

*Mid-Term Exam of University Calculus for Freshmen of  
Chemical & Materials Engineering Department of NIU*

1. Find the following derivatives (10 points for each)

(a)  $\frac{d}{dx} x^3 \tan x \cos x$

(b)  $\frac{d}{dy} \tan^2(\sin(4y^3 + 2y))$

(c)  $\frac{d}{dx} \frac{\sin x \cos x}{x^2 \sec^2(2x^3 + 1)}$

(d)  $\frac{d}{dx} \cot^3(6x^2) \cdot \sec^2(6x^2) \cdot \tan(6x^2)$

2. Find all **extrema** of the given function and classify each as a maximum or minimum. (10 points for each)

a.  $f(x) = -4x^3 - 5x + 3$

b.  $g(x) = -2(3x - 5)^{\frac{2}{3}} + 6$

c.  $h(x) = \frac{8x}{x^2 + 2x + 3}$

3. Use calculus to find the absolute maximum and minimum values of each function, if they exist, over the indicated interval. Also indicate the x-values at which each extremum occurs. When no interval is specified, use the real line,  $(-\infty, \infty)$ . (10 points for each)

a.  $f(x) = 2x^3 - x^2 - x + 2$ ;  $[-1, 3]$

b.  $g(x) = 6x - 2x^2$ ;  $[-3, 3]$

c.  $h(x) = x^2 - \frac{432}{x}$