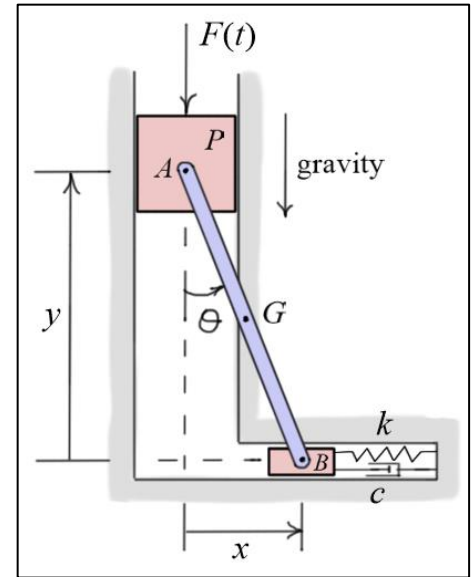


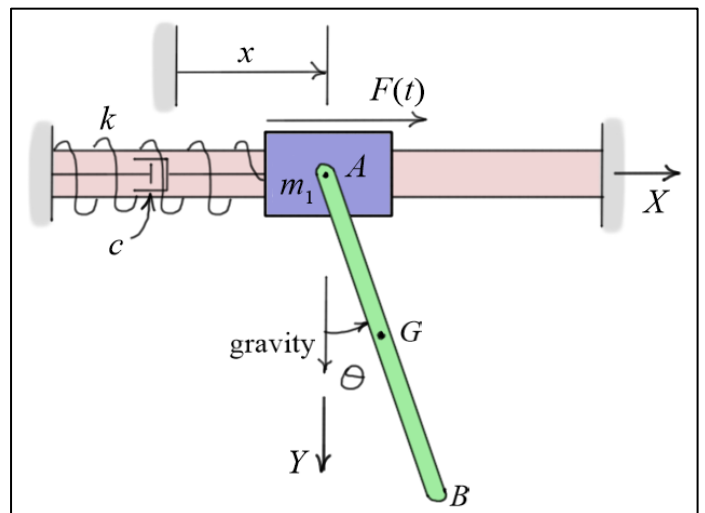
Intermediate Dynamics

Exercises #11: Lagrange's Equations with Configuration Constraints

1. In Exercises #8, the equation of motion of the system shown was found using a single generalized coordinate θ . Using Lagrange's equations, formulate the equations of motion of the system using the set of **constrained generalized coordinates** (x, y, θ) . Then differentiate the constraint equations to put them into the form of second-order, ordinary differential equations. There will be **five** differential equations in all. The equations will contain **five variables**: three generalized coordinates (x, y, θ) and two Lagrange multipliers (λ_1, λ_2) .



2. In Exercises #8, the equations of motion of the system shown were found using the generalized coordinates θ and x . Using Lagrange's equations, formulate the equations of motion of the system using the set of **constrained generalized coordinates** (x, x_G, y_G, θ) . Here, the coordinates (x_G, y_G) represent the X and Y coordinates of G relative to point A . Then differentiate the constraint equations to put them into the form of second-order, ordinary differential equations.



There will be **six differential equations** in all. The equations will contain **six variables**: four generalized coordinates (x, x_G, y_G, θ) and two Lagrange multipliers (λ_1, λ_2) .