# Final Exam (Fall 2025)

## PHYS 205A-002: UNIVERSITY PHYSICS

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

Date: 2025 Dec 12

(Name) (Signature)

## Instructions

1. Seating direction: In alternate rows, B, D, F, . . . , on even-numbered seats.
2. Total time = 120 minutes.
3. There are 4 conceptual questions and 3 problems in this exam.
4. Equation sheet is provided separately.
5. 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. Academic misconduct will lead to a failing grade in the course.

1. (**5 points.**) Given

$$\vec{\mathbf{C}} = \vec{\mathbf{A}} + \vec{\mathbf{B}}. \tag{1}$$

For vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ shown in the diagram in Figure 1 draw the vector $\vec{\mathbf{C}}$ on the diagram.

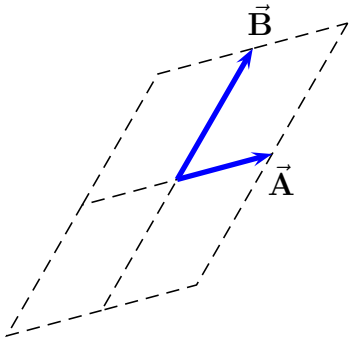


Figure 1: Problem 1.

2. (**5 points.**) A weighing scale is designed to measure the normal force acting on the object placed on the scale. A stuntman drives a car, while placing himself on the weighing scale, over the top of a hill, the cross section of which can be approximated by a circle of radius $R$. See Figure 2. Will the stuntman weigh heavier or lighter when the car is going over the top of the hill.

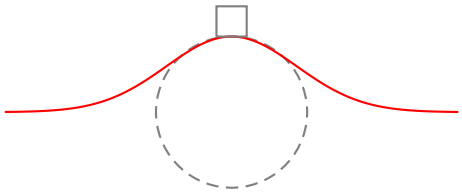

Figure 2: Problem 2

3. (**5 points.**) A mass of 100. g moving with a speed 10. m/s (elastically) collides with another identical mass that is at rest. Determine the magnitude and direction of the velocities of the masses after collision.

4. (**5 points.**) If you spin a raw egg and a hard-boiled egg (of same mass nd shape), which of them will resist spinning more. That is, which of them has a larger rotational inertia?

5. (**10 points.**) A mass $m_2 = 2.0\,\text{kg}$ is connected to another mass $m_1 = 1.0\,\text{kg}$ by a massless (inextensible) string passing over a massless pulley, as described in Figure 3. Surfaces are frictionless. Determine the acceleration of the masses.

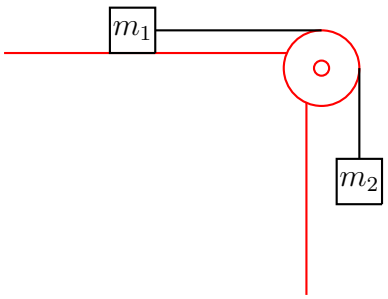


Figure 3: Problem 5

6. (**10 points.**) A spherical shell, (with $I = \frac{2}{3}MR^2$ when the axis of rotation passes through the center of sphere,) rolls perfectly (without sliding or slipping) on an inclined plane. If the sphere started from rest at the top, from a vertical height of 1.00 m, what is the velocity of the sphere when it reaches the bottom of the incline?

7. (**10 points.**) Three identical stars, each of mass $m$, are positioned at the corners of a square of edge length $L$. Find the magnitude of the gravitational field at the center of the square.