Compositions of functions (sec. 10.1)

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The composite function $f(g(t))$ uses the out t of function g as the new input of function f.

This composite function is defined for all v es of t that are the domain of g.

Example

Let $f(x) = \cos(x) + 3$ and $g(x) = x^3 + 5$

$$f(g(x)) = f(x^3+5) = \cos(x^3+5)+3$$

$$g(f(x)) = g(\cos x + 3) = (\cos x + 3)^3 + 5$$

$$f(g(1)) = \cos(1^3+5)+3 = \cos(6)+3$$

Decomposition of functions

Example Consider a function of the form $f(g(x)) = e^{\sqrt{x}+3}$

inner

outside

Find possible formulas for $f(x)$ and $g(x)$.

$g(x) = \sqrt{x}$

$f(x) = e^{x+3}$

check: $f(g(x)) = e^{\sqrt{x}+3} = f(g(x))$ ✓

OR $\left.\begin{array}{l} f(x) = e^x \\ g(x) = \sqrt{x}+3 \end{array}\right\}$ $f(g(x)) = f(\sqrt{x}+3) = e^{\sqrt{x}+3} = f(g(x))$ ✓

Example $g(h(w(z))) = (\sin(\ln(z)))^2$

Find $g(z)$, $h(z)$, $w(z)$:

$w(z) = \ln(z)$

$h(z) = \sin(z)$

$g(z) = z^2$.

Example $j(k(x)) = \sqrt{\ln(x^2+4)}$

Find $j(x)$ and $k(x)$:

$\underbrace{\begin{array}{l} k(x) = x^2+4 \\ j(x) = \sqrt{\ln(x)} \end{array}}$ OR $\underbrace{\begin{array}{l} k(x) = \ln(x^2+4) \\ j(x) = \sqrt{x} \end{array}}$

$j(k(x)) = j(x^2+4) = \sqrt{\ln(x^2+4)}$

$j(k(x)) = j(\ln(x^2+4)) = \sqrt{\ln(x^2+4)}$