Motion Graphs - Notes

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

How can we tell what was graphed? What are we looking at? Where do we look?

**We have to look at the axes!!!!**

The first graph shows distance vs. time = **Speed**

The second shows speed vs. time = **Acceleration**

Remember: (also remember the formulas we have been using)

- **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.

**Distance-Time Graphs**

*Time always goes on the _X_ axis because it is the _independant_ variable.*

*The further to the right on the x axis, the longer the time from the start.*

*The higher up on the y axis, the further from the start.*

**Interpreting Distance-Time Graphs**

**Horizontal Line** = object is **NOT** moving!

<table>
<thead>
<tr>
<th>Time</th>
<th>Distance</th>
</tr>
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<tbody>
<tr>
<td></td>
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Time is increasing to the right, but its distance does not change.

It is NOT MOVING.

We can say the object is **AT REST**
If an object is moving at a **CONSTANT SPEED**, it means it has the same increase in distance in a given time:

- Time is increasing to the right, and distance 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 change (getting larger). It is **accelerating**.

**Distance-Time Graphs Summary:**

- A distance-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 returning to the start.
**PRACTICE**: The distance-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.
3. The speed of the car is decreasing.
4. The car is coming back.

**Graph A** matches description **2** because *straight line = constant speed*.

**Graph B** matches description **4** because *downward slope = returning to start*.

**Graph C** matches description **1** because *horizontal line = not changing position = not moving*.

**Graph D** matches description **3** because *car covering less distance over time*.
SPEED-TIME GRAPHS
Speed-Time graphs are also called Velocity-Time graphs.

Speed-Time graphs look much like Distance-Time graphs. Be sure to read the labels!!

Time is plotted on the X-axis. Speed or velocity is plotted on the Y-axis.

A straight horizontal line on a speed-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!

What about comparing two moving objects at the same time?

This graph shows increasing speed.

The moving object is accelerating.

This graph shows decreasing speed.

The moving object is decelerating.

Both the dashed and solid line show increasing speed.

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

The dashed line shows a greater acceleration.
A speed-time graph shows us how the speed 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 speed.
- A downward sloping line means the object is slowing down.

**Practice:** The speed-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 speed.
7. The car is accelerating.
8. The car is slowing down.

**Graph E** matches description **7** because **speed is increasing over time**.

**Graph F** matches description **8** because **downward slope = slowing down**.

**Graph G** matches description **6** because **horizontal line = constant speed**.

**Graph H** matches description **5** because **no line = no speed = no movement**.
#1: The graph below shows how 3 runners ran a 100 meter race.

Which runner won the race? ALBERT

Which runner stopped for a rest? CHARLIE

How long was the stop? 5 SEC

How long did Bob take to complete the race? 14 SEC

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

\[
\frac{100\text{m}}{12\text{sec}} = 8.33 \text{ m/s}
\]

#2: The graph below shows how the speed 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.
• accelerating
• decelerating
• constant speed
• at rest

Segment 0-A The bus is **ACCELERATING**. Its speed changes from 0 to 10 m/s in 5s.

Segment A-B The bus is moving at a **CONSTANT SPEED** of 10 m/s for 5s.

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

Segment C-D The bus is **AT REST**. It has stopped.

Segment D-E The bus is **ACCELERATING**. It is gradually increasing in speed.