Multiple choice questions. Circle the correct answer. No work needs to be shown and no partial credit will be given.

(6 pts) 1. A baseball is thrown straight up with an initial speed of 16.0 m/s. Air resistance can be neglected. At the highest point above the ground reached by the baseball, the acceleration of the baseball is

a) 9.8 m/s$^2$ downward
b) 9.8 m/s$^2$ upward
c) 0
d) none of the above answers

(6 pts) 2. An object is moving to the right and its speed is decreasing at a constant rate. The acceleration of the object is

a) 0
b) directed to the right
c) directed to the left

(6 pts) 3. A cow that is initially standing under a tree walks 60.0 m due north and then 80.0 m due west. How far is the cow from the tree after these two displacements?

a) she has returned to the tree
b) 100.0 m
c) 140.0 m
d) 20.0 m
e) none of the above answers

(6 pts) 4. Two people are leaning out of the same window in a tall building. At the same instant one person releases rock $A$ from rest and the other person throws rock $B$ horizontally at a speed of 5.0 m/s. If air resistance is neglected, which statement is correct?

a) the two rocks strike the ground at the same time
b) rock $A$ strikes the ground before rock $B$
c) rock $B$ strikes the ground before rock $A$
(6 pts) 5. A rock is projected from level ground with a speed of 15.0 m/s at an angle of 37.0° above the horizontal. When the rock is at its highest point above the ground, what is the speed of the rock?
   a) zero
   b) 9.0 m/s
   c) 12.0 m/s
   d) 15.0 m/s
   e) none of the above answers

(6 pts) 6. A dog runs clockwise at a constant speed of 6.0 m/s around a circular track. Use the coordinates shown in the sketch, where the origin is at the center of the circle. Point A is on the +x-axis and point B is on the −y-axis. It takes the dog 4.0 s to run from point A to point B. For the motion from point A to point B the y-component of the average acceleration of the dog is
   a) zero
   b) +1.5 m/s²
   c) −1.5 m/s²
   d) +6.0 m/s²
   e) −6.0 m/s²
   f) none of the above answers

(6 pts) 7. A boat travels due north while crossing a river that is flowing due east at a speed of 3.0 m/s relative to the bank. The river is 40.0 m wide and it takes the boat 10.0 s to cross the river. What is the speed of the boat relative to the water?
   a) 7.0 m/s
   b) 5.0 m/s
   c) 4.0 m/s
   d) 3.0 m/s
   e) 2.65 m/s
   f) 1.0 m/s
   g) none of the above answers

(6 pts) 8. Two boxes are on a horizontal frictionless surface. One box has mass 40.0 kg and the other box has mass 10.0 kg. The boxes are connected by a light horizontal rope that has tension T. A horizontal force F is applied to the 40.0 kg box and the two boxes move along the surface. Which statement is true?
   a) \( F = T \)
   b) \( F < T \)
   c) \( F > T \)
On the following problems show all your work. Partial credit will be given, if earned. Write your answers in the blanks provided. All answers must include the correct plus or minus sign and the correct units.

(18 pts) 9. At a place where the ground is level a football is kicked from ground level with an initial velocity of 40.0 m/s at an angle of 37.0° above the horizontal. The ball strikes the vertical wall of a building in 4.5 s after being kicked. Air resistance can be neglected.

a) What is the horizontal distance from the point where the football was kicked to the building?

Ans. 144 m

b) What is the vertical height of the football above the ground when it strikes the building?

Ans. 8.8 m

c) What is the speed of the football just before it strikes the building?

Ans. 37.8 m/s
A rocket starts from rest at the earth’s surface and accelerates straight upward with a constant upward acceleration of 20.0 m/s$^2$. At a height of 800 m the engines cut off and the rocket continues to move upward in free fall, reaches a maximum height, and then falls back down to the earth. Air resistance can be neglected.

a) What is the speed of the rocket at the instant when the engines cut off?

Ans. 79 m/s

b) What is the maximum height above the ground reached by the rocket?

Ans. 2435 m

c) What is the speed of the rocket just before it strikes the ground?

Ans. 218 m/s
(16 pts) 11. Consider the situation shown in the sketch. Force \( \vec{F} \) is applied to the box and the box slides down the incline. The force \( \vec{F} \) is applied parallel to the incline and has magnitude 20.0 N. The box has mass 5.0 kg. The coefficient of kinetic friction between the box and the incline is \( \mu_k = 0.30 \).

As the box slides down the incline,

\[
\begin{align*}
\text{a) What is the magnitude of the friction force that acts on the box?} \\
\text{Ans. } & 11.7 \text{ N} \\
\text{b) What is the magnitude of the acceleration of the box, as it moves down the incline?} \\
\text{Ans. } & 7.56 \text{ m/s}^2
\end{align*}
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