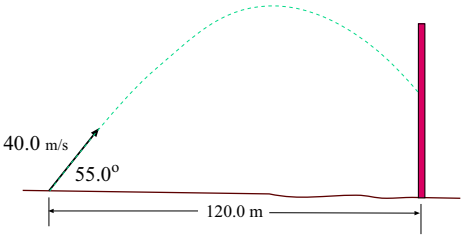
Name_____

Oct. 1, 2010

Quiz #2 — Fall 2010

Phys 2110 – Sec 3

1. A projectile is fired from ground level at a speed of $40.0\frac{\text{m}}{\text{s}}$ and an angle of $55.0°$ above the horizontal toward a high wall which is at a horizontal distance of 120.0 m from the firing point.



a) At what time after firing did the projectile strike the wall?

The projectile strikes the wall when $x = 120.0$ m. The components of the initial velocity are

$$v_{0x} = (40.0\tfrac{\text{m}}{\text{s}})\cos 55° = 22.94\tfrac{\text{m}}{\text{s}} \qquad v_{0y} = (40.0\tfrac{\text{m}}{\text{s}})\sin 55° = 32.77\tfrac{\text{m}}{\text{s}}$$

Solve for the time when $x = 120.0$ m:

$$120.0 \text{ m} = x_0 + (22.94\tfrac{\text{m}}{\text{s}})t + 0 \qquad \Longrightarrow \qquad t = \frac{(120.0 \text{ m}}{(22.92\frac{\text{m}}{\text{s}})} = 5.23 \text{ s}$$

The projectile hits the wall at $\boxed{5.23 \text{ s}}$.

b) What was the speed of the projectile when it struck the wall?

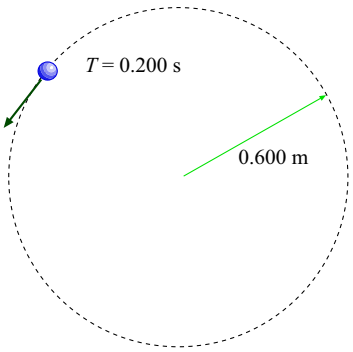
The x component of the velocity is constant at $22.9\frac{\text{m}}{\text{s}}$. The y velocity at this time is

$$v_y = v_{0y} - gt = (32.77\tfrac{\text{m}}{\text{s}}) - (9.80\tfrac{\text{m}}{\text{s}^2})(5.23 \text{ s}) = -18.5\tfrac{\text{m}}{\text{s}}$$

so then the *speed* of the projectile at the time of impact ($t = 5.23$ s) is

$$v = \sqrt{v_x^2 + v_y^2} = \sqrt{(22.9\tfrac{\text{m}}{\text{s}})^2 + (-18.5\tfrac{\text{m}}{\text{s}})^2} = 29.4\tfrac{\text{m}}{\text{s}}$$

2. A particle moves in a circle or radius 0.600 m at constant speed, making one revolution every 0.200 s. Find the magnitude of the acceleration of the particle.



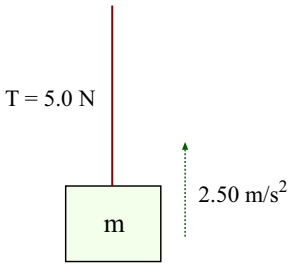
The speed of the particle is

$$v = \frac{2\pi R}{T} = \frac{2\pi(0.600\text{ m})}{(0.200\text{ s})} = 18.8\tfrac{\text{m}}{\text{s}}$$

so then the acceleration of the particle points inward and has magnitude

$$a = \frac{v^2}{r} = \frac{(18.8\frac{\text{m}}{\text{s}})^2}{(0.600\text{ m})} = 592\tfrac{\text{m}}{\text{s}^2}$$

3. A mass m is pulled upward by a string, giving it an acceleration of $2.50\frac{\text{m}}{\text{s}^2}$ (upward). The tension in the string is 5.00 N; what is the value of the mass?

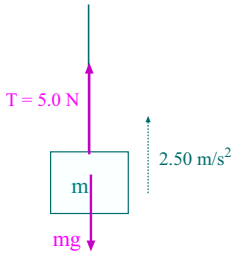


We draw the picture of the forces and see that there is a force T upward on the mass and a force mg downward. The total is ma_y. Like Newton says. So we write:

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

Plug in the numbers:

$$m = \frac{(5.00\text{ N})}{(9.80 + 2.50)\frac{\text{m}}{\text{s}^2}} = 0.407\text{ kg}$$



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

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

$g = 9.80\frac{\text{m}}{\text{s}^2}$ $\quad 1\text{ kg} = 10^3\text{ g}$ $\quad \mathbf{F} = m\mathbf{a}$ $\quad v = \frac{2\pi R}{T}$ $\quad a_c = \frac{v^2}{r}$