2.1, 2.3, 2.4, 2.5

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Q7 $f(x) = (4x^3 - x)^{10}$

$f'(x) = 10 \cdot (12x - 1) \cdot (4x^3 - x)^9$

$= (120x - 10) \cdot (4x^3 - x)^9$

41. Compute $\frac{d}{dx}(\ln(kx))$ two ways. First by using the Chain Rule. Second, by using the logarithm rule $\ln(ab) = \ln(a) + \ln(b)$ and then taking the derivative.

Show the work for both parts.

42. Compute $\frac{d}{dx}(\ln(x^k))$ two ways. First by using the Chain Rule. Second, by using the logarithm rule $\ln(a^p) = p\ln(a)$ (for positive a) and then taking the derivative.

Q12

$$g(r) = 6^{r^4-2r}$$
$$= \left(e^{\ln(6)}\right)^{(r^4-2r)}$$
$$= e^{\ln(6)(r^4-2r)}$$

Know

$$\frac{d}{dx}(e^x) = e^x$$

$$g'(r) = \underbrace{\left(e^{\ln(6)(r^4-2r)}\right)}\cdot(\ln 6)(4r^3-2),$$ by chain rule.

$$= 6^{r^4-2r}\cdot\ln(6)(4r^3-2).$$

Rule $\quad \frac{d}{dx}\left(a^x\right) = \ln(a)\,a^x$

41. Compute $\frac{d}{dx}(\ln(kx))$ two ways. First by using the Chain Rule. Second, by using the logarithm rule $\ln(ab) = \ln(a) + \ln(b)$ and then taking the derivative.

Show the work for both parts.

42. Compute $\frac{d}{dx}\left(\ln\left(x^k\right)\right)$ two ways. First by using the Chain Rule. Second, by using the logarithm rule $\ln(a^p) = p\ln(a)$ (for positive a) and then taking the derivative.

Q41.

$$\frac{d}{dx}\left(\ln(kx)\right) = \frac{1}{kx}\cdot k = \frac{1}{x}$$

where chain rule is used in first step.

Alternatively,

$$\frac{d}{dx}\left(\ln(kx)\right) = \frac{d}{dx}\left(\ln(k) + \ln(x)\right), \text{ log rule}$$

$$= \frac{d}{dx}\left(\ln(k)\right) + \frac{d}{dx}\left(\ln(x)\right), \text{ by linearity}$$

~~Q4~~

$$= 0 + \frac{1}{x} = \frac{1}{x}$$

Q42

$$\frac{d}{dx}\left(\ln(x^k)\right) = \frac{1}{x^k}\cdot kx^{k-1} = \frac{k}{x}.$$

OR

$$\frac{d}{dx}\left(\ln(x^k)\right) = \frac{d}{dx}\left(k\ln(x)\right)$$

$$= k\frac{d}{dx}\left(\ln(x)\right), \text{ by linearity}$$

$$= k \cdot \frac{1}{x}$$

$$j(g(x)) = (j \circ g)(x)$$

$$\cot(x) = \frac{1}{\tan(x)}$$

$$\frac{d}{dx}\left(\cot(x)\right) = \frac{-1}{\tan^2(x)} \cdot \frac{d}{dx}\left(\tan(x)\right)$$

$$= \frac{-1}{\tan^2(x)}\left(\frac{1}{\cos^2(x)}\right)$$

$$= \frac{-1}{\tan^2(x)} \sec^2(x)$$

$$= \frac{-1}{\tan^2(x)}\left(\tan^2(x)+1\right)$$

$$= -1 - \frac{1}{\tan^2(x)}$$

$$= -1 - \cot^2(x)$$