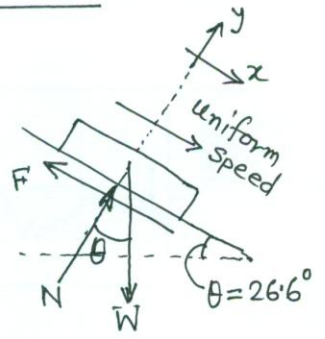
1106. A serious student wishes to perform an experiment in determining the speed of a book. Using a blackboard eraser, he coats one side of the book with chalk dust, so that the book will mark a trail as it slides. Then he places the book on a long table whose inclination is varied until the book will slide down at a uniform speed. This angle of inclination is observed to be 26.6° with the horizontal. Now with the table top horizontal, he throws the book onto the table, and measures a 7.5 ft. trail left by the book as it slid to rest. Calculate the horizontal speed with which the book struck the table. *Ans.* 15.5 fps.

1106/P. 325



Since speed is constant, $a = 0$

$\Sigma F_y = 0$ gives

$N = W\cos\theta$

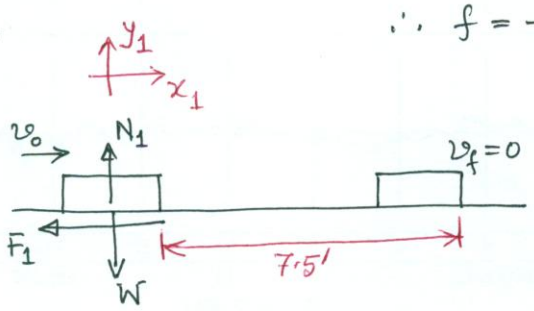
Now $\Sigma F_x = 0$ gives, ($+x$ as $+ve$ direction)

$W\sin\theta - N \cdot f = 0$

$\Rightarrow W\sin\theta - W\cos\theta \cdot f = 0$

$\therefore f = \dfrac{\sin\theta}{\cos\theta} = \tan\theta = \tan 26.6^\circ$

$= 0.5$



$\Sigma F_{y_1} = 0$ gives

$N_1 - W = 0$ ie. $N_1 = W$

$\therefore F_1 = N_1 \cdot f = W \times 0.5 = 0.5W$

Now taking $\Sigma F_{x1} = ma$, $\rightarrow +ve$

$-F_1 = \dfrac{W}{g} \cdot a$

$\Rightarrow -0.5W = \dfrac{W}{g} a$

$\therefore a = -0.5 \times 32.2 = -16.1 \text{ fps}^2$

$v_f^2 = v_0^2 + 2as$

$\Rightarrow 0 = v_0^2 + 2 \times (-16.1) \times 7.5$

$\therefore v_0 = \boxed{15.54 \text{ fps.}}$ Ans.