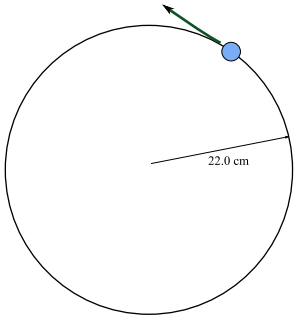
Name_____

Feb. 10, 2012

Quiz #2 — Spring 2012

Phys 2110 – Sec 4

1. A particle moves in a circle of radius 22.0 cm at constant speed. It makes one revolution in 0.310 s.



a) What is the speed of the particle?

$$v = \frac{2\pi r}{T} = \frac{2\pi(0.220\text{ m})}{(0.310\text{ s})} = \boxed{4.46\,\tfrac{\text{m}}{\text{s}}}$$

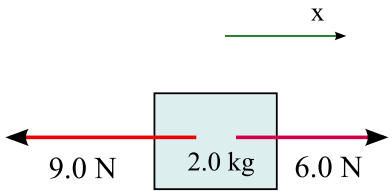
b) Give the magnitude *and direction* of its acceleration.

Magnitude of the acceleration is

$$a = \frac{v^2}{r} = \frac{(4.46\,\frac{\text{m}}{\text{s}})^2}{(0.220\text{ m})} = \boxed{90.4\,\tfrac{\text{m}}{\text{s}^2}}$$

The direction of the accelertion is toward the center of the circle.

2. A mass moves in one dimension; it is subjected to two forces, one of magnitude 6.00 N in the $+x$ direction and one of magnitude 9.00 N in the $-x$ direction.



Give the magnitude *and direction* of its acceleration.

The net force is

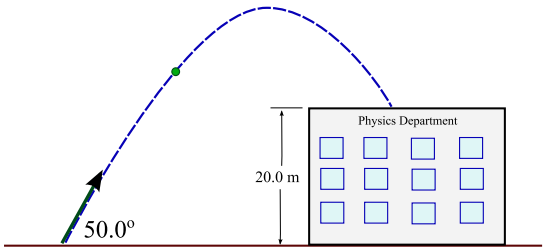
$$F_{x,\text{net}} = 6.0\text{ N} - 9.0\text{ N} = -3.0\text{ N}$$

so that the acceleration is

$$a_x = \frac{F_{x,\text{net}}}{m} = \frac{(-3.0\text{ N})}{(2.0\text{ kg})} = -1.5\,\tfrac{\text{m}}{\text{s}^2}$$

that is, $\boxed{1.5\,\frac{\text{m}}{\text{s}^2}}$ in the $\boxed{-x\text{ direction}}$.

3. A student shoots a projectile from ground level at an angle of 50.0° above the horizontal. 4.60 s later it lands on the roof of the physics building at a height of 20.0 m !



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

We know that at $t = 4.60$ s we had (with $y_0 = 0$) $y = +20.0$ m. Then the $y(t)$ equation gives

$$y = 20.0 \text{ m} = v_{y0}t + \tfrac{1}{2}a_y t^2 = v_{y0}(4.60 \text{ s}) - \tfrac{1}{2}(9.80 \tfrac{\text{m}}{\text{s}^2})(4.60 \text{ s})^2$$

Solve for v_{y0}:

$$v_{y0}(4.60 \text{ s}) = 123.7 \text{ m} \qquad \Longrightarrow \qquad v_{y0} = 26.9 \tfrac{\text{m}}{\text{s}}$$

The initial $y-$velocity was $\boxed{26.9 \tfrac{\text{m}}{\text{s}}}$.

b) What was the initial speed of the projectile?

The initial y component is $v_{y0} = v_0 \sin\theta$, so that

$$v_0 = \frac{v_{y0}}{\sin\theta} = \frac{((26.9 \tfrac{\text{m}}{\text{s}})}{\sin 50.0^\circ} = \boxed{35.1 \tfrac{\text{m}}{\text{s}}}$$

c) What was the speed of the projectile when it hit the roof?

The x component of the velocity was

$$v_{x0} = v_0 \cos\theta = 22.6 \tfrac{\text{m}}{\text{s}}$$

(it doesn't change) and the y component of the velocity was

$$v_y = v_{y0} + a_y t = 26.9 - (9.80 \tfrac{\text{m}}{\text{s}^2})(4.0 \text{ s}) = -18.2 \tfrac{\text{m}}{\text{s}}$$

so that the speed was

$$v = \sqrt{v_x^2 + v_y^2} = \boxed{29.0 \tfrac{\text{m}}{\text{s}}}$$

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

$v_x = v_{x0} + a_x t$ $\quad x = x_0 + v_{x0}t + \frac{1}{2}a_x t^2$ $\quad v_x^2 = v_{x0}^2 + 2a_x(x - x_0)$ $\quad x - x_0 = \frac{1}{2}(v_{x0} + v_x)t$

$v_y = v_{y0} + a_y t$ $\quad y = y_0 + v_{y0}t + \frac{1}{2}a_y t^2$ $\quad v_y^2 = v_{y0}^2 + 2a_y(y - y_0)$ $\quad y - y_0 = \frac{1}{2}(v_{y0} + v_y)t$

$\mathbf{v}_{A/B} + \mathbf{v}_{B/C} = \mathbf{v}_{A/C}$ $\quad g = 9.80 \frac{\text{m}}{\text{s}^2}$ $\quad v = \frac{2\pi R}{T}$ $\quad a_c = \frac{v^2}{r}$ $\quad \mathbf{F}_{\text{net}} = m\mathbf{a}$ $\quad F_{\text{spr}} = -kx$ $\quad f_s^{\max} = \mu_s n$