AP Physics C Name: _____

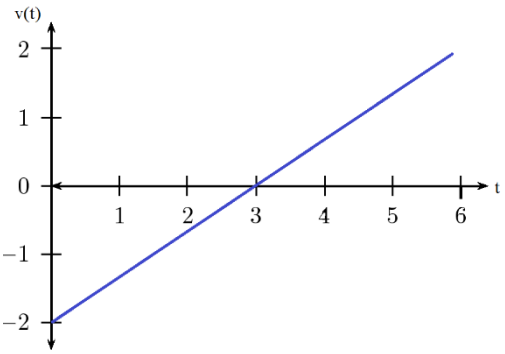
Unit 1: 1D Kinematics Test Period: _____

Part 1: Multiple Choice - Choose the answers that best answers the questions below. (4 points each)

1. A car starts from rest and accelerates at a constant rate in a straight line. In the *first* second the car moves a distance of 2.0 meters. How fast will the car be moving at the end of the *second* second?

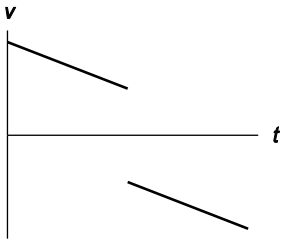
A) 2.0 m/s B) 32 m/s C) 8.0 m/s D) 16 m/s E) 4.0 m/s

2. The graph provided is a velocity vs. time graph for thing that can move and is indeed moving. Which of the following is true about the speed of the object during the time interval from 0 to 6 s.



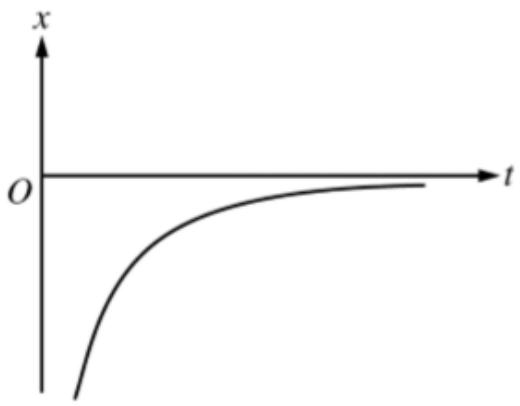
A) It increases during the entire interval.
B) It decreases during the entire interval.
C) It remains the same.
D) It first increases and then decreases.
E) It first decreases and then increases.

3. The graph below shows the velocity versus time graph for a ball. Which explanation best fits the motion of the ball as shown by the graph?

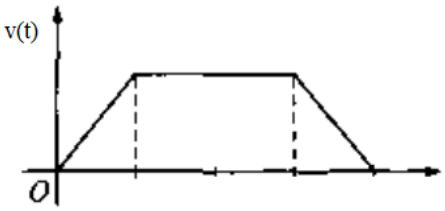


A) The ball is falling, is caught, and is thrown down with greater velocity.
B) The ball is rolling, stops, and then continues rolling.
C) The ball is rising, hits the ceiling, and falls down.
D) The ball is falling, hits the floor, and bounces up.
E) The ball is rising, is caught, and then is thrown up.

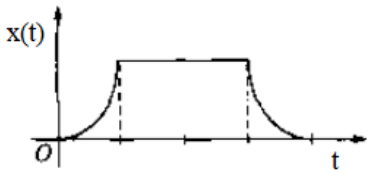
4. The position as a function of time for an object moving a straight line is shown in the graph. Which of the following best describes the object's speed and direction of motion during the time internal shown?

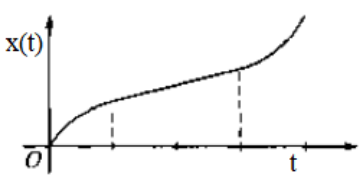


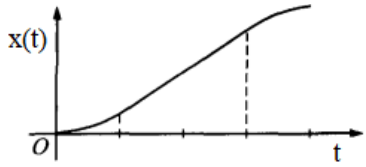
A) Speed – Decreasing Direction – Positive
B) Speed – Increasing Direction – Positive
C) Speed – Constant Direction - Positive
D) Speed – Decreasing Direction - Negative
E) Speed – Increasing Direction – Negative

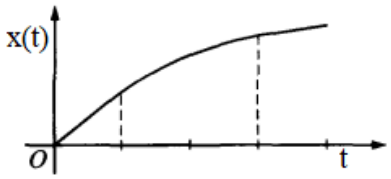


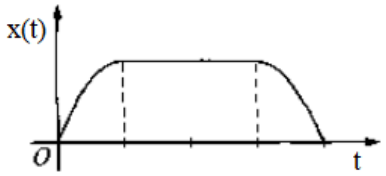
5. The graph above shows the velocity *v* as a function of time *t* for an object moving in a straight line. Which of the following graphs shows the corresponding displacement *x* as a function of time *t* for the same time interval?

A) 

B) 

C) 

D) 

E) 

6. A cannon ball is launched straight upwards. It is in the air for a time t and reaches a maximum height of H. Suppose it were instead fired with the same velocity but directly at angle of 45° above the horizontal. What would be the maximum height and time in the air be in this case?

A) Time in the air = $T/2$ Max Height = $H/4$
B) Time in the air = $\sqrt{2}T/2$ Max Height = $H/2$
C) Time in the air = $T/2$ Max Height = $H/2$
D) Time in the air = $\sqrt{2}T/2$ Max Height = $\sqrt{2}H/2$
E) Time in the air = $\sqrt{2}T/2$ Max Height = $H/4$

7. The position of a moose with respect to time is given by $x(t) = -2t^2 + 8t + 1$. At which time below is the speed of the moose increasing?

A) t = 1 s B) t = 2 s C) t = 3 s
D) The speed is of the moose never increases.
E) The speed is increasing for the entire interval.

8. Deyu drops a shoe of mass m = 0.5 kg out of an airplane. The shoe starts from rest and falls with a drag force on it given by $F_{drag} = .0004v^2$. If the ball falls straight downward, find its terminal velocity rounded to the nearest whole number.

A) 1250 m/s B) 158 m/s C) 112 m/s D) 353 m/s E) 35 m/s

9. In order to flee an impending physics test, Fiorella flees across a river in a rowboat. She is at point A an directs his rowboat due north toward point B, straight across a river of width 100 m. The river current is due east. Fiorella rows steadily at 0.75 m/s and reaches the other side of the river at point C, 150 m downstream from her starting point. What is the angle Fiorella's total velocity vector makes with the shoreline?

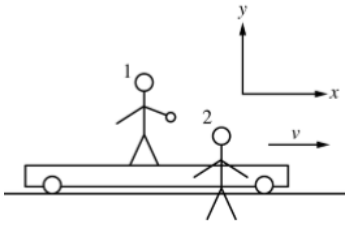
A) 34° B) 41° C) 49° D) 57° E) 63°

10. A boat moves across a river. The river's velocity relative to the land is $\vec{v}_{RL}$ and the boat's velocity relative to the river is $\vec{v}_{BR}$. Which of the following best represents the velocity of the boat relative to the land?

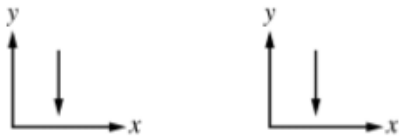
A) $\vec{v}_{BR} - \vec{v}_{RL}$ B) $|\vec{v}_{BR}| - |\vec{v}_{RL}|$ C) $-\vec{v}_{BR} + \vec{v}_{RL}$

D) $|\vec{v}_{BR}| + |\vec{v}_{RL}|$ E) $\vec{v}_{BR} + \vec{v}_{RL}$

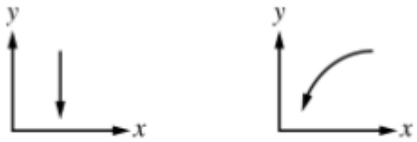
11. Quinn 1 is standing on a cart holding a small stone, while Quinn 2 is standing at rest on the ground, as shown. The cart is moving at a constant speed in the +x direction. Quinn 1 drops the stone precisely when passing Quinn 2. Which of the following best represents the path of the falling stone relative to Quinn 1 and the path of the falling stone relative to Quinn 2.



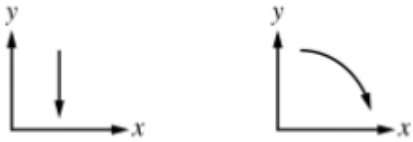
A) Quinn 1 Quinn 2



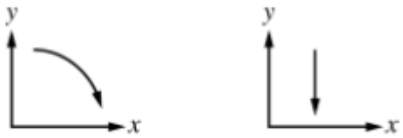
B) Quinn 1 Quinn 2



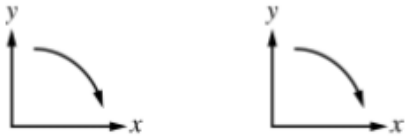
C) Quinn 1 Quinn 2



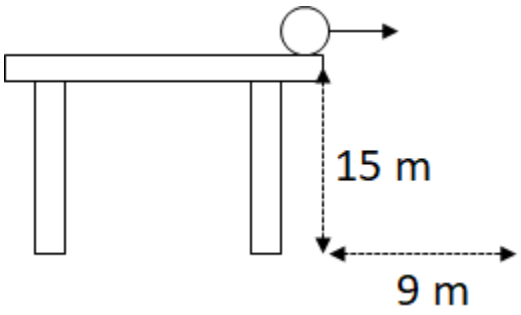
D) Quinn 1 Quinn 2



E) Quinn 1 Quinn 2



12. In order to create a situation appropriate for a high school physics problem, Godzilla rolls a ball off his 15 m high dining table. The ball leaves the table traveling horizontally and lands 9 m away from the base of the table. How fast was the ball traveling when it left the table?



A) 5.2 m/s B) 7.3 m/s C) 3.1 m/s

D) 10.6 m/s E) 11.2 m/s

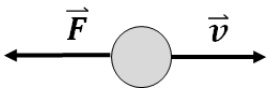
13. While in training, an astronaut goes around a centrifuge of radius 10.0 m. The centrifuge is to move in a way such that the astronaut experiences 5 g's (an acceleration of 5g). Find the frequency of the centrifuge's motion.

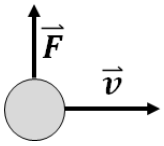
A) 22.3 Hz B) 0.13 Hz C) 1.4 Hz D) 0.36 Hz E) 25.1 Hz

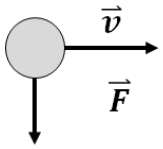
14. A ball is kicked from the ground an initial speed 50 at an angle 30 above the horizontal. Which of the following best describes the magnitudes of the velocity and acceleration of the ball when it reaches the highest point of its trajectory?

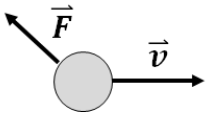
A) Velocity: 25 m/s	Acceleration: 10 m/s^2
B) Velocity: $25\sqrt{3}$ m/s	Acceleration: 10 m/s^2
C) Velocity: 25 m/s	Acceleration: 0 m/s^2
D) Velocity: 0 m/s	Acceleration: 10 m/s^2
E) Velocity: 0 m/s	Acceleration: 0 m/s^2

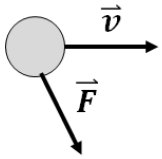
15. Which of the following velocity and force vector combinations below depict an object that is both turning and slowing down?

A) 

B) 

C) 

D) 

E) 

Part 2: Free Response: Calculate the numeric answer to the questions below with correct units. Partial credit is possible, so clearly show the steps to arrive at the final answer.

16. (8 points) Down in Africa, a gazelle and a cheetah are at rest. The cheetah is initially 20 m west of the gazelle. At some time, the gazelle starts running in the eastward direction with a constant acceleration of 2.0 m/s^2. Two seconds later, the cheetah decides to chase the gazelle and starts from rest with an acceleration given by $a(t) = 0.6t - 2$, where eastward is the positive direction. Determine how far the gazelle will have traveled before the cheetah catches up.

17. (18 points) A poorly constructed Soviet era rocket travels with a height given by $y(t) = 18t - 0.5t^2$. It also has a horizontal acceleration. The rocket also has a horizontal acceleration of $a_x(t)$ =2t. At takeoff, its x position is x = 0 m.

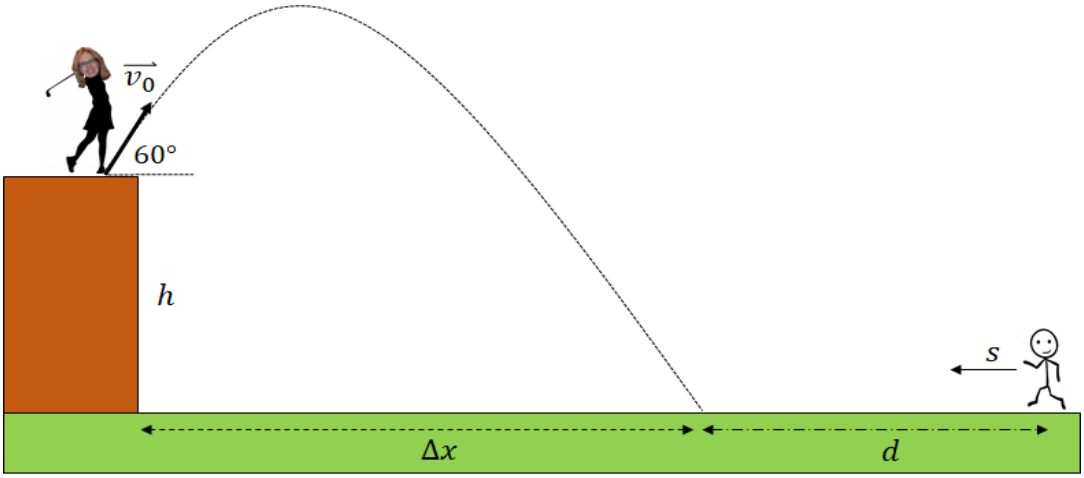
a) Write an expression for the total displacement, velocity, and acceleration of the helicopter as a function of time. Leave all expressions in vector form (with functions for components being separate).

b) Find the rocket's maximum speed.

c) At t = 1.0 s, a Soviet era potato falls off the rocket. Find the maximum height reached by the potato.

d) At some point, the rocket hits the ground and crashes. Find the horizontal distance covered by the rocket while in flight.

Bonus (only if you have time): In a 100-m race, Goku and Vegeta both accelerate uniformly from rest. Goku takes 2.0 s and Vegeta takes 3.0 s to achieve their respective maximum speeds, which they maintain for the rest of the race. Both Saiyans cross the finish line at the same time. What are the accelerations of the two?



18. (16 points) Mrs. Bobay hits a golf ball off a cliff of height $h = 200\ m$. She hits the golf ball so that it travels initially at a speed $\overrightarrow{v_0}$ at an angle of 60° above the horizontal. It is found to the hit the ground a distance of $\Delta x = 400\ m$ away.

a) Calculate the speed with which the golf ball was hit.

b) What angle does the golf ball make with the ground when it strikes?

c) An MSE student who plays sports just to put it on his college applications and doesn't understand the rules decides to catch the golf ball in order to score an out. He starts a distance of $d = 100\ m$ away from the ball's landing spot. He starts running to catch the ball the instant it is hit and catches it at ground level. What speed does the student have to run with to catch the golf ball?