Advanced Derivative Rules
4.2A – Chain Rule & Trigonometry

#1) $\frac{d}{dx}[\cos^3(x)] = \frac{d}{dx}[\cos(x)]^3$

$= 3[\cos(x)]^2 \cdot [\cos(x)]'$

$= 3\cos^2(x)\,(-\sin(x)) \cdot x'$

$= -3\cos^2(x)\sin(x) \cdot (1)$

$\frac{d}{dx}[\cos^3(x)] = -3\cos^2(x)\sin(x)$

#2) $\frac{d}{dx}[\tan^4(x)] = \frac{d}{dx}[\tan(x)]^4$

$= 4[\tan(x)]^3 \cdot \frac{d}{dx}\tan(x)$

$= 4\tan^3(x) \cdot \sec^2(x) \cdot x'$

$= 4\tan^3(x)\sec^2(x) \cdot (1)$

$\frac{d}{dx}[\tan^4(x)] = 4\tan^3(x)\sec^2(x)$

#3) $\frac{d}{dx}[\cos(x^3)]$

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

$= -\sin(x^3) \cdot 3x^2$

$\frac{d}{dx}[\cos(x^3)] = -3x^2\sin(x^3)$

#4) $\frac{d}{dx}[\cot(x^5)] = -\csc^2(x^5) \cdot (x^5)'$

$= -\csc^2(x^5) \cdot 5x^4$

$\frac{d}{dx}[\cot(x^5)] = -5x^4\csc^2(x^5)$

#5) $\frac{d}{dx}[\csc^3(x)] = \frac{d}{dx}[\csc(x)]^3$

$= 3[\csc(x)]^2 \cdot \frac{d}{dx}\csc(x)$

$= 3\csc^2(x) \cdot (-\csc(x)\cot(x))$

$\frac{d}{dx}[\csc^3(x)] = -3\csc^3(x)\cot(x)$

#6) $\frac{d}{dx}[\sec^4(x)] = \frac{d}{dx}[\sec(x)]^4$

$= 4[\sec(x)]^3 \cdot \frac{d}{dx}[\sec(x)]$

$= 4\sec^3(x) \cdot \sec(x)\tan(x)$

$\frac{d}{dx}[\sec^4(x)] = 4\sec^4(x)\tan(x)$

#7) $\frac{d}{dx}[\sin(x^3)] = \cos(x^3) \cdot (x^3)'$

$= \cos(x^3) \cdot 3x^2$

$\frac{d}{dx}[\sin(x^3)] = 3x^2\cos(x^3)$

#8) $\frac{d}{dx}[\cos(8x)] = -\sin(8x) \cdot (8x)'$

$= -\sin(8x) \cdot 8$

$\frac{d}{dx}[\cos(8x)] = -8\sin(8x)$