Name ___SOLUTION__________________________________

1. If you are measuring the length of the room, the most appropriate SI unit is
   a. Kilometer.
   b. Meter.
   c. Centimeter.
   d. Millimeter.

2. The density of a solid object is defined as the ratio of the mass of the object to its volume \( \rho = \frac{m}{V} \). The dimension of density is
   a. \([M]/[L]\).
   b. \([L]^3/[M]\).
   c. \([M][L]^2\).
   d. \([M]/[L]^3\).

3. Given that \( a = 1.50 \) m and \( c = 3.00 \) m, find:

   a. The length of side \( b \).
   
   \[
   b = (c^2 - a^2)^{1/2} = ((3.00 \text{ m})^2 - (1.50 \text{ m})^2)^{1/2} = 2.60 \text{ m}
   \]

   b. The tangent of angle \( \theta \).
   
   \[
   \tan \theta = \frac{a}{b} = \frac{1.50 \text{ m}}{2.60 \text{ m}} = 0.577
   \]
1. If you start from the Bakery, travel to the Café, and then to the Art Gallery, what is your displacement?
   a. 6.50 km.
   b. -2.50 km.
   c. 10.5 km.
   d. -1.50 km.

2. If you start from the Bakery, travel to the Art Gallery, and then to the Café, in 1.00 hour, what is your average speed?
   a. 6.50 km/hr.
   b. 2.50 km/hr.
   c. 9.00 km/hour.
   d. 10.5 km/hr.

3. Given the position-versus-time graph for a basket ball player traveling up and down the courting a straight-line path find the instantaneous velocity of the player at $t = 4.00 \text{ s}$.

\[
V = \frac{6.00 \text{ m} - 0 \text{ m}}{4.00 \text{ s} - 0 \text{ s}} = 1.50 \text{ m/s}
\]
You are given two vectors:

\( \mathbf{A} \) : 40.0 m @ 50.0°
\( \mathbf{B} \) : 90.0 m @ 10.0°

You are asked to find a new vector \( \mathbf{R} = \mathbf{A} + \mathbf{B} \).

*Note: Find the magnitude and direction of vector \( \mathbf{R} \).*

\[
\begin{align*}
A_x &= A \cos(\theta_A) = (40.0 \text{ m}) \cos(50.0^\circ) = 25.7 \text{ m} \\
A_y &= A \sin(\theta_A) = (40.0 \text{ m}) \sin(50.0^\circ) = 30.6 \text{ m} \\
B_x &= B \cos(\theta_B) = (90.0 \text{ m}) \cos(10.0^\circ) = 88.6 \text{ m} \\
B_y &= B \sin(\theta_B) = (90.0 \text{ m}) \sin(10.0^\circ) = 15.6 \text{ m} \\
R_x &= A_x + B_x = (25.7 \text{ m}) + (88.6 \text{ m}) = 114.3 \text{ m} \\
R_y &= A_y + B_y = (30.6 \text{ m}) + (15.6 \text{ m}) = 46.2 \text{ m} \\
R &= \left( R_x^2 + R_y^2 \right)^{1/2} = \left( (114.3 \text{ m})^2 + (46.2 \text{ m})^2 \right)^{1/2} = 123 \text{ m} \\
\theta_R &= \tan^{-1} \left( \frac{R_y}{R_x} \right) = \tan^{-1} \left( \frac{46.2 \text{ m}}{114.3 \text{ m}} \right) = 22.0^\circ
\end{align*}
\]
1. You throw a physics textbook horizontally at a speed of 11.0 m/s from a top of a building. The height of the building is 50.0 m. Ignoring air resistance,

   a. What are the components of the initial velocity of the book?

   \[ \mathbf{v}_0: 11.0 \text{ m/s @ } 0^\circ \]

   \[ v_{x0} = v_0 \cos(\theta_0) = (11.0 \text{ m/s}) \cos(0^\circ) = 11.0 \text{ m/s} \]

   \[ v_{y0} = v_0 \sin(\theta_0) = (11.0 \text{ m/s}) \sin(0^\circ) = 0 \text{ m/s} \]

   b. How long will it take for the book to hit the ground?

   \[ y = y_0 + v_{y0} t - \frac{1}{2} g t^2 \]

   \[ 0 = y_0 + 0 - \frac{1}{2} g t^2 \]

   \[ \frac{1}{2} g t^2 = y_0 \]

   \[ g t^2 = 2 y_0 \]

   \[ t^2 = \frac{2 y_0}{g} \]

   \[ t = \left( \frac{2 y_0}{g} \right)^{1/2} \]

   \[ t = (2 (50.0 \text{ m}) / (9.81 \text{ m/s}^2))^{1/2} \]

   \[ t = 3.19 \text{ s} \]

   c. How far from the side of the building do you need to walk in horizontal direction to retrieve the textbook?

   \[ x = x_0 + v_{x0} t \]

   \[ x = (0 \text{ m}) + (11.0 \text{ m/s}) (3.19 \text{ s}) = 35.1 \text{ m} \]
2. An object of mass $m$ sits on a flat table. The Earth pulls on this object with force $mg$, which we will call the action force. What is the reaction force?

   a. The table pushing up on the object with force $mg$.
   b. The object pushing down on the table with force $mg$.
   c. The table pushing down on the floor with force $mg$.
   d. The object pulling upward on the Earth with force $mg$.

3. Mass and weight

   a. Both measure the same thing.
   b. Are exactly equal.
   c. Are two different quantities.
   d. Are both measured in kilograms.

A crate of 50.0 kg mass containing a new lab instrument is dragged by enthusiastic physics students a distance of 30.0 m along a straight, level corridor to a physics lab. The students maintain a constant pull of magnitude 200 N applied to the crate by means of a rope inclined to the horizontal at angle of 40.0°. The velocity of the crate along the straight path is not constant.

   a. Calculate the work done by each force on the crate.

$W_g = 0$ (Gravitational force is perpendicular to the crate’s displacement)
\[ W_n = 0 \text{ (Normal force is perpendicular to the crate’s displacement)} \]

\[ W_A = A \Delta x \cos (40.0^\circ) = (200 \text{ N})(30.0 \text{ m})\cos(40.0^\circ) = 4596 \text{ N} \]

b. Calculate the total work done on the crate.

\[ W_{tot} = W_A + W_g + W_n = 4596 \text{ N} \]

c. If initially the crate was at rest, what is the final speed of the crate as it reaches the lab?

\[ W_{tot} = \frac{1}{2} mV_f^2 - \frac{1}{2} mV_i^2 = \frac{1}{2} mV_f^2 \]

\[ 2 W_{tot} = mV_f^2 \]

\[ 2 W_{tot} / m = V_f^2 \]

\[ V_f = \sqrt{2 W_{tot} / m} = 13.6 \text{ m/s} \]

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Physics 1111 – Quiz 6

Name _SOLUTION____________________________________

1. The quantity \( mgy \) is

   a. The kinetic energy of the object.

   b. The gravitational potential energy of the object.

   c. The work done on the object by the force.

   d. The power supplied to the object by the force.

2. An acorn falls from a tree. Compare its kinetic energy \( K \), to its potential energy \( U \).

   a. \( K \) increases and \( U \) decreases.

   b. \( K \) decreases and \( U \) decreases.

   c. \( K \) increases and \( U \) increases.

   d. \( K \) decreases and \( U \) increases.
3. A 30-N box is pulled 6.0 m up along a 37° inclined plane. What is the work done by the weight (gravitational force) of the box?

a. - 11 J

\[ W_g = U_{g_i} - U_{g_f} = mgy_i - mgy_f = 0 - (30.0 \text{ N})(6.00 \text{ m})(\sin 37°) = -108 \text{ J} \]

b. \(-1.1 \times 10^2 \text{ J}\)

c. \(-1.4 \times 10^2 \text{ J}\)

d. \(-1.8 \times 10^2 \text{ J}\)

Name __SOLUTION___________________________________

The blades of a fan running at low speed turn at 250 rpm. When the fan is switched to high speed, the rotation rate increases uniformly to 350 rpm in 5.75 s.

a. Express initial and final angular velocities of the fan in rad/s.

\[ \omega_0 = (250 \text{ rpm})(2 \pi \text{ rad/1 rev})(1 \text{ m/60 s}) = 26.2 \text{ rad/s} \]
\[ \omega = (350 \text{ rpm})(2 \pi \text{ rad/1 rev})(1 \text{ m/60 s}) = 36.7 \text{ rad/s} \]

b. What is the magnitude of the angular acceleration of the blades?

\[ \alpha = (\omega - \omega_0)/t \]
\[ \alpha = (36.7 \text{ rad/s} - 26.2 \text{ rad/s})/(5.75 \text{ s}) = 1.83 \text{ rad/s}^2 \]

c. How many revolutions do the blades go through while the fan is accelerating?

\[ \theta = \omega_0^2 + 2 \alpha (\theta - \theta_0) \]
\[ (\theta - \theta_0) = (\omega^2 - \omega_0^2)/(2 \alpha) \]
\[ (\theta - \theta_0) = ((36.7 \text{ rad/s})^2 - (26.2 \text{ rad/s})^2)/(2 \times 1.83 \text{ rad/s}^2) = 180 \text{ rad} = 28.7 \text{ rev} \]