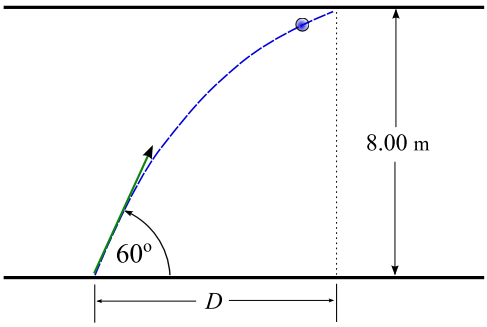
Name_____

Sept. 30, 2011

Quiz #2 — Fall 2011

Phys 2110 – Sec 4

1. A small projectile is shot from the floor of a room with a ceiling 8.00 m high. It is shot at an angle of 60.0° from the horizontal and it strikes the ceiling 0.790 s after firing.



a) What was the initial $y-$velocity of the projectile?

Placing the origin at the launch point, as we know the final coordinate (8.00 m) and the time, the y equation of motion gives us

$$8.0\text{ m} = v_{0y}(0.790\text{ s}) - \tfrac{1}{2}g(0.790\text{ s})^2 \qquad \Longrightarrow \qquad v_{0y} = \frac{(8.00\text{ m}) + 4.9\frac{\text{m}}{\text{s}^2}(0.790\text{ s})^2}{(0.790\text{ s})}$$

and from this we get

$$v_{0y} = \boxed{14.0\tfrac{\text{m}}{\text{s}}}$$

b) What was the initial *speed* of the projectile?

v_{0y} is related to the speed v_0 by

$$v_{0y} = v_0 \sin\theta \qquad \Longrightarrow \qquad v_0 = \frac{v_{0y}}{\sin 60°}$$

and

$$v_0 = \frac{(14.0\frac{\text{m}}{\text{s}})}{\sin 60°} = \boxed{16.2\tfrac{\text{m}}{\text{s}}}$$

c) What was the initial $x-$velocity of the projectile?

$$v_{0x} = v_0 \cos 60° = \boxed{8.08\tfrac{\text{m}}{\text{s}}}$$

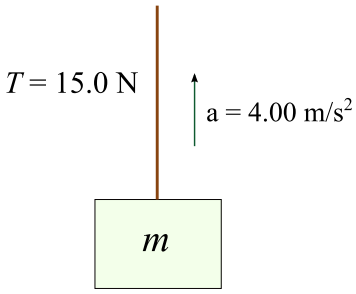
d) What was the horizontal distance D traveled by the projectile when it struck the ceiling?

The x coordinate at the time of impact was

$$x = v_{0x}t + (8.08\tfrac{\text{m}}{\text{s}})(0.790\text{ s}) = \boxed{6.38\text{ m}}$$

2. A mass m is pulled upward by a string such that its acceleration is $4.00\frac{\text{m}}{\text{s}^2}$, upward. If the tension in the string is 15.0 N, what is the mass m ?

You must be extra-careful to *show your reasoning* on this problem.



There is an upward force T and a downward force mg on the block. Newton's 2nd law gives

$$T - mg = ma \quad \Longrightarrow \quad T = mg + ma = m(g+a) \quad \Longrightarrow \quad m = \frac{T}{g+a}$$

With $a = +4.00\frac{\text{m}}{\text{s}^2}$ and $T = 15.0$ N,

$$m = \frac{(15.0\text{ N}}{(9.80\frac{\text{m}}{\text{s}^2} + 4.00\frac{\text{m}}{\text{s}^2})} = \boxed{1.09\text{ kg}}$$

You must show all your work and include the right units with your answers!

$$v_x = v_{0x} + a_x t \qquad x = x_0 + v_{0x}t + \tfrac{1}{2}a_x t^2 \qquad v_x^2 = v_{0x}^2 + 2a_x(x - x_0) \qquad x - x_0 = \tfrac{1}{2}(v_{0x} + v_x)t$$

$$v_y = v_{0y} + a_y t \qquad y = y_0 + v_{0y}t + \tfrac{1}{2}a_y t^2 \qquad v_y^2 = v_{0y}^2 + 2a_y(y - y_0) \qquad y - y_0 = \tfrac{1}{2}(v_{0y} + v_y)t$$

$$g = 9.80\tfrac{\text{m}}{\text{s}^2} \qquad a_c = \frac{v^2}{r} \qquad \mathbf{F}_{\text{net}} = m\mathbf{a}$$