Name: _____

Period: _____

Speed

1.3

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).

Speed (in meter/sec) → $S = \frac{\Delta D}{\Delta T}$ ← Change of Distance (in meters); ← Change of Time (in seconds)

Speed equal change of distance (distanced traveled) divided by change of time.

Where $\Delta D = D_{final} - D_{initial}$

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

Step 1: Variables

S = _____

ΔD = 200 m

ΔT = 5 sec

Step 2: Formula

$S = \frac{\Delta D}{\Delta T}$

Step 3: Put in numbers and solve

$S = \frac{\Delta D}{\Delta T} = \frac{200}{5}$

$S = 40$

Step 4: Check units

S = 40 m/sec

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 ΔD (change of distance) distance (D).

An object has to be moving to have speed.

Physics Explains Mathematics: *If ΔT = 0 (in S = ΔD/ΔT), 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.

Doubling the distance, doubles the speed.

100m in 10sec

$S_1 = \frac{\Delta D}{\Delta T} = \frac{100}{10} = 10 m/s$

200m in 10sec

$S_2 = \frac{\Delta D}{\Delta T} = \frac{200}{10} = 20 m/s$

Speed is indirectly proportional to time:

A faster object travels the same distance in less time.

Doubling the time, halves the speed.

200m in 20sec

$S_1 = \frac{\Delta D}{\Delta T} = \frac{200}{20} = 10 m/s$

200m in 10sec

$S_2 = \frac{\Delta D}{\Delta T} = \frac{200}{10} = 20 m/s$

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.

Each dot represents an object's position at regular time intervals (time is constant).

Fast object

Slow object

Measuring Speed

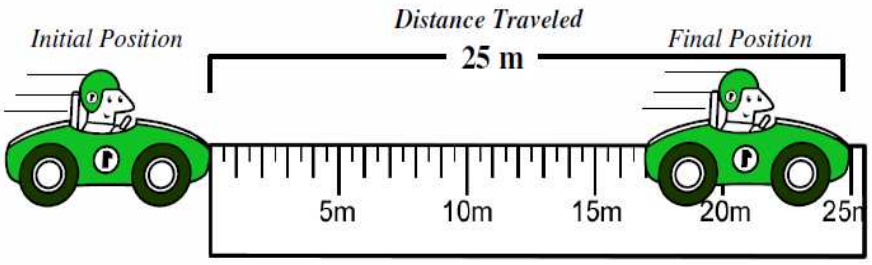
To measure speed you must measure the distance traveled and the elapsed time.

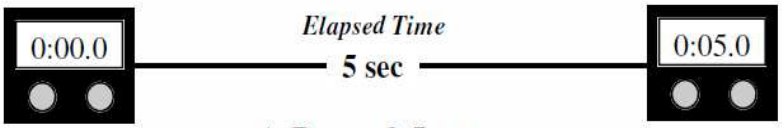
Measure distance in meters using a meter stick or measuring tape.

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.

Initial Position — *Distance Traveled* — *Final Position*





$$S = \frac{\Delta D}{\Delta T} = \frac{25\,m}{5\,sec} = 5\,m/s$$

All sections marked with a ⚡ are considered essential concepts and must be completed to receive full credit on WS.

1. Speed	A. How far an object moves between two positions.
2. Distance Traveled	B. When an object covers equal amounts of time each second.
3. Elapsed Time	C. The rate of how fast an object travels a particular distance.
4. Δ	D. How many seconds it takes for an event to occur.
5. Constant Speed	E. Delta: means "change of".

1. Slow speed	A. An object that travels a long distance quickly.
2. Fast speed	B. Can travel a long distance, but requires a lot of time.
3. Photogate	C. Uses a beam of light to start and stop a timer.
4. Directly Proportional	D. One quantity increases as another quantity increases.
5. Indirectly Proportional	E. One quantity decreases as another quantity increases.

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.

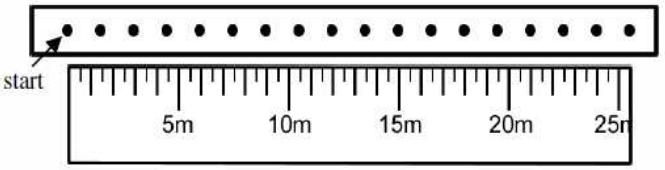
Mark these as Speed, Distance, Time, or Other

_____ 5 mm/sec	____ 20 meters/sec	____ 15 ft/min
_____ 10 inches	____ 228 meters	____ 78 sec
_____ 50 m/s^2	____ 8 minutes	____ 6 Newtons

True or false (and why): "A fast car goes farther."

Can a slow object travel as far as a fast object? Explain.

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



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?

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

Step 1: Variables: S = ΔD = ΔT =	Step 3: Plug in numbers and solve:
Step 2: Formula:	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 3: Plug in numbers and solve:
Step 2: Formula:	Step 4: Give answer with units:

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

Step 1: _____	Step 3: _____
Step 2: _____	Step 4: _____

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

Step 1: _____	Step 3: _____
Step 2: _____	Step 4: _____