Friday warm-up: units, vectors, and introductory calculus

Prof. Jordan C. Hanson

August 22, 2024

1 Chapter 1 - Unit analysis, Estimation

1. Which of the following are correct?

   - A: The quantity m s^{-1} is a unit of acceleration.
   - B: The quantity m s^{-1} is a unit of speed.
   - C: The quantity m s^{-2} is a unit of speed.
   - D: The quantity m s^{-2} is a unit of acceleration.

1. Which of the following represents the density of lead?

   - A: 0.11 g cm^{-3}
   - B: 1.1 g cm^{-3}
   - C: 11 g cm^{-3}
   - D: 111 g cm^{-3}

1. If there are 2.2 lbs/kg, which of the following is equivalent to 100 lbs in kg?

   - A: 220 kg
   - B: 100 kg
   - C: 45.5 kg
   - D: 10.5 kg

1. A train leaves Los Angeles Union Station for the Bay Area (Evansville) at 60 km/hr. If the Bay Area (Evansville) is 600 km to the North, how long before the train reaches the destination?

   - A: 1 hour
   - B: 10 hours
   - C: 15 hours
   - D: 24 hours

2 Chapter 2 - Vectors

1. Let (v_x, v_y) represent the x and y-components of a vector $\vec{v}$. The wind velocity is 10 km/hr, Southwest. North and East vector components are positive, while South and West are negative. Find $\vec{v}$ below.

   - A: (7.1,7.1) km/hr
   - B: (-7.1,7.1) km/hr
   - C: (7.1,-7.1) km/hr
   - D: (-7.1,-7.1) km/hr

2. In the previous problem, the *magnitude* of $\vec{v}$ is 10 km/hr. This is because

   - A: $\sqrt{7.1} = 10$
   - B: $\sqrt{7.1^2} = 10$
   - C: $\sqrt{7.1^2 + 7.1^2} = 10$
   - D: $2\sqrt{7.1^2} = 10$

3. Suppose $\vec{x}_1 = (2, 3)$ km and $\vec{x}_2 = (-2, 3)$ km. What is $\vec{x}_1 + \vec{x}_2$?

   - A: (6,0) km
   - B: (0,6) km
   - C: (4,0) km
   - D: (0,4) km

3 Calculus Topic - The Derivative

1. The *derivative*, or slope of a function $f(t)$ is defined as

$$f'(t) = \lim_{dt \to 0} \frac{f(t + dt) - f(t)}{dt} \tag{1}$$

   Suppose $f(t) = at^2$. Given Eq. 1, show that

$$f'(t) = 2at \tag{2}$$