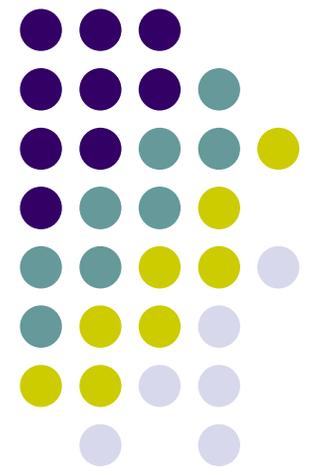
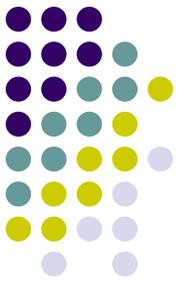


ADAMS Assignment 1

ME451: Kinematics and Dynamics of
Machine Systems
Fall 2011

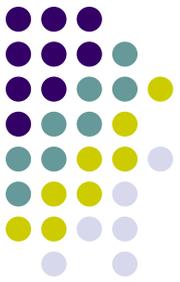


Problem Definition



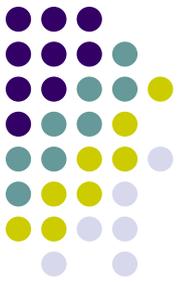
1. Using ADAMS, find the displacement, velocity, and acceleration of a ball (mass = 1 kg) after 3 seconds, when the ball falls freely under gravity (assume no aerodynamic drag forces).
2. Compare the ADAMS results with the analytical solution. Show all the calculations.

ADAMS Help

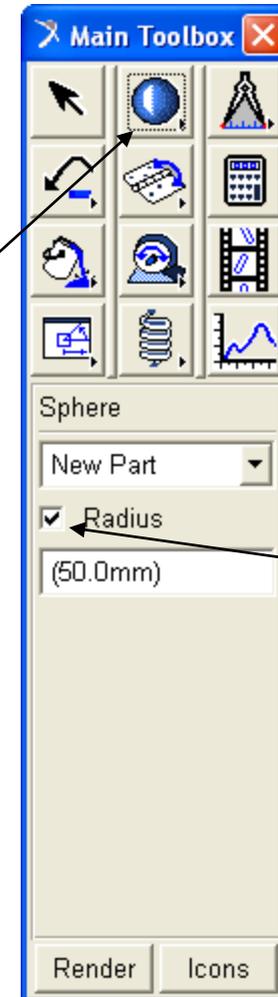


- Start ADAMS/View.
- In the Welcome dialog box
 - Under the heading, **How would you like to proceed**, select **Create a new model**.
 - Set some working directory where all the ADAMS related files will be saved.
 - e.g. I:\ME451\AdamsDir
 - Name the model **falling_ball**.
 - Verify that **Gravity**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

ADAMS Toolbox

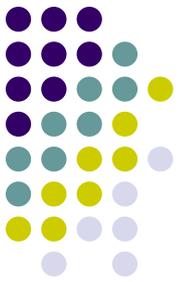


- To create a ball:
 - Use the **Sphere** tool to create a ball part with a 50 mm radius and its center at the global origin. You'll also rename the part and set its mass to 1 kg.
 - To view the coordinates as you create the sphere so you know its size, from the **View** menu, select **Coordinate Window**.
 - 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

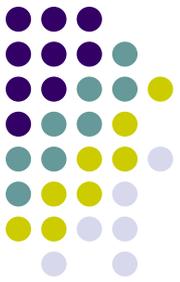
Then click on the sphere tool



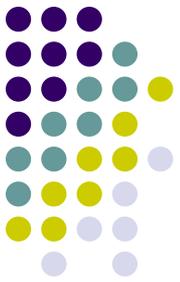
Modify the body

- 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.

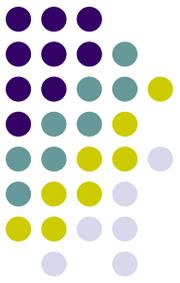


Measures con't

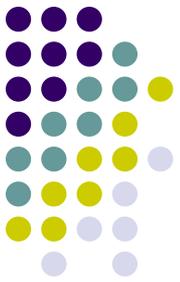
- To calculate the velocity of the ball in the Y direction:
 - Right-click the sphere, point to **Part:Ball**, and then select **Measure**.
 - In the **Measure Name** text box, enter **velocity**.
 - Set **Characteristic** to **CM velocity**.
 - Set **Component** to **Y**.
 - Select **Create strip chart**.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



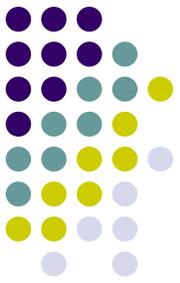
- Verify the model
 - Now you'll verify the model. When you verify the model, ADAMS/View checks for error conditions, such as misaligned joints, unconstrained parts, or massless parts in dynamic systems and alerts you to other possible problems in the model.
- To verify the model:
 - In the bottom right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

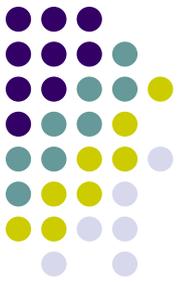
- Set up and run a simulation
 - Now you'll zoom out the display so that the falling ball is clearly visible while it simulates. You'll then simulate it for 3 seconds with 150 steps.
- To zoom out:
 - Select the **Select** tool  to display the view control options in the toolbox.
 - Select the **Zoom** 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



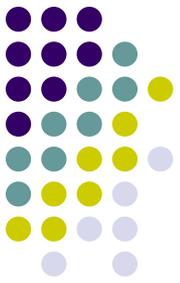
- To run a simulation for 3 seconds:
 - In the Main Toolbox, select the **Simulation** tool 
 - In the **End Time** text box, enter **3.0** and in the **Steps** text box, enter **150**.
 - Select the **Play** tool 
 - As the stone falls, ADAMS/View plots the corresponding data on the displacement, velocity, 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.

Review results



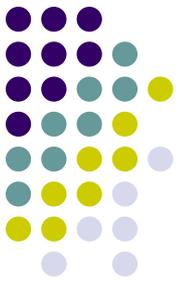
- To find the values of displacement, velocity, and acceleration:
 - Now you'll use ADAMS/PostProcessor to find the stone's displacement, velocity, and acceleration after 3 seconds.
- To run ADAMS/PostProcessor:
 - Right-click the blank area inside the stripchart **.falling_ball.displacement**, point 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.

Results con't

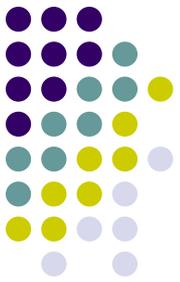


- To find the value of the ball's velocity after 3seconds:
 - Check the **Surf** box below the plot.
 - This lets you view a selected measure without using the Add Curves button.
 - Set **Source** to **Measures**.
 - From the **Measure** list, select **velocity**.
 - Because you want to know the final 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.

Results con't



- 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 the Adams/View (not postprocessor) **File** menu, select **Save database as...**, and then select **OK**.
- What to turn in
 1. 3 Plots: vertical displacement, velocity and acceleration (hint: use PrintScreen and paste into Paint or a program like XnView to quickly use screen captures of ADAMS plots)
 2. Analytical calculations to verify the ADAMS plots

Turn in w/ other homework problems