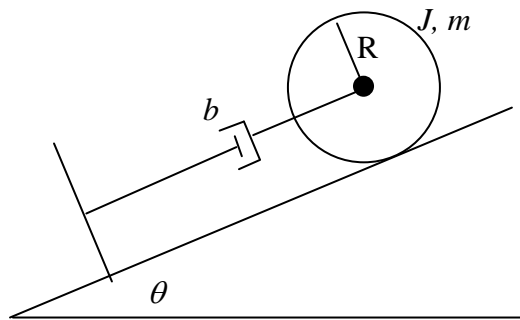


MECH 3140
Homework #2
(Problems should be worked by Monday, 1/23/12)

1. Chapter 1, Problems 1.6, 1.7, 1.8
2. Chapter 2, Problems 2.2, 2.5, 2.7, 2.8

Matlab Assignment (Due Friday 1/27/12 in class).

A wheel attached to a linear damper rolls without slipping as shown. Assume the wheel starts from rest.



- a) Draw the FBD of the system
- b) Set up the differential equations that define the system above. Solve the differential equation to provide the solution of $v(t)$. In Matlab, numerically integrate the differential equations to simulate the system and determine $v(t)$ (There is a page on the website to help set this up – if you have questions come see me). What did you pick for Δt ? Why?

Assume the following values:

$m=100$ kg
 $J= 20$ kg-m²
 $R=0.3$ m
 $\theta=30$ degrees
 $b=200$ Ns/m

- c) Plot the analytical solution vs. the numerical integration on one plot (use solid and dashed lines with a legend, and label your axis – all in Matlab. There is a page on the website on how to do this as well.).

d) Now let's assume instead of the damper the wheel is subjected to air drag ($F_{ad}=Dv^2$). Find the value of D to provide the same steady state velocity as before. What is the value of D ?

e) Now plot on the same plot the solution to this new differential equation and the solution to the differential equation from part (b).

Note: Solve the problem symbolically. Place all of your equations in Matlab in symbol form. Then at the beginning of your script assign values for all of your symbols – this is part of the power of Matlab – you can change the value of “ m ” at the top without having to rewrite all of your equations! I will grade your m-file and how your script is set-up so do this correctly!

Format of Matlab Homework Solution (to turn in)

1. Handwritten Work

a. Free body diagrams

b. Derivation of equation of motion

c. Answer to any questions in the assignment

d. 1-2 sentences on what you learned from this assignment (or what was being conveyed by the assignment).

2. Printout of Plots

3. Printout of m-file