

Exercise 1.11 (p.13): Generalized force in polar coordinates

$$Q_\alpha = \sum_{i=1}^{3N} F_i \frac{\partial x_i}{\partial q_\alpha}$$

Generalized coordinates: r, θ

$$x = r \cos \theta$$

$$y = r \sin \theta$$

$$Q_r = F_x \frac{\partial x}{\partial r} + F_y \frac{\partial y}{\partial r} = F_x \cos \theta + F_y \sin \theta \quad Q_\theta = F_x \frac{\partial x}{\partial \theta} + F_y \frac{\partial y}{\partial \theta} = -F_x r \sin \theta + F_y r \cos \theta$$

Generalized coordinate is a position
Generalized force is a force

Generalized coordinate is an angle
Generalized force is a torque