PCS211 P2022 Tutorial 1

1. a) The term $\frac{1}{2}\rho v^2$ occurs in Bernoulli's equation, with ρ being the density of a fluid and v its speed. What are the dimensions of this term?

b) The equation for the change of position of a train starting at $x = 0$ m is given by $x = \frac{1}{2}at^2 + bt^3$. What are the dimensions of b?

c) The position of a particle moving under uniform acceleration is some function of time t and the acceleration a. Suppose we write this position as $x=ka^m t^n$, where k is a dimensionless constant. What values must m and n have? Can dimensional analysis give the value of k?

2. a) Most US highways have a speed limit of 65 miles per hour. How many inches per minute would that be?

b) A house is advertised as having 1420 square feet under its roof. What is the area in square meters?

c) One U.S. fluid gallon contains a volume of 231 cubic inches. How many liters of gasoline would you have to buy in Canada to fill a 14-gallon tank? (Note: $1L = 10^{+3}$ cm^3.)

3. The radius of a uniform solid sphere is measured to be (6.50+/- 0.20) cm, and its mass is measured to be (1.85+/-0.02) kg. Determine the density of the sphere in kilograms per cubic meter, with proper uncertainty.

4. Determine the magnitude of the resultant force and its direction, measured counterclockwise from the positive x axis.
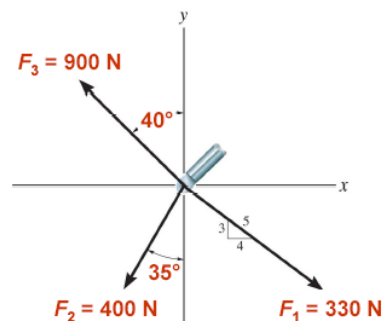
5. Three cables pull on the pipe such that they create a resultant force having a magnitude of 900 lb. If two of the cables are subjected to known forces, as shown in the figure, determine the angle θ of the third cable so that the magnitude of force F in this cable is a *minimum*. All forces lie in the x–y plane. What is the magnitude of F? *Hint*: First find the resultant of the two known forces.