EXAM ONE FORMULA SHEET

Differentiation:

$$\frac{d}{dx}(x^n) = nx^{n-1} (\text{if } n \neq 0)$$

$$\frac{d}{dx}(\ln(|x|)) = \frac{1}{x}$$

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

$$\frac{d}{dx}(\sin(x)) = \cos(x)$$

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

$$\frac{d}{dx}(\tan(x)) = \sec^2(x)$$

Product Rule:

$$(uv)' = u'v + uv'$$

Quotient Rule:

$$\left(\frac{u}{v}\right)' = \frac{u'v - uv'}{v^2}$$

Chain Rule:

$$\frac{d}{dx}(f(g(x))) = f'(g(x))g'(x)$$

Integration:

$$\int x^n \, dx = \frac{x^{n+1}}{n+1} + K \text{ if } n \neq -1$$

$$\int \frac{1}{x} \, dx = \ln(|x|) + K$$

$$\int e^{ax} \, dx = \frac{1}{a} e^{ax} + K$$

$$\int \cos(x) \, dx = \sin(x) + K$$

$$\int \sin(x) \, dx = -\cos(x) + K$$

$$\int \sec^2(x) \, dx = \tan(x) + K$$

Integration by Parts:

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

Substitution:

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

Average Values: The average value of a continuous function $f(x)$ over an interval $[a, b]$ is

$$\text{AV} = \frac{1}{b-a} \int_a^b f(x) \, dx.$$

Areas: The area A under the graph of $y = f(x)$ from a to b is

$$A = \int_a^b f(x) \, dx.$$

Producer's and Consumer's Surplus: If the demand function $p = D(x)$ and the supply function $p = S(x)$ meet at the equilibrium point $E = (x^*, p^*)$, then the Consumer's Surplus (CS) and Producer's Surplus (PS) are

$$CS = \int_0^{x^*} D(x) \, dx - x^* p^* \qquad \text{and} \qquad PS = x^* p^* - \int_0^{x^*} S(x) \, dx.$$

Approximating a Definite Integral:

$$\int_a^b f(x) \, dx \approx f(u_1)\Delta x + f(u_2)\Delta x + \cdots + f(u_n)\Delta x, \qquad \Delta x = \frac{b-a}{n}.$$