

Spec - Calculus

$$m \text{ of } x \in [a, b] = \frac{f(b) - f(a)}{b - a} = \frac{dy}{dx}$$

First principles derivative

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

Tangents & gradients

Tangent line - defined by $y = mx + c$ where $m = \frac{dy}{dx}$

Normal line - \perp tangent ($m_{\text{tan}} \cdot m_{\text{norm}} = -1$)

Secant = $\frac{f(x+h) - f(x)}{h}$

Derivatives

$f(x)$	$f'(x)$
kx^n	knx^{n-1}
$g(x) + h(x)$	$g'(x) + h'(x)$
c	0
$\frac{u}{v}$	$\frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$
uv	$u \frac{dv}{dx} + v \frac{du}{dx}$
$f \circ g$	$\frac{dy}{du} \cdot \frac{du}{dx}$
$\sin ax$	$a \cos ax$
$\sin(f(x))$	$f'(x) \cdot \cos(f(x))$
$\cos ax$	$-a \sin ax$
e^{ax}	ae^{ax}
$\log_e ax$	$\frac{1}{x}$
$\log_e f(x)$	$\frac{f'(x)}{f(x)}$

Product rule for $y = uv$

$$\frac{dy}{dx} = u \frac{dv}{dx} + v \frac{du}{dx}$$

Logarithms

$$\log_b(x) = n \quad \text{where } b^n = x$$

Integration

$$\int f(x) dx = F(x) + c$$

- area enclosed by curves

$f(x)$	$\int f(x) \cdot dx$
k (constant)	$kx + c$

$f(x)$	$\int f(x) \cdot dx$
x^n	$\frac{1}{n+1}x^{n+1} + c$
ax^{-n}	$a \cdot \log_e x + c$
e^{kx}	$\frac{1}{k}e^{kx} + c$
e^k	$e^k x + c$
$\sin kx$	$-\frac{1}{k} \cos(kx) + c$
$\cos kx$	$\frac{1}{k} \sin(kx) + c$
$\frac{f'(x)}{f(x)}$	$\log_e f(x) + c$
$g'(x) \cdot f(g(x))$	$f(g(x))$ (chain rule)
$f(x) \cdot g(x)$	$\int [f'(x) \cdot g(x)]dx + \int [g'(x)f(x)]dx$
$\frac{1}{ax+b}$	$\frac{1}{a} \log_e(ax + b) + c$
$(ax + b)^n$	$\frac{1}{a(n+1)}(ax + b)^{n+1} + c$

Definite integrals

$$\int_a^b f(x) \cdot dx = [F(x)]_a^b = F(b) - F(a)$$

Kinematics

position x - distance from origin or fixed point

displacement s - change in position from starting point (vector)

velocity v - change in position with respect to time

acceleration a - change in velocity

speed - magnitude of velocity

	no
$v = u + at$	s
$s = ut + \frac{1}{2}at^2$	v
$v^2 = u^2 + 2as$	t
$s = \frac{1}{2}(u + v)t$	a