1. A car is driving along a straight section of highway between Oklahoma City and Tulsa. At one point in time, the car is 30 miles from OKC. At a later point in time, it's 10 miles from OKC. What is its displacement?

2. An aircraft flies 20 km on a course of 030 degrees, then 30 km on a course of 270 degrees. What is its distance and bearing from its takeoff point? (Hints: Make a sketch. Convert flight legs to Cartesian vectors in standard position. See the "Overview of Vectors" handout.)

3. A snail travels for a year on a straight line, covering 1.5 km. What is its average velocity, in m/s?

4. The arresting cable on an aircraft carrier decelerates an airplane from 150 km/hr to zero in 3 s. What is the mean deceleration (negative acceleration), in gs?

5. A small powder charge propels a shoulder-launched antitank missile from its tube at 10 m/s. At 0.3 seconds after launch, the rocket motor ignites and accelerates the missile at 50m/s2. How far (from the tube) has the missile traveled after two seconds?

In the session long projects for this class, you will be asked to conduct experiments in a "virtual" laboratory.

Assignment

We will use the falling-ball simulation (Background: University of Oregon, n.d.) to calculate the acceleration of gravity on the Earth, Moon, and Mars.

The most general equation for displacement is

s = s0 + V0t + (1/2)at2

where

s = displacement after time t

s0 = initial displacement (location at t = 0)

V0 = initial velocity (velocity at t = 0)

t = elapsed time in seconds

a = acceleration in m/s2

If the object starts at point s0 = 0 with initial velocity V0 = 0, then the equation becomes

s = (1/2)at2

Solving for a in terms of s and t, we get

a = 2s/t2

For a freely falling object in a vacuum, a is the acceleration of gravity, g. If we record the time required for an object to fall a distance s in a time t, we can solve for g. Using the simulation, record the time required for the ball to fall 1, 2, 3, 4, 5, and 6 meters. Organize your results in a table, as follows (the first row has been completed for you). Round numbers to the nearest two decimals.

s (distance, m)

t (time, s)

2s

t2

(2s/t2)= g

1

0.44

2

0.19

10.33

2

3

4

5

6

Answer the following questions.

Why are all the number in the last column approximately the same?

Which of the six trials would probably yield the most accurate estimate for g? Why?

Compare your answer with the accepted value for g. How would you account for the discrepancy, if any?

Repeat the simulation for the Moon and Mars. Record your data in tables, as above. Compare your results with the accepted values for Lunar and Martian gravity (Google "Gravity on other planets.")