University of Maryland- College Park

ENPM662 Introduction to Robot Modeling - Fall 2021

Homework - 1

Total - 50

For the problems from 1 to 3 given below, find the x, x' and x'' for the respective time t1, t2, and t3 as per the graph. Here x is the position, x' is the velocity, and x'' is the acceleration.
Notes:

1. You can assume that the static, kinetic, and limiting friction values to be the same.
2. The force at time t1 is the same as the force at time t2.
3. The mass M should be considered for calculating the positional data. The value of position should be where mass M is at that instant. For example, when two masses (M, m) are together and even when the mass m falls out from the top of the mass M.
4. To solve problem three you should use the energy method.

Draw free-body diagrams to show your solutions. Show your work to get full credits.

Problem 1)

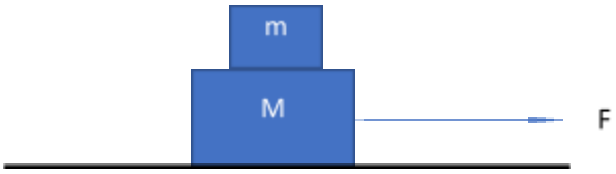
10

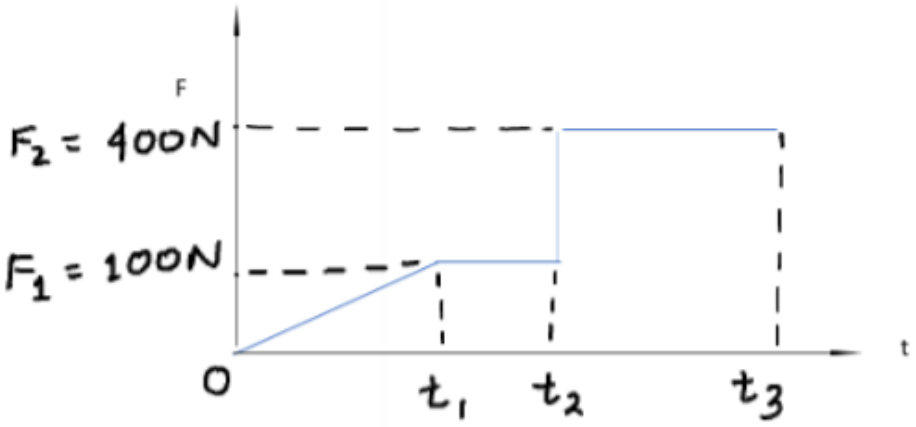
Mass M = 20 kg and mass m = 10 kg

g = 10 ms^{-2}, t1= 10 secs, t2= 15 secs and t3 = 25 secs

μ_1= Friction between two objects: M and m = 0.6

μ_2= Friction between object M and ground = 0.4





Problem 2)

10

Mass M = 20 kg and mass m = 10 kg

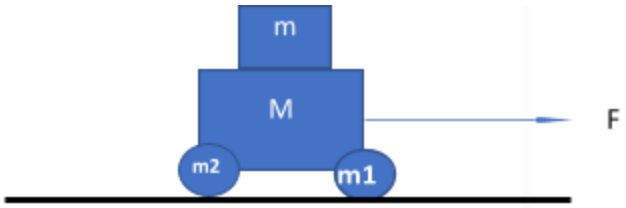
g = 10 ms^{-2}, t1= 10 secs, t2= 15 secs and t3 = 25 secs

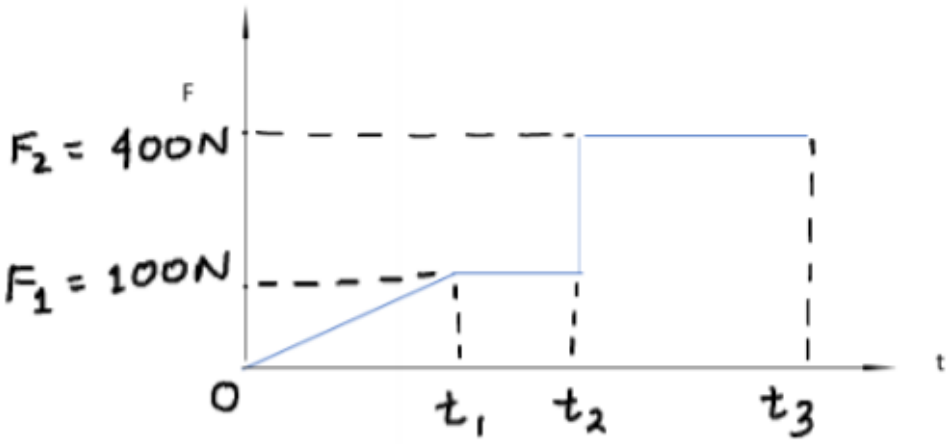
Wheels masses: m1 = m2 = m3 = m4 = 1kg

μ_1= Friction between two objects: M and m = 0.6

μ_2= 0

Moment of inertia of the wheels = I=0





Problem 3)

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Mass M = 20 kg and mass m = 10 kg

g = 10 ms^{-2}, t1= 10 secs, t2= 15 secs and t3 = 25 secs

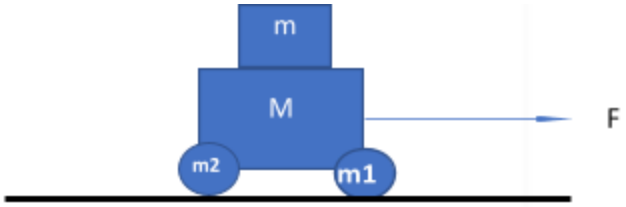
Wheels masses: m1 = m2 = m3 = m4 = 1kg

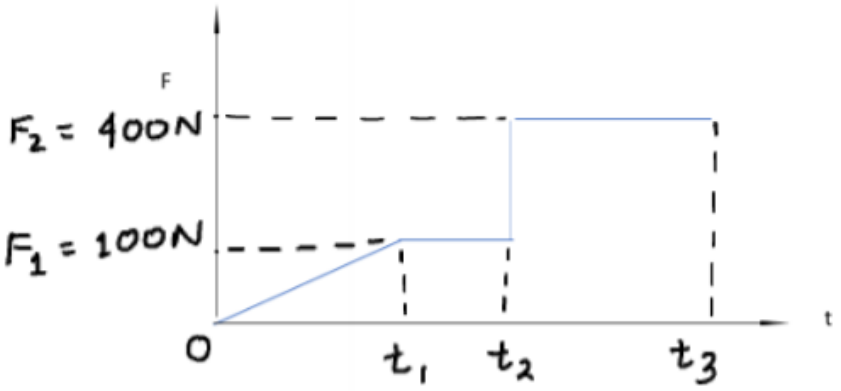
μ_1= Friction between two objects: M and m = 0.6

μ_2= Friction between object M and ground = 0.4

Radius of the wheels (m1, m2, m3, m4) = R = 0.02m

Moment of inertia = I





Problem 4)

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Consider the figure below. Find the following homogeneous transformations between frames:H_1^0, H_2^0,and H_2^1. Then show that $H_2^0 = H_1^0 H_2^1$.