Union College Winter 2015

**Physics 120**

**Lab#8: Missions to Space, the Moon, and Mars**

**Part I: Satellite to pass behind the moon**

Download the VPython file “Lab8\_MissiontotheMoon.py” from Lab folder in Nexus, and right-click to Edit with IDLE.

Run the program.

Note that the video shows two spheres—a blue sphere for the Earth and yellow sphere for the Moon. These spheres are enlarged significantly to make them more visible. Note also that you can maximize the window – you will want to maximize this view almost every time you run the program.

Note in the Shell window you get an output that says

CRASH to EARTH

trip time (days)= 0

This program models the path of a satellite, which is launched from the Earth’s surface at a velocity given by “launchvel.” Note in the Edit window an input for this value near the very top of the program. The satellite will appear as a white sphere, just a little smaller than the Moon sphere (to make it visible), coming out of Earth. The satellite starts just barely above the surface of the Earth, on the right side (the side toward the Moon), but because of the enlargement of Earth’s sphere, you won’t see the satellite until it has moved a bit.

Your goal is to try different vector values of the initial launch velocity (running the program for each attempt) to determine, as best you can, the answers to the following questions:

1. What is the escape speed from the Earth’s surface, that is the minimum speed for the satellite to escape to infinity?

2. What is the minimum launch velocity that will get the satellite to loop around the Moon, as close as possible, and return to Earth. How does this velocity compare to the escape speed from the Earth’s surface that you found in #1.

3. How many days does this trip take? (see the printout in the Shell window)

3. What is the smallest number of days to complete this trip?

**Part II: Probe to Mars**

Download the VPython file “Lab8\_MissiontoMars.py” from Lab folder in Nexus, and right-click to Edit with IDLE.

Run the program and note that the visual shows the Sun (large yellow sphere in the middle,) Venus (green sphere at the top), the Earth (blue sphere to the left), and Mars (smaller red sphere at the bottom). As with the other program, you will want to maximize this window regularly. Also, these spheres are all greatly enlarged.

This program models the motion of a satellite launched from the Earth. The satellite, again, will appear as a white sphere (of the same size as the Mars sphere). The satellite starts on the bottom side of the Earth (i.e. on Earth’s leading edge, as it orbits).

In the Shell window you should see an output that says

energy input (J)= 0.0

CRASH to EARTH

time in seconds 60

trip time (years)= 1.89873417722e-06

By adjusting “launchvel” in this program determine the following.

1. What is smallest energy input to the satellite you need to get the satellite to reach Mars. What is this energy?

2. How long does this trip to Mars take?

Submit three programs to your instructor (one for the minimum launch velocity to pass by the Moon and return; one for the trip to the Moon with the smallest number of days, and one for the minimum energy trip to Mars).

**Part III: Morse Potential Energy Curve**

If you have extra time, download and Edit with IDLE the VPython program “Lab8\_MorsePotential.py.”

Run the program and watch the development of U(r) and then watch the movement of atoms in this potential, as the kinetic energy (blue line) and total Energy (white line) are calculated and shown.

1. Note the turn-around positions. What is the value of K at these points?

2. How do the locations of the maximum K and minimum U compare?

3. Does U + K = Etot everywhere?

4. How does U compare to Etot in the regions where K is not shown?

5. In the code, change the value of Etot, and run the program again. Does the U(r) curve change? Does the K curve change?

6. What value of Etot will break the bond?