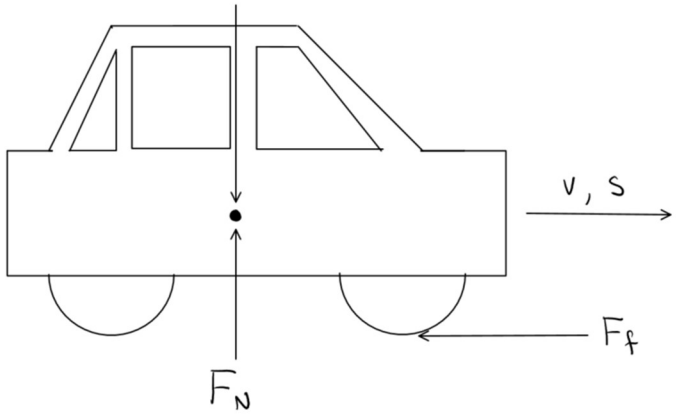
21-P-WE-AG-017

A car driving 30 km/hr takes 5 meters to stop after the brake is applied. If the car travels D meters after the brake is applied, how fast was it going when the driver began to brake?

ANSWER:

First, we draw the free-body diagram.



To find the answer, we must find the coefficient of friction using the first set of information ($v_1 = 30\frac{km}{hr} \cdot \frac{1\ hr}{3600\ s} \cdot \frac{1000\ m}{1\ km} = 8.333\frac{m}{s}\ and\ d = 5\ m$).

$$T_1 + U_{1-2} = T_2$$

$$\frac{1}{2}m{v_1}^2 - F_f \cdot d = \frac{1}{2}m{v_2}^2$$

$$\frac{1}{2}{v_1}^2 - \mu \cdot g \cdot d = \frac{1}{2}{v_2}^2$$

$$\mu = \frac{{v_1}^2}{2 \cdot g \cdot d} = \frac{\left(8.333\frac{m}{s}\right)^2}{2 \cdot 9.81\frac{m}{s^2} \cdot 5m} = 0.708$$

Then, we can determine the initial speed of the car if it took *D* meters to stop using the same equation.

$$v_1 = \sqrt{2 \cdot \mu \cdot g \cdot d} = \sqrt{2 \cdot 0.708 \cdot 9.81\frac{m}{s^2} \cdot D\ meters}$$

Then, we convert it back into km/hr by multiplying by 3.6.