# Midterm Exam No. 02 (2023 Fall)

**PHYS 205A-002: UNIVERSITY PHYSICS**

*Department of Physics, Southern Illinois University–Carbondale*

Date: 2023 Oct 13

(Name) (Signature)

## Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 4.
2. Total time = 50 minutes.
3. There are 4 conceptual questions and 3 problems in this exam.
4. Equation sheet is provided separately.
5. To be considered for partial credit you need to present your work in detail and organize it clearly.
6. A simple calculator (with trigonometric functions) is allowed.
7. Use of smart devices, including smart watches, is strictly prohibited. They should stay out of reach during the exam.
8. Restroom breaks are allowed. Under questionable circumstances this might lead up to a Makeup Exam.
9. Academic misconduct will lead to a failing grade in the course.

1. (**5 points.**) Consider a balloon filled with helium. Helium being lighter than air tends to rise up in air. While a car is taking a circular turn will a helium balloon tend to move radially inward or radially outward? Assume the doors and windows of the car are closed.

2. (**5 points.**) A car is traveling at 30. m/s (= 67 miles/hour) on a level highway. Assume the surface of the road to be dry. The coefficient of static friction $\mu_s$ between the road and tires is 1.1 and the coefficient of kinetic friction $\mu_k$ between the road and tires is 0.60. It is brought to a stop skillfully without slamming on the brakes by letting the tires roll perfectly at the verge of skidding. What is the minimum distance in which the car will stop?

3. (**5 points.**) Two masses $m_1 = 10.0\,\text{kg}$ and $m_2 = 20.0\,\text{kg}$ are stacked together on a frictionless plane. A force $\mathbf{F}$ is exerted on $m_2$. See Figure 1. Identify the forces acting on mass $m_1$.

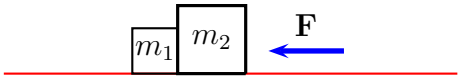


Figure 1: Problem 3.

4. (**5 points.**) A car is taking a (circular) turn while moving with a uniform speed. What can you say about the direction of the vector sum of all the forces acting on the car?

5. (**10 points.**) A 1.0 kg mass is hanging from the ceiling of an elevator. Determine the tension in the string holding the mass when the elevator is slowing down at $2.0\,\mathrm{m/s^2}$ while moving upward?

6. (**10 points.**) A mass $m = 20.0\,\text{kg}$ is on an incline with $\theta = 30°$. The coefficient of static friction is $\mu_s = 1.1$ and coefficient of kinetic friction is $\mu_k = 0.60$. The mass is projected upward with an initial velocity of $15\,\text{m/s}$. How far up the incline does the mass move before it comes to a stop.

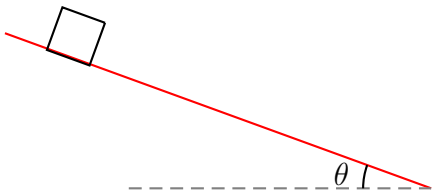


Figure 2: Problem 6.

7. (**10 points.**) A car is driven over the top of a speed bump the cross section of which can be approximated by a circle of radius $R = 2.0\,\text{m}$. See Figure 3. What is the greatest speed at which the car can be driven without the car losing contact with the road at the top of the speed bump?

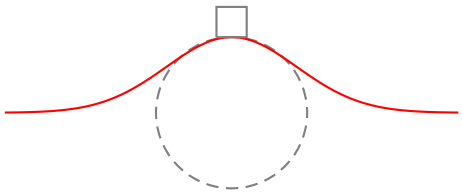

Figure 3: Problem 7