

Formula Sheet

Derivatives:

1. $\frac{d}{dx} k = 0$
2. $\frac{d}{dx} [kf(x)] = kf'(x)$
3. $\frac{d}{dx} [x] = 1$
4. Power Rule: $\frac{d}{dx} [x^n] = nx^{n-1}$
5. Sum or Difference:
 $\frac{d}{dx} [f(x) \pm g(x)] = f'(x) \pm g'(x)$
6. Product Rule:
 $\frac{d}{dx} [f(x)g(x)] = f(x)g'(x) + g(x)f'(x)$
7. Quotient Rule:
 $\frac{d}{dx} \left[\frac{f(x)}{g(x)} \right] = \frac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2}$
8. Chain Rule:
 $\frac{d}{dx} [f(x)^n] = nf(x)^{n-1}f'(x)$
9. $\frac{d}{dx} [e^x] = e^x$
10. $\frac{d}{dx} [e^{f(x)}] = e^{f(x)}f'(x)$
11. $\frac{d}{dx} [\ln x] = \frac{1}{x}$
12. $\frac{d}{dx} [\ln|f(x)|] = \frac{f'(x)}{x}$
13. $\frac{d}{dx} [a^x] = (\ln a)a^x$

14. $\frac{d}{dx} [\log_a x] = \frac{1}{\ln a} \frac{1}{x}$
15. $\frac{d}{dx} [\log_a |f(x)|] = \frac{1}{\ln a} \frac{f'(x)}{f(x)}$
16. $f(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$

Integrals:

1. $\int k dx = kx + C$
2. $\int x dx = \frac{1}{2}x^2 + C$
3. $\int kf(x)dx = k \int f(x)dx$
4. $\int x^n dx = \frac{x^{n+1}}{n+1} + C$
5. $\int [f(x) \pm g(x)]dx = \int f(x)dx \pm \int g(x)dx$
6. $\int \frac{dx}{x} = \ln|x| + C$
7. $\int e^x dx = e^x + C$
8. $\int e^{kx} dx = \frac{e^{kx}}{k} + C$
9. $\int a^x dx = \frac{a^x}{\ln a} + C$
10. $\int a^{kx} dx = \frac{a^{kx}}{k(\ln a)} + C$
11. Integration by Parts: $\int u dv = uv - \int v du$

Other Formulas:

Lagrange Multiplier: $F(x, y, \lambda) = f(x, y) - \lambda \cdot g(x, y)$

Total Differential for 2 Variables:

$$dz = f_x(x, y) \cdot dx + f_y(x, y) \cdot dy$$

Total Differential for 3 Variables:

$$dw = f_x(x, y, z) dx + f_y(x, y, z) dy + f_z(x, y, z) dz$$

Trapezoidal Rule:

$$\int_a^b f(x)dx \approx \left(\frac{b-a}{n} \right) \left[\frac{1}{2}f(x_0) + f(x_1) + \cdots + f(x_{n-1}) + \frac{1}{2}f(x_n) \right]$$

Simpson's Rule:

$$\int_a^b f(x)dx \approx \left(\frac{b-a}{3n}\right)[f(x_0) + 4f(x_1) + 2f(x_2) + 4f(x_3) + \cdots + 2f(x_{n-2}) + 4f(x_{n-1}) + f(x_n)]$$

Volume of a Solid of Revolution: $V = \int_a^b \pi[f(x)]^2 dx$

Exponential Growth Equation: $y(t) = y_0 e^{kt}$

Total Money Flow: $\int_0^T f(t)dt$

Present Value of Money Flow: $P = \int_0^T f(t)e^{-rt} dt$

Accumulated Amount of Money Flow: $A = e^{rT} \int_0^T f(t)e^{-rt} dt$

Improper Integrals:

$$\int_a^\infty f(x)dx = \lim_{b \rightarrow \infty} \int_a^b f(x)dx$$

$$\int_{-\infty}^b f(x)dx = \lim_{a \rightarrow -\infty} \int_a^b f(x)dx$$

$$\int_{-\infty}^\infty f(x)dx = \int_{-\infty}^c f(x)dx + \int_c^\infty f(x)dx$$

Integrating Factor: $I(x) = e^{\int P(x)dx}$ for the differentiable equation $\frac{dy}{dx} + P(x)y = Q(x)$

Continuous Deposits: $\frac{dA}{dt} = rA + D$

Probability Density Functions:

$$P(X \leq b) = P(X < b) = \int_{-\infty}^b f(x)dx$$

$$P(X \geq a) = P(X > a) = \int_a^\infty f(x)dx$$

$$P(-\infty < X < \infty) = \int_{-\infty}^\infty f(x)dx = 1$$

Sum of the First n Terms of a Geometric Sequence: $S_n = \frac{a(r^n - 1)}{r - 1}$, where $r \neq 1$; $S_n = \sum_{i=0}^{n-1} ar^i$

Amount of Annuity: $S = R \left[\frac{(1+i)^n - 1}{i} \right]$ or $S = R \cdot s_{\bar{n}|i}$

Present Value of an Annuity: $P = R \left[\frac{1 - (1+i)^{-n}}{i} \right]$ or $P = R a_{\bar{n}|i}$

Taylor Polynomial for $f(x) = e^x$: $P_n(x) = \sum_{i=0}^n \frac{f^{(i)}(0)}{i!} x^i = \sum_{i=0}^n \frac{1}{i!} x^i$

Taylor Polynomial of degree n:

$$P_n(x) = f(0) + \frac{f^{(1)}(0)}{1!} x + \frac{f^{(2)}(0)}{2!} x^2 + \frac{f^{(3)}(0)}{3!} x^3 + \cdots + \frac{f^{(n)}(0)}{n!} x^n = \sum_{i=0}^n \frac{f^{(i)}(0)}{i!} x^i$$

Sum of a Geometric Series: $\frac{a}{1-r}$ if the series converges

Taylor Series: $f(0) + f^{(1)}(0)x + \frac{f^{(2)}(0)}{2!} x^2 + \frac{f^{(3)}(0)}{3!} x^3 + \cdots$