

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

Instantaneous Rate of Change - $\frac{dy}{dx} = \lim_{\Delta x \rightarrow 0} \left(\frac{\Delta y}{\Delta x} \right)$
 $= \lim_{x_2 \rightarrow x_1} \left(\frac{f(x_2) - f(x_1)}{x_2 - x_1} \right)$
 $= \lim_{h \rightarrow 0} \left(\frac{f(x+h) - f(x)}{h} \right)$

Physics

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

$s(t) = t^3 - 6t^2 + 9t$

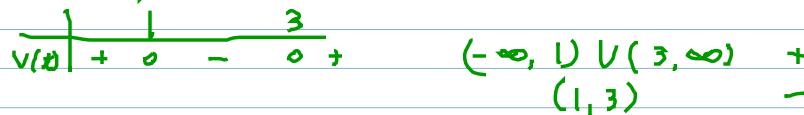
$v(t) = 3t^2 - 12t + 9$

$v(2) = -3 \text{ m/s}$

$v(4) = 9 \text{ m/s}$

$v(t) = 0 = 3t^2 - 12t + 9$
 $= 3(t^2 - 4t + 3) = 3(t-3)(t-1)$

$t = 3 \text{ s}$



$s(0) = 0 \text{ m}$

$s(5) = 125 - 150 + 45 = 20 \text{ m}$

$a(t) = 6t - 12$

$a(3) = 6 \text{ m/s}^2$

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



$m = f(x)$

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

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Physics

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$$s(t) = t^3 - 6t^2 + 9t$$

$$v(t) = 3t^2 - 12t + 9$$

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$$v(4) = 9 \text{ m/s}$$

$$v(t) = 0 = 3t^2 - 12t + 9$$

$$= 3(t^2 - 4t + 3) = 3(t-3)(t-1)$$

$$t = 3, 1 \text{ s}$$

$v(t)$	+	0	-	0	+	$(-\infty, 1) \cup (3, \infty)$	+
						$(1, 3)$	-

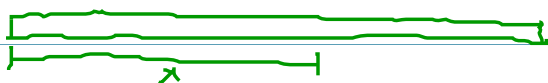
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○ linear density $\bar{\rho} = \frac{\Delta m}{\Delta x}$

$$\rho = \lim_{\Delta x \rightarrow 0} \left(\frac{\Delta m}{\Delta x} \right)$$

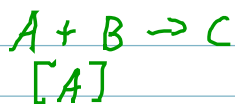
current - $\bar{I} = \frac{\Delta Q}{\Delta t}$

$$I = \lim_{\Delta t \rightarrow 0} \left(\frac{\Delta Q}{\Delta t} \right) = \frac{dQ}{dt}$$

Chemistry

concentration - $\frac{\text{moles}}{l}$

mole - 6.022×10^{23}



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

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

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 - $\lim_{\Delta t \rightarrow 0} \left(\frac{\Delta n}{\Delta t} \right) = \frac{dn}{dt}$

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

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

Economics

$c = \text{cost}$

Average cost - $\frac{\Delta C}{\Delta x}$

Marginal Cost - $\frac{dC}{dx}$