**Math 1310-004 The Final Cheat Sheet**

**Rules for Differentiating Combinations of Functions.**

$$(cf)' = cf', \quad (f+g)' = f' + g', \quad (f-g)' = f' - g'$$

$$(fg)' = f'g + fg', \quad (f/g)' = \frac{f'g - fg'}{g^2}, \quad f(g(x))' = f'(g(x)) \cdot g'(x)$$

**Two Integration Techniques**

$$\int f(g(x))g'(x)dx = \int f(u)du; \quad u = g(x), du = g'(x)dx$$

$$\int f(x)g'(x)dx = f(x)g(x) - \int f'(x)g(x)dx$$

$$\int u\ dv = uv - \int v\ du$$

$$u = f(x), dv = g'(x)dx, du = f'(x)dx, v = g(x)$$

**Some Antiderivatives/Functions/Derivatives.**

| $\int f(x)dx$ | $f(x)$ | $f'(x)$ |
|---|---|---|
| $C$ | $0$ | $0$ |
| $\frac{1}{n+1}x^{n+1} + C$ | $(n \neq -1)\ x^n$ | $nx^{n-1}$ |
| $\ln(x) + C$ | $x^{-1}$ | $-x^{-2}$ |
| $e^x + C$ | $e^x$ | $e^x$ |
| $\left(\frac{1}{\ln(a)}\right) a^x + C$ | $(a > 0, \neq 1)\ a^x$ | $(\ln(a))a^x$ |
| $-\cos(x) + C$ | $\sin(x)$ | $\cos(x)$ |
| $\sin(x) + C$ | $\cos(x)$ | $-\sin(x)$ |
| $\ln(\lvert\sec(x)\rvert) + C$ | $\tan(x)$ | $\sec^2(x)$ |
| $\ln(\lvert\sec(x) + \tan(x)\rvert) + C$ | $\sec(x)$ | $\sec(x)\tan(x)$ |
| $? + C$ | $\tan^{-1}(x)$ | $\frac{1}{1+x^2}$ |
| $? + C$ | $\sin^{-1}(x)$ | $\frac{1}{\sqrt{1-x^2}}$ |

**Two Trig Identities.** $\sin^2(x) + \cos^2(x) = 1, \tan^2(x) + 1 = \sec^2(x)$

**Exponents.** $c^{x+y} = c^x c^y, \quad c^{-x} = 1/c^x, \quad (c^x)^y = c^{xy}, \quad b^x c^x = (bc)^x$

**Logs.** $\log(xy) = \log(x) + \log(y), \quad \log(x^y) = y\log(x)$

$$\log(x/y) = \log(x) - \log(y), \quad \log_b(x) = \ln(x)/\ln(b)$$

**Miscellaneous:** $f(x)^{g(x)} = e^{g(x)\ln(f(x))}$ and $\frac{d}{dx}\ln(f(x)) = \frac{f'(x)}{f(x)}$

**Linear Approximations:** Given $f(a)$ and $f'(a)$, then:

$$L_a(b) = f(a) + f'(a)(b-a)$$

is the linear approximation of $f(b)$ for $b$ "near" $a$.