

## FORMULAS

### Derivatives

1.  $(cf)' = cf'$
2.  $(f + g)' = f' + g'$
3.  $(fg)' = f'g + fg'$
4.  $\left(\frac{f}{g}\right)' = \frac{f'g - fg'}{g^2}$
5.  $(g(f))' = g'(f) \cdot f'$
6.  $C' = 0$
7.  $(x^r)' = rx^{r-1} \quad r \neq 0$
8.  $(e^x)' = e^x \quad e = 2.7182818284590 \dots$
9.  $(a^x)' = (\ln a)a^x \quad a > 0$
10.  $(\ln x)' = \frac{1}{x}$
11.  $(\sin x)' = \cos x$
12.  $(\cos x)' = -\sin x$

### Integrals

1.  $\int cf \, dx = c \int f \, dx$
2.  $\int (f + g) \, dx = \int f \, dx + \int g \, dx$
3.  $\int x^r \, dx = \frac{x^{r+1}}{r+1} \quad r \neq -1$
4.  $\int \frac{1}{x} \, dx = \ln|x|$
5.  $\int e^x \, dx = e^x$
6.  $\int \sin x \, dx = -\cos x$
7.  $\int \cos x \, dx = \sin x$

### Definition of the Derivative

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

**Tangent Line to  $y = f(x)$  at  $x = a$**   
 $y = f(a) + f'(a)(x - a)$

### Definition of the Integral

$$\lim_{\Delta x \rightarrow 0} \sum_{i=1}^n f(c_i) \Delta x = \int_a^b f(x) \, dx$$

### Fundamental Theorem of Calculus

If  $F'(x) = f(x)$ , then  $\int_a^b f(x) \, dx = F(b) - F(a)$ .

### Areas

rectangle:  $A = (\text{base})(\text{altitude})$   
triangle:  $A = \frac{1}{2}(\text{base})(\text{altitude})$

circle:  $A = \pi(\text{radius})^2$

sphere (surface area):  $A = 4\pi(\text{radius})^2$

### Volumes

cylinder:  $V = (\text{area of base})(\text{altitude})$

pyramid or cone:  $V = \frac{1}{3}(\text{area of base})(\text{altitude})$

sphere:  $V = \frac{4}{3}\pi(\text{radius})^3$

### Quadratic Formula

$$ax^2 + bx + c = 0 \Rightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

### Sines and Cosines

$$\begin{aligned} \sin 0 &= 0 & \cos 0 &= 1 \\ \sin \frac{\pi}{6} &= \frac{1}{2} & \cos \frac{\pi}{6} &= \frac{\sqrt{3}}{2} \\ \sin \frac{\pi}{4} &= \frac{1}{\sqrt{2}} & \cos \frac{\pi}{4} &= \frac{1}{\sqrt{2}} \\ \sin \frac{\pi}{3} &= \frac{\sqrt{3}}{2} & \cos \frac{\pi}{3} &= \frac{1}{2} \\ \sin \frac{\pi}{2} &= 1 & \cos \frac{\pi}{2} &= 0 \end{aligned}$$

### Laws of Exponents

$$a^x a^y = a^{x+y}$$

$$\frac{a^x}{a^y} = a^{x-y}$$

$$a^y = a^{xy}$$

$$(ab)^x = a^x b^x$$

$$\left(\frac{a}{b}\right)^x = \frac{a^x}{b^x}$$

### Natural Logarithms

$$\ln(xy) = \ln x + \ln y$$

$$\ln\left(\frac{x}{y}\right) = \ln x - \ln y$$

$$\ln(x^y) = y \ln x$$

$$e^{\ln x} = x$$

$$\ln(e^x) = x$$

$$\ln e = 1$$

$$\ln 1 = 0$$

### Motion

$s(t)$  = distance

$s'(t) = v(t)$  = velocity

$s''(t) = v'(t) = a(t)$  = acceleration

### Exponential Growth and Decay

$y' = ky \Rightarrow y(t) = Ce^{kt}$  or  $y(t) = C(1+r)^t$

### Newton's law of Cooling

$T' = k(A - T)$ , solution:  $T = A + Ce^{-kx}$