ADAMS Assignment 1

ME451: Kinematics and Dynamics of Machine Systems
Turning in Your Assignment

- Place all files in a directory called “lastName_ADAMS_01”
- zip that directory
- Drop the resulting file “lastName_ADAMS_01.zip” in the appropriate Dropbox Folder (ADAMS_01) at Learn@UW
Problem Definition

1. Using ADAMS, find the displacement, velocity, and acceleration of a ball (mass = 1 kg) after 3 seconds, when the ball falls freely under gravity. (Assume no aerodynamic drag forces)

2. Compare the ADAMS results with the analytical solution. Show all the calculations.
ADAMS Startup

- Start ADAMS/View.
- In the Welcome dialog box
  - Under the heading, **How would you like to proceed**, select **Create a new model**.
  - Set some working directory where all the ADAMS related files will be saved.
    - E.g. I:\ME451\AdamsDir
  - Name the model **falling_ball**.
  - Verify that **Gravity** is set to **Earth Normal (-Global Y)**.
  - Verify that **Units** are set to **MMKS - mm, Kg, N, s, deg**.
- Select **OK**.
**ADAMS Toolbox**

- **To create a ball:**
  - Use the **Sphere** tool to create a ball part with a 50 mm radius and its center at the global origin. You'll also rename the part and set its mass to 1 kg.
  - To view the coordinates as you create the sphere so you know its size, from the **View** menu, select **Coordinate Window**.
  - From the Main Toolbox, right-click the **Rigid Body** tool stack, and then select the **Sphere** tool.
  - Follow the Status bar instructions and pick the center of the sphere at the global origin, then drag the cursor until you create a sphere with a **50 mm** radius or check the radius box and type in 50mm for the radius.

Check the radius and type **50.0**

Then click on the sphere tool.
Modify the body

- To rename the ball:
  - Right-click the sphere, point to `Part:PART_“number”`, and then select **Rename**.
  - In the **New Name** text box, enter `.falling_ball.Ball`, and then select **OK**.

- To set the mass to 1 kg:
  - Right-click the sphere, point to **Part:Ball**, and then select **Modify**.
  - In the **Define Mass by** text box, select **User Input**.
  - If an alert box opens, select **Close**.
  - In the **Mass** text box, enter **1.0**.
  - Select **OK**.
Create measurements

- Create measures for the falling stone
  - To calculate the vertical displacement, velocity, and acceleration of the ball’s cm marker in the Y direction, you’ll create three object (part) measures. You’ll set Y as the component to measure.

- To calculate the displacement of the stone in the Y direction:
  - Right-click the sphere, point to Part:Ball, and then select Measure.
  - In the Measure Name text box, enter displacement.
  - Set Characteristic to CM position.
  - Set Component to Y.
  - Select Create Strip Chart.
  - Select OK.
  - A measure stripchart appears. It is empty because you need to run a simulation before ADAMS/View has the necessary information for the stripchart.
Measures, con’t

- To calculate the velocity of the ball in the Y direction:
  - Right-click the sphere, point to Part:Ball, and then select Measure.
  - In the Measure Name text box, enter velocity.
  - Set Characteristic to CM velocity.
  - Set Component to Y.
  - Select Create strip chart.
  - Select OK.

- To calculate the acceleration of the ball in the Y direction:
  - Follow the instructions above but set Measure Name to acceleration, and Characteristic to CM acceleration.
Verify the model

- Verify the model
  - Now you’ll verify the model. When you verify the model, ADAMS/View checks for error conditions, such as misaligned joints, unconstrained parts, or massless parts in dynamic systems and alerts you to other possible problems in the model.

- To verify the model:
  - In the bottom right corner of the Status bar, right-click the Information tool stack, and then select the Verify tool.
  - In the Information window, check that the model has verified successfully.
  - Close the Information window.
View Control

- Set up and run a simulation
  - Now you’ll zoom out the display so that the falling ball is clearly visible while it simulates. You’ll then simulate it for 3 seconds with 150 steps.

- To zoom out:
  - Select the **Select** tool to display the view control options in the toolbox.
  - Select the **Zoom** tool, and then click and drag the mouse to zoom out until the entire working grid is visible.
  - Select the **Translate** tool, and then drag the working grid to the top of the screen.
Run the simulation

- To run a simulation for 3 seconds:
  - In the Main Toolbox, select the Simulation tool.
  - In the End Time text box, enter 3.0 and in the Steps text box, enter 150.
  - Select the Play tool.
  - As the stone falls, ADAMS/View plots the corresponding data on the displacement, velocity, and acceleration graphs.
  - When the simulation ends, reset the model to the input, or design configuration by selecting the Reset tool.
  - Animate the simulation to replay the simulation without simulating again.
To find the values of displacement, velocity, and acceleration:
- Now you’ll use ADAMS/PostProcessor to find the stone’s displacement, velocity, and acceleration after 3 seconds.

To run ADAMS/PostProcessor:
- Right-click the blank area inside the stripchart .falling_ball.displacement, point to Plot:scht1, and then select Transfer to Full Plot.
- ADAMS/PostProcessor replaces the ADAMS/View window.

To find the value of the stone’s displacement:
- In ADAMS/PostProcessor, from the main toolbar, select the Plot Tracking tool .
- Because you want to know the final conditions after 3 seconds, move the cursor over the end point of the plot.
- In the area below the menu bar, the value of X is displayed as 3. Note the value of Y; this is your answer.
- Compare this value of Y with your analytical solution.
To find the value of the ball’s velocity after 3 seconds:

- Check the **Surf** box below the plot.
- This lets you view a selected measure without using the Add Curves button.
- Set **Source** to **Measures**.
- From the **Measure** list, select **velocity**.
- Because you want to know the final conditions after 3 seconds, move the cursor over the end point of the plot.
- In the area below the menu bar, the value of X is displayed as 3. Note the value of Y; this is your answer.
- Compare this value of Y with your analytical solution.
To find the value of ball’s acceleration after 3 seconds:

- Set **Source** to **Measures**.
- From the **Measure** list, select **acceleration**.
- To display the acceleration plot, select **Surf**.
- Because you want to know the final conditions after 3 seconds, move the cursor over the end point of the plot.
- In the area below the menu bar, the value of X will be displayed as 3. Note the value of Y; this is your answer.
- Compare this value of Y with your analytical solution.
- To return to ADAM/View and close all three plots, select the **ADAMS/View** tool.
What to turn in

To save your work:
- From Adams/View (not the postprocessor), select **File->Save database as...**, and then select **OK**.

Turn in:
1. 3 Plots: vertical displacement, velocity & acceleration (screenshots are fine)
2. Analytical calculations to verify the ADAMS plots