Answer on Question #47252-Physics-Other

A combined mass of a person and a sled is $m = 25\ kg$, and the coefficient of kinetic friction between the sled and snow is $\mu = 0.08$. Another person pulls on the sled with a force of $F = 25\ N$ to move the sled at a constant velocity. Find:

a. the angle α that the rope made relative to the horizontal

b. the magnitude of the normal force N pushing up on the sled

Solution

To move the sled at a constant velocity the vertical and horizontal components of the sum of all forces acting on the sled must be equal to zero:

$$\begin{cases} mg - N - F\sin\alpha = 0 \\ F\cos\alpha - \mu N = 0 \end{cases} \rightarrow \begin{cases} \dfrac{mg - N}{F} = \sin\alpha \\ \cos\alpha = \dfrac{\mu N}{F} \end{cases} \rightarrow \sin^2\alpha + \cos^2\alpha = 1 = \left(\frac{mg - N}{F}\right)^2 + \left(\frac{\mu N}{F}\right)^2.$$

$$1 = \left(\frac{25 \cdot 9.8 - N}{25}\right)^2 + \left(\frac{0.08N}{25}\right)^2 \rightarrow N^2(1.0064) - 490N + 59400 = 0.$$

$$D = 979.36.$$

$$N = \frac{490 - 31.29}{2(1.0064)} = 228\ N.$$

$$\alpha = \cos^{-1}\frac{0.08 \cdot 228}{25} = 43°.$$

Answer: a. $43°$; b. $228\ N$.