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$$\begin{cases} \dfrac{\partial \mathcal{L}}{\partial \varphi} - \dfrac{d}{dt}\dfrac{\partial \mathcal{L}}{\partial \dot{\varphi}} = 0, \\ \dfrac{\partial \mathcal{L}}{\partial z} - \dfrac{d}{dt}\dfrac{\partial \mathcal{L}}{\partial \dot{z}} = 0, \\ \varphi(0) = \varphi_0, \\ \dot{\varphi}(0) = \omega_0, \\ z(0) = z_0, \\ \dot{z}(0) = v_0 \end{cases}$$

$$A\cos\omega t + B\sin\omega t.$$

$$x(t) = A\cos\omega t.$$

$$\ddot{x} = -\omega^2 x.$$

$$a = \ddot{x} = -\omega^2 x.$$

$$v = \frac{dx}{dt} = \dot{x}, \qquad a = \frac{dv}{dt} = \frac{d^2x}{dt^2} = \ddot{x}.$$

$$\begin{cases} \ddot{x} = -\omega^2 t, \\ x(0) = A, \\ \dot{x}(0) = 0. \end{cases}$$

$$x(t) = A\cos\omega t.$$

$$\varphi(0) = 0.$$

$$\varphi = \operatorname{arctg}\frac{x}{y}.$$