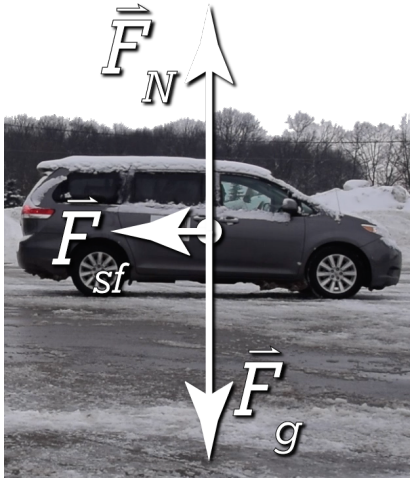
Flipping Physics Lecture Notes:

Determining the Static Coefficient of Friction between Tires and Snow

Example: A car with anti-lock brakes driving on snow has an initial velocity of 8.9 m/s and slows to a stop in 3.12 seconds. Determine the coefficient of friction between the tires and the snow.



Knowns: $v_i = 8.9\frac{m}{s};\ \Delta t = 3.12s;\ v_f = 0;\ \mu_s = ?$

$$\sum F_y = F_N - F_g = ma_y = m(0) = 0 \Rightarrow F_N = F_g = mg$$
$$\sum F_x = -F_{sf} = ma_x \Rightarrow -\mu_s F_N = ma_x \Rightarrow -\mu_s mg = ma_x$$
$$\Rightarrow -\mu_s g = a_x \Rightarrow \mu_s = -\frac{a_x}{g}$$

All we need is the acceleration in the x direction and we can use our Uniformly Accelerated Motion equations to find a_x.

$$v_f = v_i + a\Delta t \Rightarrow v_f - v_i = a\Delta t \Rightarrow a = \frac{v_f - v_i}{\Delta t} = \frac{0-(8.9)}{3.12} = -2.85256\frac{m}{s^2}$$

And we can now solve for the coefficient of friction.

$$\mu_s = -\frac{a_x}{g} = -\frac{-2.85256}{9.81} = 0.290781 \approx 0.29$$

I actually did 9 trials and the average of all nine trials gave me: $\mu_{s_{average}} = 0.299972 \approx 0.30$

FYI: $v_i = 8.9\frac{m}{s} \times \frac{3600s}{1hr} \times \frac{1mi}{1609m} = 19.913 \approx 20\frac{mi}{hr}$ (okay, fine. With 2 sig figs: $v_i \approx 2.0 \times 10^1 \frac{mi}{hr}$)