1. DESCRIBING MOTION

Position, velocity, and acceleration may all be described and quantified when explaining motion.

Objectives

- Understand the concepts of position, velocity, and acceleration.
- Model and explain constant velocity.
- Model and explain constant acceleration.
- Know that any change in velocity is an acceleration.
- Recognize that changes in motion require forces.

Materials and Equipment

- Data collection system
- Motion sensor
- Meter stick
- Tape

Safety

Follow these important safety precautions in addition to your regular classroom procedures:

- Be aware of the path you will follow when conducting this experiment. A clear path, free of obstacles is essential.

Procedure

Part 1 – Describing Position

1. Place the motion sensor on a stool, desk, or table at a height of roughly 1 meter and facing outwards towards an open area. Using the meter stick and tape, measure and label the distances away from the motion sensor at .25 m, 1 m, and 2 m.

2. Select Sensor Data in SPARKvue.

3. Connect the motion sensor to your device.

4. Select the Line Graph display and select position on the y axis, with time on the x axis

5. Stand directly in front of the motion sensor at the position .25 m. Select Start and move backwards to the 1 m position. Stop for 2 seconds and return to the .25 meter position. Attempt to do this at a constant speed (velocity) backwards and forwards. Stop recording data. Record your data in Graph 1.

6. Moving more quickly: Stand directly in front of the motion sensor at the position .25 m. Select Start and move backwards to the 1 m position. Stop for 2 seconds and return to the .25 meter position. Attempt to do this at a faster - constant speed (velocity) backwards and forwards. Stop recording data. Record your data in Graph 2.

7. Moving more slowly: Stand directly in front of the motion sensor at the position .25 m. Select Start and move backwards to the 1m position. Stop for 2 seconds and return to the .25 meter position. Attempt to do this at a slower - constant speed (velocity) backwards and forwards. Stop recording data. Record your data in Graph 3.

Part 2 – Describing Velocity

8. Change the y axis to velocity. The x axis will remain with time.

9. Stand directly in front of the motion sensor at the position .25 m. Select Start and move backwards to the 2 m position. Stop for 2 seconds and return to the .25 meter position. Attempt to do this at a constant velocity (speed) backwards and forwards. Stop recording data. Record your data in Graph 4.

Data Collection

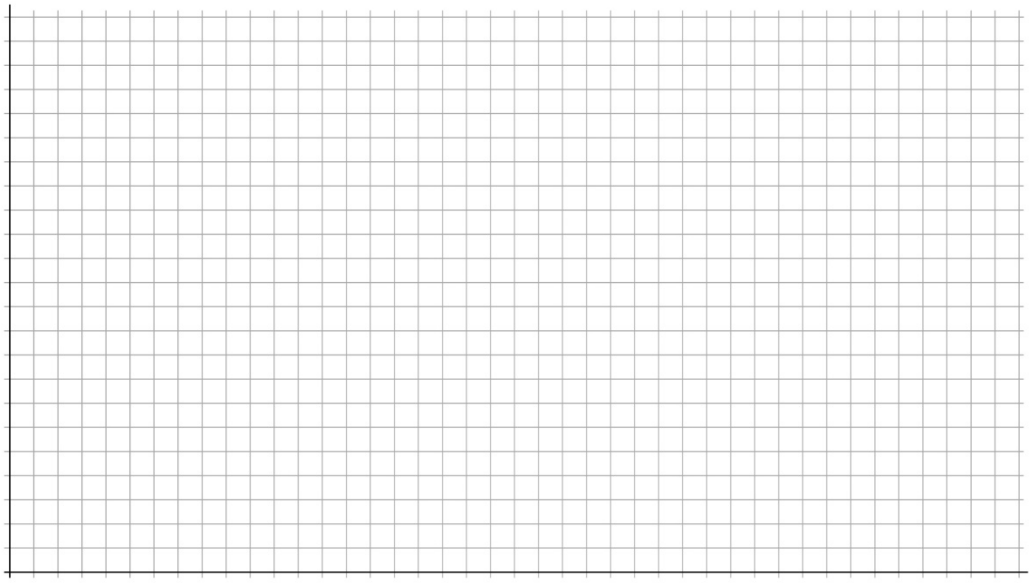
Part 1 – Describing Position

1. Regular pace: recreate the graph of *position* versus *time* in the blank graph #1 axes. Label both axes, include units, and use the correct number scale.

Graph 1: Position vs. Time at regular pace

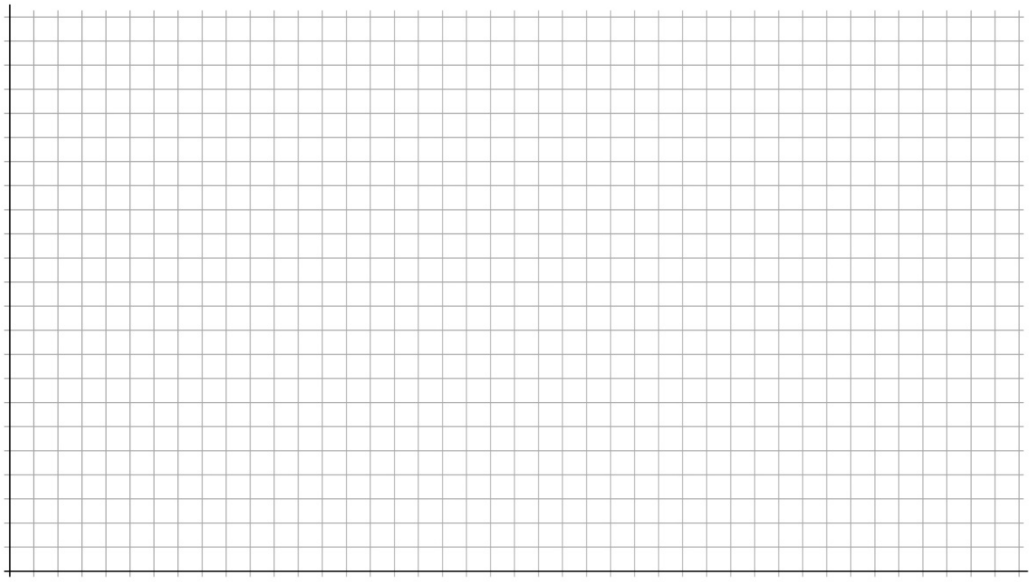
2. Fast speed: recreate the graph of *position* versus *time* in the blank graph #2 axes. Label both axes, include units, and use the correct number scale.

Graph 2: Position vs. Time at fast speed



3. Slow speed: recreate the graph of *position* versus *time* in the blank graph #3 axes. Label both axes, include units, and use the correct number scale.

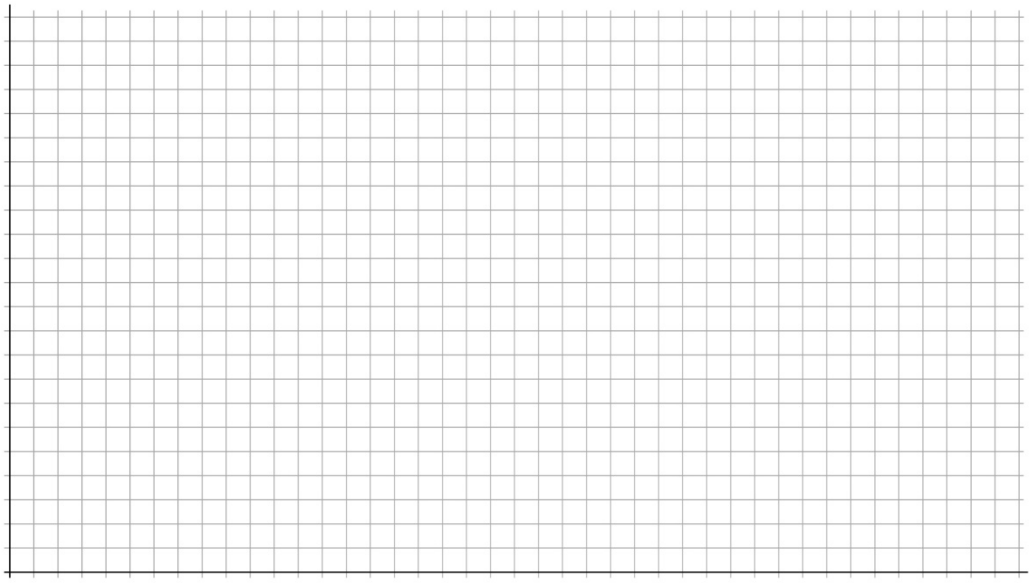
Graph 3: Position vs. Time at slow speed



Part 2 – Describing Velocity

4. Recreate the graph of *velocity* versus *time* in the blank graph #4 axes. Label both axes, include units, and use the correct number scale.

Graph 3: Velocity vs. Time



Questions and Analysis

Part 1 – Describing Position

1. What is the starting position in Graph #1? What is the stopping position in Graph #1? What is the change in position in Graph #1?

2. Compare Graphs 1,2 and 3. Each graph is a change in position at different speeds. What do you notice changes in each graph?

3. What does the slope of the line indicate in graphs 1, 2 and 3?

4. How is slope calculated?

5. Select an area of changing position and calculate the slope for graphs 1, 2 and 3. This may be done using the SPARKvue graphing tool. What are the units associated with this calculation?

6. What are the velocities for graphs 1, 2 and 3?

Part 2 – Describing Velocity

7. Examine Graph #4. Between what times were you able to maintain a constant velocity?

8. A change in velocity is call acceleration. Between what times is an acceleration taking place?

9. The acceleration can be calculated as the slope of the line in a velocity vs. time graph. Select one region of Graph #4 where the velocity is changing and calculate the slope. This may be done using the SPARKvue graphing tool. What are the units for this calculation? What is the acceleration in this region of the graph?

10. What happens to velocity when acceleration is constant?