



$$v(t) = \lim_{\varepsilon \rightarrow 0} \frac{x(t_1 + \varepsilon) - x(t_1)}{(t_1 + \varepsilon) - t_1}$$


$$\frac{dx}{dt} = \lim_{\Delta t \rightarrow 0} \frac{\Delta x}{\Delta t}$$

$t_2 \rightarrow t_1 + \varepsilon$
 $x(t)$ $\varepsilon \ll 1$
 $\frac{dx}{dt}$
 向量

$$f(x) = a_n x^n$$

$\sin x, \cos x, \dots$

$e^x \quad \ln x$



下午演講課更改於「天文數學館」

$$\frac{d a_n x^n}{dx} = \lim_{\Delta x \rightarrow 0} \frac{a_n (x + \Delta x)^n - a_n x^n}{\Delta x}$$

$$(x + \Delta x)(x + \Delta x) \dots (x + \Delta x)$$

$$= a_n x^{n-1} \Delta x + \frac{n(n-1)}{2} x^{n-2} (\Delta x)^2 + \dots + (\Delta x)^n$$



$$v(t) = \lim_{\varepsilon \rightarrow 0} \frac{\chi(t_1 + \varepsilon) - \chi(t_1)}{(t_1 + \varepsilon) - t_1}$$

$$t_2 \rightarrow t_1 + \varepsilon$$

$\chi(t)$

$\varepsilon \ll 1$

$$\frac{d\chi}{dt}$$

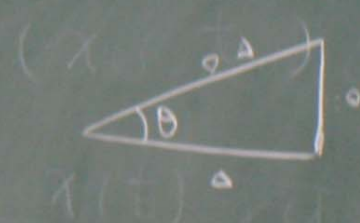
量

$$\frac{dx}{dt} = \lim_{\Delta t \rightarrow 0} \frac{\Delta x}{\Delta t}$$

$$f(x) = a_n x^n$$

$\sin x, \cos x, \dots$

$e^x \quad \ln x$



$$\frac{d a_n x^n}{d x} = \lim_{\Delta x \rightarrow 0} \frac{a_n (x + \Delta x)^n - a_n x^n}{\Delta x}$$

$$\frac{(x + \Delta x)(x + \Delta x) \cdots (x + \Delta x)}{\Delta x}$$

$$x^n + n x^{n-1} \Delta x + \frac{n(n-1)}{2} x^{n-2} (\Delta x)^2 + \cdots + (\Delta x)^n$$

$$= \lim_{\Delta x \rightarrow 0} \frac{n x^{n-1} \Delta x}{\Delta x} = n x^{n-1}$$

$$\frac{d a_n x^n}{dx} = \lim_{\Delta x \rightarrow 0} \frac{a_n (x+\Delta x)^n - a_n x^n}{\Delta x} = a_n n x^{n-1}$$

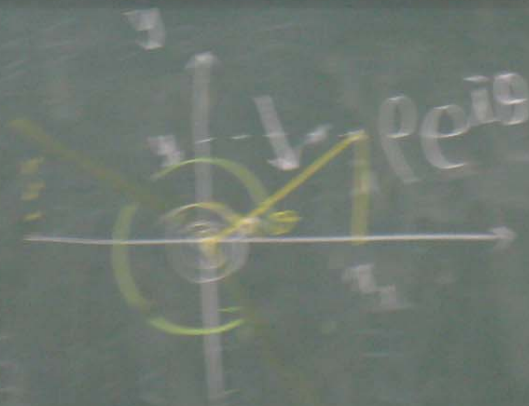
$$\frac{(x+\Delta x)^n - x^n}{\Delta x} = \frac{(x+\Delta x)^n - x^n}{\Delta x}$$

$$x^n + n x^{n-1} \Delta x + \frac{n(n-1)}{2} x^{n-2} (\Delta x)^2 + \dots + (\Delta x)^n$$

$$= \lim_{\Delta x \rightarrow 0} \frac{n x^{n-1} \Delta x}{\Delta x} = n x^{n-1}$$

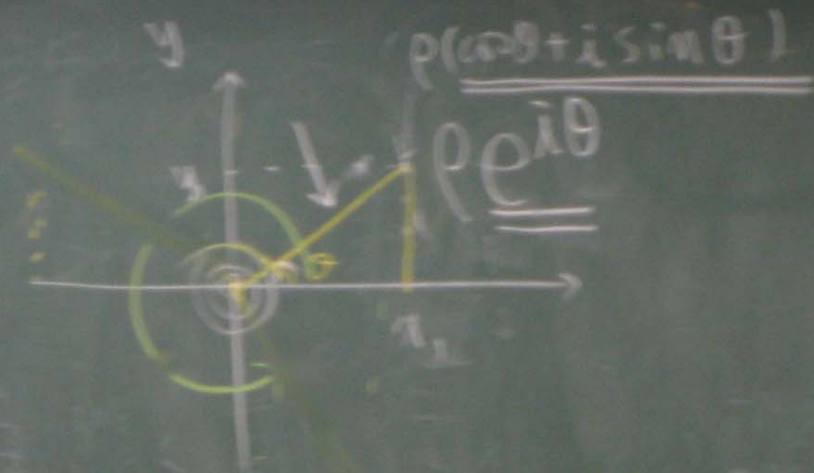
$$\cos \theta = \frac{x}{\sqrt{x^2+y^2}}$$

$$\sin \theta = \frac{y}{\sqrt{x^2+y^2}}$$



$$\cos \theta = \frac{x_1}{\sqrt{x_1^2 + y_1^2}}$$

$$\sin \theta = \frac{y_1}{\sqrt{x_1^2 + y_1^2}}$$



$$(\rho \cos \theta, \rho \sin \theta)$$

$$\frac{d e^{i\theta}}{d\theta} = e^{i\theta}$$

$$\frac{d \cos \theta}{d\theta} = \lim_{\Delta \theta \rightarrow 0} \frac{\cos(\theta + \Delta \theta) - \cos \theta}{\Delta \theta}$$

$$= \lim_{\Delta \theta \rightarrow 0} \dots$$

$$= -\sin \theta$$

$$\frac{d \sin \theta}{d\theta} = \cos \theta$$

$$= -\sin \theta$$