Midterm Exam No. 01 (Fall 2025)

PHYS 205A-002: UNIVERSITY PHYSICS

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

Date: 2025 Sep 15

(Name) (Signature)

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.**) Given the expression

$$x = \sqrt{A^2 + B^2 x^2}, \tag{1}$$

where x is a length with dimension L. What is the dimension of B?

2. (**5 points.**) The position of an object moving in a straight line, as a function of time, is plotted in Figure 1. Estimate the velocity of the object at 3.0 hours.

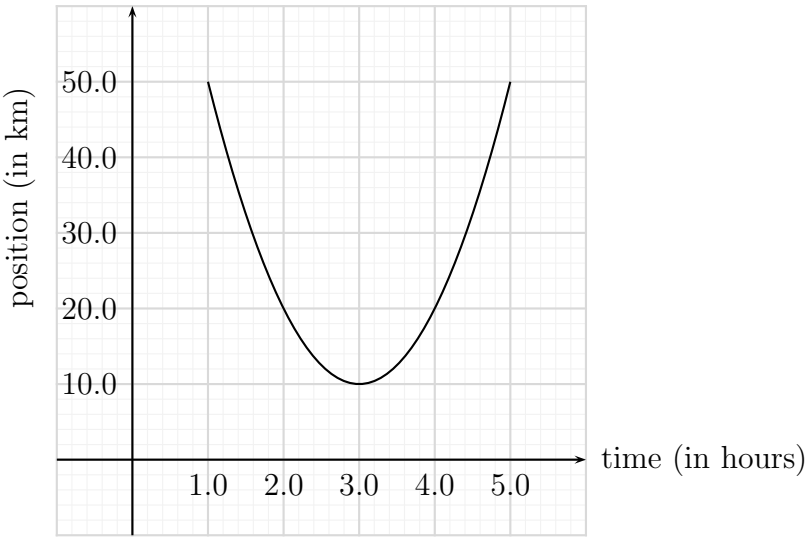

Figure 1: Problem 2.

3. (**5 points.**) Given

$$\vec{\mathbf{C}} = \vec{\mathbf{A}} + \vec{\mathbf{B}}. \tag{2}$$

For vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ shown in the diagram in Figure 2 draw the vector $\vec{\mathbf{C}}$ on the diagram.

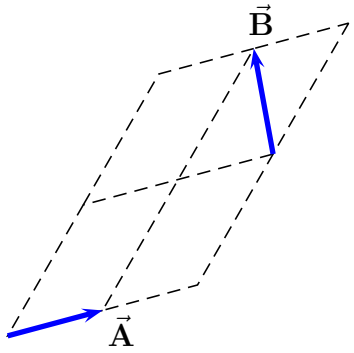

Figure 2: Problem 3.

4. (**5 points.**) A projectile is launched with an initial velocity of magnitude $v_0 = 28\,\mathrm{m/s}$ at an angle $\theta_0 = 60°$ above the horizontal. What is the magnitude and direction of the velocity of the projectile when it is at the highest point B in Figure 3?

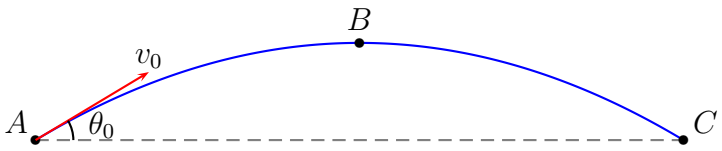

Figure 3: Problem 4.

5. (**10 points.**) While standing on a 50.0 m tall building you throw a stone straight downwards at a speed of 15 m/s. How long does the stone take to reach the ground?

6. (**10 points.**) An explorer is caught in a whiteout while returning to base camp. He was supposed to travel due north for 4.0 km, but when the snow clears, he discovers that he actually traveled 7.0 km at 30.° west of due north.

   (a) How far must he now travel to reach base camp?

   (b) In what direction must he travel?

7. (**10 points.**) A package is dropped from an aeroplane while it is moving horizontally with a speed of 45 m/s at a height of 75 m from the ground. What is the speed of the package right before it hits the ground?