Name_____

Motion Graphs

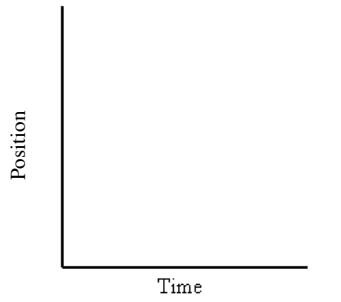
Describing the motion of an object is occasionally hard to do with words. Sometimes **graphs** help make motion easier to picture, and therefore understand.

Remember:

- **Motion** is a change in position measured by distance and time.
- **Speed** tells us the rate at which an object moves.
- **Velocity** tells the speed and direction of a moving object.
- **Acceleration** tells us the rate speed or direction changes.

POSITION-TIME GRAPHS

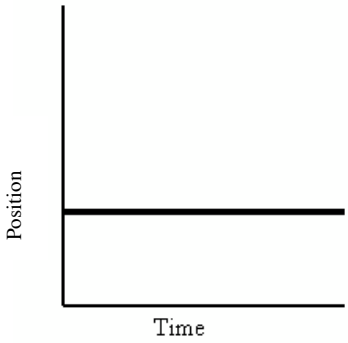
Plotting position against time can tell you a lot about motion. Let's look at the axes:



Time is always plotted on the X-axis (bottom of the graph). The further to the right on the axis, the longer the time from the start.

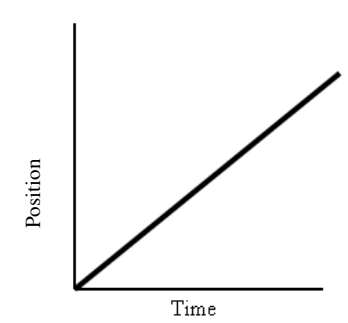
Position is plotted on the Y-axis (side of the graph). The higher up the graph, the further from the start.

If an object is not moving, a horizontal line is shown on a position-time graph.



Time is increasing to the right, but its position does not change. It is not moving. We say it is **At Rest**.

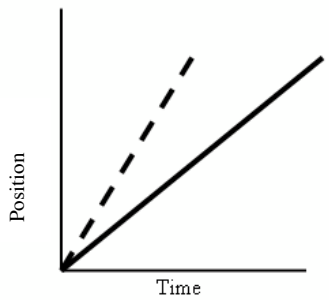
If an object is moving at a constant speed, it means it has the same increase in position in a given time:



Time is increasing to the right, and position is increasing constantly with time. The object moves at a **constant speed**.

Constant speed is shown by straight lines on a graph.

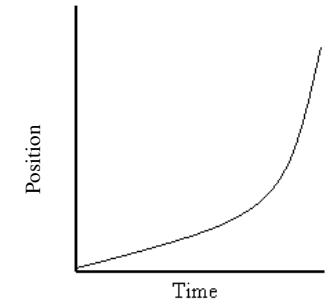
Let's look at two moving objects:
Both of the lines in the graph show that each object moved the same distance, but the steeper dashed line got there before the other one:



A steeper line indicates a larger distance moved in a given time. In other words, **higher speed**.

Both lines are **straight**, so both speeds are **constant**.

Graphs that show acceleration look different from those that show constant speed.



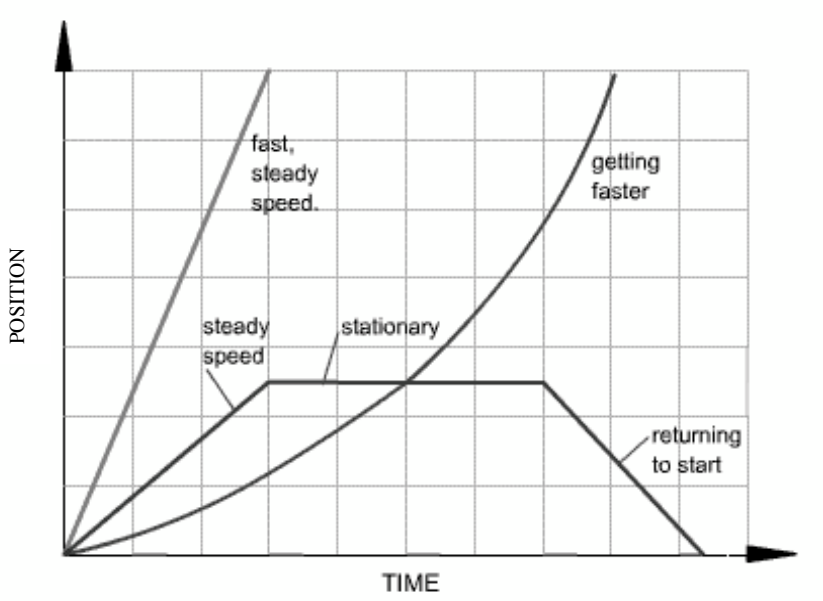
The line on this graph is curving upwards. This shows an **increase in speed**, since the line is getting steeper:

In other words, in a given time, the distance the object moves is changing (getting larger). It is **accelerating**.

Summary:

A position-time graph tells us how far an object has moved with time.

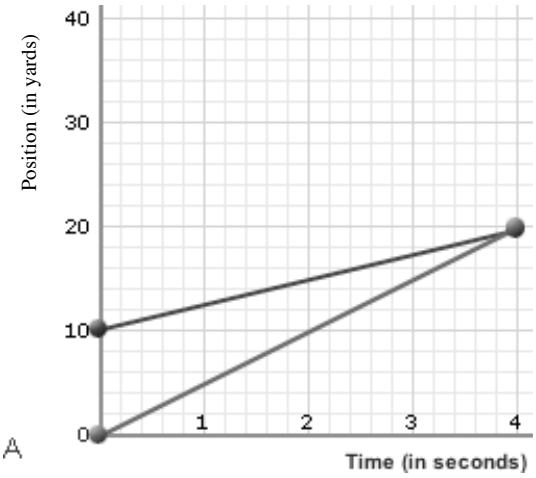
- The steeper the graph, the faster the motion.
- A horizontal line means the object is not changing its position - it is not moving, it is at rest.
- A downward sloping line means the object is moving in the negative direction.



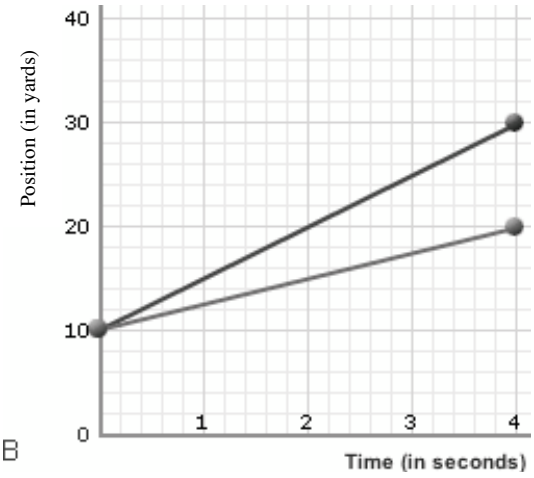
(Graph from:
http://www.bbc.co.uk/schools/gcsebitesize/physics/forces/speedvelocityaccelerationfhrev2.shtml)

Examine the graphs below.

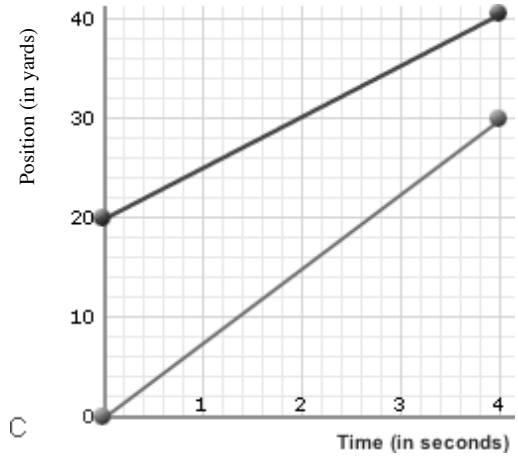
A



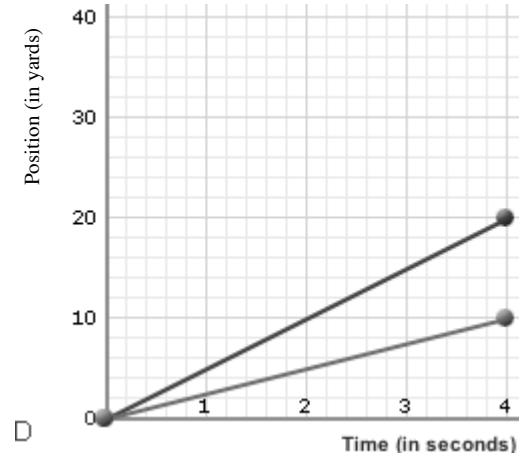
B



C



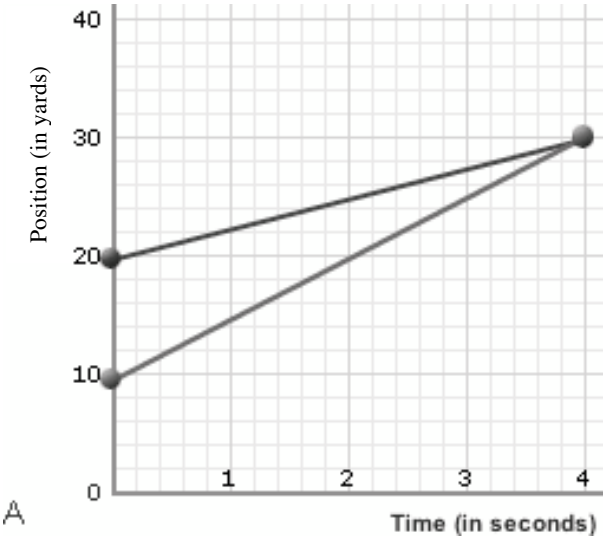
D



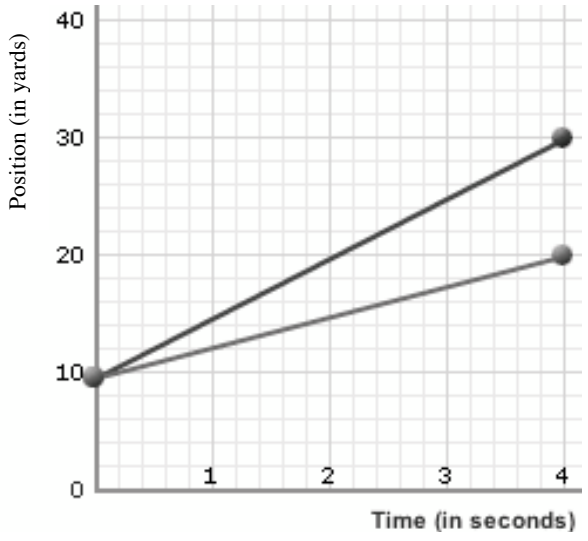
Which of the graphs shows that one of runners started 10 yards further ahead of the other? Explain your answer.

In which of the following graphs below are both runners moving at the same speed? Explain your answer.

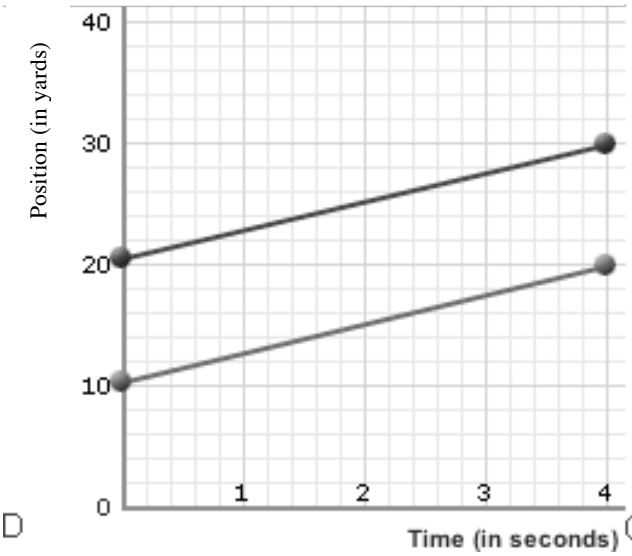
A



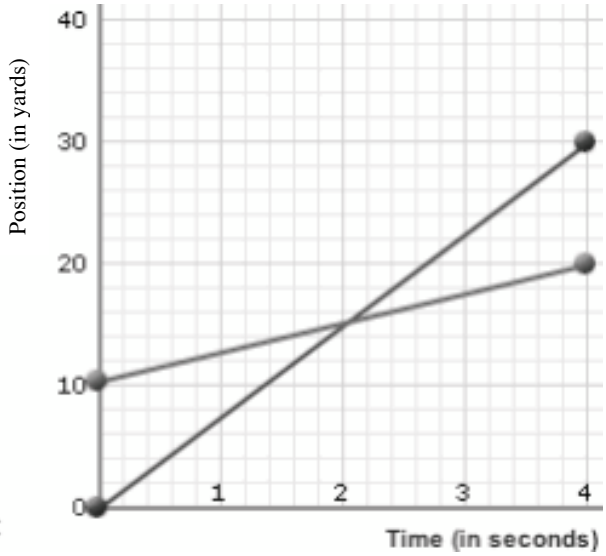
B



D



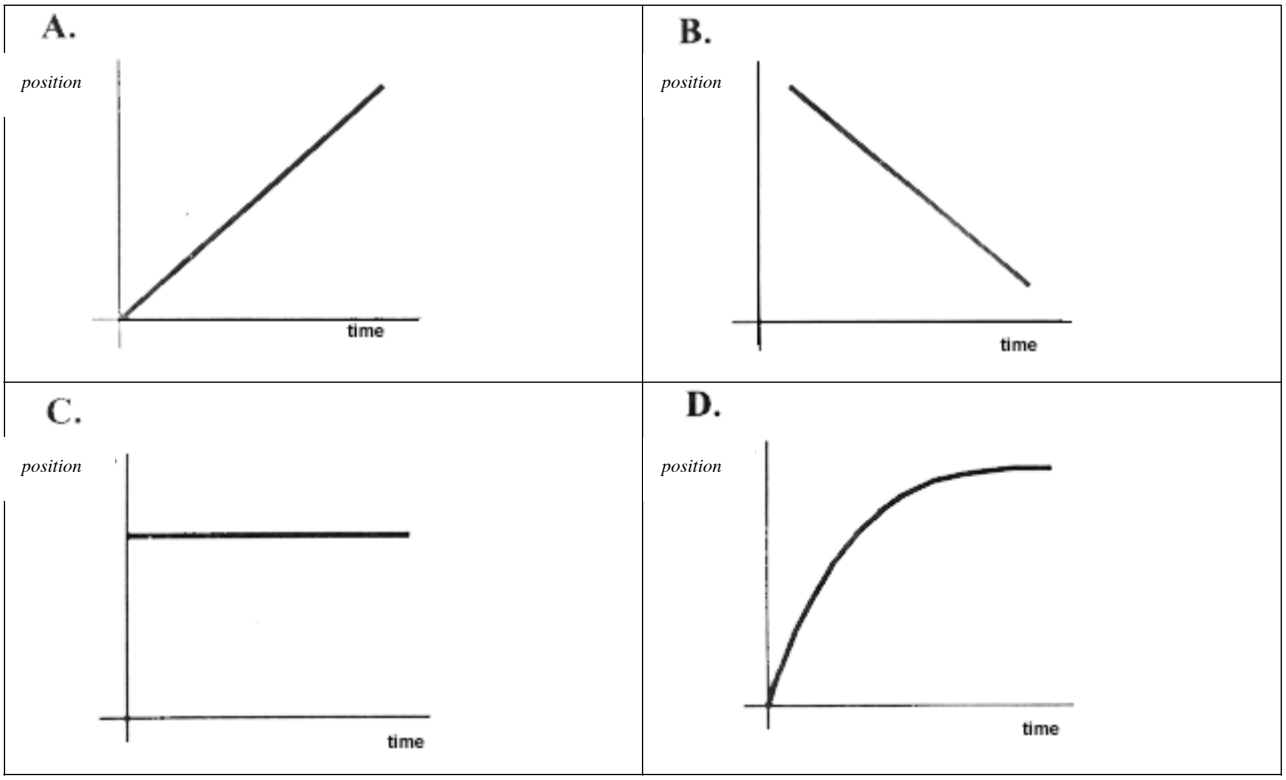
C



The position-time graphs below represent the motion of a car. Match the descriptions with the graphs. **Explain your answers.**

Descriptions:

1. The car is stopped.
2. The car is traveling at a constant speed in the positive direction.
3. The speed of the car is decreasing.
4. The car is moving at a constant speed in the negative direction.



Graph A matches description _____ because _____.

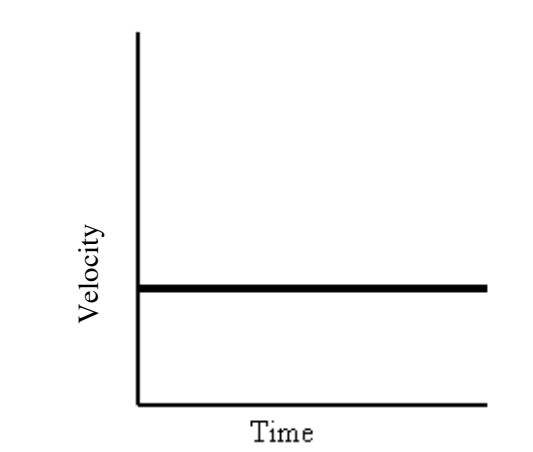
Graph B matches description _____ because _____.

Graph C matches description _____ because _____.

Graph D matches description _____ because _____.

VELOCITY-TIME GRAPHS

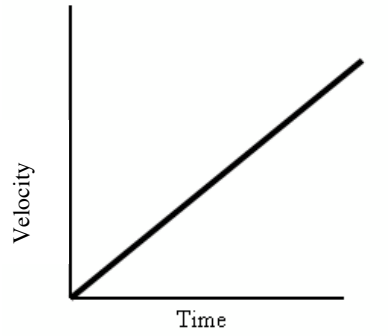
Velocity-Time graphs are sometimes referred to as Speed-Time graphs.



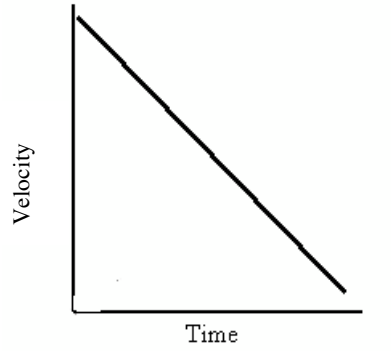
Velocity-Time graphs look much like Position-Time graphs. Be sure to read the labels! Time is plotted on the X-axis. Velocity is plotted on the Y-axis.

A straight horizontal line on a velocity-time graph means that speed is constant. It is not changing over time.

A straight line does not mean that the object is not moving! (Unless it is at zero)

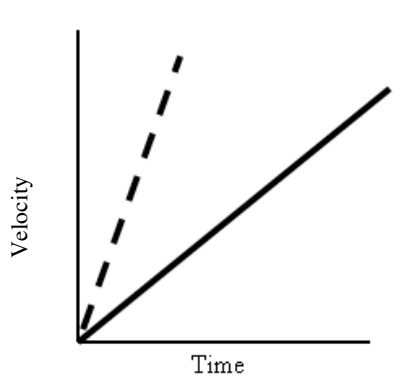


This graph shows increasing speed. The moving object is **accelerating**.



This graph shows decreasing speed. The moving object is **accelerating in the negative direction**.

What about comparing two moving objects at the same time?



Both the dashed and solid line show increasing velocity.

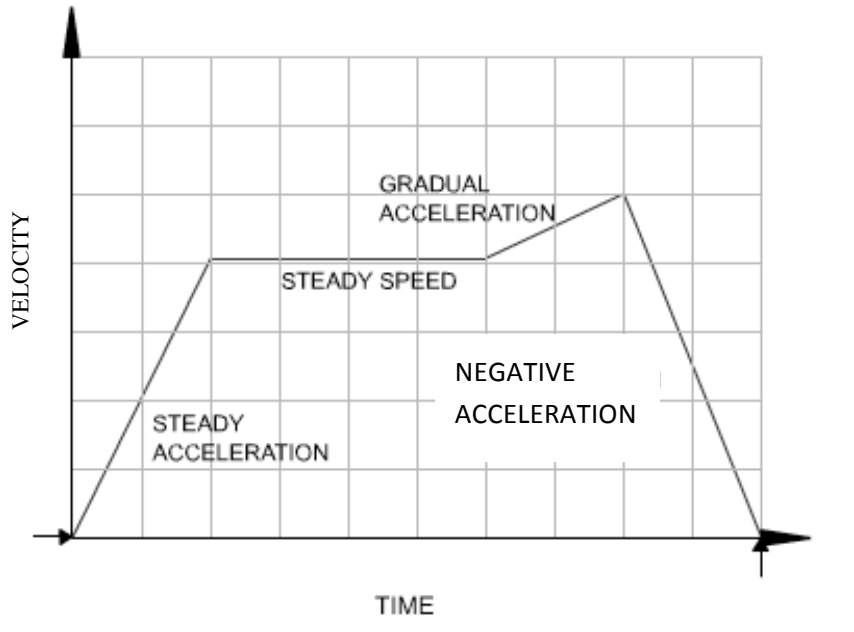
Both lines reach the same top speed, but the solid one takes longer.

The dashed line shows a greater acceleration.

Summary:

A velocity-time graph shows us how the velocity of a moving object changes with time.

- The steeper the graph, the greater the acceleration.
- A horizontal line means the object is moving at a constant velocity.
- A downward sloping line means the object is slowing down – has negative acceleration.



(Graph from: http://www.bbc.co.uk/schools/gcsebitesize/physics/forces/speedvelocityaccelerationfhrev2.shtml)

The velocity-time graphs below represent the motion of a car. Match the descriptions with the graphs**. Explain your answers.**

Descriptions:

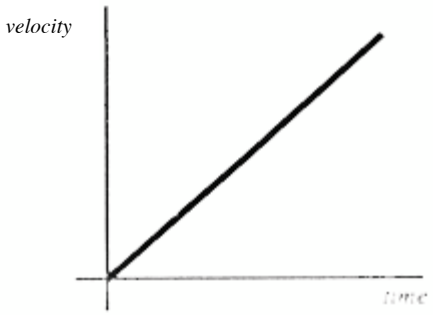
5. The car is stopped.

6. The car is traveling at a constant velocity.

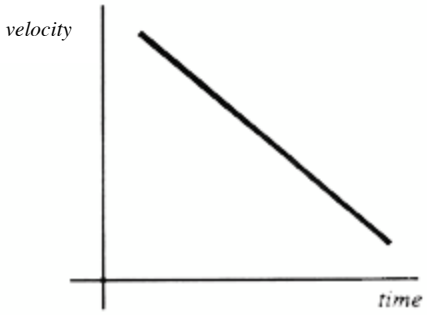
7. The car is speeding up (positive acceleration).

8. The car is slowing down (negative acceleration).

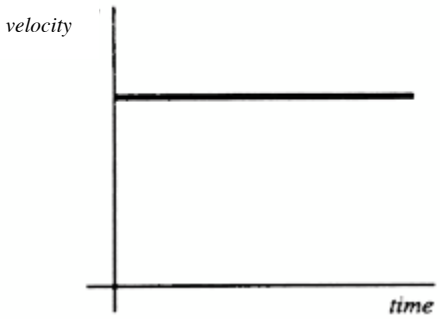
E.



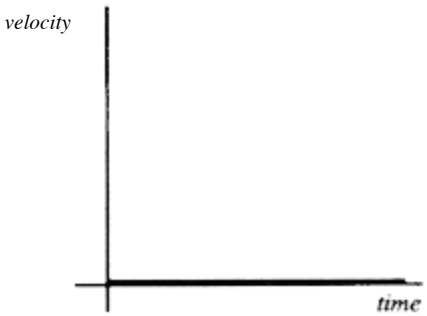
F.



G.



H.



Graph E matches description _____because _____.

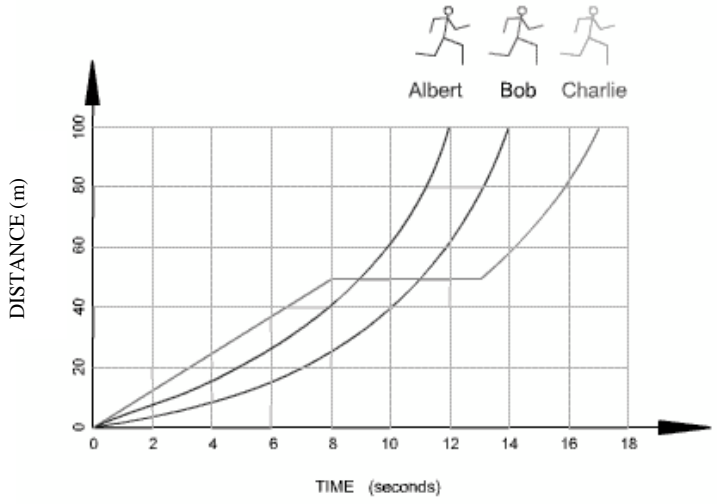
Graph F matches description _____because _____.

Graph G matches description _____because _____.

Graph H matches description _____because _____.

Questions:

(Some questions adapted from
http://www.bbc.co.uk/schools/gcsebitesize/physics/forces/speedvelocityaccelerationfhrev2.shtml)



Look at the graph above. It shows how three runners ran a 100-meter race.

Which runner won the race? Explain your answer.

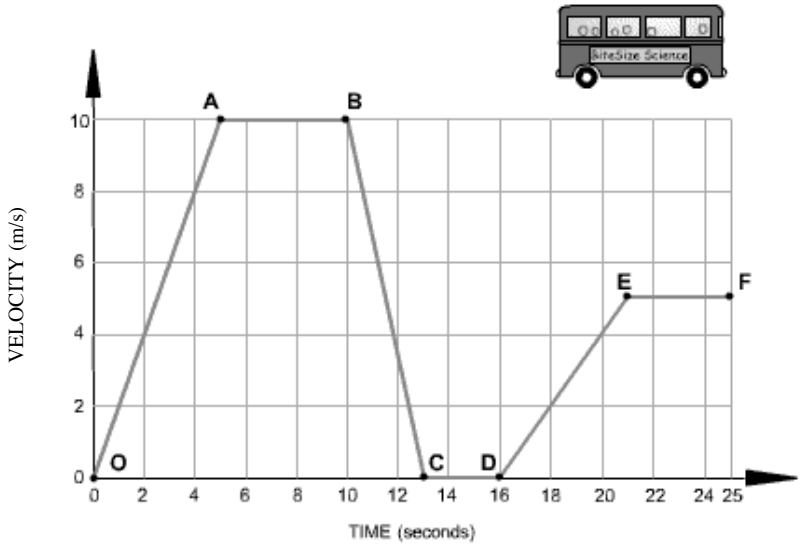
Which runner stopped for a rest? Explain your answer.

How long was the stop? Explain your answer.

How long did Bob take to complete the race? Explain your answer.

Calculate Albert's average speed. (Figure the distance and the time first!)

The graph below shows how the velocity of a bus changes during part of a journey



Choose the correct words from the following list to describe the motion during each segment of the journey to fill in the blanks.

- positive acceleration
- negative acceleration
- constant velocity
- at rest

Segment 0-A The bus is _____. Its velocity changes from 0 to 10 m/s in 5 seconds.

Segment A-B The bus is moving at a _____of 10 m/s for 5 seconds.

Segment B-C The bus is _____. It is slowing down from 10 m/s to rest in 3 seconds.

Segment C-D The bus is _____. It has stopped.

Segment D-E The bus is _____.
It is gradually increasing in velocity.