

MATH 3151 - Homework II on the Derivative

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1. Find the derivatives of the following functions:

(a) $\cos x^2$

(b) $\sec(x^5)e^{x^2+\tan x}$

(c) $(x^3 + x^2)^6$

(d) 2^x

(e) $|x|$

(f) $\frac{d}{dx} \ln |x|$

2. The trigonometric functions in degrees are defined by:

$$\sin x^\circ = \sin\left(\frac{\pi}{180}x\right).$$

$$\cos x^\circ = \cos\left(\frac{\pi}{180}x\right).$$

Find the periods of these functions. Express the derivative of $\sin x^\circ$ in terms of $\cos x^\circ$.

3. Find $(f^{-1})'(a)$:

(a) $f(x) = 5x^3 - 4x^2 + 11x + 9$, $a = 9$.

(b) $f(x) = \sqrt{3x^3 + 5x^2 + 3x + 5}$, $a = 4$.

4. Evaluate (do not simplify):

(a) $\frac{d}{dx} \sin^{-1} x$

(b) $\frac{d}{dx} \tan^{-1} x$

(c) $\frac{d}{dx} \sqrt[3]{x^2 + 3x}$

(d) $\frac{d}{dx} \sin^3(3x - 1)$

(e) $\frac{d}{dx} \left(\frac{e^x + 3}{3 - e^x}\right)^3$

(f) $\frac{d}{dx} \frac{\sqrt{x+13} - 4}{x - 3}$

(g) $\frac{d}{dx} [\sin(3\pi - x) \ln(x^3 + 1)]$

(h) $\frac{d}{dx} \tan^3(\sin(\pi x - 3))$

(i) $\frac{d}{dx} [e^{2x}(x^2 + \cos x)]$

(j) $\frac{d}{dx} \ln(\ln(\ln(x)))$

(k) $\frac{d}{dx} (\sin x)^x$

5. Differentiate the following functions: (do not simplify):

(a) $f(x) = \left(\frac{e^x + 3}{3 - e^x}\right)^3$

(b) $f(x) = e^{(2+\ln(3+\ln x))}$

(c) $f(x) = \ln(\ln(2 + e^x))$

(d) $g(x) = \tan(\cos^3(x))$

(e) $f(x) = e^{(2+\ln(3+\ln x))}$

(f) $f(x) = \ln(2 + \ln(3 + \ln x))$

(g) $g(x) = \cos(\tan(\sqrt{x}))$

(h) $h(x) = e^{e^x}$

6. Evaluate the following second derivatives:

(a) $\frac{d^2}{dx^2} (e^x \sin x)$

(b) $\frac{d^2}{dx^2} \left[(1 + 2x) \frac{d}{dx} (5 - x^3) \right]$

(c) Evaluate $\frac{d^3}{dx^3} (e^x \sin x)$

7. Let $f(x) = \cos 2x$. Find $f'(x)$, $f''(x)$, $f^{(3)}(x)$ and $f^{(10)}(x)$. Find a formula for $f^{(n)}(x)$, $n \in \mathbb{N}$.

8. Let $f(x) = e^x \cos x$. Find $f'(x)$, $f''(x)$, $f^{(3)}(x)$ and $f^{(4)}(x)$.

¹<https://pennance.us>