

# Midterm Exam No. 02 (2022 Fall)

PHYS 205A-002: UNIVERSITY PHYSICS

*School of Physics and Applied Physics, Southern Illinois University–Carbondale*

Date: 2022 Oct 14

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(Name)

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(Signature)

## Instructions

- Seating direction: Please be seated on seats with seat numbers divisible by 5.
- Total time = 50 minutes.
- There are 7 questions in this exam.
- Equation sheet is provided separately.
- To be considered for partial credit present your work in detail and organize it clearly.
- A simple calculator (with trigonometric functions) is allowed.
- Use of mobile phones is strictly prohibited. It should stay out of reach during the exam.

1. **(5 points.)** You are standing at rest on the floor of your classroom. Your mass is  $m$  and the mass of Earth is  $M$ . Earth is exerting a gravitational force on you. Clearly identify the reaction force associated to this force in the context of Newton's third law of motion. What is the magnitude and direction of the reaction force?

2. **(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?

3. (5 points.) What is the direction of the acceleration of an object when it is moving in a circle of radius  $R$  with uniform speed  $v$ ?

4. (5 points.) A mass  $m$  slides down a track and goes around a vertical loop as illustrated in Figure 1. Identify all the forces acting on the mass when it is at the highest point in the loop. Describe the forces using a diagram.

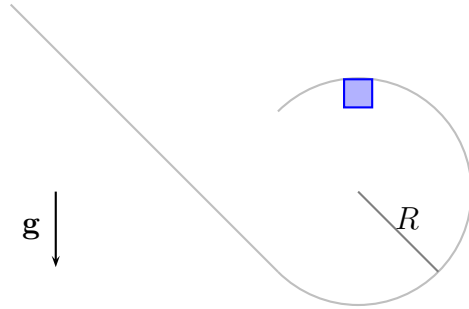


Figure 1: Problem 4.

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 slowing down at  $2.0 \text{ m/s}^2$  while moving upward?

6. **(10 points.)** A 10.0 kg mass is initially held at rest on an incline that makes  $30^\circ$  with respect to the horizontal. It is let go. The coefficient of static friction between the mass and incline is 0.80 and the coefficient of kinetic friction between the mass and incline is 0.50. Qualitatively describe what happens? Determine the acceleration of the mass to give a quantitative description.

7. (10 points.) A stuntman whose mass is 75 kg drives a car at a uniform speed of 30.0 m/s through the bottom of a valley, the cross section of which can be approximated by a circle of radius  $R = 150$  m. What is the normal force acting on the stuntman while crossing the deepest part of the valley?

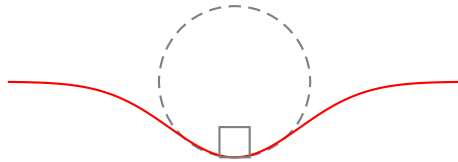


Figure 2: Problem 7