

# Midterm Exam No. 02 (2023 Spring)

## PHYS 205A-001: UNIVERSITY PHYSICS

*Department of Physics, Southern Illinois University–Carbondale*

Date: 2023 Mar 10

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(Name)

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(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.)** A weighing scale is designed to measure the normal force acting on the object placed on the scale. A mass  $m$  rests on this weighing scale while it is placed on the floor of an elevator. Imagine the scenario when all the cables snap and the elevator falls freely. What does the weighing scale read while the elevator, the scale, and the mass, are all falling freely?

2. (**5 points.**) Newton's third law states that every action force has an equal and opposite reaction force. Give an example of an action-reaction pair of forces.

3. (5 points.) Figure 3 illustrates an attempt by a student to keep a mass  $m = 5.0 \text{ kg}$  from falling down. How much should the horizontal force  $\mathbf{F}$  be if it has to keep the mass  $m$  pinned to a frictionless vertical wall by pushing on it horizontally.

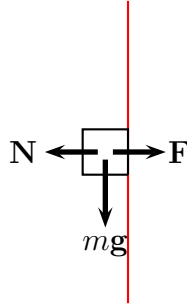


Figure 1: Problem 3

4. (**5 points.**) You are driving a car on an icy (frictionless) flat (unbanked) road. How will you maneuver a right turn while the tires are perfectly rolling (without sliding or slipping)?

5. (10 points.) Your mass is 75 kg. How much will you weigh on a bathroom scale (designed to measure the normal force in Newtons) inside an elevator that is speeding up at  $2.0 \text{ m/s}^2$  while moving upward?

6. (10 points.) A mass  $m_2 = 2.0$  kg is connected to another mass  $m_1 = 1.0$  kg by a massless (inextensible) string passing over a massless pulley, as described in Figure 2. Surfaces are frictionless. Determine the acceleration of mass  $m_2$ .

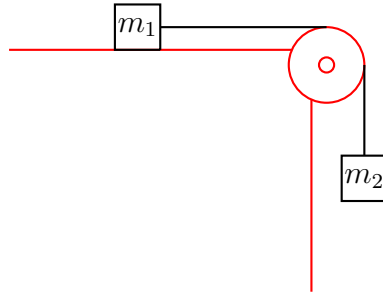


Figure 2: Problem 6

7. **(10 points.)** A car is traveling at 70.0 miles/hour ( $= 31.3 \text{ m/s}$ ) on a horizontal highway. It is brought to a stop by slamming on the brakes, which amounts to the tires skidding (without rolling) on the road. What is the stopping distance when the surface is dry and the coefficient of kinetic friction  $\mu_k$  between road and tires is 0.60?