1. Make sure you're using the correct rule:

Function	Derivative rule	Example
c^b	Constant	$\frac{d}{dx}[\pi^e] = 0$
x^c	Power	$\frac{d}{dx}\left[x^3\right] = 3x^2$
c^x	Exponent	$\frac{d}{dx}[c^x] = \ln(c)\, c^x$
$\log_b(x)$	Logarithm	$\frac{d}{dx}[\log_2(x)] = \frac{d}{dx}\left[\frac{\ln(x)}{\ln(2)}\right] = \frac{1}{\ln(2)x}$

2. Make sure you're familiar with the laws of logarithms! Simplifying before taking a derivative can make the problem much easier!!

$$\begin{aligned}
&\frac{d}{dx}\left[\ln\left(\frac{(42x^2+1)^2(33x-15)^3(110x^{-1}-1)^4}{(2x+7)^3\cos(x)e^{-x}}\right)\right] \\
&= \frac{d}{dx}\left[2\ln(42x^2+1)+3\ln(33x-15)+4\ln(110x^{-1}-1)-3\ln(2x+7)-\ln(\cos(x))+x\right] \\
&= 2\frac{84x}{42x^2+1}+3\frac{33}{33x-15}+4\frac{-110x^{-2}}{110x^{-1}-1}-3\frac{2}{2x+7}-\frac{-\sin(x)}{\cos(x)}+1
\end{aligned}$$

3. Logarithmic differentiation can be used to "break apart" functions of the form $f(x)^{g(x)}$. Notice that this is when the base AND the exponent of the function contain a variable:

$$\begin{aligned}
f(x) = (3x^2+1)^{\cos(x)} &\Rightarrow \ln(f(x)) = \ln\left((3x^2+1)^{\cos(x)}\right) \\
&\Rightarrow \ln(f(x)) = \cos(x)\ln\left(3x^2+1\right)
\end{aligned}$$

The next step uses chain rule on the left-hand side and product rule on the right:

$$\Rightarrow \frac{1}{f(x)}f'(x) = \frac{d}{dx}[\cos(x)]\ln\left(3x^2+1\right)+\cos(x)\frac{d}{dx}\left[\ln\left(3x^2+1\right)\right]$$

Use the derivative of $\cos(x)$ and $\ln(f(x))$ (chain-rule)

$$\begin{aligned}
&\Rightarrow \frac{f'(x)}{f(x)} = -\sin(x)\ln\left(3x^2+1\right)+\cos(x)\frac{1}{3x^2+1}\cdot\frac{d}{dx}\left[3x^2+1\right] \\
&\Rightarrow \frac{f'(x)}{f(x)} = -\sin(x)\ln\left(3x^2+1\right)+\cos(x)\frac{6x}{3x^2+1}
\end{aligned}$$

Since the original function was only in terms of x, we need to write the derivative solely in terms of x. We do this by multiplying both sides by $f(x)$ and then substituting the original function back in:

$$\begin{aligned}
&\Rightarrow f'(x) = f(x)\left(-\sin(x)\ln\left(3x^2+1\right)+\cos(x)\frac{6x}{3x^2+1}\right) \\
&\Rightarrow \boxed{f'(x) = \left(3x^2+1\right)^{\cos(x)}\left(-\sin(x)\ln\left(3x^2+1\right)+\cos(x)\frac{6x}{3x^2+1}\right)}
\end{aligned}$$

4. MyLab Math has examples where you can rewrite a function using e^x and $\ln(x)$. This method is equivalent:

$$
\begin{aligned}
f(x) &= \left(3x^2+1\right)^{\cos(x)} = e^{\ln\left(\left(3x^2+1\right)^{\cos(x)}\right)} = e^{\cos(x)\ln\left(3x^2+1\right)} \\
f'(x) &= e^{\cos(x)\ln\left(3x^2+1\right)}\frac{d}{dx}\left[\cos(x)\ln\left(3x^2+1\right)\right] \\
f'(x) &= e^{\cos(x)\ln\left(3x^2+1\right)}\left(\frac{d}{dx}[\cos(x)]\ln\left(3x^2+1\right)+\cos(x)\frac{d}{dx}\left[\ln\left(3x^2+1\right)\right]\right) \\
f'(x) &= e^{\cos(x)\ln\left(3x^2+1\right)}\left(-\sin(x)\ln\left(3x^2+1\right)+\cos(x)\frac{6x}{3x^2+1}\right) \\
f'(x) &= \left(3x^2+1\right)^{\cos(x)}\left(-\sin(x)\ln\left(3x^2+1\right)+\cos(x)\frac{6x}{3x^2+1}\right)
\end{aligned}
$$