

⑦ $y = f(x)^{g(x)}$, find $\frac{dy}{dx}$

$$\ln y = g(x) \ln(f(x))$$

$$\frac{d}{dx} \ln y = \frac{d}{dx} [g(x) \ln(f(x))]$$

$$\frac{1}{y} \frac{dy}{dx} = g(x) \frac{f'(x)}{f(x)} + \ln(f(x)) \cdot g'(x)$$

$$\frac{dy}{dx} = f(x)^{g(x)} \cdot \left[g(x) \frac{f'(x)}{f(x)} + \ln(f(x)) \cdot g'(x) \right]$$

"Tower Rule" for deriv of $f(x)^{g(x)}$

Additional Problems

① Temperature = $\left(T_0 - \frac{h-2000}{300} \right)^0 F$

where h = altitude

② a) positive

• at 3 hours of sleep, your happiness is increasing with each additional hour you sleep

b) negative

• after having done 19 hours of work, your happiness is decreasing as you do more work

c) $\frac{dh}{ds}$ is larger at $s=2$

• after sleeping 2 hours ($s=2$), more sleep makes you much happier. after 12 hours of sleep ($s=12$), more sleep makes you only a little happier.