Speed

Speed is how fast something is moving. Precisely, it is how far an object travels in a certain amount of time. The standard metric units are meters per second (m/s), but any units of distance divided by time will work (like miles per hour [mph] or cm per sec [cps], etc).

\[ S = \frac{\Delta D}{\Delta T} \]

Where \( \Delta D = D_{\text{final}} - D_{\text{initial}} \)

**Ex. A plane flies 200 meters in 5 sec. Calculate its speed.**

**Step 1: Variables**
\[ S = \quad \Delta D = 200 \text{ m} \]
\[ \Delta T = 5 \text{ sec} \]

**Step 2: Formula**
\[ S = \frac{\Delta D}{\Delta T} \]

**Step 3: Put in numbers and solve**
\[ S = \frac{200}{5} = 40 \text{ m/sec} \]

**Step 4: Check units**

**Why we use change of distance:**
A tree 4 m away for 2 sec has a speed of zero — it hasn’t moved. That’s why we have to use \( \Delta D \) (change of distance) distance (D).

An object has to be moving to have speed.

**Physics Explains Mathematics:**
If \( \Delta T = 0 \) (in \( S = \frac{\Delta D}{\Delta T} \)), then an object is in two places at once, which is impossible. This is why dividing by zero is undefined: it makes no physical sense!

**Speed is proportional to distance:**
A faster object goes farther, in the same amount of time.

\[
\begin{align*}
\text{100 m in 10 sec} & \\
\text{200 m in 10 sec}
\end{align*}
\]

**Speed is indirectly proportional to time:**
A faster object travels the same distance in less time.

\[
\begin{align*}
\text{200 m in 20 sec} & \\
\text{200 m in 10 sec}
\end{align*}
\]

A slower object can travel the same distance as a faster object, it just takes more time. A fast object travels the same distance faster.

**Constant Speed**

If an object moves at constant speed, it travels the same amount of distance each second. Notice that there is equal space between each dot.

**Measuring Speed**

To measure speed you must measure the distance traveled and the elapsed time.

Measure distance in meters using a meter stick or measuring tape.

Measure time with a stopwatch or with photogates.

Photogates (which start and stop when an object breaks beams of light) are a very accurate and precise method of measuring time.

\[
S = \frac{\Delta D}{\Delta T} = \frac{25 \text{ m}}{5 \text{ sec}} = 5 \text{ m/sec}
\]
### Speed, Distance Traveled, Elapsed Time, and Constant Speed

1. **Speed**
   - A. How far an object moves between two positions.
   - B. When an object covers equal amounts of time each second.
   - C. The rate of how fast an object travels a particular distance.
   - D. How many seconds it takes for an event to occur.
   - E. Delta: means “change of”.

2. **Distance Traveled**
3. **Elapsed Time**
4. **Δ**
5. **Constant Speed**

### True or False (and why): “A fast car goes farther.”

1. A slow object can travel as far as a fast object. **False**

2. Why do we have to use change of distance (ΔD) instead of just distance (D)?

### Will Speed Increase or Decrease?

- Distance is constant and time increases.
- Time is constant and distance decreases.
- Time is constant and distance increases.
- Distance is constant and time decreases.

### Mark these as Speed, Distance, Time, or Other

- 5 mm/sec
- 20 meters/sec
- 15 ft/min
- 10 inches
- 228 meters
- 78 sec
- 50 m/s²
- 8 minutes
- 6 Newtons

### A bike moves 50 m in 10 seconds. Calculate the speed of the bike.

**Step 1:**
- Variables:
  - S =
  - ΔD =
  - ΔT =

**Step 2:** Formula:

**Step 3:** Plug in numbers and solve:

**Step 4:** Give answer with units:

### A car travels 200 miles in 4 hours. Calculate the car’s speed.

**Step 1:**
- Variables:
  - S =
  - ΔD =
  - ΔT =

**Step 2:** Formula:

**Step 3:** Plug in numbers and solve:

**Step 4:** Give answer with units:

### On holiday, a family travels from Meyerville (10 miles away) to Sprytown (70 miles away), in 3 hours. Find their speed.

**Step 1:**

**Step 2:**

**Step 3:**

**Step 4:**

### A car travels 60 m/s for 10 secs. Calculate how far it traveled.

**Step 1:**

**Step 2:**

**Step 3:**

**Step 4:**

### Will Speed Increase or Decrease?

1. Is the above motion at constant speed?
2. Why or why not?
3. Each dot = 1 sec. How long did it take to go 15 m?
4. Calculate the object’s speed.
5. How would the dots change if it were moving faster?
1. Speed  
2. Distance Traveled  
3. Elapsed Time  
4. A  
5. Constant Speed  
   A. How far an object moves between two positions.  
   B. When an object covers equal amounts of time each second.  
   C. The rate at which an object travels a particular distance.  
   D. How many seconds it takes for an event to occur.  
   E. Delta: means \text{"change of"}.  

<table>
<thead>
<tr>
<th>Will Speed Increase or Decrease?</th>
<th>Mark these as Speed, Distance, Time, or Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. Distance is constant and time increases.</td>
<td>5 mm/sec</td>
</tr>
<tr>
<td>B. Time is constant and distance decreases.</td>
<td>20 meters/sec</td>
</tr>
<tr>
<td>I. Time is constant and distance increases.</td>
<td>15 ft/min</td>
</tr>
<tr>
<td>J. Distance is constant and time decreases.</td>
<td>10 inches</td>
</tr>
</tbody>
</table>

True or False (and why): “A fast car goes farther.”  
Just goes there in less time.  
Can a slow object travel as far as a fast object?  
Explain.  
Yes. Just takes more time.  

Why do we have to use change of distance (ΔD) instead of just distance (D)? Object must move!  

A bike moves 50 m in 10 seconds.  
Calculate the speed of the bike.  

Step 1: Variables:  
\[ S = \frac{\Delta D}{\Delta T} \]  
\[ S = \frac{50}{10} \]  
\[ S = 5 \text{ m/s} \]  

A car travels 200 miles in 4 hours.  
Calculate the car’s speed.  

Step 1: Variables:  
\[ S = \frac{\Delta D}{\Delta T} \]  
\[ S = \frac{200}{4} \]  
\[ S = 50 \text{ mph} \]  

A car travels 60 m/s for 10 seconds.  
Calculate how far it traveled.  

Step 1: \[ \text{var} \]  
\[ S = 60 \text{ m/s} \]  
\[ D = \frac{\Delta D}{\Delta T} \]  
\[ D = \frac{60}{10} \]  
\[ D = 60 \text{ m} \]  
\[ \text{Ans.} \]  
600 meters  

On holiday, a family travels from Meyerville (10 miles away) to Sprytown (70 miles away), in 3 hours. Find their speed.  

Step 1: \[ \text{var} \]  
\[ S = \frac{\Delta D}{\Delta T} \]  
\[ S = \frac{60}{3} \]  
\[ S = 20 \text{ mph} \]