Quiz Average 6.25 **Quiz High Score** 10

PH 220 **Quiz # 03 (10 pts)** **Name** Solution

A golf ball is struck by a wedge and the ball leaves the ground with an initial velocity of $\overrightarrow{v_0} = 13.5\ {}^{m}/_{s}$ @ $28.9°$ above $(\widehat{\text{North}})$. Ignoring any effects of air resistance and there is nothing in the area for the ball to strike until the ball returns back to ground level. How long is the ball in the air?

A. 2.41 s **B.** **1.33 s** **C.** 1.15 s **D.** 1.55 s

$$y = 0 = v_{0y}t - \frac{1}{2}gt^2 = t\left(v_0 \sin(\theta) - \frac{1}{2}gt\right)$$

Thus, either $t = 0.00\ s$ which is launch time or

$$v_0 \sin(\theta) - \frac{1}{2}gt = 0$$

So,

$$t = \frac{2v_0 \sin(\theta)}{g} = \frac{2(13.5\ {}^{m}/_{s}) \sin(28.9°)}{9.80\ {}^{m}/_{s^2}} = 1.33\ s$$

So, the correct answer is B !

The "Green Monster" the left field wall at Fenway Park is located a distance of 94.5 m from home plate. A batter hits a baseball and drives the ball to the wall with a speed of $31.4\ {}^{m}/_{s}$ @ θ above the horizontal. The ball takes 3.77 s for the ball to hit the wall. What is the angle the ball comes off the bat with? As usual ignore effects of air resistance.

A. 52.9° **B.** 18.6° **C.** **37.1°** **D.** 38.6°

$$x = v_{0x}t + \frac{1}{2}a_x t^2 = v_0 \cos(\theta)\, t + 0$$

Solve for θ

$$\cos(\theta) = \frac{x}{v_0 t} = \frac{94.5\ m}{(31.4\ {}^{m}/_{s})(3.77\ s)} = 0.798$$

$$\theta = \cos^{-1}(0.798) = 37.1°$$

So, the correct answer is C !

A car has an initial velocity of $\overrightarrow{v_0} = 7.61\ {}^{m}/_{s}\ \widehat{East} + 8.93\ {}^{m}/_{s}\ \widehat{North}$. The car experiences an acceleration given by $\vec{a} = 4.30\ {}^{m}/_{s^2}\ \widehat{North}$ for a period of 3.22 s. What is the final velocity of the car after the time period the acceleration is acting?

A. $\vec{v} = \mathbf{7.61\ {}^{m}/_{s}\ \widehat{East} + 22.8\ {}^{m}/_{s}\ \widehat{North}}$

B. $\vec{v} = 7.61\ {}^{m}/_{s}\ \widehat{East} + 4.92\ {}^{m}/_{s}\ \widehat{South}$

C. $\vec{v} = 6.24\ {}^{m}/_{s}\ \widehat{West} + 4.92\ {}^{m}/_{s}\ \widehat{South}$

D. $\vec{v} = 6.24\ {}^{m}/_{s}\ \widehat{West} + 22.8\ {}^{m}/_{s}\ \widehat{North}$

Since there is no acceleration in the $\widehat{East}$ direction, there is no change in that component of velocity. We can find the change in the $\widehat{North}$ direction using the equation

$$\overrightarrow{v_N} = \overrightarrow{v_{0N}} + \overrightarrow{a_N}t = \mathbf{8.93\ {}^{m}/_{s}\ \widehat{North} + \left(4.30\ {}^{m}/_{s^2}\ \widehat{North}\right)(3.22\ s)}$$

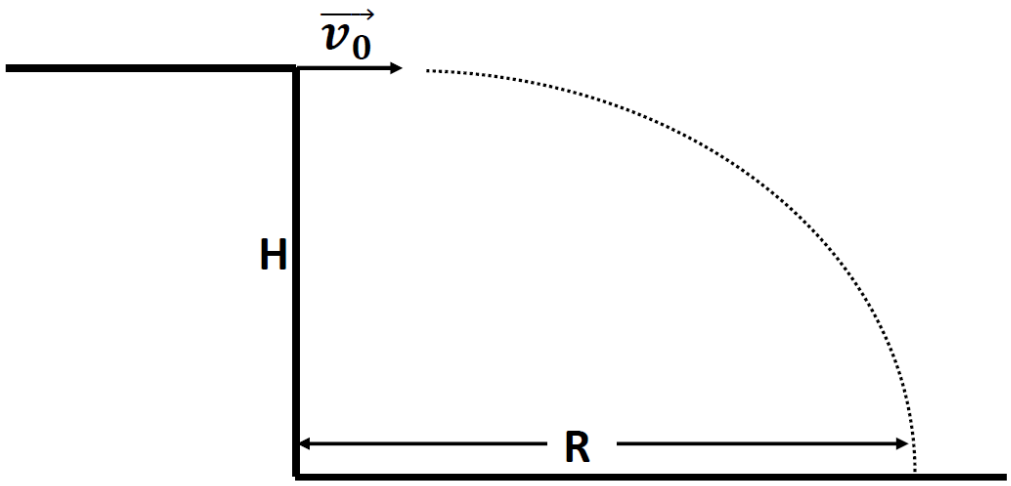
$$\overrightarrow{v_N} = \mathbf{8.93\ {}^{m}/_{s}\ \widehat{North} + \left(13.85\ {}^{m}/_{s^2}\ \widehat{South}\right)}$$

$$\overrightarrow{v_N} = \mathbf{22.8\ {}^{m}/_{s}\ \widehat{North}}$$

So final answer is

$$\vec{v} = \mathbf{7.61\ {}^{m}/_{s}\ \widehat{East} + 22.8\ {}^{m}/_{s}\ \widehat{North}}$$

So, the correct answer is A !



Consider if you had a way to launch a steel ball horizontally off a tabletop. The ball lands a distance R from where it was launched as shown in the picture above. If the initial velocity $v_0 = 7.32\ {}^{m}/_{s}$ Horizontally, and the ball is launched a height $H = 0.870$ m above the floor, what is the distance R that the ball lands at? Ignore all effects of air resistance.

A. 1.30 m **B.** **3.08 m** **C.** 0.65 m **D.** 2.18 m

$$x = R = v_{0x}t + \frac{1}{2}a_x t^2 = v_0 t$$

Since there is no air resistance, there is no horizontal acceleration. Since the initial velocity is horizontal, the x initial velocity is just the initial velocity.

$$R = v_0 t$$

So, we need time. Use the vertical motion

$$y = H = v_{0y}t + \frac{1}{2}a_y t^2 = \frac{1}{2}gt^2$$

Since there is no initial y velocity everything just goes down, so we make down positive. Solve for time.

$$\frac{1}{2}gt^2 = H \quad \rightarrow \quad t^2 = \frac{2H}{g} \quad \rightarrow \quad t = \sqrt{\frac{2H}{g}} = \sqrt{\frac{2(0.870\ m)}{9.80\ {}^{m}/_{s^2}}} = 0.421\ s$$

Plug in to find R

$$R = v_0 t = (7.32\ {}^{m}/_{s})(0.421\ s) = 3.08\ m$$

So, the correct answer is B !

A long jumper in a competition jumps with an initial speed of $10.4\ {}^{\mathrm{m}}/_{\mathrm{s}}$. They land a horizontal distance of $7.87\ \mathrm{m}$. At what angle did the long jumper launch with?

A. $45.5°$ **B.** $67.3°$ **C.** $17.7°$ **D.** $\mathbf{22.7°}$

$$x = \frac{v_0^2 \sin(2\theta)}{g}$$

Solve for the angel

$$\sin(2\theta) = \frac{xg}{v_0^2}$$

$$2\theta = \sin^{-1}\left(\frac{xg}{v_0^2}\right)$$

$$\theta = \frac{1}{2}\sin^{-1}\left(\frac{xg}{v_0^2}\right) = \frac{1}{2}\sin^{-1}\left(\frac{(7.87\ m)\left(9.80\ {}^{m}/_{s^2}\right)}{(10.4\ {}^{m}/_{s})^2}\right) = \frac{1}{2}\sin^{-1}\left(\frac{77.13\ {}^{m^2}/_{s^2}}{108.16\ {}^{m^2}/_{s^2}}\right)$$

$$\theta = \frac{1}{2}\sin^{-1}(0.7131) = 22.7°$$

So, the correct answer is D !

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