Midterm Exam No. 01 (2024 Spring)

PHYS 205A-001: UNIVERSITY PHYSICS

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

Date: 2024 Feb 12

(Name) (Signature)

Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 3.
2. Total time = 50 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.**) The equation

$$x = 3At^2 + 5Bt^4 \tag{1}$$

describes the motion of an object, with x having the dimension of length and t having the dimension of time. Determine the dimension of

$$\frac{A}{B}. \tag{2}$$

(Use L for the dimension of length and T for the dimension of time.)

2. (**5 points.**) The position of an object moving in a straight line as a function of time is plotted in Figure 1. Is the object speeding up or slowing down at 4.0 hours?

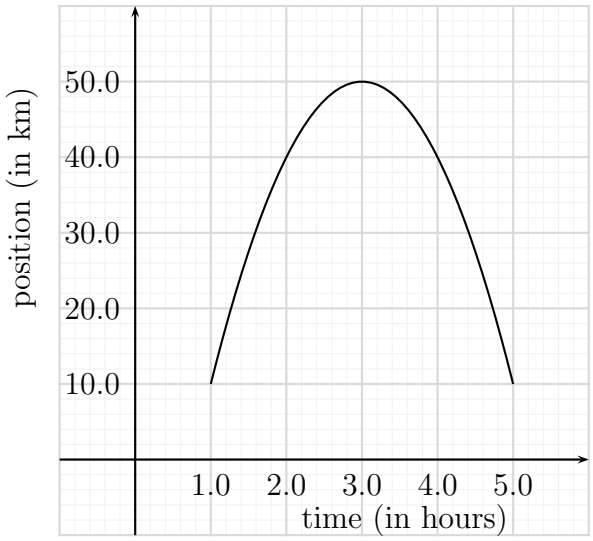

Figure 1: Problem 2.

3. (**5 points.**) Find the components of vector **A** whose magnitude is 25 m and its direction is 30.0° clockwise with respect to the negative y axis.

4. (**5 points.**) A car is moving with uniform velocity. A passenger in the car tosses an orange vertically upwards with respect to him. Will the orange return to his hands? If so, explain. If not, why not? Assume no air resistance.

5. (**10 points.**) A key falls from a bridge that is 49 m above the water. It falls directly into a boat that is moving with constant velocity, that was 15 m from the point of impact when the key was released. What is the speed of the boat?

6. (**10 points.**) An explorer is caught in a whiteout (in which the snowfall is so thick that the ground cannot be distinguished from the sky) while returning to base camp. He was supposed to travel due North for 5.0 km, but when the snow clears, he discovers that he actually traveled 7.0 km at 30.0° West of due North. How far and in what direction must he travel to reach the base camp?

7. (**10 points.**) A rifle is aimed at a bullseye. The muzzle speed of the bullet is 550 m/s. The gun is pointed directly at the center of the bullseye, but the bullet strikes the target 0.15 m below the center. What is the horizontal distance between the end of the rifle and the bullseye?

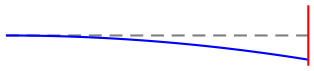

Figure 2: Problem 7