

Name: \_\_\_\_\_

Class Period: \_\_\_\_\_ Date: \_\_\_\_\_

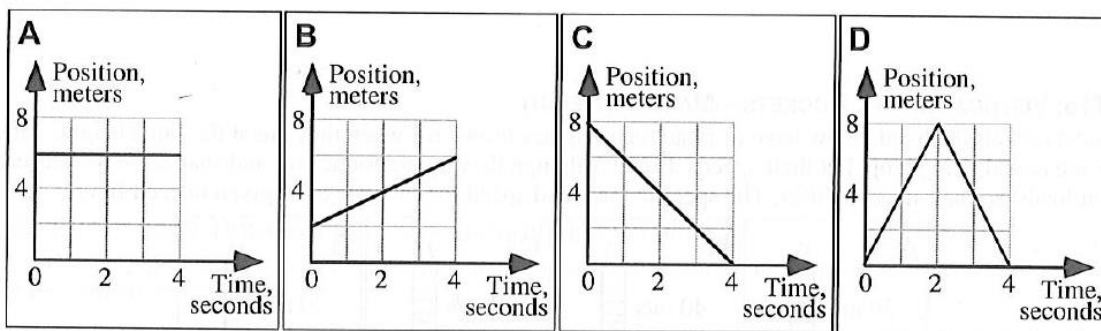
**AP Physics 1 & 2 Unit 1 – Motion in One Dimension**

**Tremendously Great Problems to Solve**

**Phase 2: Analysis of Kinematics Relationships**

**B1-RT13: POSITION-TIME GRAPHS—DISPLACEMENT**

Each graph below shows the position of an object as a function of time.



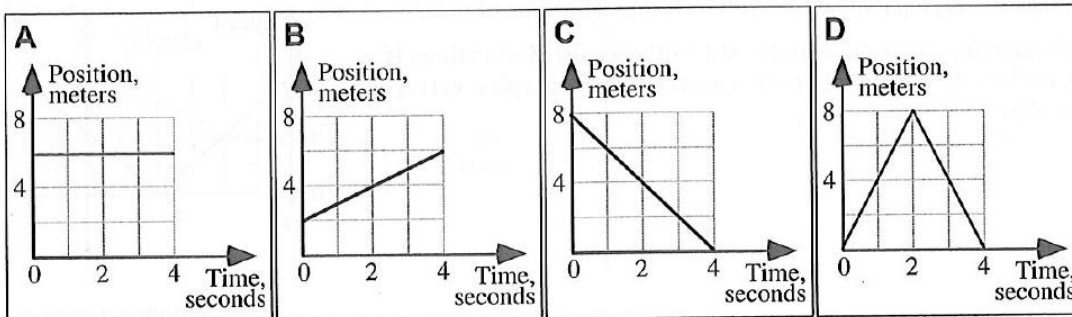
Rank the magnitude of the displacement during the time interval from 0 to 4 seconds.

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	OR	<input type="text"/>	<input type="text"/>	<input type="text"/>
1	2	3	4		All	All	Cannot
Greatest			Least		the same	zero	determine

Explain your reasoning.

**B1-RT14: POSITION-TIME GRAPHS—AVERAGE SPEED**

Each graph below shows the position of an object as a function of time.



Rank the average speed of the object during the time interval from 0 to 4 seconds.

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	OR	<input type="text"/>	<input type="text"/>	<input type="text"/>
1	2	3	4		All	All	Cannot
Greatest			Least		the same	zero	determine

Explain your reasoning.

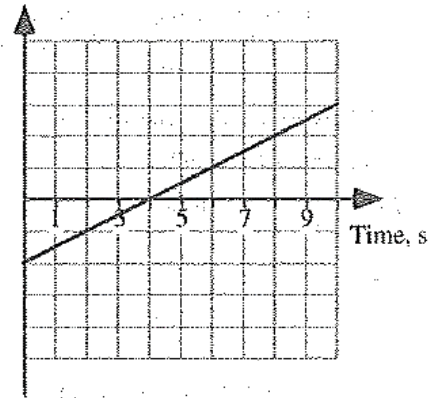
**B1-QRT31: POSITION OR VELOCITY GRAPHS—CHANGE DIRECTION.**

The graph shown is for an object in one-dimensional motion.

(a) If the vertical axis of the graph is position, does the object ever change direction?

If so, at what time or times does this change in direction occur?

Explain your reasoning.



(b) If the vertical axis of the graph is velocity, does the object ever change direction?

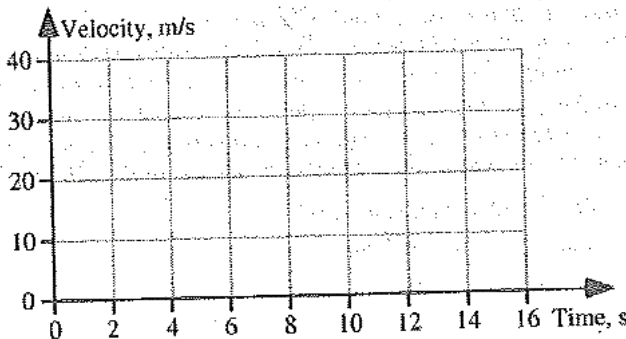
If so, at what time or times does this change in direction occur?

Explain your reasoning.

**B1-CRT27: TRAVELING STUDENTS—VELOCITY-TIME GRAPH**

Carmela and Desi leave a parking lot separately and drive west. They both start from rest. Desi leaves first, traveling with an acceleration of  $4 \text{ m/s}^2$  west for the first 6 seconds, and then driving at a constant velocity. Two seconds after Desi started, Carmela starts with an acceleration of  $3 \text{ m/s}^2$  west for 10 seconds, and then she drives at a constant velocity.

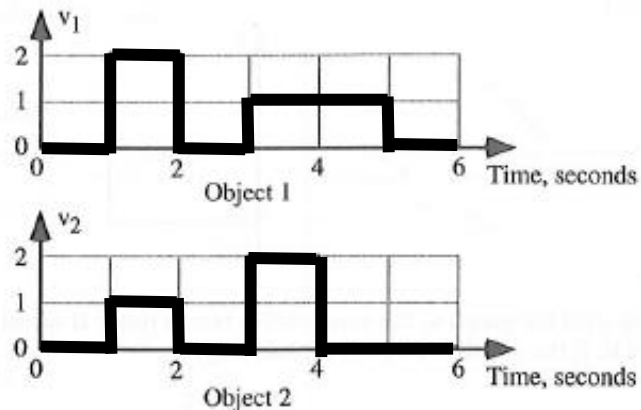
Graph the velocity of both travelers as a function of time up to  $t = 16$  seconds starting at time  $t = 0$  when Desi leaves the classroom. Use a solid line for Desi's velocity and a dashed line for Carmela's velocity.



Explain your reasoning.

**B1-CT22: VELOCITY-TIME GRAPHS OF OBJECTS—DISPLACEMENT**

The graphs below show the velocity of two objects during the same time interval.

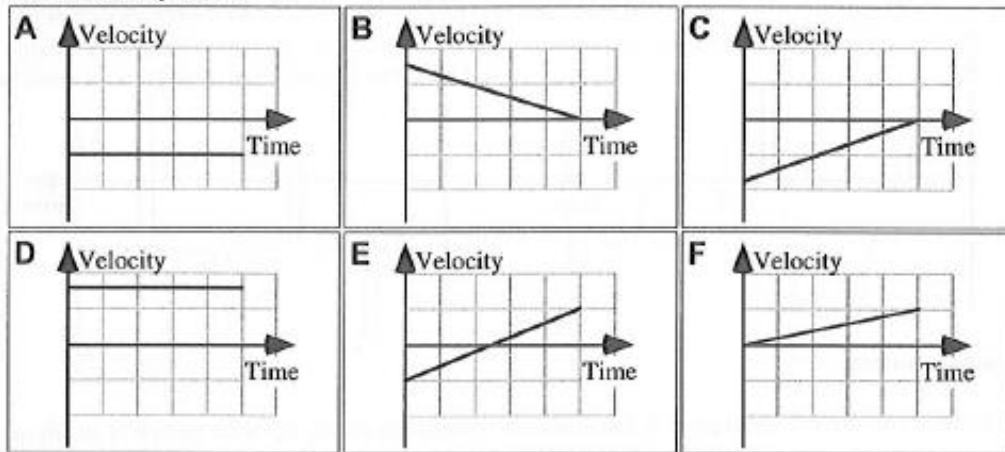


For the 6-second time interval shown, is the displacement of Object 1 in the upper graph (i) *greater than*, (ii) *equal to*, or (iii) *less than* the displacement of Object 2 in the lower graph? \_\_\_\_\_

Explain your reasoning.

**B1-RT23: VELOCITY-TIME GRAPHS—DISPLACEMENT**

Shown below are six velocity-time graphs for toy robots that are traveling along a straight hallway. All graphs have the same time and velocity scales.



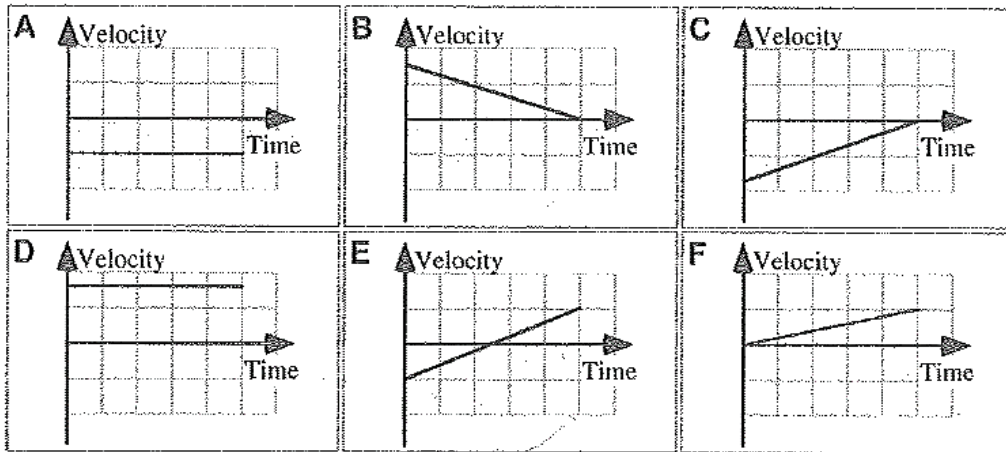
Rank the magnitudes of the displacements during these intervals.

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>				
1	2	3	4	5	6	OR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Greatest					Least		All the same	All zero	Cannot determine

Explain your reasoning.

**B1-RT29: VELOCITY-TIME GRAPHS—DISTANCE TRAVELED**

Velocity-time graphs for six toy robots that are traveling along a straight hallway are shown. All graphs have the same time and velocity scales.



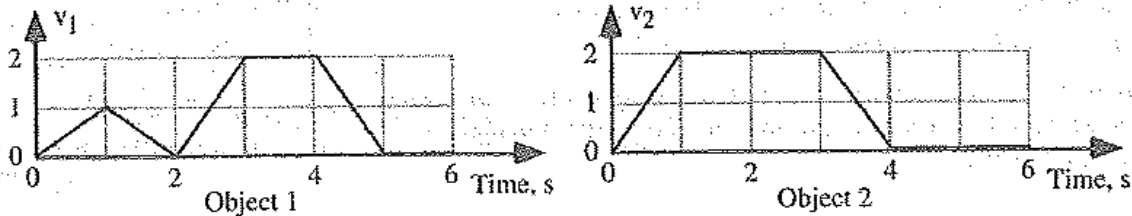
Rank the distance traveled during these intervals.

1	2	3	4	5	6	OR	All the same	All zero	Cannot determine		
Greatest					Least						

Explain your reasoning.

**B1-SCT30: VELOCITY-TIME GRAPHS OF OBJECTS—DISPLACEMENT**

The graphs below show the velocity of two objects during the same time interval.



Three students are discussing the displacements of these objects for this interval.

Amos: "I think Object 2 will have the greater displacement because it gets to a higher speed faster than Object 1."

Badu: "No, Object 1 will have the greater displacement because it travels for a longer time than Object 2."

Candi: "I agree with Amos, but for a different reason. Object 2 has the larger displacement because the area under the graph is greater."

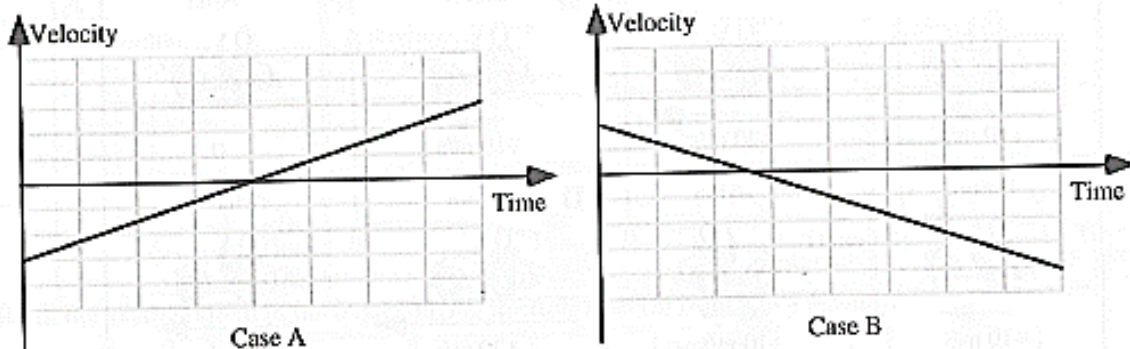
With which, if any, of these three students do you agree?

Amos \_\_\_\_\_ Badu \_\_\_\_\_ Candi \_\_\_\_\_ None of them \_\_\_\_\_

Explain your reasoning.

**B1-CT18: VELOCITY-TIME GRAPHS—DISPLACEMENT**

The graphs represent the velocity of two toy robots moving in one dimension for a particular time interval. Both graphs have the same time and velocity scales.



Is the magnitude of the displacement of the robot for the entire time interval shown (i) *greater* in Case A, (ii) *greater* in Case B, or (iii) *the same* in both cases? \_\_\_\_\_

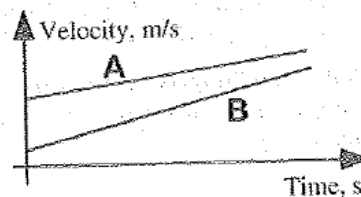
Explain your reasoning.

**B1-WWT26: VELOCITY-TIME GRAPH OF TWO OBJECTS—FASTEST OBJECT**

A student is shown the velocity-time graphs for two objects and is asked to decide which object is moving faster. The student responds:

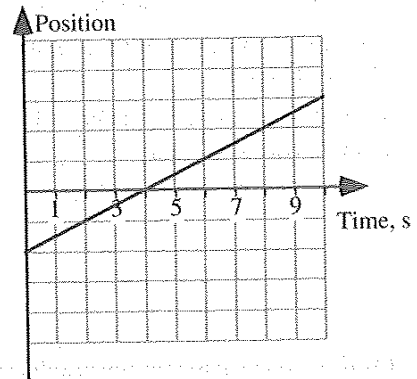
*"B is faster because it has the steeper slope."*

What, if anything, is wrong with the student's statement? If something is wrong, explain the error and how to correct it. If the statement is correct, explain why.



**B1-QRT33: POSITION-TIME GRAPH—DIRECTION**

A bicyclist is moving along a straight street oriented east—west. In drawing the graph, positions to the east of the origin were marked as positive and positions to the west were marked as negative.



(a) At 1 second, is the cyclist moving?

If so, in what direction?

Explain your reasoning.

(b) At 1 second, is the cyclist accelerating?

If so, in what direction?

Explain your reasoning.

(c) At 9 seconds, is the cyclist moving?

If so, in what direction?

Explain your reasoning.

(d) At 9 seconds, is the cyclist accelerating?

If so, in what direction?

Explain your reasoning.

(e) At 4 seconds, is the cyclist moving?

If so, in what direction?

Explain your reasoning.

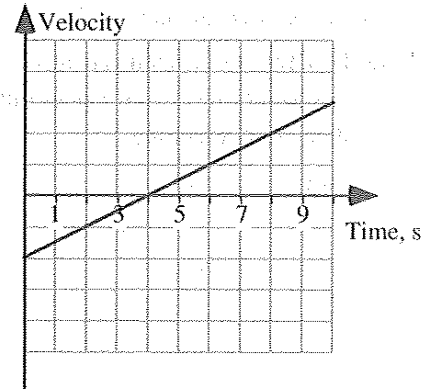
(f) At 4 seconds, is the cyclist accelerating?

If so, in what direction?

Explain your reasoning.

**B1-QRT34: VELOCITY-TIME GRAPH—DIRECTION**

A unicyclist, someone riding a single-wheel cycle, is moving along a straight street oriented east—west. In drawing the graph, east was taken as the positive direction and west the negative direction.



(a) At 1 second, is the cyclist moving?

If so, in what direction?

Explain your reasoning.

(b) At 1 second, is the cyclist accelerating?

If so, in what direction?

Explain your reasoning.

(c) At 9 seconds, is the cyclist moving?

If so, in what direction?

Explain your reasoning.

(d) At 9 seconds, is the cyclist accelerating?

If so, in what direction?

Explain your reasoning.

(e) At 4 seconds, is the cyclist moving?

If so, in what direction?

Explain your reasoning.

(f) At 4 seconds, is the cyclist accelerating?

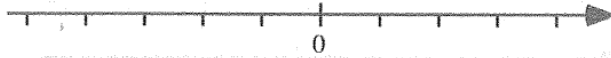
If so, in what direction?

Explain your reasoning.

**B1-QRT47: POSITION, VELOCITY, AND ACCELERATION SIGNS—POSITION, DIRECTION, AND RATE**

Eight possible combinations for the signs for the instantaneous position, velocity, and acceleration of an object moving in one dimension are given in the table. Above the table is a coordinate axis that shows the origin, marked 0, and that indicates that the positive direction is to the right. The three columns on the right-hand side of the table are to describe the location of the object (either left or right of the origin), the direction of the velocity of the object (either toward or away from the origin), and what is happening to the speed of the object (either speeding up or slowing down at the given instant). The appropriate descriptions for the first case are shown.

Complete the rest of the table for position, direction, and rate.



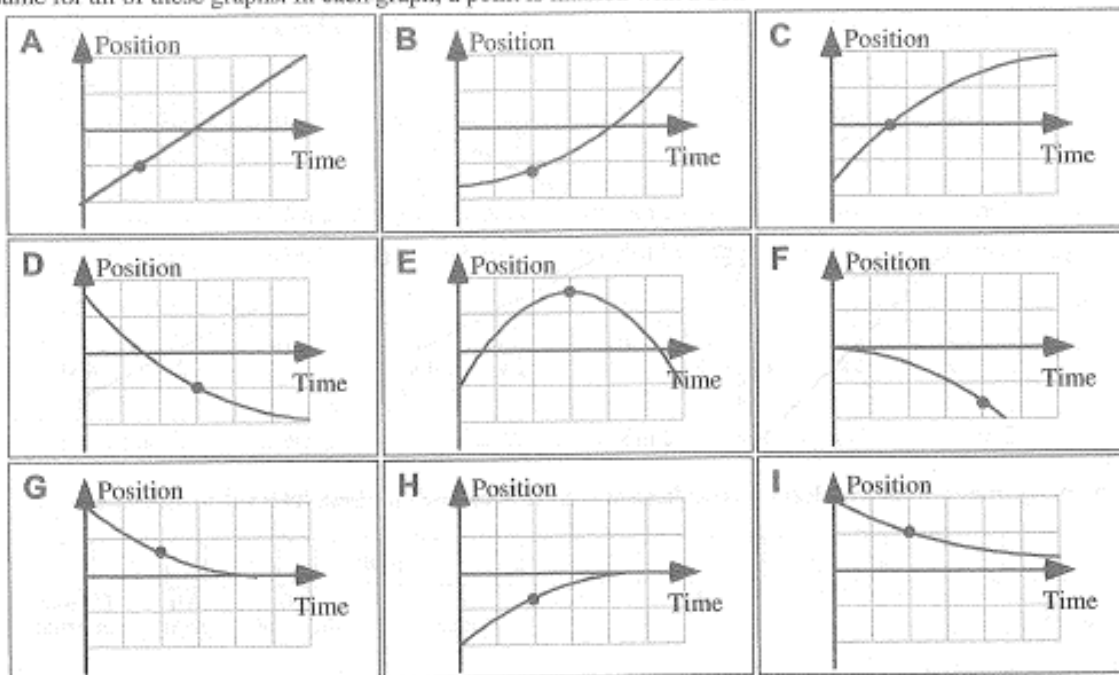
	Position	Velocity	Acceleration	Position (Left or Right)	Direction (Toward or Away from)	Rate (Speeding up or Slowing down)
A	+	+	+	<del>Left</del> R	Away from	Speeding up
B	+	+	-			
C	+	-	+			
D	+	-	-			
E	-	+	+			
F	-	+	-			
G	-	-	+			
H	-	-	-			

Explain your reasoning.



**B1-QRT56: POSITION-TIME GRAPHS—ACCELERATION AND VELOCITY**

Position versus time graphs for boats traveling along a narrow channel are shown below. The scales on both axes are the same for all of these graphs. In each graph, a point is marked with a dot.



(a) For which of these cases, if any, is the position zero at the indicated point?

Explain your reasoning.

(b) For which of these cases, if any, is the position negative at the indicated point?

Explain your reasoning.

(c) For which of these cases, if any, is the velocity zero at the indicated point?

Explain your reasoning.

(d) For which of these cases, if any, is the velocity negative at the indicated point?

Explain your reasoning.

(e) For which of these cases, if any, is the acceleration zero at the indicated point?

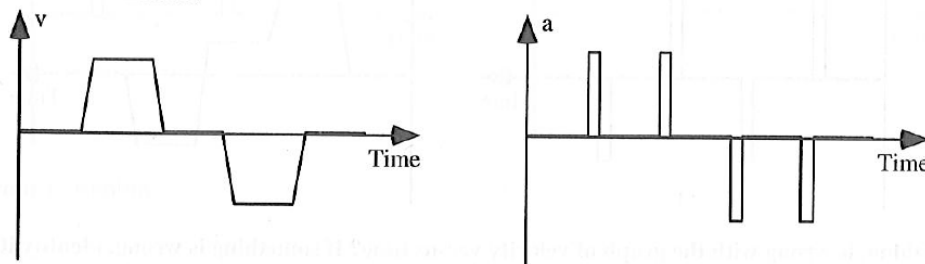
Explain your reasoning.

(f) For which of these cases, if any, is the acceleration negative at the indicated point?

Explain your reasoning.

**B1-WWT17: VELOCITY-TIME GRAPH—ACCELERATION-TIME GRAPH**

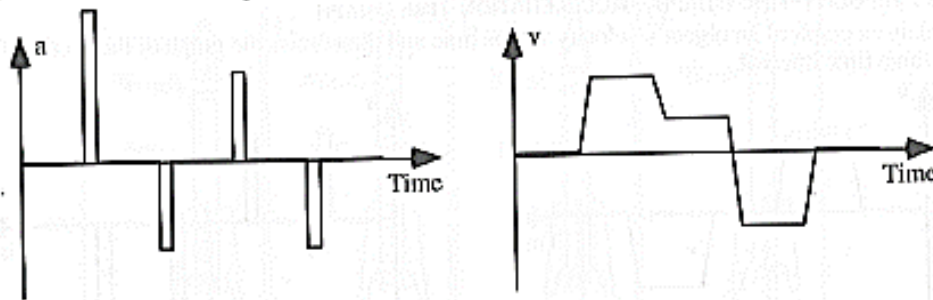
A student obtains a graph of an object's velocity versus time and then draws the graph of the acceleration versus time for the same time interval.



What, if anything, is wrong with the graph of the acceleration versus time? If something is wrong, identify it and explain how to correct it. If the graph is correct, explain why.

**B1-WWT19: ACCELERATION-TIME GRAPH—VELOCITY-TIME GRAPH**

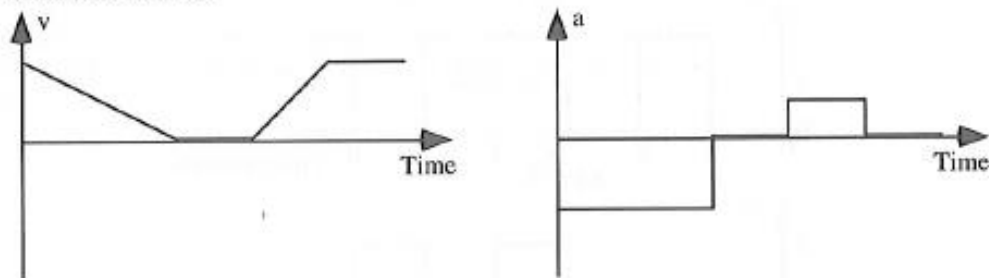
A student obtains a graph of an object's acceleration versus time and then draws the graph of the velocity versus time for the same time interval. The object starts from rest.



What, if anything, is wrong with the graph of velocity versus time? If something is wrong, identify it and explain how to correct it. If the graph is correct, explain why.

**B1-WWT20: VELOCITY-TIME GRAPH—ACCELERATION-TIME GRAPH**

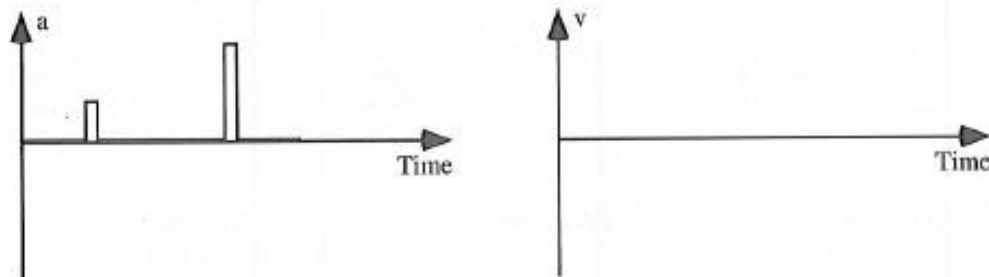
A student obtains a graph of an object's velocity versus time and then draws the graph of the acceleration versus time for the same time interval.



What, if anything, is wrong with the graph of the acceleration versus time? If something is wrong, identify it and explain how to correct it. If the graph is correct, explain why.

**B1-CRT21: ACCELERATION-TIME GRAPH—VELOCITY-TIME GRAPH**

Sketch a possible velocity versus time graph given the acceleration graph for the same time interval.

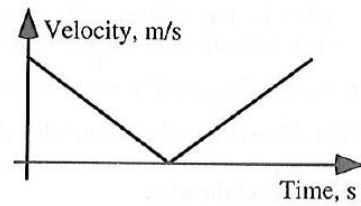


Explain your reasoning.

**B1-WWT24: BALL THROWN UPWARD AND COMES BACK DOWN—VELOCITY-TIME GRAPH**

A ball is thrown straight upward and falls back to the same height. A student makes this graph of the velocity of the ball as a function of time.

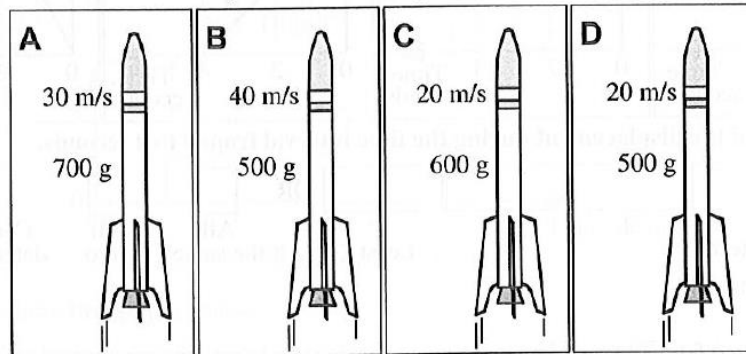
What, if anything, is wrong with the student's graph? If something is wrong, explain the error and how to correct it. If the graph is correct, explain why.



In the remaining problems consider air resistance to be negligible.

**B1-RT15: VERTICAL MODEL ROCKETS—MAXIMUM HEIGHT**

The model rockets depicted below have just had their engines turned off when they are at the same height. All of the rockets are aimed straight up, but their speeds differ. Although they are the same size and shape, the rockets carry different loads, so their masses differ. The specific mass and speed for each rocket is given in each figure.



Rank the maximum height the model rockets will reach.

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	OR	<input type="text"/>	<input type="text"/>	<input type="text"/>
1	2	3	4		All	All	Cannot
Greatest			Least		the same	zero	determine

Explain your reasoning.

**B1-WWT32: BALL THROWN STRAIGHT UPWARD—TIME TO REACH TOP**

A student throws a ball straight upward. A friend times how long it takes the ball to reach its maximum height.



The student predicts:

*“Faster things take less time. If I throw the ball faster, it will reach its highest point in less time.”*

**What, if anything, is wrong with this statement? If something is wrong, identify it and explain how to correct it. If this statement is correct, explain why.**

**B1-WWT46: BALL THROWN STRAIGHT UPWARD—TIME TO REACH TOP**

A student throws a ball straight upward. A friend times how long it takes the ball to reach its maximum height.

The student predicts:

*“It takes more time to go larger distances. If I throw the ball so that it goes higher, it will take more time to get there.”*

**What, if anything, is wrong with this statement? If something is wrong, identify it and explain how to correct it. If this statement is correct, explain why.**

