

Answer on Question #70231-Physics-Other

You and your friend decide to have a snowball fight, he stands away from you at an incline that is angled at $\beta = 28.7$ degrees. Assuming you are standing right at the base of the incline and throw a snowball at $\alpha = 46.5$ degrees above the horizontal at 14.8m/s how far up the incline will it travel?

Solution

The equations for projectile motion:

$$x = vt \cos \alpha$$

$$y = vt \sin \alpha - \frac{gt^2}{2}$$

$$\frac{y}{x} = \tan \beta$$

Thus,

$$\frac{vt \sin \alpha - \frac{gt^2}{2}}{vt \cos \alpha} = \tan \beta$$

$$\frac{v \sin \alpha - \frac{gt}{2}}{v \cos \alpha} = \tan \beta$$

$$\frac{gt}{2} = v \sin \alpha - v \cos \alpha \tan \beta$$

The time of flight:

$$t = \frac{2v}{g} (\sin \alpha - \cos \alpha \tan \beta) = \frac{2(14.8)}{9.81} (\sin 46.5 - \cos 46.5 \tan 28.7) = 2.873 \text{ s.}$$

The total distance it travel up the incline is

$$l = \frac{x}{\cos \alpha} = \frac{vt \cos \alpha}{\cos \beta} = \frac{(14.8)(2.873) \cos 46.5}{\cos 28.7} = 37.9 \text{ m.}$$

Answer: 37.9 m.

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