Exam Average 76.6 **Exam High Score** 95

PH 220 **Exam # 01 (100 pts)** **Name** Solution

1

The average mass density of the space in the Solar System is estimated to be $3.07 \text{ x } 10^7 \ {}^{\text{kg}}/_{\text{ls}^3}$. "ls" is light second, the distance light travels in a second. Two relationships related to light years are $1 \text{ ly} = 3.156 \text{ x } 10^7 \text{ ls}$ and $1 \text{ ly} = 9.461 \text{ x } 10^{15} \text{ m}$. What is the average mass density in units of ${}^{\text{kg}}/_{\text{m}^3}$?

A. $\mathbf{1.14 \text{ x } 10^{-18} \ {}^{kg}/_{m^3}}$

B. $1.02 \text{ x } 10^{-1} \ {}^{\text{kg}}/_{\text{m}^3}$

C. $8.27 \text{ x } 10^{32} \ {}^{\text{kg}}/_{\text{m}^3}$

D. $3.42 \text{ x } 10^{-10} \ {}^{\text{kg}}/_{\text{m}^3}$

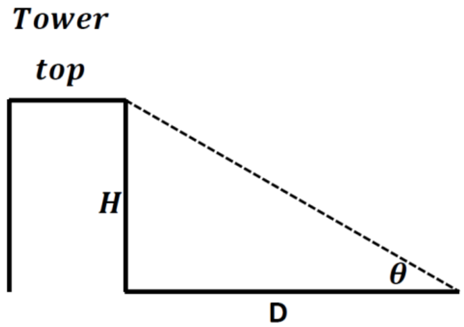
$$\rho = 3.07 \ x \ 10^7 \ {}^{kg}/_{ls^3} \ x \left(\frac{3.156 \ x \ 10^7 \ ls}{ly}\right)^3 \ x \left(\frac{1 \ ly}{9.461 \ x \ 10^{15} \ m}\right)^3$$

$$\rho = 3.07 \ x \ 10^7 \ {}^{kg}/_{ls^3} \ x \ 3.1435 \ x \ 10^{22} \ {}^{ls^3}/_{ly^3} \ x \ 1.181 \ x \ 10^{-48} \ {}^{ly^3}/_{m^3}$$

$$\rho = 1.14 \ x \ 10^{-18} \ {}^{kg}/_{m^3}$$

So, the correct answer is A !

2



As shown on the left you have a tower that is 23.7 m tall. If you are on the ground sighting to the top of the tower, you measure and angle $\theta = 48.9°$. How far are you away from the tower?

A. 27.2 m **B.** **20.7 m** **C.** 17.9 m **D.** 31.5 m

$$\tan(\boldsymbol{\theta}) = \frac{\boldsymbol{oppposite}}{\boldsymbol{adjacent}} = \frac{\boldsymbol{H}}{\boldsymbol{D}}$$

Solving for D

$$\boldsymbol{D} = \frac{\boldsymbol{H}}{\tan(\boldsymbol{\theta})} = \frac{\mathbf{23.7}\ \boldsymbol{m}}{\tan(\mathbf{48.9°})} = \mathbf{20.7}\ \boldsymbol{m}$$

So, the correct answer is B !

3

Three forces act on a box. They are: $\overrightarrow{F_1} = +87.0\ \text{N}\ (\widehat{\text{North}})$, $\overrightarrow{F_2} = -37.0\ \text{N}\ (\widehat{\text{North}})$, and $\overrightarrow{F_3} = 94.0\ \text{N}\ (\widehat{\text{South}})$. What is the total force acting on the box?

A. $44.0\ \text{N}\ (\widehat{\text{North}})$ **C.** $\mathbf{44.0\ N}\ (\widehat{\mathbf{South}})$

B. $218.\ \text{N}\ (\widehat{\text{North}})$ **D.** $218.\ \text{N}\ (\widehat{\text{South}})$

$$\sum \vec{\boldsymbol{F}} = \overrightarrow{\boldsymbol{F_1}} + \overrightarrow{\boldsymbol{F_2}} + \overrightarrow{\boldsymbol{F_3}} = \left(+\mathbf{87.0}\ \boldsymbol{N}\ (\widehat{\boldsymbol{North}})\right) + \left(-\mathbf{37.0}\ \boldsymbol{N}\ (\widehat{\boldsymbol{North}})\right) + \left(\mathbf{94.0}\ \boldsymbol{N}\ (\widehat{\boldsymbol{South}})\right)$$

To add vectors, all must be in the same direction so getting them all in the $(\widehat{\boldsymbol{North}})$, we get

$$\sum \vec{\boldsymbol{F}} = +\mathbf{87.0}\ \boldsymbol{N}\ (\widehat{\boldsymbol{North}}) - \mathbf{37.0}\ \boldsymbol{N}(\ \widehat{\boldsymbol{North}}) - \mathbf{94.0}\ \boldsymbol{N}\ (\widehat{\boldsymbol{North}}) = -\mathbf{44.0}\ \boldsymbol{N}\ (\widehat{\boldsymbol{North}})$$

$$\sum \vec{\boldsymbol{F}} = -\mathbf{44.0}\ \boldsymbol{N}\ (\widehat{\boldsymbol{North}}) = +\mathbf{44.0}\ \boldsymbol{N}\ \ (\widehat{\boldsymbol{South}})$$

So, the correct answer is C !

4

A bus is driving down the highway. Its engine is producing a drive force of $\overrightarrow{\mathrm{F_{Drive}}} = 750.\,\mathrm{N}\ (\widehat{\mathrm{South}})$. There is a head wind the bus is driving into which is $\overrightarrow{\mathrm{F_{Head}}} = 250.\,\mathrm{N}\ (\widehat{\mathrm{North}})$. The bus is also experiencing a cross wind $\overrightarrow{\mathrm{F_{Cross}}} = 350.\,\mathrm{N}\ (\widehat{\mathrm{East}})$. What is the net force acting on the bus?

A. $610.\,\mathrm{N}\ @\ 35.0°\ (\widehat{\mathrm{South}})\ \mathrm{of}\ (\widehat{\mathrm{West}})$

B. $610.\,\mathrm{N}\ @\ 35.0°\ (\widehat{\mathrm{North}})\ \mathrm{of}\ (\widehat{\mathrm{East}})$

C. $610.\,\mathrm{N}\ @\ 35.0°\ (\widehat{\mathrm{North}})\ \mathrm{of}\ (\widehat{\mathrm{West}})$

D. $\mathbf{610.\,N\ @\ 35.0°\ (\widehat{South})\ of\ (\widehat{East})}$

First resolve the two north south forces

$$\overrightarrow{\boldsymbol{F_{NS}}} = \overrightarrow{\mathbf{F_{Drive}}} + \overrightarrow{\mathbf{F_{Head}}} = \mathbf{750.\,N\ (\widehat{South}) + 250.\,N\ (\widehat{North}) = 750.\,N\ (\widehat{South}) - 250.\,N\ (\widehat{South})}$$

$$\overrightarrow{\boldsymbol{F_{NS}}} = \mathbf{500.\,N\ (\widehat{South})}$$

$$\overrightarrow{\boldsymbol{F_{Net}}} = \mathbf{500.\,N\ (\widehat{South}) + 350.\,N\ (\widehat{East})}$$

These are perpendicular so use Pythagorean Theorem

$$\boldsymbol{F_{Net}} = \sqrt{(\mathbf{500.}\,\boldsymbol{N})^2 + (\mathbf{350.}\,\boldsymbol{N})^2} = \sqrt{\mathbf{2.50}\ \boldsymbol{x}\ \mathbf{10^5}\ \boldsymbol{N^2} + \mathbf{1.225}\ \boldsymbol{x}\ \mathbf{10^5}\ \boldsymbol{N^2}}$$

$$\boldsymbol{F_{Net}} = \sqrt{\mathbf{3.725}\ \boldsymbol{x}\ \mathbf{10^5}\ \boldsymbol{N^2}} = \mathbf{610.}\,\boldsymbol{N}$$

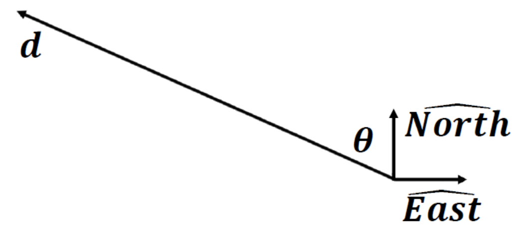
Find the angle relative to due East

$$\boldsymbol{\theta} = \mathbf{tan^{-1}}\left(\frac{\mathbf{350.}\,\boldsymbol{N}}{\mathbf{500.}\,\boldsymbol{N}}\right) = \mathbf{tan^{-1}(0.7000) = 35.0°}\ (\widehat{\boldsymbol{South}})\ \boldsymbol{of}\ (\widehat{\boldsymbol{East}})$$

So, the correct answer is D !

5

A pipeline extends a distance $d = 87.6\ m$ as shown in the figure to the right. The pipeline makes an angle $\theta = 66.0°\ \widehat{West}$ of $\widehat{North}$. How far would someone have to walk north from the origin of the axes included in the diagram, to be even with the end of the pipeline? This means you could draw a straight line horizontally from the end of the pipeline to the person walking north.



A. $95.9\ m$ **B.** $39.0\ m$ **C.** $80.0\ m$ **D.** $\mathbf{35.6\ m}$

We want the north component of the vector. In this drawing the north component is adjacent to the angle $\boldsymbol{\theta}$. So

$$\cos(\boldsymbol{\theta}) = \frac{\boldsymbol{adj}}{\boldsymbol{hyp}} = \frac{\boldsymbol{d_{north}}}{\boldsymbol{d}}$$

Solve for $\boldsymbol{d_{north}}$

$$\boldsymbol{d_{north}} = \boldsymbol{d}\ \cos(\boldsymbol{\theta}) = (\mathbf{87.6}\ \boldsymbol{m})\cos(\mathbf{66.0}°) = \mathbf{35.6}\ \boldsymbol{m}$$

So, the correct answer is D !

6

An object is found to have a displacement function given by:

$$\vec{x} = (4t^3 - 5t^2 + 17t - 9)(\widehat{\text{West}})$$

x will have units of m when t is in units of s. What is the acceleration of this object at $t = 3.41$ s?

A.	$122.\ ^{m}/_{s^2}\ (\widehat{\text{East}})$	**C.**	$\mathbf{71.8}\ ^{\mathbf{m}}/_{\mathbf{s^2}}\ (\widehat{\mathbf{West}})$
B.	$71.8\ ^{m}/_{s^2}\ (\widehat{\text{East}})$	**D.**	$122.\ ^{m}/_{s^2}\ (\widehat{\text{West}})$

$$\vec{v} = \frac{d\vec{x}}{dt} = \frac{d}{dt}(4t^3 - 5t^2 + 17t - 9)(\widehat{West}) = (12t^2 - 10t + 17)(\widehat{West})$$

$$\vec{a} = \frac{d\vec{v}}{dt} = \frac{d}{dt}(12t^2 - 10t + 17)(\widehat{West}) = (24t - 10)(\widehat{West})$$

$$\vec{a}(t = 3.41\ s) = (24(3.41\ s) - 10)(\widehat{West}) = (81.8 - 10)(\widehat{West}) = 71.8\ (\widehat{West})$$

Units for acceleration must be $^{m}/_{s^2}$ since we had position in m and time in s.

$$\vec{a}(t = 3.41\ s) = 71.8\ ^{m}/_{s^2}\ (\widehat{West})$$

So, the correct answer is C !

7

An object has a net displacement of $840.\,\mathrm{m}\ \widehat{\mathrm{West}}$. This displacement occurred during a time period of $750.\,\mathrm{s}$. The final velocity of the object is found to be $7.63\ {}^{\mathrm{m}}/_{\mathrm{s}}\ \widehat{\mathrm{West}}$. What was the initial velocity of the object?

A. $5.39\ {}^{\mathrm{m}}/_{\mathrm{s}}\ \widehat{\mathrm{West}}$

B. $\mathbf{5.39\ {}^{m}/_{s}\ \widehat{East}}$

C. $9.87\ {}^{\mathrm{m}}/_{\mathrm{s}}\ \widehat{\mathrm{West}}$

D. $9.87\ {}^{\mathrm{m}}/_{\mathrm{s}}\ \widehat{\mathrm{East}}$

$$\vec{S} = \frac{1}{2}\left(\vec{v_f} + \vec{v_0}\right)t$$

Solve for initial velocity

$$\frac{2\vec{S}}{t} = \vec{v_f} + \vec{v_0}$$

$$\vec{v_0} = \frac{2\vec{S}}{t} - \vec{v_f} = \frac{2\left(840.\,m\ \widehat{West}\right)}{750.\,s} - 7.63\ {}^{m}/_{s}\ \widehat{West} = 2.24\ {}^{m}/_{s}\ \widehat{West} - 7.63\ {}^{m}/_{s}\ \widehat{West}$$

$$\vec{v_0} = 2.24\ {}^{m}/_{s}\ \widehat{West} - 7.63\ {}^{m}/_{s}\ \widehat{West} = -5.39\ {}^{m}/_{s}\ \widehat{West} = 5.39\ {}^{m}/_{s}\ \widehat{East}$$

So, the correct answer is B !

8

An object travels a distance $\vec{S} = 26.1\ \text{m}\ (\widehat{\text{North}})$ in a time of $t = 4.13\ \text{s}$. The object had an initial velocity of $\vec{v_0} = 3.61\ {}^{\text{m}}/_{\text{s}}\ (\widehat{\text{North}})$. What was the acceleration that acted on the object during that time?

A. $\mathbf{1.31\ {}^{m}/_{s^2}\ (\widehat{North})}$

B. $1.31\ {}^{\text{m}}/_{\text{s}^2}\ (\widehat{\text{South}})$

C. $4.81\ {}^{\text{m}}/_{\text{s}^2}\ (\widehat{\text{North}})$

D. $4.81\ {}^{\text{m}}/_{\text{s}^2}\ (\widehat{\text{South}})$

$$\vec{S} = \vec{v_0}t + \frac{1}{2}\vec{a}t^2$$

Solve for acceleration

$$\frac{1}{2}\vec{a}t^2 = \vec{S} - \vec{v_0}t$$

$$\vec{a} = \frac{2(\vec{S} - \vec{v_0}t)}{t^2} = \frac{2\left(26.1\ \text{m}\ (\widehat{\text{North}}) - \left(3.61\ {}^{\text{m}}/_{\text{s}}\ (\widehat{\text{North}})(4.13\ \text{s})\right)\right)}{(4.13\ \text{s})^2}$$

$$\vec{a} = \frac{2(26.1\ \text{m} - 14.9\ \text{m})(\widehat{\text{North}})}{17.06\ s^2} = \frac{2(11.2\ \text{m})(\widehat{\text{North}})}{17.06\ s^2} = 1.31\ {}^{m}/_{s^2}\ (\widehat{\text{North}})$$

So, the correct answer is A !

9

You are at the center of a bridge which spans a lake that is located $1200.\ \text{m}$ below the bridge. You take a rock and throw it straight down, imparting an initial velocity of $12.5\ {}^{\text{m}}/_{\text{s}}\ \widehat{\text{down}}$. What is the velocity of the rock $5.19\ \text{s}$ after it is thrown?

A. $\mathbf{63.4\ {}^{m}/_{s}\ \widehat{down}}$

B. $38.4\ {}^{\text{m}}/_{\text{s}}\ \widehat{\text{down}}$

C. $50.9\ {}^{\text{m}}/_{\text{s}}\ \widehat{\text{down}}$

D. $9.80\ {}^{\text{m}}/_{\text{s}}\ \widehat{\text{down}}$

$$\vec{v_f} = \vec{v_0} + \vec{a}t = 12.5\ {}^{m}/_{s}\ \widehat{down} + 9.80\ {}^{m}/_{s^2}\ \widehat{down}\ (5.19\ s)$$

$$\vec{v_f} = \vec{v_0} + \vec{a}t = (12.5\ {}^{m}/_{s} + 50.9\ {}^{m}/_{s})\ \widehat{down} = 63.4\ {}^{m}/_{s}\ \widehat{down}$$

So, the correct answer is A !

10

A drag racing car has an initial velocity of $134.0\ ^{\text{m}}/_{\text{s}}\ \widehat{\text{South}}$ when it begins to brake. It takes a displacement of $813.0\ \text{m}\ \widehat{\text{South}}$ for the car to come to rest. What was the acceleration that the car used to stop?

A. $11.0\ ^{\text{m}}/_{\text{s}^2}\ \widehat{\text{South}}$

B. $\mathbf{11.0\ ^{m}/_{s^2}\ \widehat{North}}$

C. $22.1\ ^{\text{m}}/_{\text{s}^2}\ \widehat{\text{South}}$

D. $22.1\ ^{\text{m}}/_{\text{s}^2}\ \widehat{\text{North}}$

$$\boldsymbol{v_f^2 = 0 = v_0^2 - 2aS}$$

Solve for a

$$\boldsymbol{a = \frac{v_0^2}{2S} = \frac{(134.0\ ^{m}/_{s})^2}{2(813.0\ m)} = 11.043\ ^{m}/_{s^2}}$$

Since the initial velocity is South, and the displacement is South, the acceleration must be slowing the car down, so it must be North

So, the correct answer is B !

11

A rail gun uses electromagnetic fields to impart an initial velocity to a metal projectile. A rail gun fires its projectile straight up. The projectile reaches a height of $457.\ \text{m}$ above its launch point before it begins to fall back to the ground. What was the initial velocity imparted to the projectile?

A. $66.9\ ^{\text{m}}/_{\text{s}}$ **B.** $9.80\ ^{\text{m}}/_{\text{s}}$ **C.** $\mathbf{94.6\ ^{m}/_{s}}$ **D.** $47.3\ ^{\text{m}}/_{\text{s}}$

$$\boldsymbol{v_f^2 = 0 = v_0^2 - 2gS}$$

Solve for initial velocity

$$\boldsymbol{v_0^2 = 2gS}$$

$$\boldsymbol{v_0 = \sqrt{2gS} = \sqrt{2\left(9.80\ ^{m}/_{s^2}\right)(457.\ m)} = \sqrt{8957.2\ ^{m^2}/_{s^2}} = 94.6\ ^{m}/_{s}}$$

So, the correct answer is C !

12

A rock is thrown upward with an initial speed of $15.6\ ^{\mathrm{m}}/_{\mathrm{s}}$ How long was the rock in the air before it fell back to the starting point again?

A. 12.4 s **B.** 24.8 s **C.** 1.59 s **D.** **3.18 s**

We can get $t$from using

$$y = 0 = v_0 t - \frac{1}{2} g t^2 = t\left(v_0 - \frac{1}{2} g t\right) = 0$$

$$\frac{1}{2} g t = v_0$$

$$t = \frac{2v_0}{g} = \frac{2(15.6\ ^{m}/_{s})}{9.80\ ^{m}/_{s^2}} = \frac{31.2\ ^{m}/_{s}}{9.80\ ^{m}/_{s^2}} = 3.18\ s$$

So, the correct answer is D !

13

The distance from Marquette to Escanaba is 106 km. It takes you 1.27 hr to drive to Escanaba. You spend 3.67 hr visiting a friend. The distance from Escanaba to Munising is 101 km. It takes you 1.20 hr to drive there. Munising is 68.9 km away from Marquette. What was the magnitude of the average velocity going from Marquette to Escanaba to Munising for this trip?

A. $27.9\ ^{\mathrm{km}}/_{\mathrm{hr}}$ **B.** $33.7\ ^{\mathrm{km}}/_{\mathrm{hr}}$ **C.** $83.9\ ^{\mathrm{km}}/_{\mathrm{hr}}$ **D.** $\mathbf{11.2\ ^{km}/_{hr}}$

$$|\vec{\bar{v}}| = \frac{|\overrightarrow{S_{total}}|}{\Delta t_{total}} = \frac{68.9\ km}{1.27\ hr + 3.67\ hr + 1.20\ hr} = \frac{68.9\ km}{6.14\ hr} = 11.2\ ^{km}/_{hr}$$

So, the correct answer is D !

14

A tennis ball is launched from the ground with an initial velocity of $30.0\ ^{\mathrm{m}}/_{\mathrm{s}}$ @ 30.0° above ground. When the tennis ball is 6.78 m above the ground, what is the acceleration of the tennis ball?

A. $0.0\ ^{\mathrm{m}}/_{\mathrm{s}^2}$ **B.** $16.6\ ^{\mathrm{m}}/_{\mathrm{s}^2}$ **C.** $\mathbf{9.80\ ^{m}/_{s^2}}$ **D.** $1.11\ ^{\mathrm{m}}/_{\mathrm{s}^2}$

Once the tennis ball has left ground, the only acceleration on the ball is that of gravity

$$\vec{a} = 9.80\ ^{m}/_{s^2}\ \widehat{down}$$

So, the correct answer is C !

15

A quarterback throws a football with an initial velocity of $\vec{v_0} = 16.9\ ^{m}/_{s}$ @ $23.9°$ above $(\widehat{-x})$. When the football is at the highest point above the ground, what is its velocity? Ignore all effects of air resistance.

A. $0.00\ ^{m}/_{s}\ (\widehat{-x})$

B. $\mathbf{15.5\ ^{m}/_{s}\ (\widehat{-x})}$

C. $6.85\ ^{m}/_{s}\ (\widehat{-x})$

D. $16.9\ ^{m}/_{s}\ (\widehat{-x})$

At the highest point in the trajectory, the vertical component of the velocity has gone to zero. However, the horizontal component is unchanged, so

$$\vec{v} = v_0 \cos(\theta)\ \widehat{-x} = (16.9\ ^{m}/_{s}) \cos(23.9°)\ \widehat{-x} = 15.5\ ^{m}/_{s}\ \widehat{-x}$$

So, the correct answer is B !

16

A rock is rolling with a speed of $12.5\ ^{m}/_{s}$ horizontally when it goes off the edge of a cliff. What is its speed $3.40\ s$ after it goes off the cliff?

A. $\mathbf{35.6\ ^{m}/_{s}}$ **B.** $12.5\ ^{m}/_{s}$ **C.** $33.3\ ^{m}/_{s}$ **D.** $13.8\ ^{m}/_{s}$

$$v_f = \sqrt{v_{fx}^2 + v_{fy}^2} = \sqrt{v_{0x}^2 + \left(v_{oy} + gt\right)^2} = \sqrt{v_{0x}^2 + g^2t^2}$$

$$v_f = \sqrt{(12.5\ ^{m}/_{s})^2 + \left(9.80\ ^{m}/_{s^2}\right)^2 (3.40\ s)^2} = \sqrt{156.25\ ^{m^2}/_{s^2} + 1.11\ x\ 10^3\ ^{m^2}/_{s^2}}$$

$$v_f = \sqrt{1.267\ x\ 10^3\ ^{m^2}/_{s^2}} = 35.6\ ^{m}/_{s}$$

So, the correct answer is A !

17

A tennis ball is struck and provided an initial velocity of 37.3 $^{m}/_{s}$ @ 34.4° above the horizontal. The ball travels a distance of 84.9 m horizontally when it strikes a large wall. How high above the launch point of the ball does the ball strike the wall?

A. $\mathbf{20.9\ m}$ **B.** 58.1 m **C.** 37.3 m **D.** 47.6 m

$$y = v_{0y}t + \frac{1}{2}a_y t^2 = v_0 \sin(\theta)\, t - \frac{1}{2}g t^2$$

Need time which we get from horizontal motion

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

Solve for time

$$t = \frac{x}{v_0 \cos(\theta)} = \frac{84.9\ m}{(37.3\ ^{m}/_{s}) \cos(34.4°)} = \frac{84.9\ m}{30.778\ ^{m}/_{s}} = 2.759\ s$$

$$y = v_0 \sin(\theta)\, t - \frac{1}{2}g t^2 = (37.3\ ^{m}/_{s}) \sin(34.4°)\,(2.759\ s) - \frac{1}{2}\left(9.80\ ^{m}/_{s^2}\right)(2.759\ s)^2$$

$$y = 58.14\ m - 37.27\ m = 20.87\ m$$

So, the correct answer is A !

18

A motorcycle stunt driver is going to drive off a ramp angled at 28.0° above the (horizontal). He wants to land at the same height a distance of 31.0 m away. What does he need to have for a launch speed? Ignore all effects of air resistance.

A. 25.4 $^{m}/_{s}$ **C.** 1.95 $^{m}/_{s}$

B. $\mathbf{19.1\ ^{m}/_{s}}$ **D.** 17.4 $^{m}/_{s}$

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

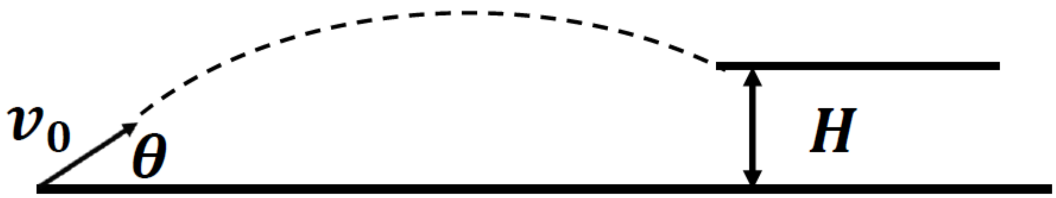
Solve for initial speed

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

$$v_0 = \sqrt{\frac{Rg}{\sin(2\theta)}} = \sqrt{\frac{(31.0\ m)\left(9.80\ ^{m}/_{s^2}\right)}{\sin\left(2(28.0°)\right)}} = \sqrt{\frac{303.8\ ^{m^2}/_{s^2}}{\sin(56.0°)}} = \sqrt{366.4\ ^{m^2}/_{s^2}} = 19.1\ ^{m}/_{s}$$

So, the correct answer is B !

19



Pictured above a golfer strikes a golf ball with an initial velocity of $13.79\ ^{\mathrm{m}}/_{\mathrm{s}}$ @ 33.0° above the horizontal as shown. The golf ball lands on an elevated green 1.01 s after the ball was struck by the club. How high (H) is the elevated green above the ground?

A. 12.6 m **B.** 7.59 m **C.** $\mathbf{2.59\ m}$ **D.** 5.00 m

$$y = v_{0y}t + \frac{1}{2}a_y t^2 = H = v_0 \sin(\theta)\, t - \frac{1}{2}gt^2$$

$$H = v_0 \sin(\theta)\, t - \frac{1}{2}gt^2 = (13.79\ ^{m}/_{s}) \sin(33.0°)\,(1.01\ s) - \frac{1}{2}\left(9.80\ ^{\mathrm{m}}/_{s^2}\right)(1.01\ s)^2$$

$$H = 7.586\ m - 5.000\ m = 2.59\ m$$

So, the correct answer is C !

20

While researching a new concept in Physics, a scientist believes the appropriate relationship between the force of a "Tractor Beam" and the distance an object is moved can be modeled by

$$F = \left(42.3\ {}^{N}\!/_{m^3}\right) d^3$$

Where F is the force in units of N (Newtons) and d is the distance in units of m (meters). In performing an experiment, the natural log of measured force is plotted on the y-axis of a graph and the natural log of measured distance is plotted on the x-axis. $\left(\text{Ln}(x) \text{ vs } \text{Ln}(d)\right)$. When a best straight line is found, what are the values for the slope and y-intercept?

A. $\text{Slope} = 42.3, \quad \text{Y} - \text{intercept} = 3.00$

B. $\text{Slope} = 1.10, \quad \text{Y} - \text{intercept} = 3.74$

C. $\text{Slope} = 3.00, \quad \text{Y} - \text{intercept} = 42.3$

D. $\mathbf{Slope = 3.00, \quad Y - intercept = 3.74}$

On a Ln-Ln plot, with a Power Law $y = kx^n$, plotting Ln(y) vs Ln(x) results in the slope being the power n which in this case is 3.00, The value k in front of x becomes the y-intercept = Ln(k). So here it is Ln(42.3) = 3.74.

So, the correct answer is D !

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