*Solutions*

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**1:** **Let** $f(x) = \frac{sin(x)}{cos(x)}$, **and** $g(x) = \frac{1}{x}$

**a)** **Write** $g \circ f$ **as a trig function.**

**b)** **What is the domain of** $g \circ f$ **when** $-2\pi \leq x \leq 2\pi$?

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**a)** $g \circ f = g(\frac{sin(x)}{cos(x)}) = \frac{cos(x)}{sin(x)} = cot(x)$

**b)** To find the domain of $g \circ f$, we must consider the domain of $g \circ f$ *and* $f(x)$. We must also consider $f(x)$ because when doing composition, we have a chosen $x$ and apply it to $f$ first, then g. If I apply $f$ to $x$ and the value does not exist, it cannot be applied to $g$.

The domain of $f(x)$ is all reals except when the denominator is 0; namely, when $cos(x) = 0$. This occurs at $\frac{-3\pi}{2}, \frac{-\pi}{2}, \frac{\pi}{2}$, and $\frac{3\pi}{2}$.

The domain of $g \circ f = cot(x)$ may be easier to calculate writing it as a fraction- then we see that $\frac{cos(x)}{sin(x)}$ holds for all values except when the denominator is 0; namely when $sin(x) = 0$. This occurs at $-2\pi, -\pi, \pi$, and $2\pi$.

Hence the domain is all reals for $x$ such that $-2\pi \leq x \leq 2\pi$, excluding $\frac{k\pi}{2}$, where $k$ is an integer, for $-4 \leq k \leq 4$.

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**2:** **Find the inverse of** $y = 3e^{5x}$ **and write it as a difference of two terms**

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We begin by switching $x$ and $y$, then solving for $y = f^{-1}(x)$:

$$x = 3e^{5y} \implies \frac{x}{3} = e^{5y}$$

$$ln(\frac{x}{3}) = 5y$$

$$\frac{ln(\frac{x}{3})}{5} = y$$

$$\frac{ln(x) - ln(3)}{5} = y$$

$$\implies f^{-1}(x) = y = \frac{ln(x) - ln(3)}{5}$$