What are the steps to solving
$f(x) = function^{function}$
using implicit differentiation?

1. Rewrite f(x) as y
2. Ln both sides
3. Use Rules of ln to bring power out front as multiplication.
4. Take derivative of both sides. Use implicit on left and always use power rule on right.
5. Solve for $\frac{d}{dx}$
6. Substitute in your original y.

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Find $f'(x)$

Given $f(x) = \sin x^{\cos x}$

$y = \sin x^{\cos x}$ 1. Rewrite

$\ln y = \ln \sin x^{\cos x}$ 2. Ln both sides

$\ln y = \cos x \cdot \ln(\sin x)$ 3. Bring out front.

$\frac{1}{y} \cdot \frac{dy}{dx} = \cos x \cdot \frac{d}{dx}[\ln(\sin x)] + \ln(\sin x) \cdot \frac{d}{dx}[\cos x]$ 4. Take $d/dx$

$\frac{1}{y} \cdot \frac{dy}{dx} = \cos x \cdot \frac{1}{\sin x} \cdot \cos x + \ln(\sin x)(-\sin x)$

$\cancel{y} \cdot \cancel{\frac{1}{y}} \cdot \frac{dy}{dx} = y \cdot \left[\frac{\cos^2 x}{\sin x} - \sin x \cdot \ln(\sin x)\right]$ 5. Solve for $dy/dx$.

$\frac{dy}{dx} = (\sin x^{\cos x}) \left[\frac{\cos^2 x}{\sin x} - \sin x \cdot \ln(\sin x)\right]$ 6. Substitute y.

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Find $f'(x)$

Given $f(x) = \frac{(2x-7)^5 (5x+9)^7}{(\sin x)^3 \sqrt{8x-3}}$

$f(x) = \frac{(2x-7)^5 (5x+9)^7}{(\sin x)^3 \sqrt{8x-3}}$ $f'(x)$

$y = \frac{(2x-7)^5 (5x+9)^7}{(\sin x)^3 (8x-3)^{1/2}}$ 1. Rewrite

$\ln y = \ln\left(\frac{(2x-7)^5 (5x+9)^7}{(\sin x)^3 (8x-3)^{1/2}}\right)$ 2. Ln both

$\ln y = 5\ln(2x-7) + 7\ln(5x+9) - 3\ln(\sin x) \quad \frac{1}{2}\ln(8x-3)$ 3. Rewrite

$\frac{1}{y} \cdot \frac{dy}{dx} = 5 \cdot \frac{1}{2x-7}(2) + 7 \cdot \frac{1}{5x+9} \cdot 5 - 3 \cdot \frac{1}{\sin x} \cdot \cos x - \frac{1}{2} \cdot \frac{1}{8x-3} \cdot 8$ 4. Take $d/dx$

$\frac{dy}{dx} = y \cdot \left[\frac{10}{2x-7} + \frac{35}{5x+9} - 3\cot x - \frac{4}{8x-3}\right]$

$\frac{dy}{dx} = \left[\frac{(2x-7)^5 (5x+9)^7}{(\sin x)^3 (8x-3)^{1/2}}\right] \cdot \left[\frac{10}{2x-7} + \frac{35}{5x+9} - 3\cot x - \frac{4}{8x-3}\right]$