

Monday warm-up: unit analysis and vectors

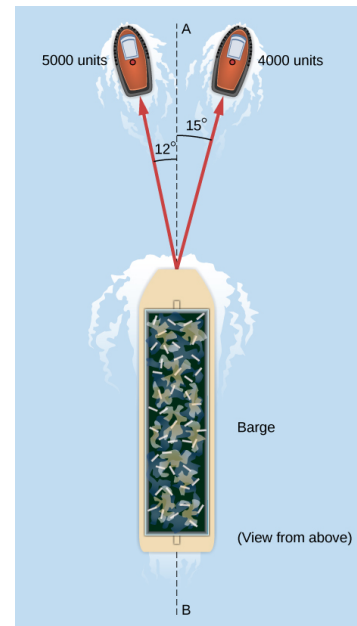
Prof. Jordan C. Hanson

August 25, 2025

1 Unit Analysis, Vectors

1. Suppose a track runner completes a 1600 meter run in 275 seconds. (a) What is the average speed of the runner in meters per second? (b) Convert this to minutes per mile (1 mile is 1.6 km).
2. Acceleration is defined as the rate of change in velocity. If a train starts at rest, and accelerates to 30 km hr^{-1} in 40 seconds, what is the acceleration in m s^{-2} ?
 - A: 2.0 m s^{-2}
 - B: 0.2 m s^{-2}
 - C: 2.0 m s^{-1}
 - D: 0.2 m s^{-1}
3. A delivery driver starts at the post office, drives 40 km north, then 20 km west, then 60 km northeast, and finally 50 km north to stop for lunch. (a) Draw a graph of the situation. (b) What is the final position? The final displacement?

5. (a) In the previous exercise, at what angle does the total force pull? (b) Create two tension vectors, one for each tugboat, that would yield an angle of 0 degrees with respect to the dashed line in Fig. 1.



4. A barge is pulled by the two tugboats shown in Fig. 1. The right tugboat pulls with a force of 4000 Newtons, 15 degrees away from the line AB. The left tugboat pulls with a force of 5000 Newtons, 12 degrees away from the line AB. (a) Using trigonometry, break each force into x and y components, and list them below. (b) What is the total force (as a vector) in Newtons?

Figure 1: The barge is pulled by two tugboats, and the tensions in the ropes are described by two vectors.