1.4: Graphing Motion

Create and interpret graphs that represent motion (position-time graphs and velocity-time graphs).

We can talk about motion and other measurements, but sometimes it is easier to explain what we've seen by using images. Graphing is often used by scientists to visually represent data in a way that is easier to understand. It is easy to see a relationship between independent and dependent variables when they are plotted on a graph.

Position-Time Graphs

Creating a graph is not difficult; there are five simple steps. (We'll look at details for each step in just a moment.)

1. Draw axes.
2. Label axes.
3. Scale axes.
4. Plot points.
5. Sketch the "best fit" line or curve.

Let's look at an example of data that could be better understood with a graph. Suppose you observed a jogger in the park and recorded her position (in meters) at various times (in seconds). You created a table of the following data:

Table 1.3: Data table

Time (seconds)	Position (meters)
0	0
1	2
2	4
3	6

A data table is one way to represent the motion of this jogger. Another way to represent it would be a position vs. time graph. Now let’s create a position-time graph together using the information we collected from the jogger.

Fig. 1.4. How to draw a graph

Velocity-Time Graph

You may have noticed that the jogger’s position increased by 2 meters each second. Recall that we can find displacement by taking the final position and subtracting the starting position from it. We see that for the 3 seconds, the jogger’s displacement was 6 meters. To find the velocity, then, we divide 6 meters by 3 seconds, which equals 2 meters per second. We can do the same thing using our position-time graph.

First, remember that the graph you created earlier is linear (a straight line). To find the displacement, look at the starting position (the position at time of 0 seconds). Then find the ending position. Take the end position minus the start position. This gives the displacement. Now look at how much time it took to travel that far. Take the ending time minus the starting time. To find the velocity, simply divide this displacement by this time.

The change in the vertical divided by the change in the horizontal is called the slope of the graph. To find the slope of a graph, first you must choose two points on the line. (Often we just look at the beginning and ending points of the line.) Then find the rise (vertical change). Next find the run (horizontal change). Finally, simply take the rise divided by the run.

Now we can take the velocity that we found and create a graph of velocity vs. time. First, we create a table of the time and velocity. It should look like the one below.

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}}$$

Fig. 1.5: Formula for finding the slope of a line

Table 1.4: Velocity vs. Time Table

Time (seconds)	Velocity (m/s)
1	2
2	2
3	2

Next, go through the same steps you used to create the earlier graph—draw the axes, label them, scale them, plot the points, and draw the line. This velocity vs. time graph will be a horizontal line at 2 m/s. Since our graph is a straight horizontal line, we see that the slope of the graph does not change. It is constant. The slope of a position vs. time graph is the velocity, so we can conclude that the velocity is constant whenever the position vs. time graph is linear. In the example of the jogger, the velocity was a constant 2 m/s.

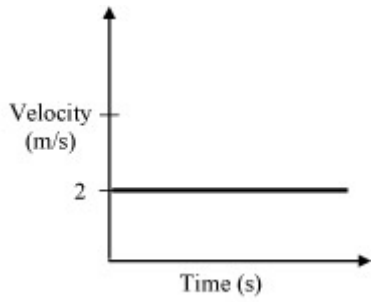

Fig. 1.6: Velocity vs. time graph