

1. **(75%)** Practice force and energy problems by completing WeBWorK set # 4.
2. **(25%)** In the software download area of the Physics 121 website (located at <http://teacher.pas.rochester.edu/phy121/Software/SoftwareIndex.htm>) you will find a movie that shows the launch of the space shuttle. Use LoggerPro to analyze this movie and answer the following questions:
 - a. What is the vertical acceleration of the space shuttle?
 - b. What is the force generated by the engines?

Use the following steps in this analysis:

- a. Download the movie clip from the Physics 121 website.
- b. Start LoggerPro.
- c. From the “Insert” menu, select “Movie” to open the movie you want to analyze.
- d. At the bottom right-hand side of the video window you see a button with red dots with allows you to “Enable/Disable Video Analysis”. Enable video analysis a set of tools will appear on the right-hand side of the video window.
- e. Select the ruler button to set the scale. Use the “ruler” on the right of the space shuttle to calibrate your screen. After selecting the ruler button you move your mouse to one end of the “ruler” in the video, click-and-hold your mouse button, move your mouse to the other end of the “ruler,” and release the mouse button. A window will emerge, asking you for the length the “green line” you just drew on the screen.
- f. Use the “red-green dot button” to add a “point series” and use the mouse to determine the position of one particular point on the space shuttle. Each time you select a position in a frame, the video will advance to the next frame.
- g. After completing your data entry you will see that the x and y positions and velocities for all frames are listed in the data table. These data can be exported by selecting “Export as Text” from the file menu. The file created can be opened with Excel and you can use Excel to plot for example the vertical velocity as function of time and determine the acceleration.

Hand in a graph showing the velocity of the shuttle as function of time and describe how you obtained the acceleration of the shuttle and the force generated by its engines. The answer to this questions needs to be dropped off in the Physics 121 homework locker in B&L, across from B&L 106. Please make sure your work is clearly labeled with your name.