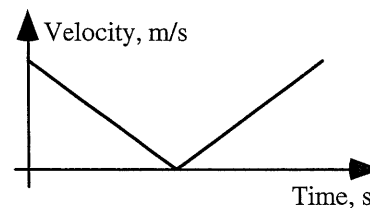


**NT3A-WWT10: BALL THROWN UPWARD AND COMES BACK DOWN—VELOCITY VS. TIME GRAPH**

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.

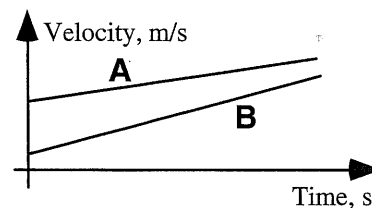


What, if anything, is wrong with the student's graph? If something is wrong, explain the error and how to correct it. If the graph is correct, explain why.

**NT3A-WWT11: VELOCITY VS. 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:

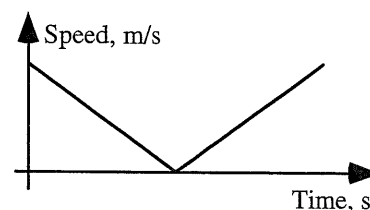
*"B is faster because it has the steeper slope."*



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.

### NT3A-CCT19: BALL THROWN UPWARD AND COMES BACK DOWN—ACCELERATION

A ball is thrown straight upward and falls back to the same height. A student makes the graph of the speed of the ball as a function of time. Three students who are discussing this graph make the following contentions:



Akira: “I don’t think this can be correct because the sign of the acceleration changes on this graph, but the acceleration on the ball will be constant.”

Burt: “No, I think this is right because it is only showing what happens to the speed, which will decrease to zero at the top and then increase as the ball falls. Since the slopes for both segments are the same except for sign that means the acceleration is constant.”

Catalina: “This graph makes sense to me because it shows the speed decreasing. I disagree with Burt, because I think this means the acceleration is also decreasing until the ball gets to the top and stops. Then both the speed and acceleration increase as the ball falls down again.”

Which, if any, of these three students do you agree with and think is correct?

Akira \_\_\_\_\_ Burt \_\_\_\_\_ Catalina \_\_\_\_\_ None of them \_\_\_\_\_

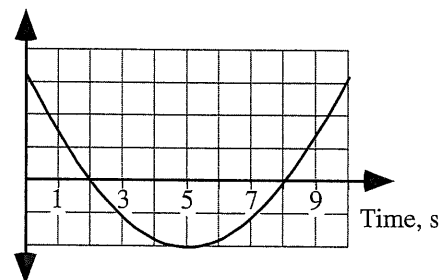
Please explain your reasoning.

### NT3A-QRT20: KINEMATICS GRAPHS—CHANGE DIRECTION

The graph at right is for an object in one-dimensional motion. The vertical axis is not labeled.

a) If the vertical axis is position, does the object ever change direction? If so, at what time or times does this change in direction occur?

Explain.

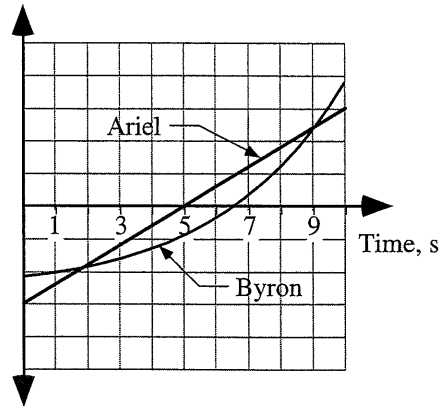


b) If the vertical axis is velocity, does the object ever change direction? If so, at what time or times does this change in direction occur?

Explain.

**NT3A-QRT21: POSITION TIME GRAPHS OF TWO CHILDREN—KINEMATICS**

The graph at right is of the motion of two children, Ariel and Byron, who are moving along a straight hallway. The vertical axis is not labeled.



a) **If the vertical axis is position, does either child ever change direction? If so, at what time or times does this change in direction occur?**

**Explain.**

b) **If the vertical axis is position, are the two children ever at the same position along the hallway? If so, at what time or times?**

**Explain.**

c) **If the vertical axis is position, do the two children ever have the same speed? If so, at what time or times?**

**Explain.**

d) **If the vertical axis is position, do the two children ever have the same acceleration? If so, at what time or times?**

**Explain.**

e) **If the vertical axis is velocity, do either of the children ever change direction? If so, at what time or times does this change in direction occur?**

**Explain.**

f) **If the vertical axis is velocity, do the two children ever have the same velocity? If so, at what time or times?**

**Explain.**

g) **If the vertical axis is velocity, do the two children ever have the same acceleration? If so, at what time or times?**

**Explain.**

**NT3B-CCT24: BICYCLIST ON A STRAIGHT ROAD—AVERAGE SPEED**

Three students are discussing a situation where a bicyclist travels at a steady 18.0 m/s for 10 minutes, then at 6.0 m/s for 20 minutes and finally at 12.0 m/s for 15 minutes along a straight level road. Students make the following contentions about the bicyclist’s average speed for the overall trip:

- Aaron: *“I think the average speed for the entire period is 18 m/s because to find an average you sum the three values and divide by two.”*
- Bessie: *“I disagree. The average speed is 12 m/s because you add the three velocities, but then you have to divide by three.”*
- Cesar: *“No, you are both wrong. The average speed is 10.7 m/s because that is what you get when you divide 28,800 m, the total distance traveled on the straight road, by 2700 seconds, the total time it took.”*

**Which, if any, of these three students do you agree with?**

Aaron \_\_\_\_\_ Bessie \_\_\_\_\_ Cesar \_\_\_\_\_ None of them \_\_\_\_\_

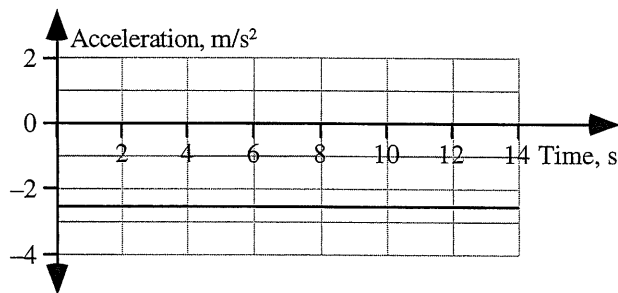
**Please explain your reasoning.**

**NT3C-WWT25: ACCELERATION VS. TIME GRAPH—FINAL VELOCITY**

A student is given the acceleration versus time graph for a motorcyclist traveling along a straight level stretch of road. The student states:

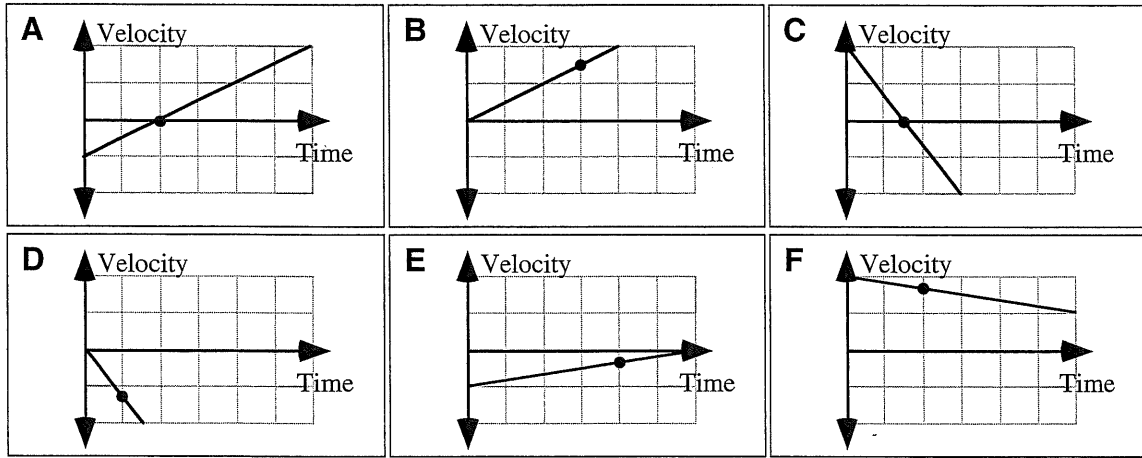
*“This motorcyclist was slowing down during the period up to 14 seconds because her acceleration was negative during this period.”*

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



**NT3C-RT28: VELOCITY VS. TIME GRAPHS—INSTANTANEOUS VELOCITY**

The graphs below show the velocity versus time for six boats traveling along a narrow channel that runs east to west. The scales on both axes are the same for all of these graphs, and east is positive. In each graph, a point is marked with a dot.



**Rank these situations on the basis of the velocity of the boat at the point indicated.**

Greatest    1 \_\_\_\_\_ 2 \_\_\_\_\_ 3 \_\_\_\_\_ 4 \_\_\_\_\_ 5 \_\_\_\_\_ 6 \_\_\_\_\_    Least

OR, The velocity at the marked points is the same but not zero for all these boats. \_\_\_\_\_

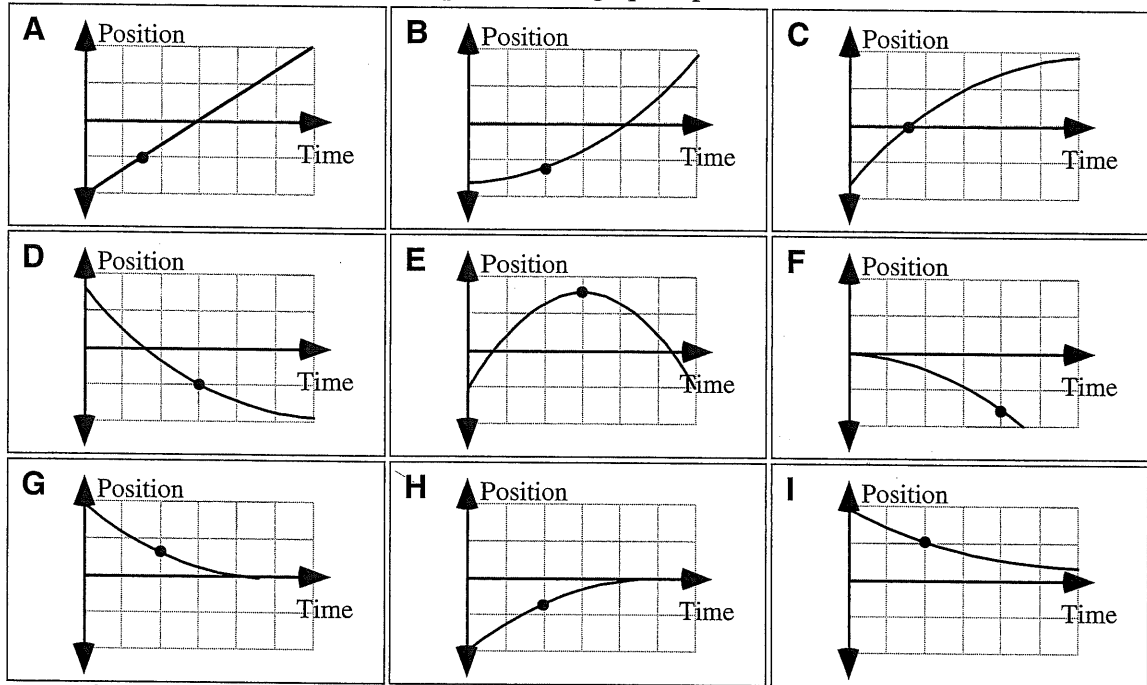
OR, The velocity at the marked points is zero for all these boats. \_\_\_\_\_

OR, We cannot determine the ranking for the velocity of these boats. \_\_\_\_\_

**Please explain your reasoning.**

**NT3G-QRT42: POSITION VS. 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.



- For which of these, if any, is the position zero at the indicated point?
- For which of these, if any, is the position negative at the indicated point?
- For which of these, if any, is the velocity zero at the indicated point?
- For which of these, if any, is the velocity negative at the indicated point?
- For which of these, if any, is the acceleration zero at the indicated point?
- For which of these, if any, is the acceleration negative at the indicated point?