Physics 7A Section 1
Fall Semester 2003
First Midterm
Sept. 29, 2003 (6:10-7:40 pm)

Instructions

1. This is a **closed book** exam. You are allowed to bring along only one 3"x5" "cheat sheet", pens, pencils, scientific calculator, and blue books.
2. **Read all questions carefully.** Attempt the easiest ones first.
3. **Write your name, Discussion Section #, GSI name and SID#** on the top of all materials you intend to hand in and want to be graded.
4. While cleanliness and legibility of your hand-writing will not get your extra credit, they will help to make sure that your answers get the credit they deserve. In case you make mistakes be sure to cross them out so they will not be mistaken as your answer. It helps to put

a box or circle around your final answers.

5. **Partial credit**: You will get typically 90% of the total credit if you can either derive your equations or show how the equation you wrote down from your cheat sheet can be used to answer the question in terms of symbols you have defined. When you substitute numbers into these symbols to obtain a numerical answer, make sure that you specify also the units. On the other hand, a pure numerical answer without calculation to support it will get no credit.

You are provided with the following constants for your reference. There is no guarantee that they will all be required in solving the problems.

Useful Constant:

π=3.1416; g=9.803 m/s^2; 1 mile=1.61 Km; 1 mph=0.447 m/s;

Question 1 (total: 20 Points)

The advertisement for a sports car claims that the car can reach a speed of 60 miles per hour (mph) from rest in 6 seconds. A sports utility vehicle (SUV) advertisement claims that the car can reach a speed of 60 miles per hour (mph) in 13 seconds.

(a) Assuming that both cars can achieve *instantaneously* their maximum acceleration, what are the distances (expressed in miles) covered, respectively, by these two cars when they reach 60 mph?

(b) The masses of the sports car and SUV are 1250 Kg and 2800 Kg, respectively. What are the forces produced by the two car's engine, assuming that there is not friction from the road and no air resistance?

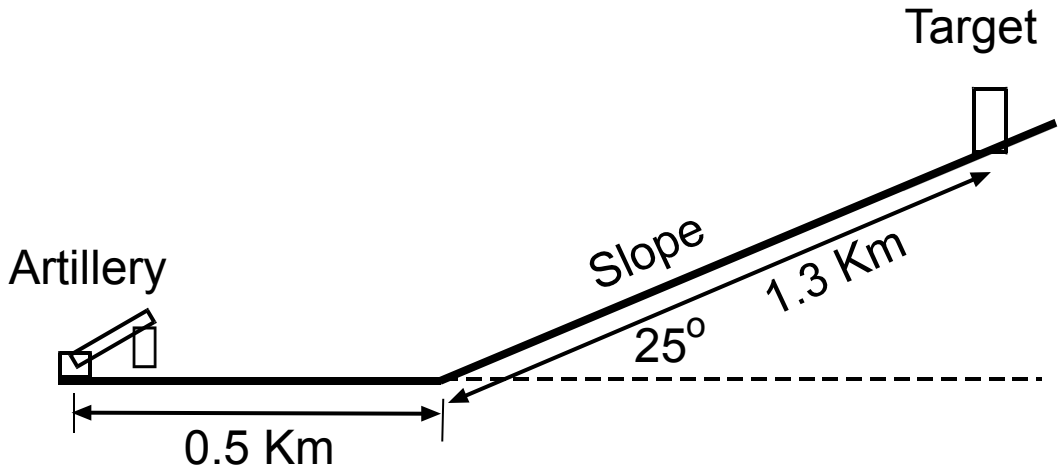
(c) What will be the forces produced by the two car's engine to obtain the same acceleration if there is friction and that the coefficient of kinetic friction between the road and the tires on both cars is 0.1? Air resistance is assumed to be negligible.

Question 2 (total: 20 Points)

An artillery want to hit a target located at a distance of 1.8 Km away.

(a) Suppose the artillery can fire shells with a maximum speed of 0.2 Km/s, what should be the angle of tilt (θ) of the canon to the ground in order that the shell will hit the target?

(b) What should be tilt of the canon in case the target is located on a slope inclined at 25^o to the horizontal as shown in the figure? The distance between the artillery and the bottom of the slope is 0.5 Km while the target is at a distance of 1. 3 Km from the bottom of the slope.



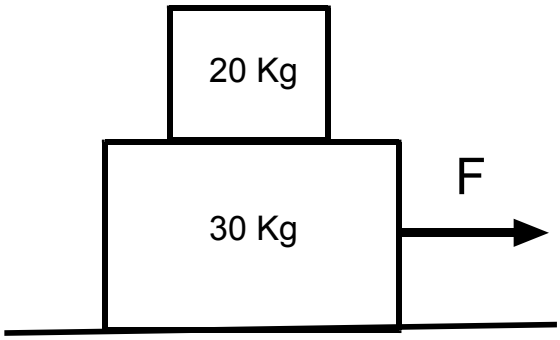
Question 3 (total: 20 Points)

A small block of mass 20 Kg is resting on a larger block of mass 30 Kg. The two blocks are resting on a table. A force F is applied to the large block as shown in the figure.

(a) The two blocks remain stationary with respect to the table until F=40 N when the two blocks start to move together. What is the coefficient of static friction between the large block and the table?

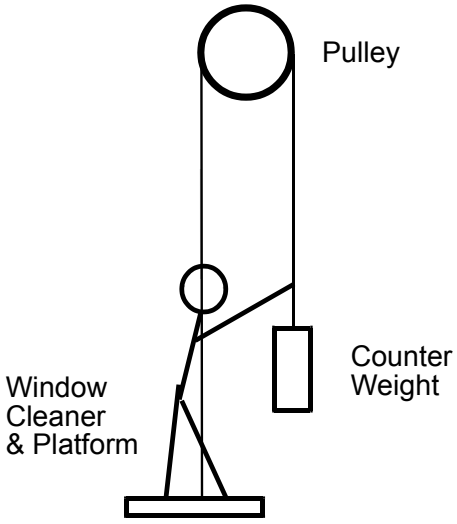
(b) Once the two blocks start moving the coefficient of friction between the large block and the table quickly drops to the value of 0.05 for kinetic friction, what is the acceleration of the two blocks?

(c) Suppose the coefficient of static friction between the small block and the large block is 0.1. What will be the force when the small block starts to fly off the large block?



Question 4 (total: 20 Points)

A window cleaner and his platform has a total mass of 170 Kg. The platform is suspended from a frictionless and massless pulley by a counter weight of 100 Kg as shown in figure:



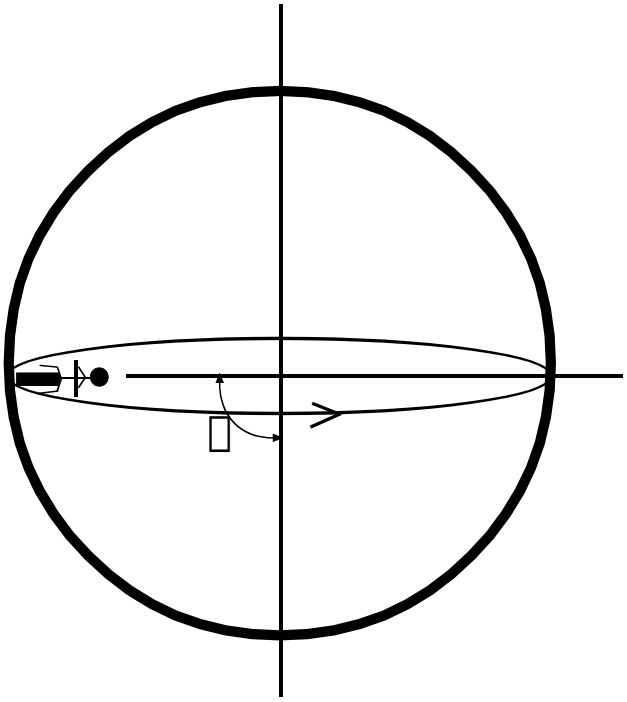
Assume that the rope has no mass also.

(a) How much force should the window cleaner apply to the rope in order that he can *raise* himself slowly at a constant speed? *Give your answer to 4 significant figures.*

(b) Suppose the window cleaner is *ascending* with a constant speed of 0.3 m/s towards a window at a distance of 5 m above him. What force should he apply now in order that he will stop just in front of the window? *Give your answer to 4 significant figures.*

Question 5 (total: 20 Points)

In a circus a dare-devil performer can go around a steel spherical cage (of radius r= 10 meters) on a motor-cycle so fast that his motor-cycle becomes horizontal as shown in the figure! The coefficients of static and kinetic friction between the motor-cycle and the steel cage are 0.8 and 0.5 respectively.



(a) What is the speed of the motor-cyclist in order to ride around the cage in this horizontal position?

(b) As the motor-cycle slows down the angle θ between the motor-cyclist and the vertical decreases from 90^o. What should be the speed of the motor-cyclist when θ equals to 45^o.

----------END OF QUESTIONS----------