Name: _____

Period: _____

Speed

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).

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

Speed (in meter/sec) → S

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 = _____
$\Delta D = 200$ m
$\Delta T = 5$ 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 $\Delta T = 0$ (in $S = \Delta D/\Delta T$), 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:
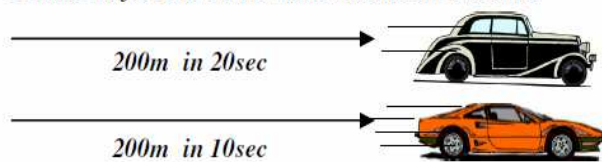A faster object goes farther, in the same amount of time.

100m in 10sec

200m in 10sec
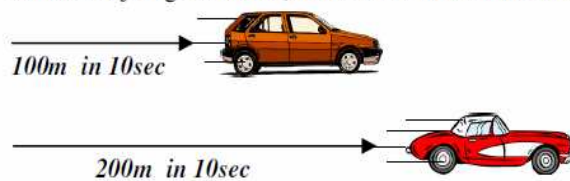
Doubling the distance, doubles the speed.

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

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

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

200m in 20sec

200m in 10sec

Doubling the time, halves the speed.

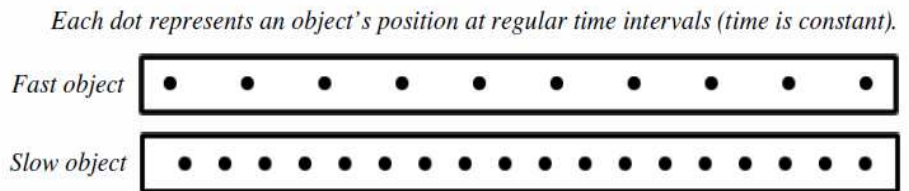$S_1 = \frac{\Delta D}{\Delta T} = \frac{200}{20} = 10$m/s

$S_2 = \frac{\Delta D}{\Delta T} = \frac{200}{10} = 20$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.
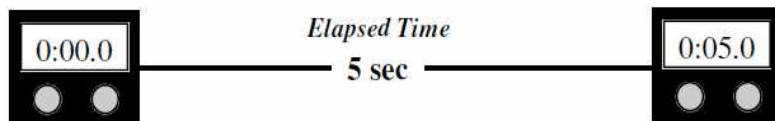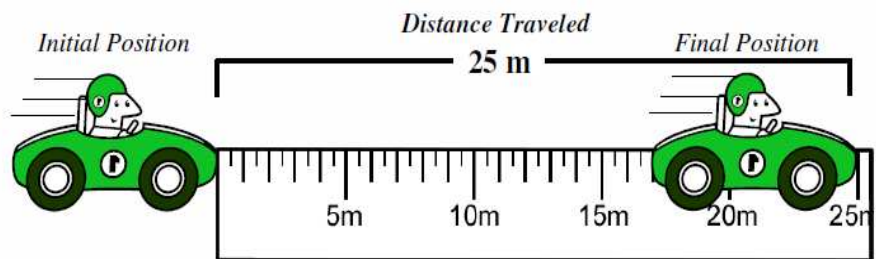
Each dot represents an object's position at regular time intervals (time is constant).

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.
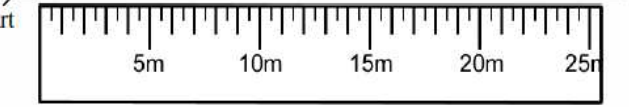
Initial Position

Distance Traveled
25 m

Final Position

5m   10m   15m   20m   25m

0:00.0

Elapsed Time
5 sec

0:05.0

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

1. Speed	A. How far an object moves between two positions.	1. Slow speed	A. An object that travels a long distance quickly.
2. Distance Traveled	B. When an object covers equal amounts of time each second.	2. Fast speed	B. Can travel a long distance, but requires a lot of time.
3. Elapsed Time	C. The rate of how fast an object travels a particular distance.	3. Photogate	C. Uses a beam of light to start and stop a timer.
4. Δ	D. How many seconds it takes for an event to occur.	4. Directly Proportional	D. One quantity increases as another quantity increases.
5. Constant Speed	E. Delta: means "change of".	5. Indirectly Proportional	E. One quantity decreases as another quantity increases.

Will Speed Increase or Decrease?	Mark these as Speed, Distance, Time, or Other
____ Distance is constant and time increases.	____ 5 mm/sec ____ 20 meters/sec ____ 15 ft/min
____ Time is constant and distance decreases.	____ 10 inches ____ 228 meters ____ 78 sec
____ Time is constant and distance increases.	____ 50 m/s^2 ____ 8 minutes ____ 6 Newtons
____ Distance is constant and time decreases.	

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

start

5m   10m   15m   20m   25m

1. Is the above motion at constant speed?
2. Why or why not?

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

3. Each dot = 1 sec. How long did it take to go 15 m?
4. Calculate the object's speed.

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

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.	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:	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 60 m/s for 10 secs. Calculate how far it traveled.	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: _____	Step 1: _____ Step 2: _____	Step 3: _____ Step 4: _____