Midterm Exam No. 01 (2022 Fall)

PHYS 205A-002: UNIVERSITY PHYSICS

Department of Physics, Southern Illinois University–Carbondale
Date: 2022 Sep 19

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(Name)   (Signature)

Instructions

- Seating direction: Please be seated on seats with seat numbers divisible by 5.

- Total time = 50 minutes.

- There are 8 questions in this exam.

- Equation sheet is provided separately.

- To be considered for partial credit present your work in detail and organize it clearly.

- A simple calculator (with trigonometric functions) is allowed.

- Use of mobile phones is strictly prohibited. It should stay out of reach during the exam.

1. (**5 points.**) Consider the mathematical expression

$$x = Ae^{-\omega t}, \tag{1}$$

where x is measured in units of distance and t is measured in units of time. Determine the dimension of ω.

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 or slowing at 2.0 hours?
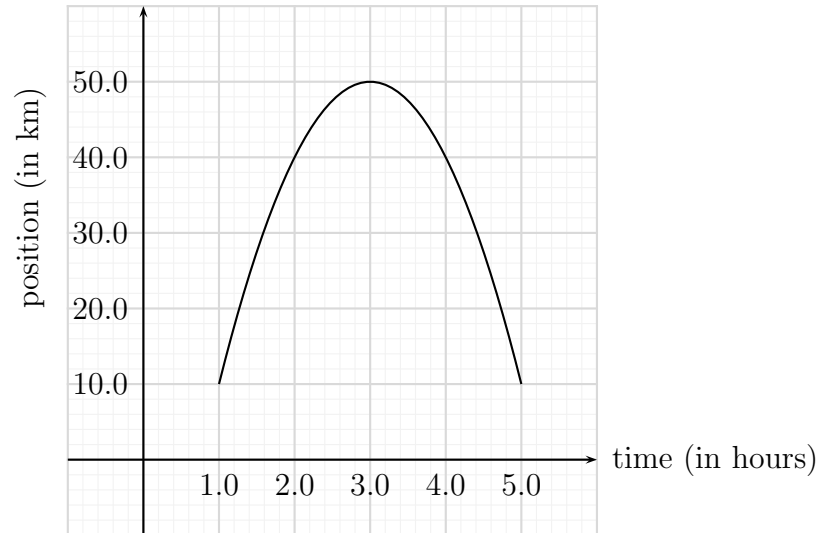

Figure 1: Problem 2.

3. (**5 points.**) You throw a ball vertically up at $4.9\,\mathrm{m/s}$. How long does it take to return back in your hands?

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.**) Two vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ have equal magnitudes of $5.0\,\text{m}$. Vector $\vec{\mathbf{A}}$ is pointing along the positive x axis, and vector $\vec{\mathbf{B}}$ is pointing along the positive y axis. Determine the magnitude and direction of the vector $\vec{\mathbf{B}} - \vec{\mathbf{A}}$.

6. (**10 points.**) Imagine that a man is running at a uniform speed $v = 7.0\,\mathrm{m/s}$ to catch a bus that is stopped at a traffic light. When he is still a distance $d = 10.\,\mathrm{m}$ from the bus, the bus starts to move away with a constant acceleration $a = 2.0\,\mathrm{m/s^2}$. How long after the bus starts to move will the man catch the bus? Assume that the motion of the man and the bus is along a straight road.

7. (**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 60.° North of East. How far and in what direction must he travel to reach the base camp?

8. (**10 points.**) A package is dropped from an aeroplane while it is moving horizontally with a speed of $45\,\mathrm{m/s}$ at a height of $75\,\mathrm{m}$ from the ground. What is the speed of the package right before it hits the ground?