$$ma = -kx \Rightarrow \ddot{x} + \frac{k}{m}x = 0 \Rightarrow \ddot{x} + \omega^2 x = 0$$

$$-L\frac{dI}{dt} = \frac{q}{C} \Rightarrow \sum \mathcal{E} + \sum \mathcal{E}_{in} = IR + \frac{q}{C} \Rightarrow \frac{dI}{dt} + \frac{1}{LC}q \Rightarrow \ddot{q} + \omega^2 q = 0 \Rightarrow I = \dot{q} \Rightarrow \frac{dI}{dt} = \ddot{q}$$

$$x = C_1 \sin\omega t + C_2 \cos\omega t \Rightarrow \dot{x} = \omega C_1 \cos\omega t - \omega C_2 \sin\omega t \Rightarrow \ddot{x} = -\omega^2 C_1 \sin\omega t - \omega^2 C_2 \cos\omega t$$

$$x = \frac{v(0)}{\omega}\sin\omega t + x(0)\cos\omega t$$

$$\ddot{x} + \omega^2 x = 0 \Rightarrow -\omega^2 C_1 \sin\omega t - \omega^2 C_2 \cos\omega t + \omega^2 (C_1 \sin\omega t + C_2 \cos\omega t) = 0$$

$$x = A\sin(\omega t + \varphi) \Rightarrow \dot{x} = \omega A\cos(\omega t + \varphi) \Rightarrow \ddot{x} = -\omega^2 A\sin(\omega t + \varphi)$$

$$\ddot{x} + \omega^2 x = 0 \Rightarrow -\omega^2 A\sin(\omega t + \varphi) + \omega^2 A\sin(\omega t + \varphi)$$

$$x(0) < A \Rightarrow v(0) < \omega A \Rightarrow x(0) = C_2.1 \Rightarrow C_2 = x(0) \Rightarrow v(0) = \omega C_1.1 \Rightarrow C_1 = \frac{v(0)}{\omega}$$

$$x = A\sin\omega t\cos\varphi + A\cos\omega t\sin\varphi = \frac{v(0)}{\omega}\sin\omega t + x(0)\cos\omega t \Rightarrow A\cos\varphi = \frac{v(0)}{\omega};\ A\sin\varphi = x(0)$$

$$A = \sqrt{\frac{v^2(0)}{\omega^2} + x^2(0)} = \frac{\sqrt{v^2(0) + \omega^2 x^2(0)}}{\omega^2} \Rightarrow \tan\varphi = \frac{\omega x(0)}{v(0)}$$

$$x = A\sin(\omega t + \varphi)$$

$$x = Ce^{\lambda t} \Rightarrow \dot{x} = \lambda Ce^{\lambda t} \Rightarrow \ddot{x} = \lambda^2 Ce^{\lambda t}$$

$$\lambda^2 Ce^{\lambda t} + \omega^2 Ce^{\lambda t} = 0 \Rightarrow \lambda^2 = -\omega^2 \Rightarrow \lambda = \pm i\omega \Rightarrow x = C_1 e^{i\omega t} + C_2 e^{-i\omega t}$$

$$\dot{x} = i\omega C_1 e^{i\omega t} - i\omega C_2 e^{-i\omega t} \Rightarrow \ddot{x} = -\omega^2 C_1 e^{i\omega t} - \omega^2 C_2 e^{-i\omega t}$$

$$e^{ix} = \cos x + i\sin x \Rightarrow e^{-ix} = \cos x - i\sin x$$

$$x = C_1(\cos\omega t + i\sin\omega t) + C_2(\cos\omega t - i\sin\omega t) = (C_1 + C_2)\cos\omega t + i(C_1 - C_2)\sin\omega t$$

$$C_1 = C_2$$

$$\sqrt{1 - x^2} \Rightarrow x = \sin z \Rightarrow x = \cos z \Rightarrow \sqrt{1 - \sin^2 z} = \cos z$$

$$\sqrt{1 + x^2} \Rightarrow x = \tan z \Rightarrow x = \cot z \Rightarrow \sqrt{1 + \tan^2 z} = \sqrt{1 + \frac{\sin^2 z}{\cos^2 z}} = \frac{1}{\cos z}$$

$f(x_0) = \text{sabit}$

$$f(x) = C_0 + C_1(x - x_0) + C_2(x - x_0)^2 + C_3(x - x_0)^3 + C_4(x - x_0)^4 + \ldots\ldots..$$

$$x = x_0 \Rightarrow C_0 = f(x_0)$$

$$f'(x) = C_1 + 2C_2(x - x_0) + 3C_3(x - x_0)^2 + 4C_4(x - x_0)^3 + \ldots\ldots.$$

$$x = x_0 \Rightarrow C_1 = f'(x)_{x=x_0}$$

$$f''(x) = 2C_2 + 3.2C_3(x - x_0) + 4.3C_4(x - x_0)^2 + \ldots\ldots.$$

$$x = x_0 \Rightarrow C_2 = \frac{f''(x)_{x=x_0}}{2}$$

$$f'''(x) = 3.2C_3 + 4.3.2C_4(x - x_0) + \ldots\ldots.$$

$$x = x_0 \Rightarrow C_3 = \frac{f'''(x)_{x=x_0}}{3.2.1} = \frac{f'''(x)_{x=x_0}}{3!}$$

$$f''''(x) = 4.3.2C_4 + \ldots\ldots.$$

$$x = x_0 \Rightarrow C_4 = \frac{f''''(x)_{x=x_0}}{4.3.2.1} = \frac{f''''(x)_{x=x_0}}{4!}$$

$$f(x) = f(x_0) + f'(x)_{x=x_0}(x - x_0) + \frac{f''(x)_{x=x_0}(x - x_0)^2}{2!} + \frac{f'''(x)_{x=x_0}(x - x_0)^3}{3!} + \frac{f''''(x)_{x=x_0}(x - x_0)^4}{4!} + \ldots.$$

$$f(x)=f(x_0)+f'(x)_{x=x_0}(x-x_0)+\frac{f''(x)_{x=x_0}(x-x_0)^2}{2!}+\frac{f'''(x)_{x=x_0}(x-x_0)^3}{3!}+\frac{f''''(x)_{x=x_0}(x-x_0)^4}{4!}+....$$

$\sin x \Rightarrow \sin 0 = 0$

$(\sin x)' = \cos x \Rightarrow (\sin x)'' = (\cos x)' = -\sin x \Rightarrow (\sin x)''' = (-\sin x)' = -\cos x \Rightarrow (\sin x)'''' = (-\cos x)' = \sin x$

$(\sin x)^{V} = (\sin x)' = \cos x \Rightarrow (\sin x)^{VI} = (\cos x)' = -\sin x \Rightarrow (\sin x)^{VII} = (-\sin x)' = -\cos x \Rightarrow (\sin x)^{VIII} = (-\cos x)' = \sin x$

$f'(x)_{x=x_0} = (\sin x)' = 1 \Rightarrow f''(x)_{x=x_0} = (\sin x)'' = 0 \Rightarrow f'''(x)_{x=x_0} = (\sin x)''' = -1 \Rightarrow f^{IV}(x)_{x=x_0} = (\sin x)^{IV} = 0$

$f^{V}(x)_{x=x_0} = (\sin x)^{V} = 1 \Rightarrow f^{VII}(x)_{x=x_0} = (\sin x)^{VI} = 0 \Rightarrow f^{VIII}(x)_{x=x_0} = (\sin x)^{VIII} = -1 \Rightarrow f^{VIII}(x)_{x=x_0} = (\sin x)^{VIII} = 0$

$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \frac{x^9}{9!}...$

$\sin 80 = 1{,}395 - 0{,}452 + 0{,}044 - 0{,}0012$

$$f(x)=f(x_0)+f'(x)_{x=x_0}(x-x_0)+\frac{f''(x)_{x=x_0}(x-x_0)^2}{2!}+\frac{f'''(x)_{x=x_0}(x-x_0)^3}{3!}+\frac{f''''(x)_{x=x_0}(x-x_0)^4}{4!}+....$$

$\cos x \Rightarrow \cos 0 = 1$

$(\cos x)' = -\sin x \Rightarrow (\cos x)'' = (-\sin x)' = -\cos x \Rightarrow (\cos x)''' = (-\cos x)' = \sin x \Rightarrow (\cos x)'''' = (\sin x)' = \cos x$

$(\cos x)^{V} = (\cos x)' = -\sin x \Rightarrow (\cos x)^{VI} = (-\sin x)' = -\cos x \Rightarrow (\cos x)^{VII} = (-\cos x)' = \sin x \Rightarrow (\cos x)^{VIII} = (\sin x)' = \cos x$

$f'(x)_{x=x_0} = (\cos x)' = 0 \Rightarrow f''(x)_{x=x_0} = (\cos x)'' = -1 \Rightarrow f'''(x)_{x=x_0} = (\cos x)''' = 0 \Rightarrow f^{IV}(x)_{x=x_0} = (\cos x)^{IV} = 1$

$f^{V}(x)_{x=x_0} = (\cos x)^{V} = 0 \Rightarrow f^{VII}(x)_{x=x_0} = (\cos x)^{VI} = -1 \Rightarrow f^{VIII}(x)_{x=x_0} = (\cos x)^{VIII} = 0 \Rightarrow f^{VIII}(x)_{x=x_0} = (\cos x)^{VIII} = 1$

$(\sin x)' = \left(x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \frac{x^9}{9!}...\right)' = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \frac{x^8}{8!}.$

$(\cos x)' = \left(1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \frac{x^8}{8!}...\right)' = -x + \frac{x^3}{3!} - \frac{x^5}{5!} + \frac{x^7}{7!} - \frac{x^9}{9!}.... = -\left(x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \frac{x^9}{9!}...\right)$

$$f(x)=f(x_0)+f'(x)_{x=x_0}(x-x_0)+\frac{f''(x)_{x=x_0}(x-x_0)^2}{2!}+\frac{f'''(x)_{x=x_0}(x-x_0)^3}{3!}+\frac{f''''(x)_{x=x_0}(x-x_0)^4}{4!}+....$$

$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \frac{x^9}{9!}.... \Rightarrow \cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \frac{x^8}{8!}.....$

$e^{ix} \Rightarrow e^{i0} = 1$

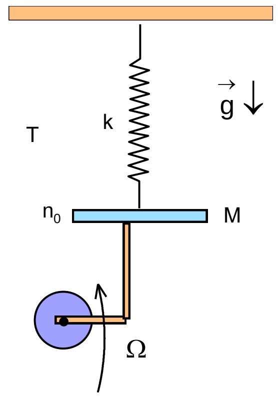
$(e^{ix})' = ie^{ix} \Rightarrow (e^{ix})'' = (ie^{ix})' = -e^{ix} \Rightarrow (e^{ix})''' = (-e^{ix})' = -ie^{ix} \Rightarrow (e^{ix})^{IV} = (-ie^{ix})' = e^{ix}$

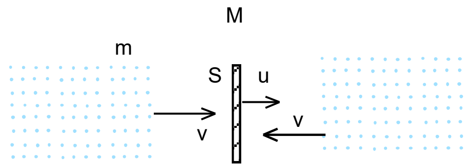
$(e^{ix})^{V} = (e^{ix})' = ie^{ix} \Rightarrow (e^{ix})^{VI} = (ie^{ix})' = -e^{ix} \Rightarrow (e^{ix})^{VII} = (-e^{ix})' = -ie^{ix} \Rightarrow (e^{ix})^{VIII} = (-ie^{ix})' = e^{ix}$

$f'(x)_{x=x_0} = (e^{ix})' = i \Rightarrow f''(x)_{x=x_0} = (e^{ix})'' = -1 \Rightarrow f'''(x)_{x=x_0} = (e^{ix})''' = -i \Rightarrow f^{IV}(x)_{x=x_0} = (e^{ix})^{IV} = 1$

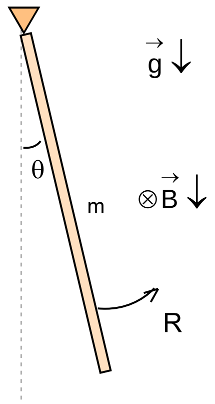
$f^{V}(x)_{x=x_0} = (e^{ix})^{V} = i \Rightarrow f^{VII}(x)_{x=x_0} = (e^{ix})^{VI} = -1 \Rightarrow f^{VIII}(x)_{x=x_0} = (e^{ix})^{VIII} = -i \Rightarrow f^{VIII}(x)_{x=x_0} = (e^{ix})^{VIII} = 1$

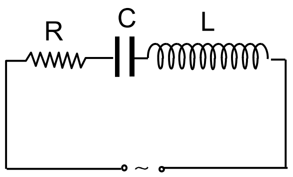
$e^{ix} = 1 + ix - \frac{x^2}{2!} - i\frac{x^3}{3!} + \frac{x^4}{4!} + i\frac{x^5}{5!} - \frac{x^6}{6!} - i\frac{x^7}{7!} + \frac{x^8}{8!} + ... = \left(1 - \frac{x^2}{2!} - \frac{x^4}{4!} - \frac{x^6}{6!} - \frac{x^8}{8!} + ...\right) + i\left(x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + ...\right) = \cos x + i\sin x$





$$v = \sqrt{\frac{3kT}{m}}$$





$$U = U_0 \sin \Omega t$$

$$\Delta N_1 = \frac{n_0 S(v+u)\Delta t}{6} \Rightarrow \Delta N_2 = \frac{n_0 S(v-u)\Delta t}{6} \Rightarrow \Delta N = \frac{n_0 S v \Delta t}{6}$$

$$\Delta p_1 = 2m(v+u).\frac{n_0 S(v+u)\Delta t}{6} = \frac{m n_0 S(v+u)^2 \Delta t}{3} \Rightarrow \Delta p_1 = 2m(v-u).\frac{n_0 S(v-u)\Delta t}{6} = \frac{m n_0 S(v-u)^2 \Delta t}{3}$$

$$F_1 = \frac{\Delta p_1}{\Delta t} = \frac{m n_0 S(v+u)^2}{3} \Rightarrow F_2 = \frac{\Delta p_2}{\Delta t} = \frac{m n_0 S(v-u)^2}{3}$$

$$F = F_1 - F_2 = \frac{m n_0 S(v+u)^2}{3} - \frac{m n_0 S(v-u)^2}{3} = \frac{m n_0 S\left[\left(v^2+2vu+u^2\right)-\left(v^2-2vu+u^2\right)\right]}{3} = \frac{4 m n_0 S v u}{3} = \chi u = \chi \dot{x}$$

$$ma = -kx - \chi\dot{x} \Rightarrow \ddot{x} + \frac{\chi}{m}\dot{x} + \frac{k}{m}x = 0 \Rightarrow \ddot{x} + \beta\dot{x} + \omega_0^2 x = 0 \Rightarrow \beta = \frac{\chi}{m} \Rightarrow \omega_0^2 = \frac{k}{m}$$

$$x = Ae^{-\gamma t}\cos\omega t \Rightarrow \dot{x} = -\gamma Ae^{-\gamma t}\cos\omega t - \omega Ae^{-\gamma t}\sin\omega t$$

$$\ddot{x} = \gamma^2 Ae^{-\gamma t}\cos\omega t + \omega\gamma Ae^{-\gamma t}\sin\omega t + \omega\gamma Ae^{-\gamma t}\sin\omega t - \omega^2 Ae^{-\gamma t}\cos\omega t = \gamma^2 Ae^{-\gamma t}\cos\omega t + 2\omega\gamma Ae^{-\gamma t}\sin\omega t - \omega^2 Ae^{-\gamma t}\cos\omega t$$

$$\gamma^2 Ae^{-\gamma t}\cos\omega t + 2\omega\gamma Ae^{-\gamma t}\sin\omega t - \omega^2 Ae^{-\gamma t}\cos\omega t + \beta\left(-\gamma Ae^{-\gamma t}\cos\omega t - \omega Ae^{-\gamma t}\sin\omega t\right) + \omega_0^2 Ae^{-\gamma t}\cos\omega t = 0$$

$$\gamma^2\cos\omega t + 2\omega\gamma\sin\omega t - \omega^2\cos\omega t + \beta\left(-\gamma\cos\omega t - \omega\sin\omega t\right) + \omega_0^2\cos\omega t = 0 \Rightarrow \gamma^2\cos\omega t + 2\omega\gamma\sin\omega t - \omega^2\cos\omega t - \beta\gamma\cos\omega t - \beta\omega\sin\omega t + \omega_0^2 c$$

$$\left(\gamma^2 - \omega^2 - \beta\gamma + \omega_0^2\right)\cos\omega t + \left(2\omega\gamma - \beta\omega\right)\sin\omega t = 0 \Rightarrow 2\gamma - \beta = 0 \Rightarrow \gamma = \frac{\beta}{2}$$

$$\gamma^2 - \omega^2 - \beta\gamma + \omega_0^2 = 0 \Rightarrow \frac{\beta^2}{4} - \omega^2 - \frac{\beta^2}{2} + \omega_0^2 = 0 \Rightarrow \omega = \sqrt{\omega_0^2 - \frac{\beta^2}{4}} = \omega_0\sqrt{1 - \frac{\beta^2}{4\omega_0^2}} = \omega_0\left(1 - \frac{\beta^2}{8\omega_0^2}\right) = \omega_0 - \frac{\beta^2}{8\omega_0}$$

$$f(x) = f(x_0) + f'(x)_{x=x_0}(x-x_0) + \frac{f''(x)_{x=x_0}(x-x_0)^2}{2!} + \frac{f'''(x)_{x=x_0}(x-x_0)^3}{3!} + \frac{f''''(x)_{x=x_0}(x-x_0)^4}{4!} + \ldots.$$

$$\tan x \Rightarrow \tan 45 = 1$$

$$(\tan x)' = \frac{1}{\cos^2 x} \Rightarrow (\tan x)'' = \left[(\cos x)^{-2}\right]' = -2(\cos x)^{-3}.(-\sin x) = \frac{2\sin x}{\cos^3 x} \Rightarrow (\tan x)''' = \left(\frac{2\sin x}{\cos^3 x}\right)' = 2.\frac{\cos^4 x + 3\cos^2 x\sin^2 x}{\cos^6 x}$$

$$\tan x = 1 + 2\left(x - \frac{\pi}{4}\right) + 2\left(x - \frac{\pi}{4}\right)^2 + 16\left(x - \frac{\pi}{4}\right)^3 + \ldots$$