Exam #1: Newton's Laws and Equations of Motion

Name: _____

1) To not fall back to Earth, space shuttles must travel faster than 11 km/s. What is that speed in mph? (2 points)

2) Light travels at a constant speed of 3.0 x 10^8 m/s. The distance between the Earth and the Sun is 93 million miles, how long (in minutes) does it take for light to reach Earth? (3 points)

3) Based on the graph of position vs. time, what is the average velocity at 0.60 s? at 0.80 s? (4 points)

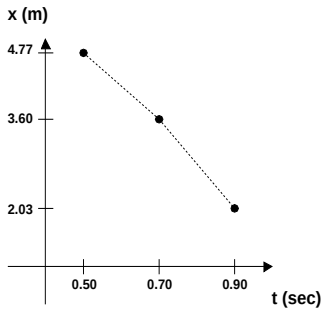

Figure 1: Plot of x vs. t for Problem #3.

4) As you are driving along I-235 in Des Moines at 65 mph, you witness a car accident directly in front of you. You break your car at a constant 40 mi/hr/s, what is the minimum distance you need to be to avoid hitting the cars in front of you? (3 points)

Figure 2: Diagram of the battle for Marye's Heights west of Fredricksburg, Virginia, December 1862. Used in Problems #5 and #6.

5) In the Civil War Battle of Fredricksburg in December of 1862, the Union made several charges on Marye's Heights west of the town. The hill is steep at 20°. Confederate cannon were mounted on the side of the hill with Confederate infantry 550 m below entrenched at the bottom of the hill. If the cannon were to shoot at 0 angle with the shells having a speed of 125 m/s, would they hit their own line? (4 points)

6) Continuing the problem from before. The union artillery placed guns 0.5 miles from Marye's Heights and attempted to shell the Confederate line at the bottom of the hill. If the muzzle velocity of the shells is 125 m/s, at what angle should the artillerists fire their guns? (4 points)

7) Consider a smooth (frictionless) incline that is tipped at an angle of 25° and has a maximum height of 36 cm. What is the minimum speed of a ball rolled up the incline which will reach the top of the incline? (4 points)

8) You are rearranging your carpeted office and drag your 45 kg file cabinet across the floor at a constant speed with a force of 200 N at an angle of 36° from the horizontal. Find the coefficient of kinetic friction between the file cabinet and the carpet. (4 points)

9) Suppose we modify the Newton's 2nd Law lab so that the (frictionless) air track is inclined at an angle of 35°. If the hanger has a mass of 50 g and the cart has a mass of 190 g, what is the acceleration of the cart? (4 points)