A. According to a study conducted by the CDC over the years 2007-2010 the average American male has a height of 5 feet 9 inches and a weight of 200 pounds.

1. What is the height of the average American male measured in centimeters (1 inch = 2.54 cm)?

\[ 1 \text{ foot} = 12 \text{ inches} \Rightarrow 5'9'' \text{ inches} = 5 \times 12 + 9 = 69 \text{ inches} \]

\[ 69 \text{ in} \times \frac{2.54 \text{ cm}}{1 \text{ in}} = 175 \text{ cm} \]

2. What is the height of the average American male measured in meters?

\[ 1 \text{ cm} = 10^{-2} \text{ m} \Rightarrow 175 \text{ cm} \times \frac{10^{-2} \text{ m}}{1 \text{ cm}} = 1.75 \text{ m} \]

3. What is the weight of the average American male measured in Newtons (1 Newton = 0.225 pounds)?

\[ 200 \text{ pounds} \times \frac{1 \text{ N}}{0.225 \text{ pounds}} = 889 \text{ N} \]

4. What is the mass of the average American male measured in kilograms?

\[ m = \frac{W}{g} = \frac{889 \text{ N}}{9.8 \text{ m/s}^2} = 90.7 \text{ kg} \]

B. Give the power of ten corresponding to each prefix:

- kilo \( 10^3 \)
- giga \( 10^9 \)
- micro \( 10^{-6} \)
- centi \( 10^{-2} \)
- nano \( 10^{-9} \)

C. Write the x and y components of vector \( \vec{F} \) in terms of its magnitude, \( F \), and the angle \( \phi \).

\[ F_x = F \sin \phi \]

\[ F_y = -F \cos \phi \]

D. Vectors \( \vec{A} \) and \( \vec{B} \) have the same magnitude. Which of the following combination of vectors points along the positive x-axis? (Circle one answer)

- (a) \( \vec{A} + \vec{B} \)
- (b) \( \vec{A} - \vec{B} \)
- (c) \( -\vec{A} + \vec{B} \)
- (d) \( -\vec{A} - \vec{B} \)
A. A ball rolls across the ground with a constant velocity of +1.27 m/s. How long does it take for the ball to undergo a displacement of +10 m?

\[ d = 0 \Rightarrow \Delta x = v - \Delta t \]

\[ \Delta t = \frac{\Delta x}{v} = \frac{10\text{m}}{1.27\text{m/s}} = 7.875 \text{s} \]

B. A ball is launched directly upwards with an initial speed of \( v_0 = 3.47 \text{ m/s} \).

1. How high above the launching point does the object reach?

\[ \frac{v_f^2}{2g} = \frac{v_0^2}{2g} \]

\[ \Rightarrow \Delta y = \frac{v_0^2}{2g} = \left(3.47\text{ m/s}\right)^2 = 10.614\text{ m} \]

2. How long after it is released does it reach this height?

\[ u_f = v_0 + 2 \Delta t \Rightarrow \Delta t = \frac{v_f - v_0}{-g} = \frac{0 - (3.47\text{ m/s})}{-9.8\text{ m/s}^2} = 0.354\text{s} \]

4. If we double the initial velocity, by what factor does the maximum height increase?

\[ \Delta y = \frac{v_0^2}{2g} \]

let \( v_0' = 2v_0 \) then

\[ \Delta y' = \frac{v_0'^2}{2g} = \frac{(2v_0)^2}{2g} = 4 \cdot \frac{v_0^2}{2g} \]

\[ \Delta y' = 4 \cdot \Delta y \]

\[ \Rightarrow \text{Max height increases by a factor of } 4 \]
One of Rich's many hole-in-ones occurred on a course where the hole was 18 m above the teeing area and 160 m away (see the diagram). The ball was gracefully struck at an angle of 46° above the horizontal. The ball soared through the air and 5.5 s after being launched, the ball landed directly into the hole.

1. What was the displacement of the ball? Give both its magnitude and its angle measured with respect to the horizontal.

\[ x\text{-component} = 160\text{ m} \]
\[ y\text{-component} = 18\text{ m} \]
\[ \text{magnitude} = \sqrt{(160\text{ m})^2 + (18\text{ m})^2} = 161\text{ m} \]
\[ \text{angle} = \tan^{-1}\left(\frac{18\text{ m}}{160\text{ m}}\right) = 6.42° \text{ above horizontal} \]

2. Fill in the blank. The magnitude of the ball’s displacement was \text{ the distance the ball traveled. (Circle one)}

Greatest than \hspace{1cm} Smaller than \hspace{1cm} Equal to

3. Find the initial speed of the ball. \[ \text{(Note: due to mistake in statement of the problem, there are multiple correct answers)} \]

Since \[ \Delta x = 0 \]
\[ \Rightarrow U_{0x} = \frac{\Delta x}{t} = \frac{160\text{ m}}{5.5\text{ s}} = 29.091\text{ m/s} \]
\[ \Delta y = \frac{1}{2}gt^2 \Rightarrow U_{0y} = \frac{\Delta y}{t} + \frac{1}{2}gt^2 = 30.223\text{ m/s} \]
\[ U_0 = \sqrt{U_{0x}^2 + U_{0y}^2} = \sqrt{(29.091\text{ m/s})^2 + (30.223\text{ m/s})^2} = 41.9\text{ m/s} \]

4. What was the speed of the ball just before it landed?

- No acceleration in x-direction \( \Rightarrow \) \[ U_{f,x} = U_{0x} \]
- For y-direction: \[ U_{f,y} = U_{0y} - 2g\Delta y \]
\[ U_f = \sqrt{U_{f,x}^2 + U_{f,y}^2} = \sqrt{U_{0x}^2 + U_{0y}^2 - 2g\Delta y} = \sqrt{(29.091\text{ m/s})^2 + (30.223\text{ m/s})^2 - 2(9.8\text{ m/s}^2)(18\text{ m})} \]
\[ U_f = 37.5\text{ m/s} \]
A. Consider an object undergoing uniform circular motion. Check all that apply

____ The object has a constant velocity  
____ The object has a constant speed  
____ The direction of the object’s velocity is constant  

____ The acceleration of the object has a constant magnitude  
____ The direction of the object’s acceleration is constant  
____ The net force acting on the object has a constant magnitude

B. A rock connected to a string is being swung clockwise around a circle at a constant speed. For the following questions, specify the direction of the stated quantity at the instant the rock is at the point P using $\pm \mathbf{x}, \pm \mathbf{y}, -\mathbf{x}$ or $-\mathbf{y}$

- $\mathbf{x}$ Direction of the net force acting on the rock
- $\mathbf{x}$ Direction of the centripetal acceleration
- $\mathbf{y}$ Direction of the velocity
- $\mathbf{x}$ Direction of the centripetal force
- $\mathbf{y}$ Direction the rock would go if the string snapped at point P

C. Suppose a patient’s aortic arch curves with a radius of 50 mm. Each time the patient’s heart beats it sends an 8.0 gram pulse of blood through the arch at a speed of 0.4 m/s.

1. What is the magnitude of the acceleration felt by the pulse of blood as it goes around the aortic arch?

$$a = \frac{v^2}{r} = \frac{(0.4 \text{ m/s})^2}{50 \times 10^{-3} \text{ m}} = 3.2 \text{ m/s}^2$$

2. What net force must the aortic arch apply to the pulse of blood?

If patient is lying down → $F_{\text{net}} = ma = 0.0256 \text{ N}$

If patient is standing → $F_{\text{arch}} = ma - mg = -0.0528 \text{ N}$

Either answer is accepted