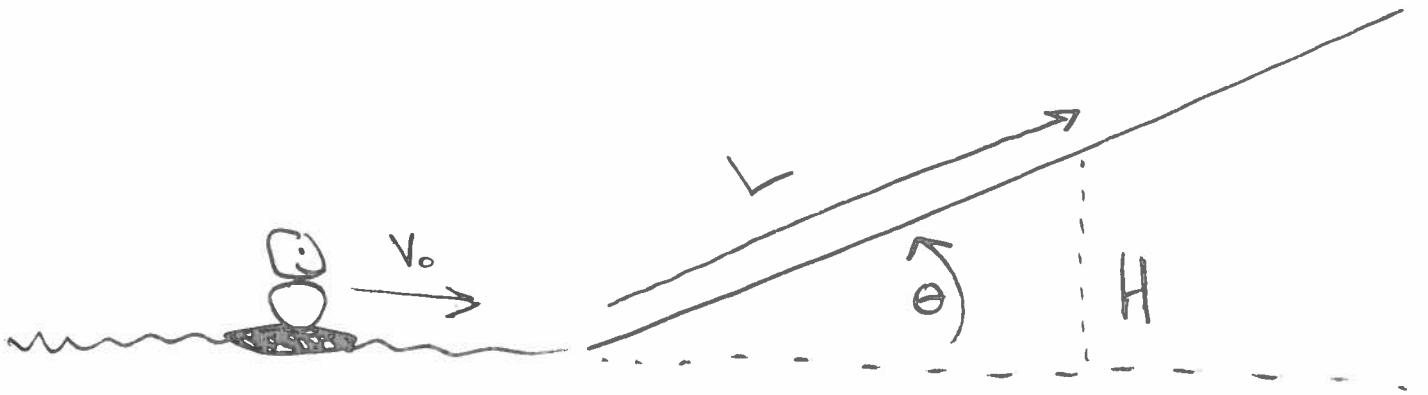
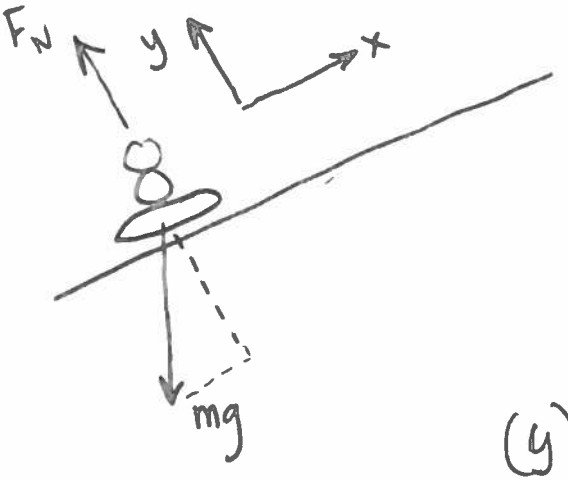


Frosty the Snowman slides at speed $V_0 = 9\ m/s$ on snow, at base of hill with slope at angle θ. He slides up the hill a distance $L = 20\ m$ along the slope.

If no friction, what is angle θ ?



force	x	y
grav	$-mg\sin\theta$	$-mg\cos\theta$
normal	0	$+F_N$
total	ma_x	$ma_y = 0$

(y) $F_N = mg\cos\theta$

(x) $a_x = -g\sin\theta$

To find angle θ, use kinematic equation

$$V_f^2 - V_i^2 = 2a_x(x_f - x_i)$$

$$0^2 - V_0^2 = 2(-g\sin\theta)L$$

So

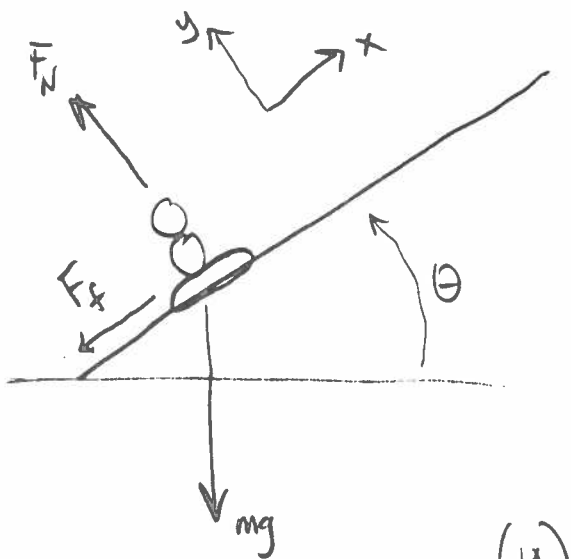
$$\sin\theta = \frac{V_0^2}{2gL} = \frac{\left(9\frac{m}{s}\right)^2}{2\left(9.8\frac{m}{s^2}\right)(20\,m)}$$

$$= 0.2066$$

$$\rightarrow \theta = \sin^{-1}(0.2066) = 11.93^\circ$$

$$= 12^\circ \quad \text{if we use significant figures}$$

If friction coefficient is $\mu_K = 0.05$, then what is angle θ?



force	x	y
grav	$-mg\sin\theta$	$-mg\cos\theta$
normal	0	$+F_N$
friction	$-\mu_K F_N$	0
total	ma_x	$ma_y = 0$

(y) $F_N = mg\cos\theta$

(x) $a_x = -g(\sin\theta + \mu_K\cos\theta)$

To find angle θ, again use 1-D kinematic formula

$$V_f^2 - V_i^2 = 2a_x(x_f - x_i)$$

$$0^2 - V_0^2 = 2(-g)(\sin\theta + \mu_K\cos\theta)L$$

Solve for angle θ

$$\sin\theta + 0.05\cos\theta = \frac{\left(9\frac{m}{s}\right)^2}{2\left(9.8\frac{m}{s^2}\right)(20\,m)}$$

$$\sin\theta = 0.2066 - 0.05\cos\theta$$

Use trial-and-error or graphing calculator or other method to find

$$\theta \approx 9.05^\circ$$

$$= 9^\circ \quad \text{if we use significant figures}$$