 - 25 \\ &= (x^2 - 25)^2 - 25 \\ &= (x^2 - 25)(x^2 - 25) - 25 \\ &= x^4 - 25x^2 - 25x^2 + 625 - 25 \\ &= x^4 - 50x^2 + 600\end{aligned}$$

$$\begin{aligned}(f \circ f)(-7) &= f(f(-7)) \\ &= f(-7 + 3) \\ &= f(-4) \\ &= -4 + 3 \\ &= -1\end{aligned}$$

$$\begin{aligned}(g \circ g)(4) &= g(g(4)) \\ &= g((4)^2 - 25) \\ &= g(16 - 25) \\ &= g(-9) \\ &= (-9)^2 - 25 \\ &= 81 - 25 \\ &= 56\end{aligned}$$

$$\begin{aligned}(f \circ f)(-7) &= -7 + 6 \\ &= -1\end{aligned}$$

$$\begin{aligned}(g \circ g)(4) &= (4)^4 - 50(4)^2 + 600 \\ &= 256 - 50(16) + 600 \\ &= 856 - 800 \\ &= 56\end{aligned}$$

$$f(x) = x + 3$$

$$g(x) = x^2 - 25$$

$$h(x) = 3x$$

find  $h \circ (g \circ f)(x)$

Step 1 - find  $(g \circ f)(x)$

already found earlier  
in this lesson

$$(g \circ f)(x) = x^2 + 6x - 16$$

Step 2 - find  $h \circ (g \circ f)(x)$

$$h \circ (g \circ f)(x) = 3(x^2 + 6x - 16)$$

$$= 3x^2 + 18x - 48$$

find  $h \circ (f \circ g)(-4)$

Step 1 - find  $(f \circ g)(x)$

already found earlier  
in this lesson

$$(f \circ g)(x) = x^2 - 22$$

Step 2 - find  $h \circ (f \circ g)(x)$

$$h \circ (f \circ g)(x) = 3(x^2 - 22)$$

$$= 3x^2 - 66$$

Step 3 - find  $h \circ (f \circ g)(-4)$

$$h \circ (f \circ g)(-4) = 3(-4)^2 - 66$$

$$= 3(16) - 66$$

$$= 48 - 66$$

$$= -18$$