

1.1

O주차 - X, X

관성계 : 절대 좌표계 (x, y, z)

비관성계 : 회전좌표계 (x', y', z') 극좌표 (r, θ, z)

$(x, y, z) \rightarrow (r, \theta, z)$

수평 방향은 정역학 평형 상태에 있으므로, $(x, y) \rightarrow (r, \theta)$

$$\vec{F} = F_x \hat{i} + F_y \hat{j}$$

$$F_x = m \frac{d^2 x}{dt^2} \quad F_y = m \frac{d^2 y}{dt^2}$$

$$(x, y) = (r \cos \theta, r \sin \theta)$$

$$F_r = F_x \cos \theta + F_y \sin \theta = m \left(\frac{d^2 x}{dt^2} \cos \theta + \frac{d^2 y}{dt^2} \sin \theta \right)$$

$$F_\theta = F_y \cos \theta - F_x \sin \theta = m \left(\frac{d^2 y}{dt^2} \cos \theta - \frac{d^2 x}{dt^2} \sin \theta \right)$$

1.2

O주차 - X, X

$$x = r \cos \theta$$

$$\frac{dx}{dt} = \cos \theta \frac{dr}{dt} - r \sin \theta \frac{d\theta}{dt}$$

$$\frac{d^2x}{dt^2} = \cos \theta \frac{d^2r}{dt^2} - \sin \theta \frac{dr}{dt} - \sin \theta \frac{dr}{dt} \frac{d\theta}{dt} - r \cos \theta \frac{d^2\theta}{dt^2}$$

$$y = r \sin \theta$$

$$\frac{dy}{dt} = \sin \theta \frac{dr}{dt} + r \cos \theta \frac{d\theta}{dt}$$

$$\frac{d^2y}{dt^2} = \sin \theta \frac{d^2r}{dt^2} + \cos \theta \frac{dr}{dt} + \cos \theta \frac{dr}{dt} \frac{d\theta}{dt} - r \sin \theta \frac{d^2\theta}{dt^2}$$

정리하면,

$$F_r = m \left[\frac{d^2r}{dt^2} - r \left(\frac{d\theta}{dt} \right)^2 \right]$$

$$F_\theta = m \left[r \frac{d^2\theta}{dt^2} + 2 \frac{dr}{dt} \frac{d\theta}{dt} \right]$$

1.3

O주차 - X, X

$$F_r = F_x \cos \theta + F_y \sin \theta = m \left(\frac{d^2 x}{dt^2} \cos \theta + \frac{d^2 y}{dt^2} \sin \theta \right)$$

$$F_\theta = F_y \cos \theta - F_x \sin \theta = m \left(\frac{d^2 y}{dt^2} \cos \theta - \frac{d^2 x}{dt^2} \sin \theta \right)$$

$$\begin{aligned} \frac{d^2 x}{dt^2} &= \cos \theta \frac{d^2 r}{dt^2} - \sin \theta \frac{dr}{dt} - \sin \theta \frac{dr}{dt} \frac{d\theta}{dt} - r \cos \theta \frac{d^2 \theta}{dt^2} \\ \frac{d^2 y}{dt^2} &= \sin \theta \frac{d^2 r}{dt^2} + \cos \theta \frac{dr}{dt} + \cos \theta \frac{dr}{dt} \frac{d\theta}{dt} - r \sin \theta \frac{d^2 \theta}{dt^2} \end{aligned}$$

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$$F_r = m \left[\frac{d^2 r}{dt^2} - r \left(\frac{d\theta}{dt} \right)^2 \right]$$

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1.4

O주차 - X, X

$$\frac{d\theta}{dt} = \Omega, \quad r \frac{d\theta}{dt} = r\Omega, \quad u_\theta, \quad \frac{dr}{dt} = v_r$$

$$\frac{d}{dt} r^2 \Omega = 2r \frac{dr}{dt} \Omega + r^2 \frac{d\Omega}{dt}$$

$$= r \left(r \frac{d\Omega}{dt} + 2 \frac{dr}{dt} \Omega \right)$$

$$r F_\theta = m \frac{d}{dt} (r^2 \Omega) \quad r^2 \Omega = \text{const}$$

$$r (r\Omega) = r u_\theta = \text{const}$$

$$R_1 v_1 = R_2 v_2$$

1.5

O주차 - X, X

$$dV = dx \cdot dy \cdot dz$$

x 방향

$$F_x = P \cdot \Delta y \cdot \Delta z - (P + \Delta P) \Delta y \cdot \Delta z$$

$$F_x = -\Delta P \cdot \Delta y \cdot \Delta z$$

$$\frac{\Delta y}{\Delta x} = \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

$$f'(x) = \lim_{\Delta x \rightarrow 0} \frac{\Delta y}{\Delta x} = \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

$$z = f(x, y), y = b \text{ (constant) } //$$

$$\frac{\partial z}{\partial x} = \lim_{\Delta x \rightarrow 0} \frac{\Delta z}{\Delta x} = \frac{f(x + \Delta x, b) - f(x, b)}{\Delta x}$$

$$\frac{\partial z}{\partial y} = \lim_{\Delta y \rightarrow 0} \frac{\Delta z}{\Delta y} = \frac{f(y + \Delta y, b) - f(y, b)}{\Delta y}$$

$$\Delta z = \frac{\partial z}{\partial x} \Delta x + \frac{\partial z}{\partial y} \Delta y$$

$$dz = \frac{\partial z}{\partial x} dx + \frac{\partial z}{\partial y} dy$$

1.5

O주차 - X, X

$$\Delta T = \frac{\partial T}{\partial t} \Delta t + \frac{\partial T}{\partial x} \Delta x + \frac{\partial T}{\partial y} \Delta y + \frac{\partial T}{\partial z} \Delta z$$

$$F_x = -\Delta P \cdot \Delta y \cdot \Delta z = \frac{\partial P}{\partial x} \cdot \Delta x \cdot \Delta y \cdot \Delta z$$

$$\rho = \frac{m}{\Delta x \cdot \Delta y \cdot \Delta z}$$

$$\frac{F_x}{m} = -\frac{1}{\rho} \frac{\partial P}{\partial x}$$

$$\frac{F}{m} = -\frac{1}{\rho} \left(\frac{\partial P}{\partial x} i + \frac{\partial P}{\partial y} j + \frac{\partial P}{\partial z} k \right) = -\frac{1}{\rho} \nabla P$$

asdf

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O주차 - X, X

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2016 이산구조

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경기과학고등학교

AC

2018년 9월 21일

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1.2

O주차 - X, X

$$\begin{aligned}x &= r \cos \theta, \quad \frac{dx}{dt} = \cos \theta \frac{dr}{dt} - r \sin \theta \frac{d\theta}{dt}, \\ \frac{d^2x}{dt^2} &= \cos \theta \frac{d^2r}{dt^2} - \sin \theta \frac{dr}{dt} - \sin \theta \frac{dr}{dt} \frac{d\theta}{dt} - r \cos \theta \frac{d^2\theta}{dt^2} \\ y &= r \sin \theta, \quad \frac{dy}{dt} = \sin \theta \frac{dr}{dt} + r \cos \theta \frac{d\theta}{dt}, \\ \frac{d^2y}{dt^2} &= \sin \theta \frac{d^2r}{dt^2} + \cos \theta \frac{dr}{dt} + \cos \theta \frac{dr}{dt} \frac{d\theta}{dt} - r \sin \theta \frac{d^2\theta}{dt^2}\end{aligned}$$

정리하면,

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$$= r \left(r \frac{d\Omega}{dt} + 2 \frac{dr}{dt} \Omega \right)$$

$$y = r \sin \theta, \quad \frac{dy}{dt} = \sin \theta \frac{dr}{dt} + r \cos \theta \frac{d\theta}{dt},$$

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오주차 - x, x

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