

EXAM 3 – Working Model Simulation

NAME _____

SECTION NUMBER _____

CAMPUS MAILBOX NUMBER _____

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Problem 1 (50 points)

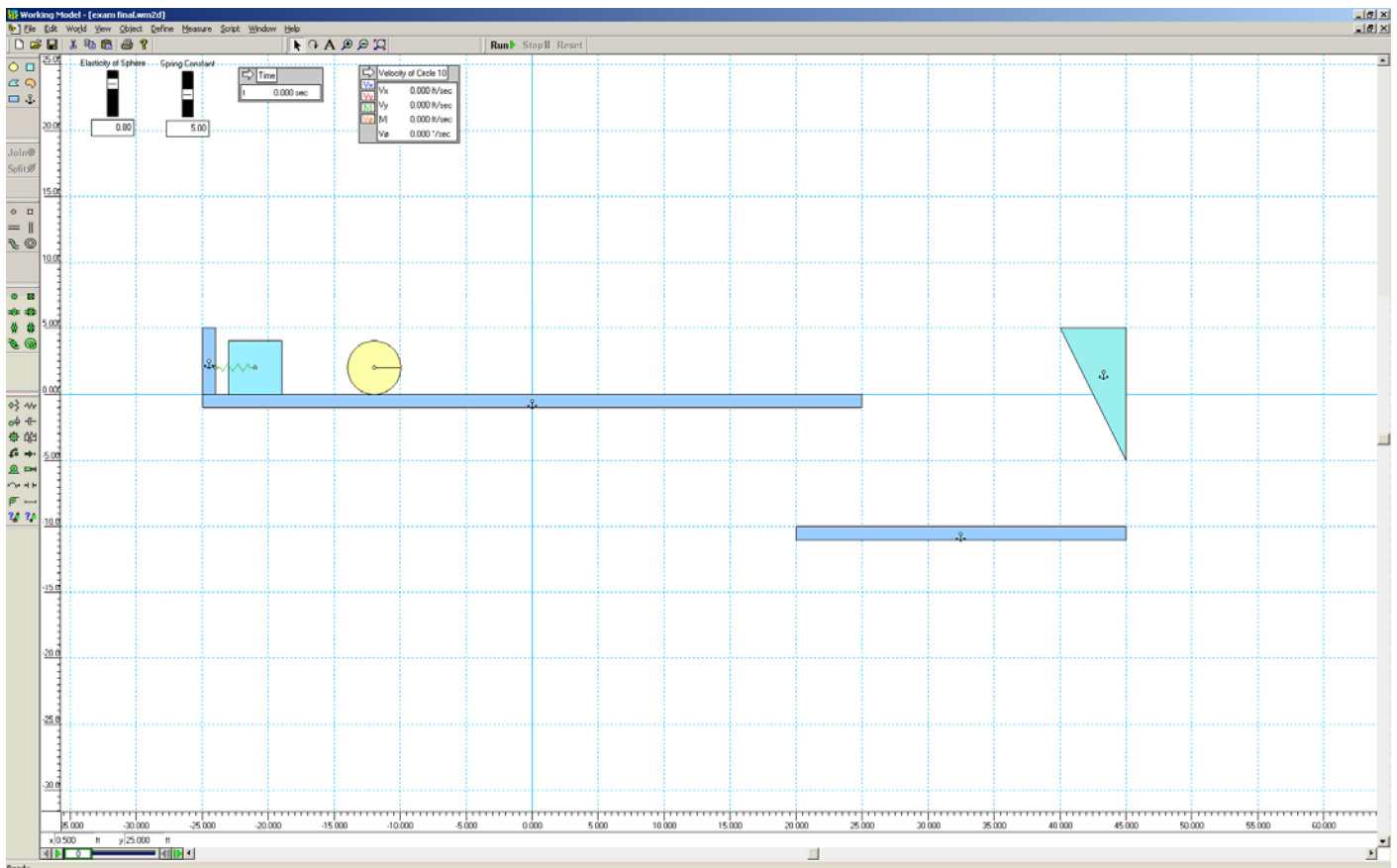
Open a new Working Model document. Name it *lastname_firstname.wm2d*.

For this problem, you must do the following:

1. Create the Working Model simulation shown in the figure below by following the instructions on Page 3 – 4.
2. Set the elasticity control of the sphere to be 0.8.
3. Set the spring constant of the linear spring to be 5 lb/ft.
4. Automatically terminate the simulation when the center of the sphere falls below $y = -15$ ft. Run the simulation and determine the termination time.
5. Enter this time on the blank line below the figure on this page.
6. Ask for your instructor to validate your simulation and answer by putting down his/her initials.
7. Upload your Working Model file to the DFS server (see instructions on the last page).

Time at which the sphere falls below $y = -15$ ft: _____

Instructor initials: _____



Instructions for Working Model simulation:

1. Properly set up your workspace to display the rulers, grid lines, and the x,y axes.
2. Choose the English unit system with pounds as the units for mass and feet as the units for distance.
3. Create 2 rectangular bodies to act as the floors. The rectangles should create floor surfaces along the following boundaries:
 - a. along $y = 0$ ft from $x = -25$ ft to 25 ft, with a height of 1 ft
 - b. along $y = -10$ ft from $x = 20$ ft to 45 ft with a height of 1 ft and an elastic coefficient of 0.40
4. Create another rectangular body to act as the stationary left wall with the right boundary along $x = -24$ ft and the top boundary along $y = 5$ ft.
5. Create a triangular body to act as a stationary rebounding surface with the following properties:
 - a. right boundary along $x = 45$ ft and a height of 10 ft
 - b. top boundary along $y = 5$ ft and a width of 5 ft
 - c. an elastic coefficient of 0.80
6. Create a 3D/sphere with the following properties:
 - a. radius of 2 ft and mass of 2 lb
 - b. elastic coefficient set by a slider control with a minimum value of 0 and a maximum value of 1
 - c. kinetic friction coefficient of 0.1
 - d. initial x -position of -12 ft, initial y -position of 2 ft
 - e. initially at rest
7. Create a square block with the following properties:
 - a. width of 4 ft
 - b. mass of 5 lb
 - c. elastic coefficient set by the same slider control of the sphere
 - d. initial x -position of -21 ft, initial y -position of 2.0 ft
 - e. initially x -velocity of -1 ft/sec, zero y -velocity
 - f. zero kinetic friction coefficient

8. Connect the center of the square block to the right edge of the stationary wall by a *horizontal* spring with the following properties:
 - a. linear force-extension behavior (*i.e.* $F = k x$)
 - b. spring constant set by a slider control with a minimum value of 0 lb/ft and a maximum value of 10 lb/ft
 - c. un-stretched length of 8.0 ft
9. Apply an external position-dependent force acting on the center of the sphere, in the positive x -direction, according to the following prescription:

$$F_x = 0.1 V_{x,\text{sphere}} \quad \text{when } x_{\text{sphere}} < 0 \text{ ft}$$
$$F_x = 0 \quad \text{when } x_{\text{sphere}} \geq 0 \text{ ft}$$

where $V_{x,\text{sphere}}$ denotes the x -velocity of the sphere.

10. Create a measure for time on the screen, so you can determine the time at which the center of the sphere reaches $y = -15$ ft.
11. Create a text-box measure for both the x and y velocity of the sphere.
12. Set the simulation accuracy such that it uses an animation step of 0.001s, an integrator error of 0.01ft, and the Kutta-Merson integrator with a fixed integration step of 0.001s.
13. Now return to the problem statement and complete the rest of the steps of the problem.

Instructions for submitting your files to the DFS server

When you are done, post your m-file to the correct folder:

1. Launch a Windows Explorer window by clicking on the folder icon menu bar at the bottom of your screen.
2. Click on the "DFS Root" folder in the upper left corner of the Explorer window
3. Double-click on Academic Affairs.
4. Double-click on ME.
5. Double-click on ME123.
6. Double-click on Exams.
7. Double-click on the folder with your section number.
8. Copy and paste your Working Model file (the *.wm2d file) to this folder.

NOTE: All Working Model work must stop at 8:30pm. You will have a few minutes after that to post your file if you need that time.