Physics 7A (Prof. Hallatschek)

First Midterm, Fall 2018, Berkeley, CA

Rules: *This midterm is closed book and closed notes. You are allowed one single-sided 8.5" x 11" sheet of paper on which you can whatever note you wish.* ***You are not allowed to use scientific calculators.*** *Cell phones must be turned off during the exam and placed in your backpacks.* ***In particular, cell-phone-based calculators cannot be used.***

If you have your solutions on scratch paper, staple it to the last page. Do not insert it in the exam.

Please make sure that you do the following during the midterm:

- *Write your name, discussion number, ID number on all documents you hand in.*
- *Make sure that the grader knows what s/he should grade by circling your final answer.*
- *Answer all questions that require a numerical answer to three significant figures.*

We will give partial credit on this midterm*, so if you are not altogether sure how to do a problem, or if you do not have time to complete a problem, be sure to write down as much information as you can on the problem. This includes any or all of the following: Drawing a clear diagram of the problem, telling us how you would do the problem if you had the time, telling us why you believe (in terms of physics) the answer you got to a problem is incorrect, and telling us how you would mathematically solve an equation or set of equations once the physics is given and the equations have been derived. Don't get too bogged down in the mathematics; we are looking to see how much physics you know, not how well you can solve math problems.*

If at any point in the exam you have any problems, just raise your hand, and we will see if we are able to answer it.

Name: _____ *Disc Sec Number:* _____

Signature: _____ *Disc Sec GSI:* _____

Student ID Number: _____

Problem	***Possible***	***Score***
1	20	
2	15	
3	20	
4	20	
5	25	
Total	100	

Problem 1 – Car stunt (20 points)

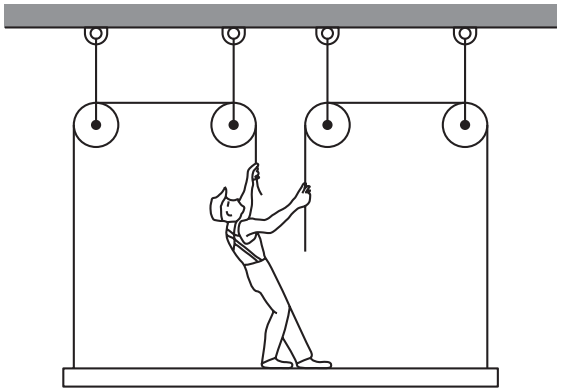
A car jumps between two identical ramps on a horizontal surface. As shown in the figure below, the car is launched from the point A on the first ramp that is at a distance *L* from the landing point B on the second ramp. Both ramps are tilted with the same angle θ from the horizontal.

(a) Write equations for the *x* and *y* position of the car as a function of time *t* using the launch point A as the origin. Express your answers in terms of v_0, θ, *t* and g.

(b) Calculate the magnitude of the initial speed v_0 of the car needed to complete the jump successfully in terms of L, θ, g.

End of Problem 1 workspace.

Problem 2: Painter on a scaffold (15 points)



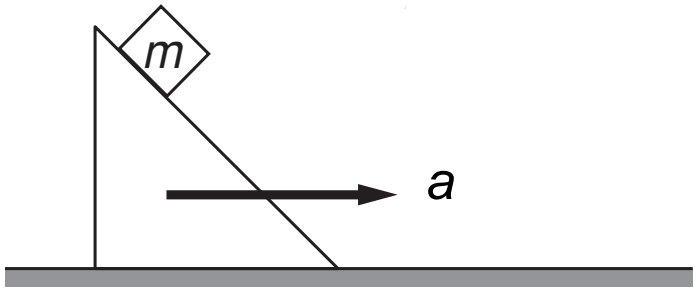
A painter of mass *M* stands on a scaffold of mass m (m<M) and pulls himself up by two massless ropes, which hang over pulleys, as shown. Ignore any friction.

(a) He pulls each rope with force *F* and accelerates upward with a uniform acceleration *a.* Find *a* – neglegting the fact that no one could do this for long.

(b) Now suppose the painter is lighter than the stand (M<m). He again pulls each rope with a force *F* and gets lifted off the stand. Find his initial acceleration and the acceleration of the stand.

End of Problem 2 workspace.

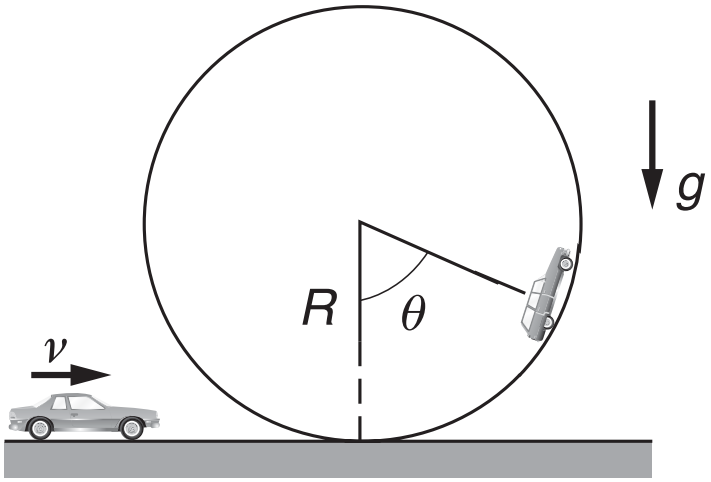
Problem 3: Mass on wedge (20 points)



A 45° wedge is pushed along a table with constant acceleration *a*. A block of mass m slides without friction on the wedge. Find the block's acceleration relative to the ground. Gravity is directed down.

End of Problem 3 workspace.

Problem 4: Loop-the-loop (20 points)



An automobile of mass *M* drives at constant speed *v* onto a loop-the-loop, as shown.

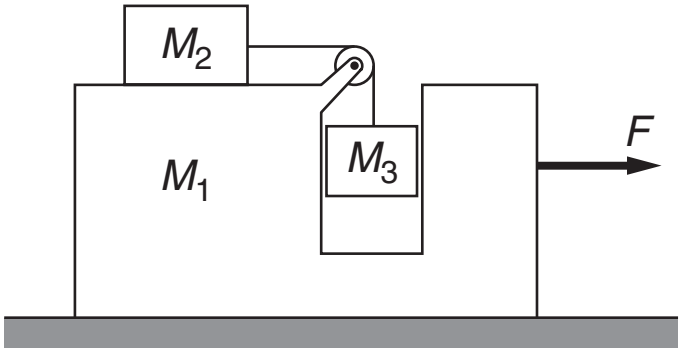
(a) Find the minimum speed v_0 for going completely around the loop without falling off. (For this part of the problem, you can assume that the friction coefficient is so large that slipping is unlikely unless the normal force vanishes. In other words, you can answer this question without worrying about friction forces.)

(b) Now assume the automobile drives at constant speed $v<v_0$. As a result, the car starts to slip at some angle theta. Find the static friction coefficient μ_s in terms of v, θ, m and g.

You may continue your work on the next page.

End of Problem 4 workspace.

Problem 5 (25 points)



Consider a system of 3 masses, one pulley and one massless string as illustrated in the sketch. All surfaces are frictionless.

(a) Assume that the force F is such that M_1 is held fixed ($v_1=0$). What are the acceleration of M_3, the tension in the rope and the force F, respectively?
(b) What force F must be applied to M_1 to keep M_3 from rising or falling?
(c) Assume F is zero. What is the initial acceleration of M_1?

You may continue your work on the next page.

End of Problem 5 workspace.