

## Midterm Exam No. 02 (Spring 2026)

### PHYS 205A-001: UNIVERSITY PHYSICS

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

Date: 2026 Mar 06

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(Name)

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### Instructions

1. Seating direction: In alternate rows, B, D, F, . . . , on even-numbered seats.
2. Total time = 50 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.)** 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. Will the mass weigh heavier when it is speeding while moving upward or when it is slowing down while moving upward?

2. (5 points.) Two masses  $m_1$  and  $m_2$  are stacked together on a frictionless plane. A force  $\mathbf{F}$  is exerted on  $m_2$ . See Figure 1. Identify an action-reaction pair of forces in this system. [Caution: Action and reaction (pair of) forces never act on the same mass.]

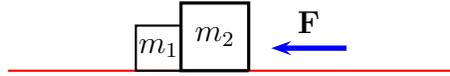


Figure 1: Problem 2.

3. (5 points.) A car is driven with uniform speed over the top of a hill, the cross section of which can be approximated by a circle of radius  $R$ . See Figure 2. What is the direction of the acceleration of the car when it is going over the top of the hill.

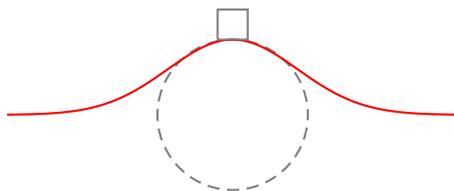


Figure 2: Problem 3

4. (5 points.) A 12 kg mass slides down a frictionless track going around a vertical loop of radius 15 m, as illustrated in Figure 3. Draw the direction of the normal force acting on the mass while it is at the highest point in the loop.

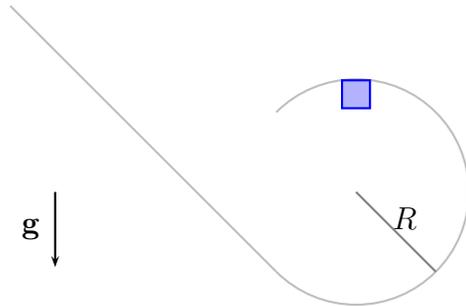


Figure 3: Problem 4.

5. (10 points.) A student is skateboarding down a ramp that is 20.0 m long and inclined at  $30.^\circ$  with respect to the horizontal. The skateboarder starts from rest at the top of the ramp. Neglect friction. See Figure 4. Find the speed of the student at the bottom of the ramp.

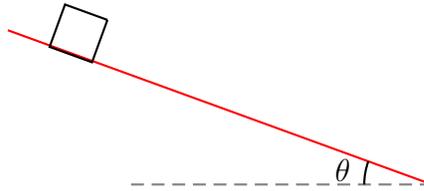


Figure 4: Problem 5.

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 5. Surfaces are frictionless. Determine the acceleration of the masses.

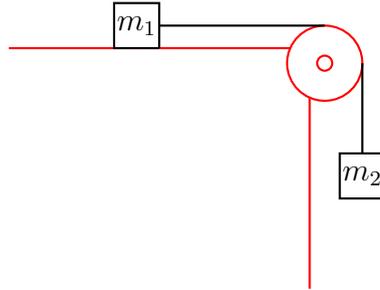


Figure 5: Problem 6

7. (10 points.) Two inclined planes making angles  $\theta_1 = 30.^\circ$  and  $\theta_2 = 60.^\circ$ , respectively, meet together to build a corner where a mass  $m = 20.$  kg rests, as described in Figure 6. Identify the forces acting on the mass. Then, determine the magnitude and direction of these forces.

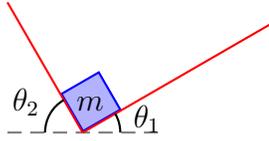


Figure 6: Problem 7.