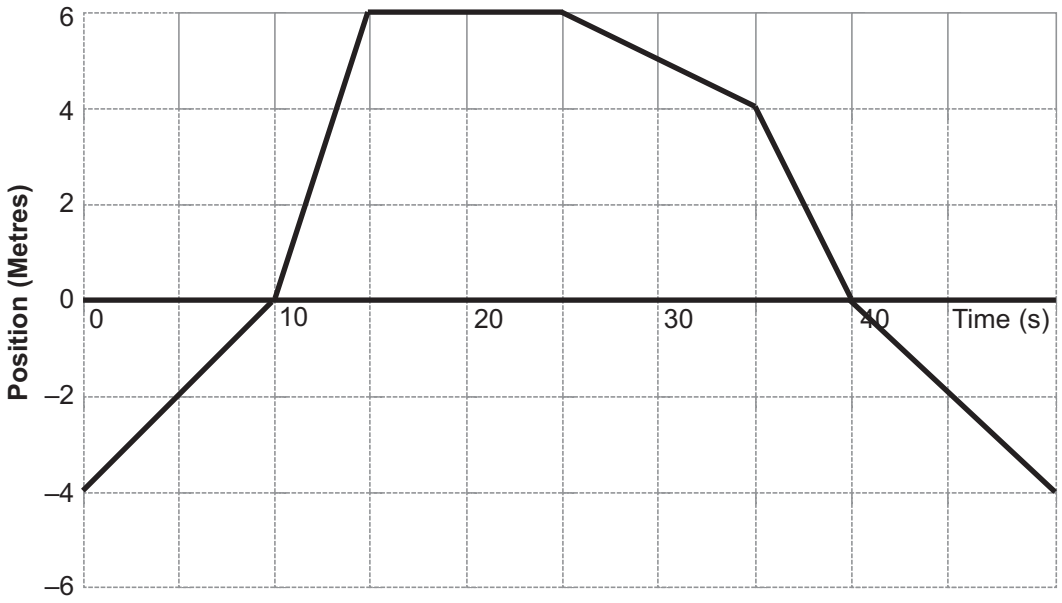
SLA
Student
Learning
Activity

Appendix 3.8: Motion: Interpreting Position-Time Graphs



The position-time graph above represents the motion of a remote-controlled toy truck as it moves back and forth along a straight line. The origin marks the position of the boy who controls the truck. The boy has not yet learned how to make the truck change its direction.

A positive position marks positions to the right of the boy, and a negative position marks positions to the left of the boy.

1. During which time intervals is the truck to the right of the boy?

   To the left of the boy?

2. During which time intervals is the truck moving in the positive direction?

   In the negative direction?

   Not moving?

3. What is the position of the truck at 0 seconds? _____ 15 seconds? _____

   30 seconds? _____ 45 seconds? _____

4. When is the truck in front of the boy?

5. Describe, in words, the position-time story of the motion that the truck showed during this 50-second interval.

The graph of position-time gives **directly** some information about the motion. This tells the position-time version of the story of this motion (that is, where the truck is at a particular instant in time).

The graph of position-time also gives **indirect** information about the motion of the truck. The following questions deal with obtaining this indirect information, such as distance travelled, displacement, average speed, and average velocity.

6. How far did the truck travel during the following time intervals?

0–10 s _____ 10–15 s _____ 15–25 s _____

25–35 s _____ 35–40 s _____ 40–50 s _____

7. What was the displacement of the truck during the following intervals?

0–10 s _____ 10–15 s _____ 15–25 s _____

25–35 s _____ 35–40 s _____ 40–50 s _____

8. Average speed is given by the distance travelled divided by the time interval. Calculate the average speed for each interval:

0–10 s _____

10–15 s _____

15–25 s _____

25–35 s _____

35–40 s _____

40–50 s _____

9. The following relationship is used to calculate average velocity:

   average velocity = displacement/time interval or $\vec{v}_{\text{average}} = \dfrac{\overrightarrow{\Delta d}}{\Delta t}$.

   This relationship also represents the slope of the line on a position-time graph. Calculate the average velocity for each time interval by calculating the slope of the line segment. Show your work.

Run = Δt **Time Interval**	**Rise = Δd** **Displacement**	**Slope = $\vec{v}_{\text{average}} = \dfrac{\overrightarrow{\Delta d}}{\Delta t}$**

10. How do the signs (+, –) of the velocities in Question #9 above compare with the direction of motion in Question #2?

11. In terms of the truck's motion, what does a negative velocity mean?

    A positive velocity?

    A velocity of 0 m/s?

12. Draw a chord joining the initial position of the truck at 0 s to its final position at 50 s. The slope of this chord represents the average velocity for the whole journey. Calculate the ***average velocity*** for the whole journey represented by the position-time graph.

13. Displacement is a **vector** quantity. It is always stated with a direction. Distance travelled is just how far an object moves without regard to direction. Distance is a **scalar** quantity.

    From the chart on the previous page, determine the distance travelled during each time interval and then calculate the total distance travelled during the 50-s interval.

    Calculate the **average speed** of the truck.

14. The average speed for any time interval can be found by drawing a chord joining the position at the first instant in time to the position at the second instant in time. The slope of this chord gives the average velocity for that interval.

    Calculate the average velocity for the time interval from 5 s to 35 s.

    Calculate the average velocity for the time interval from 15 s to 50 s.

Summary for Analyzing Position-Time Graphs:

1. What information is given directly from a position-time graph?

2. What information is given indirectly from a position-time graph?

3. How is average speed calculated from a position-time graph?

4. How is average velocity calculated from a position-time graph?
   a) For a given interval?

   b) For the whole journey?

5. Just by looking at a position-time graph, what can you tell from the slope?

6. Relate the velocity-time version of the story of the motion of the truck.