21-P-MOM-AG-046

In the winter following the summer heatwave, Vancouver experiences a snowstorm, and the snow-plow fleet is mobilized in full. A *M* megaton snowplow moves through the residential neighbourhoods at a very fast constant speed of $V\ \frac{km}{hr}$. If the traction force developed on all the wheels is *T*, then how thick is the snowfall? The snow-plow is *X* meters wide, and the density of snow is ρ.

ANSWER:

First, we write out the equation for force in this scenario.

$$T = \sum F_{snow} = m\frac{dv}{dt} + v_{snowplow/snow}\frac{dm_{snow}}{dt}$$

Since the speed is constant, $m\frac{dv}{dt} = 0$, and the rate is easily calculated.

$$V\ \frac{km}{hr} \cdot \frac{1\ hr}{60\ min} \cdot \frac{1\ min}{60\ s} \cdot \frac{1000\ m}{1\ km} = V'\frac{m}{s}$$

$$rate = \frac{dm_{snow}}{dt} = \frac{T}{v_{snowplow/snow}} = \frac{T}{V'}$$

To calculate the thickness of the snow fall, we must consider both volume and density.

$$thickness = \frac{rate}{volume \cdot density} = \frac{rate}{(V' \cdot X) \cdot \rho}$$