Car materials:

2 toilet paper rolls
8 water bottle caps
2 straws
masking tape
2 4-inch bamboo skewers
5 paper clips
10 toothpicks

PHYSICS:
the study of matter and its motion through space and time, along with related concepts such as energy and force.

MOTION

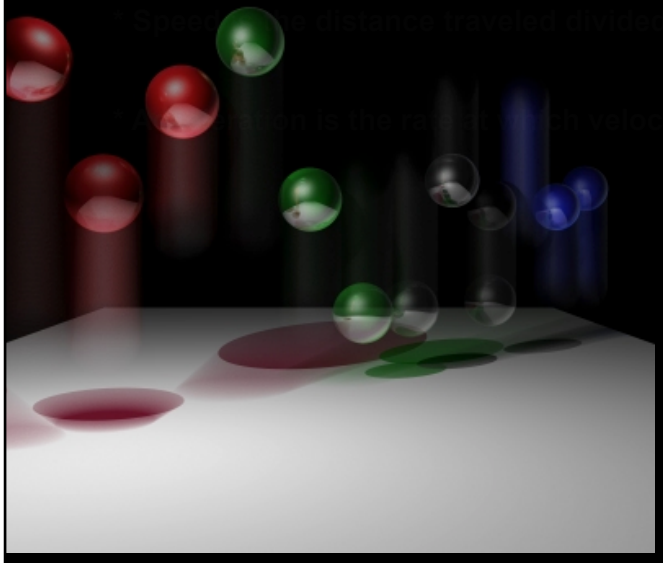
Do Now: Be as still as possible. Even if you don't move a muscle you are still moving. Explain.

ENDURING UNDERSTANDINGS

* An object is in motion if its distance from a reference point is changing.

* Speed is the distance traveled divided by the time traveled. $V = d / t$

* Acceleration is the rate at which velocity changes.



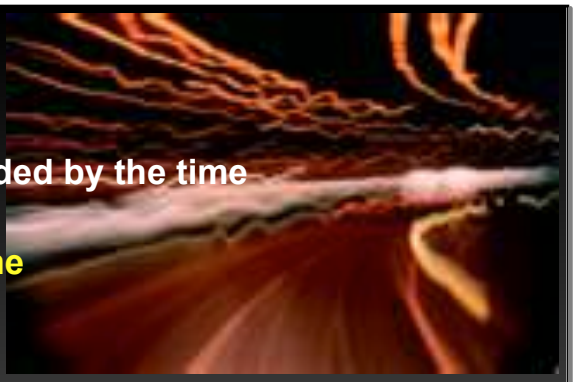
RELATIVE MOTION

* Relative Motion depends on your point of view.

↳ change in position

position change must be in relation to a reference point

SPEED



* Speed is the distance traveled divided by the time

speed = distance / time

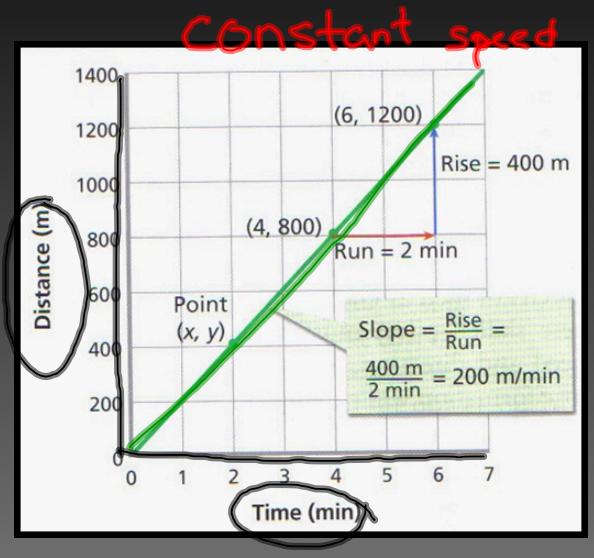
Speed video

GRAPHING MOTION

* When graphing motion, time is on the *x*-axis and distance on the *y*-axis.

* The faster the motion, the steeper the slope of the straight line.

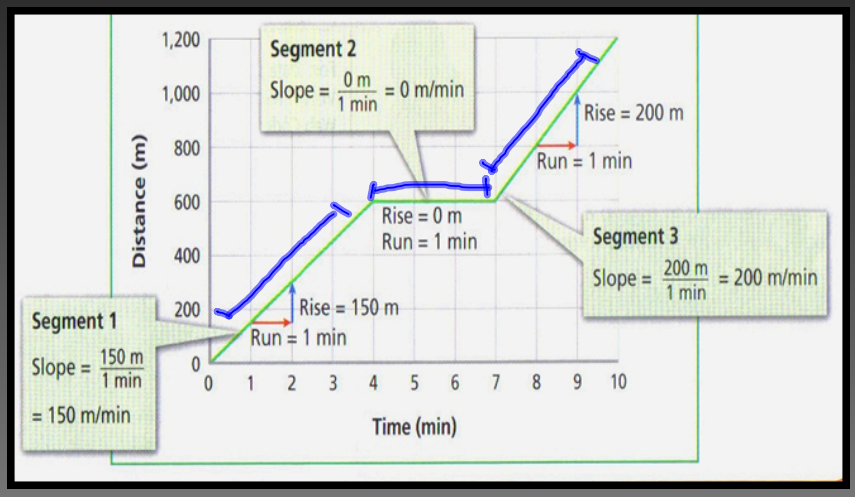
* Slope is calculated as the rise (distance on the y-axis) divided by run (distance on the x-axis).



GRAPHING SPEED

* A graph of speed shows separate line segments, each with a slope relating distance covered during that particular time period.

* A horizontal line shows an object is not moving as time passes.



Velocity

Velocity is speed in a given direction. It is calculated by dividing distance by time also. A measurement of velocity must include a direction in the units

Example: Todd's speed was 5 m/s but his velocity was 5 m/s **East**

$$\frac{300000000\ m/s}{8\ min}$$

$$300000000\ m \cdot \frac{8\ min}{1\ s}$$

Try it . . .

Sam rides his bike 4 miles to Sylvan's house. It takes him 20 minutes. What was Sam's average speed?

S = $\frac{4 \text{ miles}}{20 \text{ min}} = 0.2 \frac{\text{miles}}{\text{min}}$

What is Sam's speed in miles per hour?

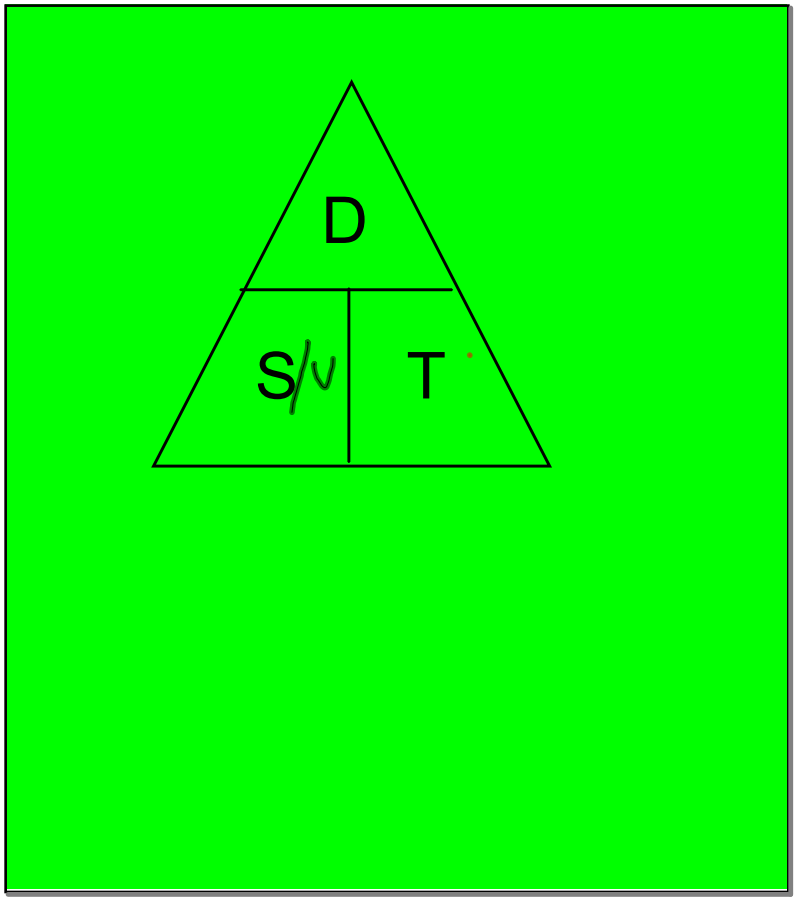
S =

If Sylvan rode to Sam's house averaging 15 mi/hr, how long would it take him to go the 4 miles?

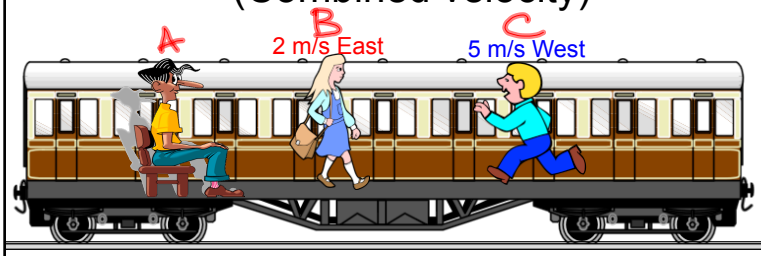
$T = \frac{4 \text{ mi}}{15 \text{ mi/hr}} = .27 \text{ hrs}$

$15 \overline{)4.00}$ (26; 30; 100; 90)

: 1/hr



Resultant Velocity
(Combined velocity)



the train is moving 20 m/s East (⟶)

What is the resultant velocity of Mr. A and the train?
What is the resultant velocity of Ms. B and the train?
What is the resultant velocity of Mr. C and the train?
How would you define resultant velocity?

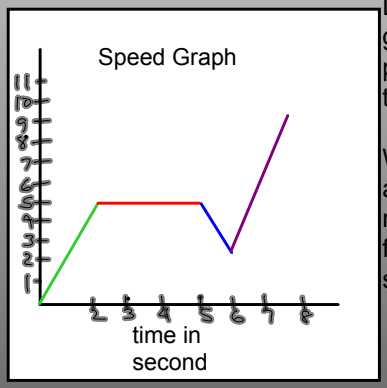
PRACTICE PROBLEMS :

1. Calculate the speed of a dog running through a field if he is covering 23.7 meters in 54 seconds. S=? D=23.7m T=54s (S=D/T)

2. If a cross country runner covers a distance of 347 meters in 134 seconds what is her speed?

3. What is the speed of a baseball that travels 49 meters in 2.4 seconds?

4. Calculate the velocity of a car that travels 556 kilometers northeast in 3.4 hours. Leave your answer in kilometers per hour.



Do Now: This is a graph showing a person walking through a park.

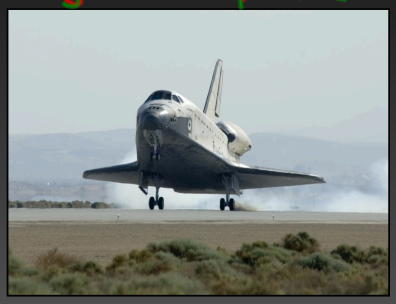
What can you tell about this person motion and speed for each colored segment?

ACCELERATION

*** Acceleration is any change in velocity**

*** Acceleration can be a decrease in speed, increase in speed, or a change in direc**

negative positive angular



CALCULATING ACCELERATION

To determine acceleration, calculate the change in speed per unit of time or as in the following equation:

Acceleration = final speed - initial speed / time

$a = \frac{v_f - v_i}{t_f - t_i}$

$a = \frac{\Delta v}{\Delta T}$

Δ = change

m/s2

Acceleration means a change in speed or direction. It can also be defined as a change in velocity per unit of time.

$$a = \frac{v_f - v_i}{t}$$ where a = velocity, v_f = final velocity, v_i = initial velocity, t = time

Calculate the acceleration for the following data.

	Initial Velocity	Final Velocity	Time	Acceleration
1.	0 ~~km/hr~~ m/s	24 ~~km/hr~~ m/s	3 s	$8\ m/s^2$
2.	0 m/s	35 m/s	5 s	$7\ m/s^2$
3.	20 ~~km/hr~~ m/s	60 ~~km/hr~~ m/s	10 s	$4\ m/s^2$
4.	50 m/s	150 m/s	5 s	$20\ m/s^2$
5.	25 ~~km/hr~~ m/s	1200 ~~km/hr~~ m/s	2 min (switch to seconds: 120s)	$9.8\ m/s^2$

6. A car accelerates from a standstill to 60 ~~km/hr~~ m/s in 10.0 seconds.
   What is its acceleration? $6\ m/s^2$

(switch to seconds)

6. A car accelerates from a standstill to 60 ~~km/hr~~ m/s in 10.0 seconds.
   What is its acceleration? $6\ m/s^2$

7. A car accelerates from 25 ~~km/hr~~ m/s to 55 ~~km/hr~~ m/s in 30 seconds.
   What is its acceleration? $1\ m/s^2$

8. A train is accelerating at a rate of 2.0 ~~km/hr/s~~ m/s^2.
   If its initial velocity is 20 ~~km/hr~~ m/s, what is its velocity after 30 seconds? $80\ m/s$

9. A runner achieves a velocity of 11.1 m/s 9 s after he begins.
   What is his acceleration? $1.23\ m/s^2$
   What distance did he cover? $99.9\ m$

$a = 2.0\ m/s^2$

$V_i = 20\ m/s$

$t = 30\ s$

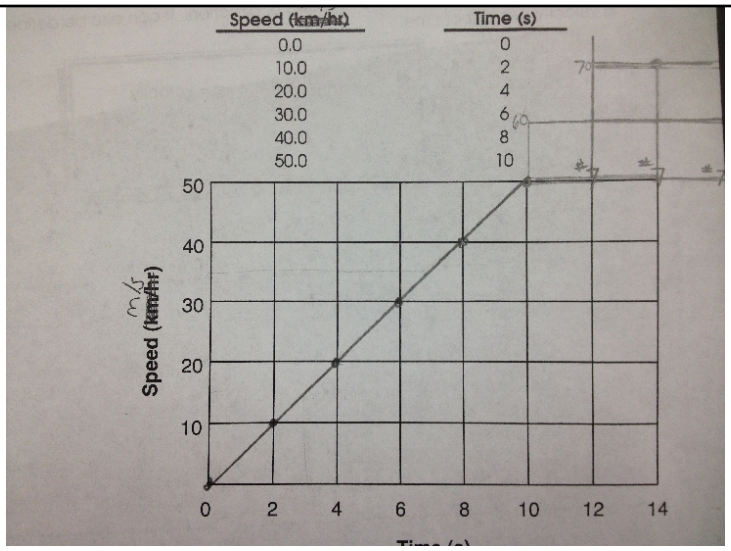
$a = \frac{V_f - V_i}{t} \Rightarrow 2.0\ m/s^2 = \frac{V_f - 20\ m/s}{30\ s}$

$\times 30$

$60\ m/s = V_f - 20\ m/s$

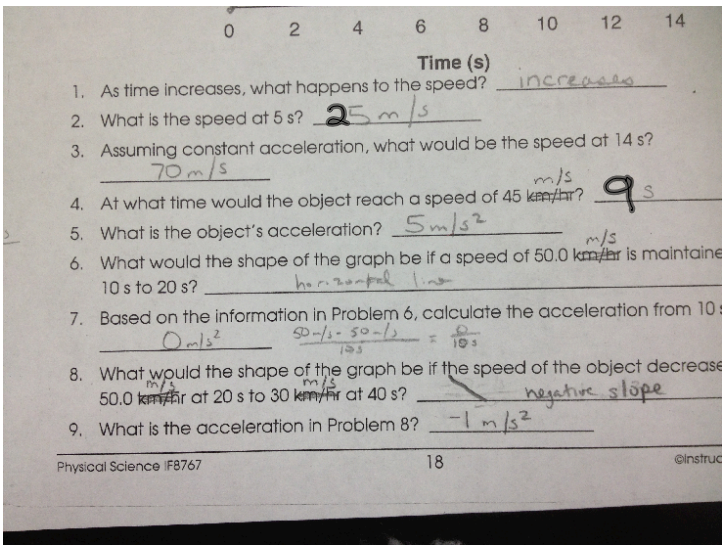
$+20\ m/s$

$80\ m/s = V_f$



$$a = \frac{50\ m/s^2 - 0}{10\ s}$$

$$= 5\ m/s^2$$



0 2 4 6 8 10 12 14

Time (s)

1. As time increases, what happens to the speed? increases
2. What is the speed at 5 s? 25 m/s
3. Assuming constant acceleration, what would be the speed at 14 s? 70 m/s
4. At what time would the object reach a speed of 45 ~~km/hr~~ m/s? 9 s
5. What is the object's acceleration? 5 m/s²
6. What would the shape of the graph be if a speed of 50.0 ~~km/hr~~ m/s is maintaine 10 s to 20 s? horizontal line
7. Based on the information in Problem 6, calculate the acceleration from 10 0 m/s² $\frac{50\text{ m/s} - 50\text{ m/s}}{10\text{ s}} = \frac{0}{10\text{ s}}$
8. What would the shape of the graph be if the speed of the object decrease 50.0 ~~km/hr~~ m/s at 20 s to 30 ~~km/hr~~ m/s at 40 s? negative slope
9. What is the acceleration in Problem 8? −1 m/s²

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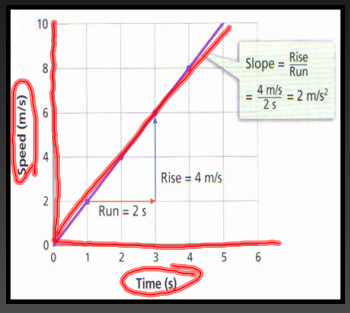
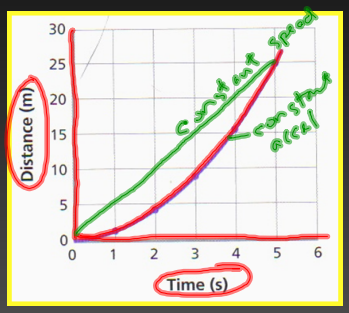
$$a = \frac{30\text{ m/s} - 50\text{ m/s}}{40\text{ s} - 20\text{ s}} = \frac{-20\text{ m/s}}{20\text{ s}} = -1\text{ m/s}^2$$

GRAPHING ACCELERATION

Constant acceleration forms a straight line on a speed vs time graph.



Constant acceleration forms a curve on a distance vs time graph



1. $a = \frac{v_f - v_i}{t}$

$a = \frac{24\ m/s - 0\ m/s}{3\ s} = \frac{24\ m/s}{3\ s}$

$= \frac{24}{3} \cdot \frac{m/s}{s}$

$8\ m/s^2$

$v_i = 0\ m/s$

$v_f = 60\ m/s$

$t = 10$

$a = \frac{v_f - v_i}{t}$

$a = \frac{60\ m/s - 0\ m/s}{10\ s} = \frac{60\ m/s}{10\ s}$

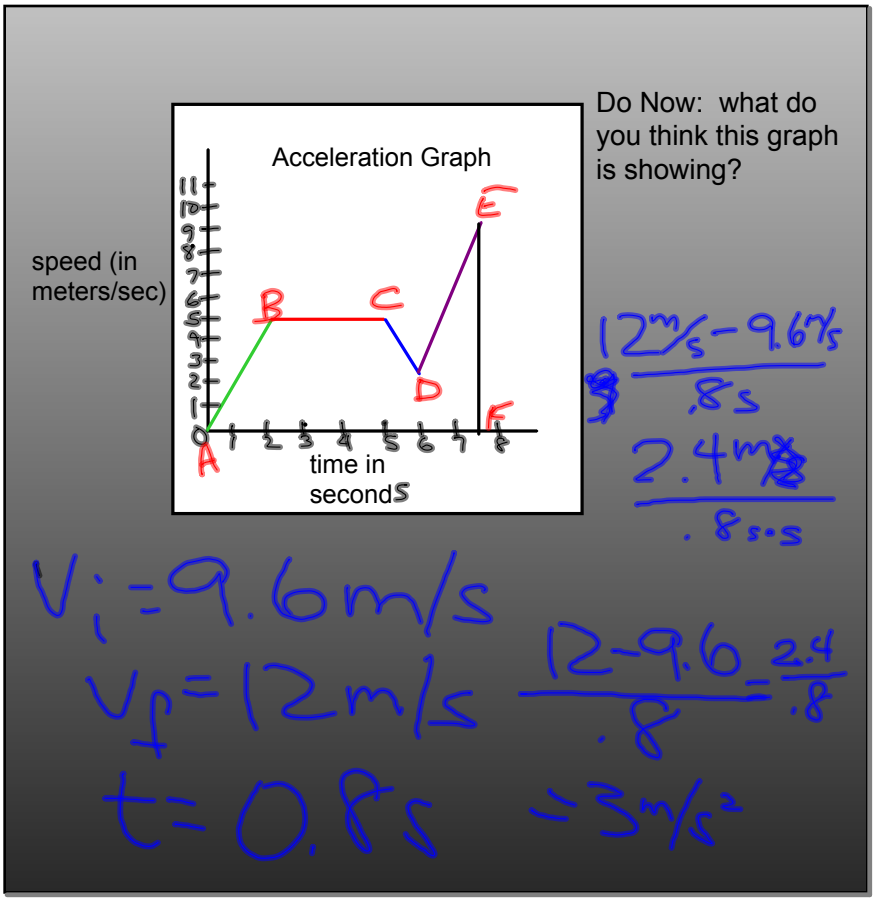
$= 6\ m/s^2$

Do Now:

What is the acceleration of a car that is speeding up from 20 m/s East to 25 m/s East in 2 seconds?

$a = \frac{25\,m/s - 20\,m/s}{2} = \frac{5\,m/s}{2\,s} = 2.5\,m/s^2$

What is the acceleration of a rocket that was moving at 100m/s then, after 10 seconds, it crashes?



"Do Now." On a blank piece of paper, copy the following questions and leave 2-4 lines after. DO NOT ANSWER THEM!

What is motion?
What is a reference point?
What is speed?
What are the units we measure distance in?
What are the units we measure time in?
How can you measure the speed of a toy car?___
What is acceleration?
What are 3 ways something can accelerate?
How can we find the acceleration of something?
*What are the 4 states of matter?
*How do the atoms differ in each state?
*How is the periodic table organized?
*What are the 3 main types of elements on the periodic table?
*What is the law of conservation of mass?
*What does this law have to do with balancing equations?

1 The change in position relative to a reference point is

A speed

B motion

C velocity

D car parts

2 What is an object that is used to determine if an object is in motion?

A point of contact

B motion point

C reference point

3 What is the distance travelled in a certain amount of time known as?

4 What is the one factor that makes speed different from velocity?

5 the rate of change in velocity is

6 what are the three ways an object can accelerate?

7 what is the equation to determine an object's acceleration?

8 what are the 4 states of matter?

9 How do the atoms behave in each state of matter?

10 How is the periodic table organized?