

# Final Exam (2023 Spring)

## PHYS 205A-001: UNIVERSITY PHYSICS

*Department of Physics, Southern Illinois University–Carbondale*

Date: 2023 May 12

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(Name)

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### Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 4.
2. Total time = 120 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 projectile is launched with an initial velocity of magnitude  $v_0 = 25 \text{ m/s}$  at an angle  $\theta_0 = 30^\circ$  above the horizontal. What is the magnitude and direction of the instantaneous acceleration of the projectile when it is at the highest point  $B$  in Figure 1?

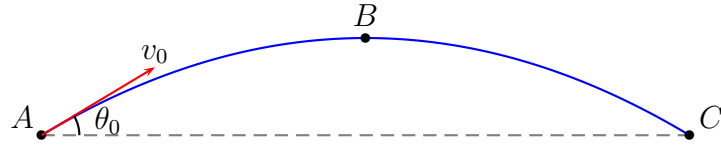


Figure 1: Problem 1.

2. **(5 points.)** What is the direction of the acceleration of an object when it is moving in a circle with uniform speed.

3. (5 points.) A 25 kg mass slides down an inclined plane. Determine the work done by the normal force while it falls a vertical height of 10.0 m.

4. (5 points.) What is the difference between elastic and inelastic collision?

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 ring (with  $I = MR^2$  when the axis of rotation is along the axis of ring) rolls perfectly (without sliding or slipping) on an inclined plane. If the ring started from rest at the top, center of ring at vertical height of 20.m, what is the velocity of the ring when it reaches the bottom of the incline?

7. **(10 points.)** Three identical objects of mass  $m$  each are positioned at the corners of an equilateral triangle of side length  $a$ . Find the expression for the gravitational potential energy of this three-body configuration. Choose the gravitational potential energy of the configuration to be zero when they are (infinitely) far from each other.