Final Exam (Spring 2026)

PHYS 205A-001: UNIVERSITY PHYSICS

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

Date: 2026 May 8

(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.**) The position of an object moving in a straight line as a function of time is plotted in Figure 1. The slope of the curve in the position-time graph at 3.0 hours is zero. Thus, the velocity of the object at 3.0 hours is zero. Is the acceleration of object at 3.0 hours zero? If so, explain. If not, why not?

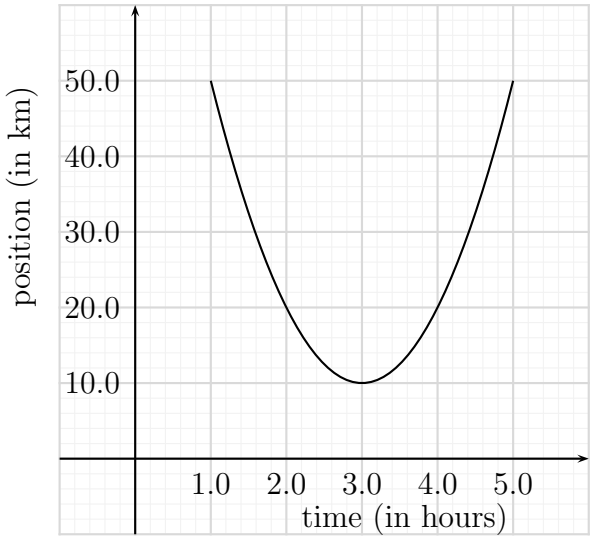

Figure 1: Problem 1.

2. (**5 points.**) What is the direction of the acceleration of an object when it is moving in a circular path of radius R with uniform speed v.

3. (**5 points.**) You climb up a stair at the North entrance of a building, walk around in the corridors, climb down a stair at the South entrance of the building, and return back to where you started. What is the work done by the gravitational force acting on you during the round trip?

4. (**5 points.**) Given

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

For vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ shown in the diagram in Figure 2, in the plane of paper, determine the direction of vector $\vec{\mathbf{C}}$.

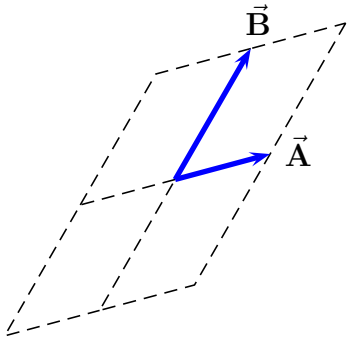

Figure 2: Problem 4.

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 tension in the string.

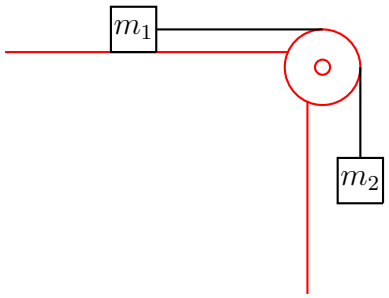

Figure 3: Problem 5

6. (**10 points.**) Five balls of masses $m_1 = 1.0\,\text{kg}$, $m_2 = 2.0\,\text{kg}$, $m_3 = 3.0\,\text{kg}$, $m_4 = 4.0\,\text{kg}$, and $m_0 = 5.0\,\text{kg}$, are connected by massless rods of length $a = 10.0\,\text{cm}$ and $b = 15.0\,\text{cm}$, as shown in Figure 4. This configuration is rotated about an axis passing through the masses m_1, m_0, and m_3. The inertia associated with this rotational motion is quantified by the moment of inertia. Compute the moment of inertia.

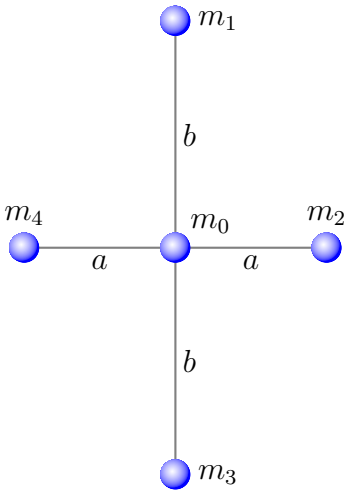

Figure 4: Problem 6.

7. (**10 points.**) Four identical stars, each of mass m, are positioned at the corners of a square of edge length L. Find the gravitational potential at the center of the square, with respect to a point very far away from the square..