Average Rate of Change – $\frac{f(x_2)-f(x_1)}{x_2-x_1} = \frac{\Delta y}{\Delta x}$

Instantaneous Rate of Change – $\frac{dy}{dx} = \lim_{\Delta x \to 0}\left(\frac{\Delta y}{\Delta x}\right)$

$= \lim_{x_2 \to x_1}\left(\frac{f(x_2)-f(x_1)}{x_2-x_1}\right)$

$= \lim_{h \to 0}\left(\frac{f(x+h)-f(x)}{h}\right)$

Physics

position – ~~f(x)~~ $s(t) = f(t)$
velocity – $v(t) = s'(t)$
acceleration – $a(t) = v'(t) = s''(t)$

$s(t) = t^3 - 6t^2 + 9t$
$v(t) = 3t^2 - 12t + 9$
$v(2) = -3$ m/s
$v(4) = 9$ m/s
$v(c) = 0 = 3c^2 - 12c + 9$
$= 3(c^2 - 4c + 3) = 3(c-3)(c-1)$
$c = 3, 1$ s

	1		3	
v(t)	+	0	–	0	+

$(-\infty, 1) \cup (3, \infty)$ +
$(1, 3)$ –

$s(0) = 0$ m
$s(5) = 125 - 150 + 45 = 20$ m
$a(t) = 6t - 12$
$a(3) = 6$ m/s²

~~density~~ density – $\rho = \frac{m}{l}$

$m = f(x)$

linear density $\bar{\rho} = \frac{\Delta m}{\Delta x}$ $\rho = \lim_{\Delta x \to 0}\left(\frac{\Delta m}{\Delta x}\right)$

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Current - $I = \frac{\Delta Q}{\Delta t}$ $\quad I = \lim_{\Delta t \to 0}\left(\frac{\Delta Q}{\Delta t}\right) = \frac{dQ}{dt}$

Chemistry

concentration - $\frac{\text{moles}}{l}$ $\quad$ mole - 6.022×10^{23}

$A + B \rightarrow C$

$[A]$

Rate of Reaction - $\lim_{\Delta t \to 0}\left(\frac{\Delta [C]}{\Delta t}\right) = \frac{d[C]}{dt}$

Average rate of reaction $= \frac{\Delta [C]}{\Delta t} = \frac{[C](t_2) - [C](t_1)}{t_2 - t_1}$

compressibility

- isothermal compressibility $= \beta = -\frac{1}{V}\frac{dV}{dP}$, $\frac{dV}{dP} < 0$

Biology

Average growth - $\frac{\Delta n}{\Delta t} = \frac{f(t_2) - f(t_1)}{t_2 - t_1}$

Instantaneous growth rate - $\lim_{\Delta t \to 0}\left(\frac{\Delta n}{\Delta t}\right) = \frac{dn}{dt}$

law of laminar flow - $v = \frac{P}{4\eta l}(R^2 - r^2)$

Velocity gradient $= \frac{dv}{dr}$

Economics

c = cost

Average cost - $\frac{\Delta C}{\Delta x}$ $\quad$ Marginal Cost - $\frac{dC}{dx}$