Science 1206

Unit 3: Physical Science Motion

Uniform Motion → straight line motion at a constant speed. Equal distances are covered in equal time intervals.

Ex:____

Qualitative Description : A description made by observing with the senses.

e.g. Sam runs faster than Jack

Quantitative Description : A description based on a measurement.

e.g. Sam runs at 2.0m/s while Jack runs at 1.8 m/s

Units

- Most measurements are useless to us without units
- Using inappropriate units also causes confusion

SI Units- Le Systeme International d'Unites

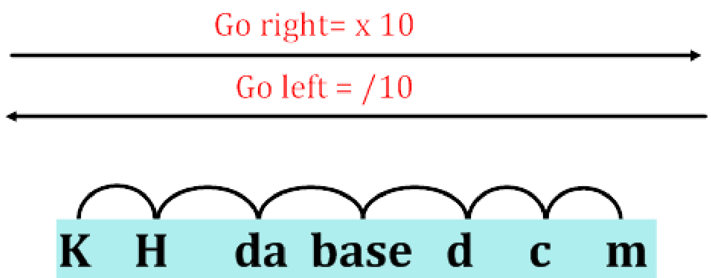
- single system agree on by scientists worldwide
- seven base units + other derived units

Table 1. SI base units

Base quantity	Name (SI base unit)	Symbol (SI base unit)
length	meter	m
mass	kilogram	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd

These are the ones we will use (length, mass, time)

Converting Base Units



"King Henry's Daughter Bakes Delicious Chocolate Muffins"

K - kilo
H - hecta
da - deka

d - deci
m - mili

Try these!

a) 31.6 cm = _____m

b) 2.6 kL = ____mL

c) 40 g = _____ mg

d) 2000 hm = ____km

e) 45 g = _______kg

f) 1 200 mm = _____kg

Complex Conversion Examples:

1) 270 mm/s to m/s

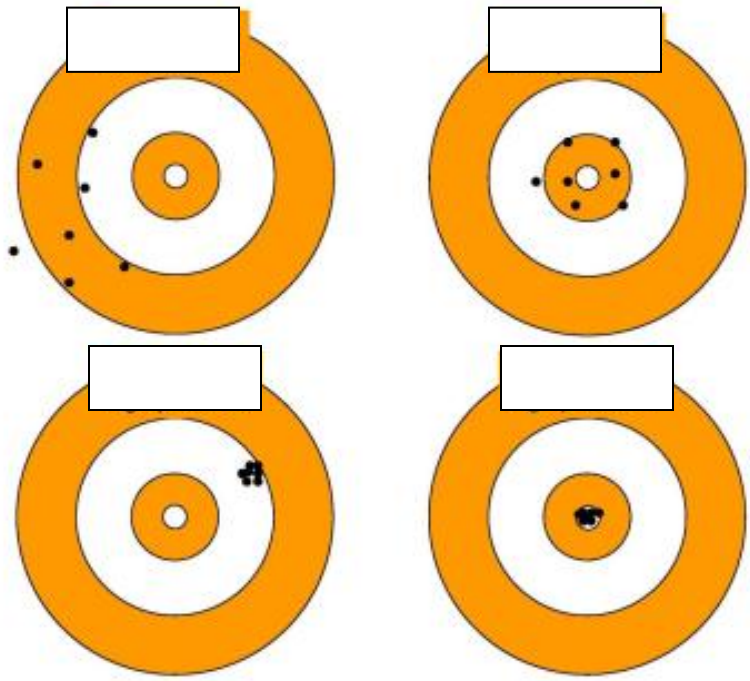
2) 50 km/hr to m/s

3) Convert your age into minutes

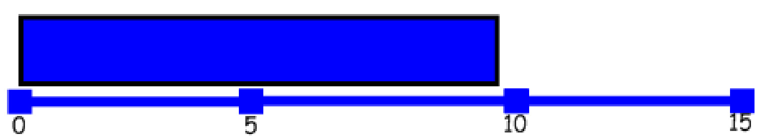
Accuracy vs. Precision

Accuracy: refers to the closeness of a measured value to a standard or known value.

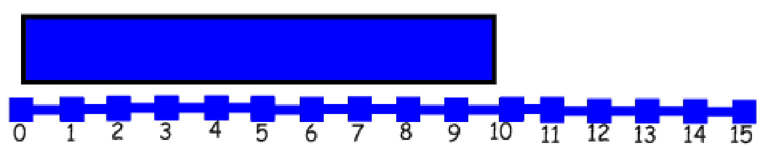
Precision: refers to the closeness of two or more measurements to each other.



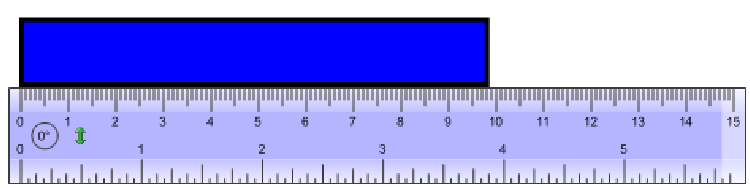
How long is the block?



Ans: ______



Ans: ______



Ans: ______

Which measurement is the most precise?

Significant Figures

1. Any digit that is not zero is significant
   example: 2.456 4 Sig Figs

2. Zeros between non-zero digits are significant. Count the "TRAPPED" zeros!
   example: 302 3 Sig Figs

3. Leading zeros are NOT significant.
   example: 0.006 1 Sig Fig

4. Trailing zeros only count IF there is a decimal in the number.
   example: 8.0 2 Sig Figs
   80 1 Sig Fig

5. Counted or Defined Values = Exact Values

- Exact values are objects that have an **infinite** (unlimited) number
- of significant digits Exs: 4 dogs, 10 CDs, 3 birds, 452 coins, etc.

PRACTICE!

How many significant figures are in the following?

1. 4562 →
2. 9.81 →
3. 0.106 →
4. 0.0004 →
5. 3.0700 →
6. 7200 →

Rounding!

We need to figure out how many sig figs we need then drop the extra digits. This is done by rounding!

If the number is 5 or higher we round up!

ex) rewrite with 2 sig figs,

3.367 --> 3.4

If the number is less than 5 we leave it!

ex) rewrite with 2 sig figs,

3.347 --> 3.3

Practice!

Rewrite the following with the number of sig figs indicated in the brackets!

1) 0.2067 (2) --->

4) 0.0523 (1) --->

2) 34.2 (5) --->

5) 4502.4 (1) --->

3) 256000 (2) --->

6) 1.5607 (4) --->

Scientific Notation

Scientific notation is a way to write numbers that are very large or very small. It can also be useful when dealing with significant figures.
Scientific notation is written in two parts:

- The first is just the digits (with the decimal point placed after the first digit).
- The second part is ×10 to a power that would put the decimal point back where it should be.

Hint: The power we choose is the number of decimal places we move the number. If we move left the power is positive. If we move right the power is negative!

Practice!
Re-write the following in scientific notation

1) 4167→

2) 0.478→

3) 200 →

4) 0.00382 →

5) 50178000 →

6) 0.0000000072 →

Addition and Subtraction using Significant Figures

When adding or subtracting the answer should have the same number of DECIMAL places are the LEAST number found in the original problem

Example: 2.10 m + 3.1 m = 5.2 m

1.304 m - 0.2 m = 1.1 m

Practice!

1. 4.02 + 7.135 =

2. 12.23 - 1.124 =

3. 4.569 + 0.1 =

4. 108.92 - 1.1 =

Multiplication and Division using significant figures

The answer should have the same number of significant figures as the measurement with the LEAST number of significant figures in the original problem.

Example: 3.245 x 5.02 = 16.2899 = 16.3

16.5 / 2.3342 = 7.068803016....=7.07

Practice!

1. 0.02 x 5.23 =

2. 23.5 / 7.0 =

3. 32.0 / 0.0032 =

4. 100 x 45 =

Uniform Motion and Graphing

What is **uniform motion**?

____

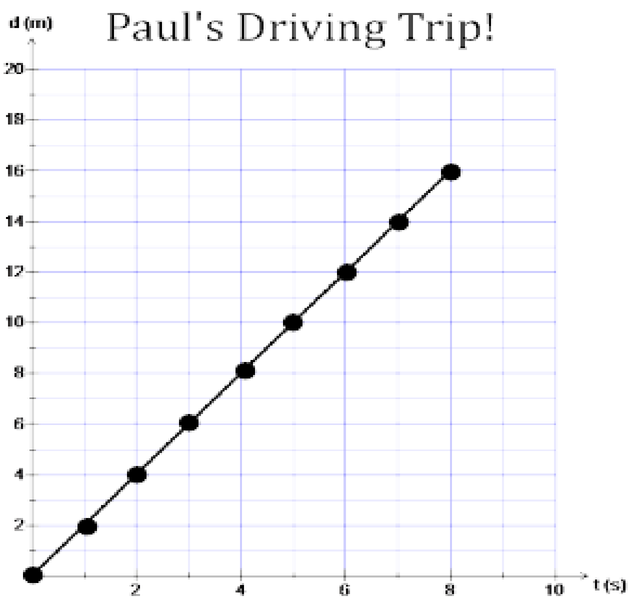
____

Paul is a safe driver who always drives the speed limit. Here is a record of his driving on a straight road.

Time (s)	0	1	2	3	4	5	6	7	8	
Distance (m)	0	2	4	6	8	10	12	14	16	

Uniform motion is the same as a ______________________relation in math class.

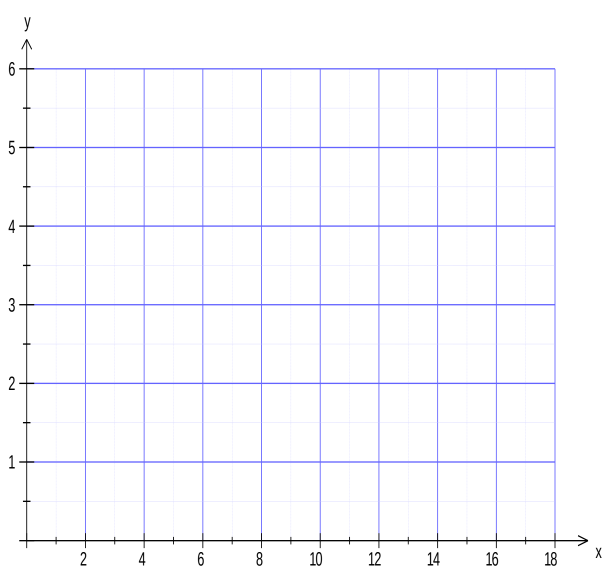
That must mean it can also be graphed!



1. What is another word for rate?

2. At what rate did Paul travel? (Note: don't forget your units!)

Since we figured out Paul's speed we can graph it! You try first!

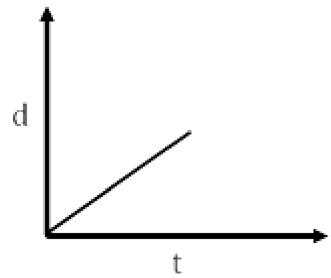


5. What do you notice about this graph?

6. Will this always be the case if the motion is uniform?

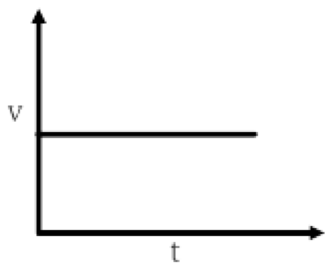
General rules for interpreting **uniform motion** graphs

Distance-Time Graphs



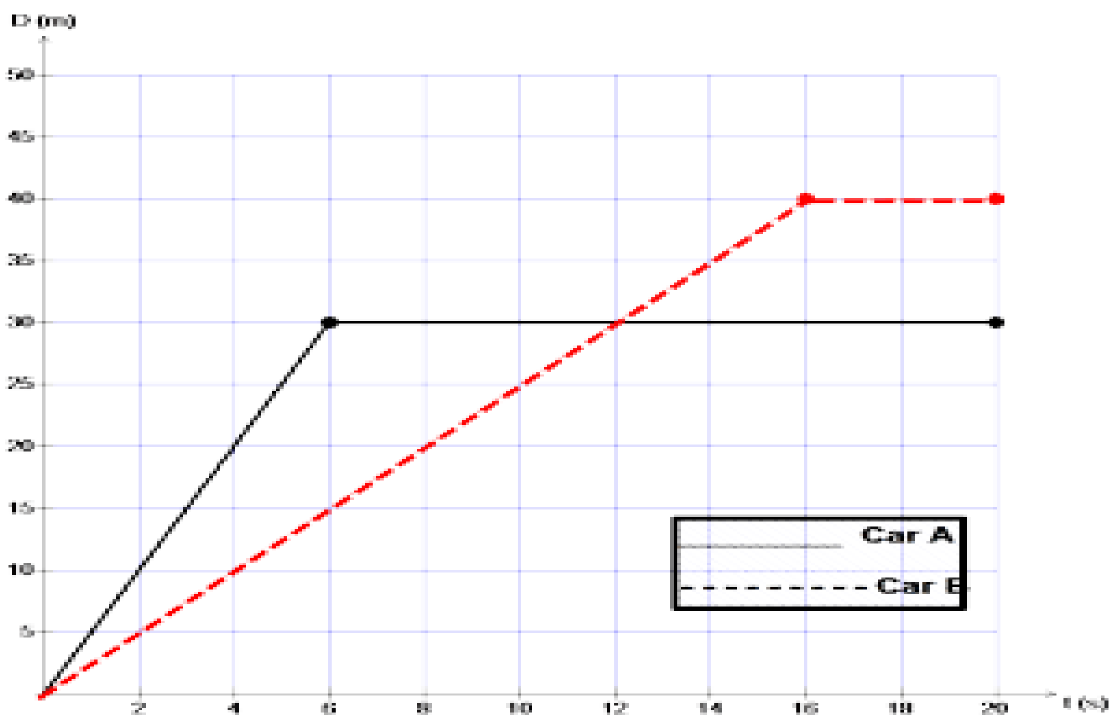
- These graphs will always have straight lines
- The slope represents the ________________
- A horizontal line means the object is ___________________

Speed -Time Graph



- These graphs will always have a ________________________
- The area under the speed-time graph is the ______________________.

Example: Car A and Car B are having a drag race where they both must move at constant speeds. The race is 40 m long.



1) Which car was travelling faster? How do you know?

2) What was the speed of car A at 4 seconds?

3) What was the speed of car B at 4 seconds?

4) At what time did each car stop? At what distance did each car stop?

5) Who won the race?

6) Did both cars finish the race?

7) With the information on the graph draw the speed-time graphs for both cars.

SCALAR & VECTOR QUANTITIES

Scalar Quantity: has a magnitude (size) and units.
ex. distance, time, speed

Vector Quantity: has a magnitude, units **and** direction.
ex. displacement, velocity, acceleration

Distance vs. Displacement

Distance: a measure of the total amount traveled regardless of direction
Symbol -->

Displacement: a change in position measured from where you start to where you finish
Symbol -->

Examples! For each of the following, find the distance and displacement.

1. A car travels 10 km [N], then turns and travels 8 km [S].

2. A shopper walks 20 m east, 42 m west and then 14 m east.

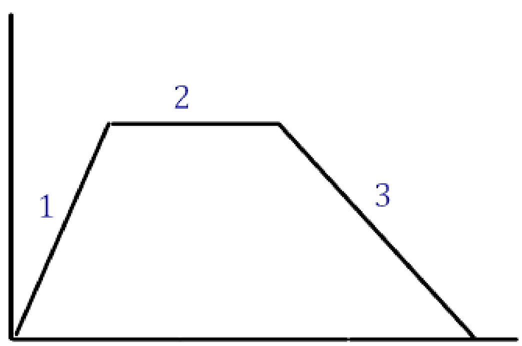
3. A jogger runs 2 laps around a 500 m oval track.

4.John starts at a position 6.00 km [N], travels 12.00 km [S] and then 7.00 km [N]

Graph Possibilities:

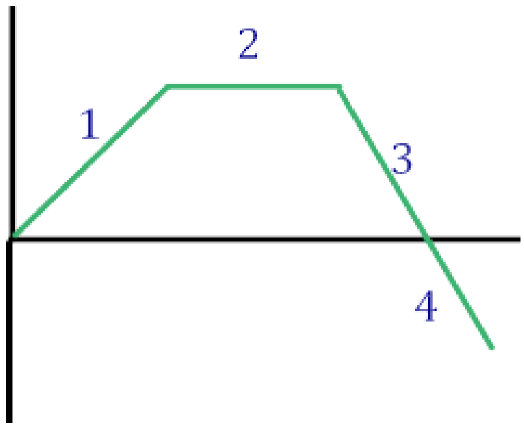
(1) Moving Right **(2) Moving Left** **(3) Stopped**

Ex 1: Describe the graph.



1) Tony is at home. He then leaves and travels at a constant velocity to a distance of 10 m north.
2) Tony stops at Sam's for 20 minutes.
3) Tony returns home at a constant velocity in the south direction.

Example 2: Describe the graph



1.________________________

____

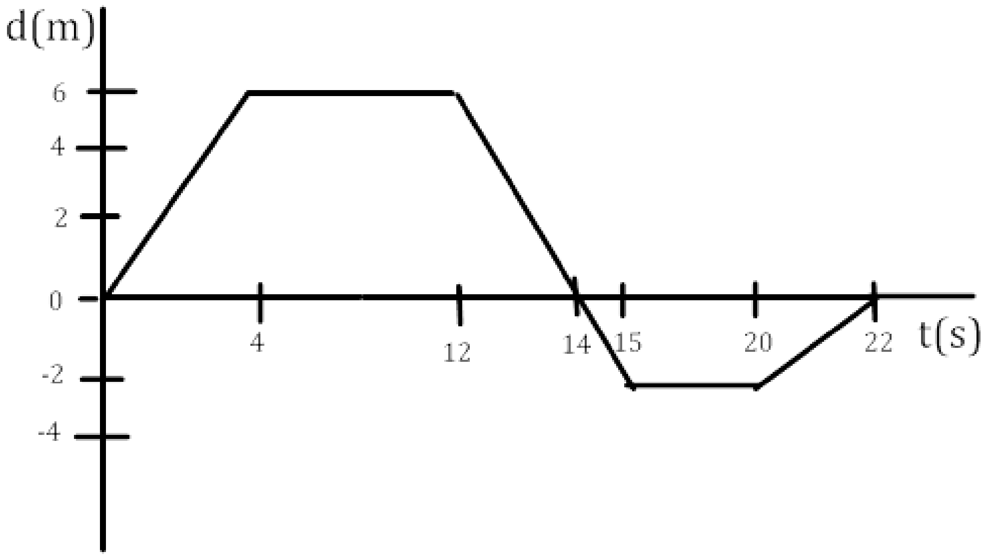
2. ________________________

____

____

____

Create a story that would explain this scenario. Don't forget what we've learned about displacement!



Sources of Error!

Random Error

____

____

Example:

Systematic Error -

____

____

Example:

Mistakes in calculations or in reading an instrument are NOT considered systematic or random errors!

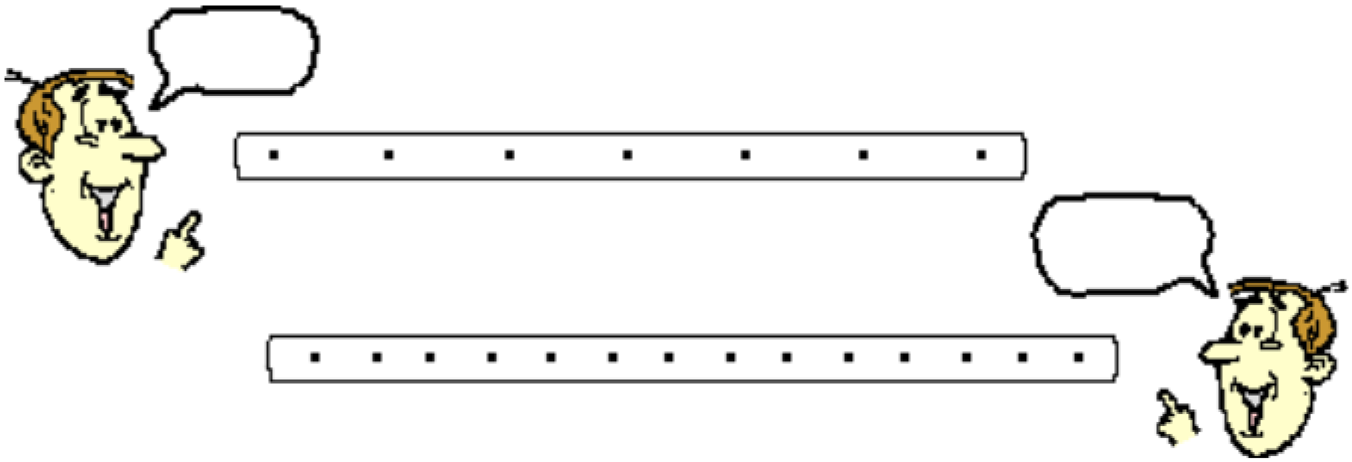
What Type of Error is it? How can we fix/reduce it?

Error	Type	Fix/Reducing
Scale is showing consistent incorrect values		
Many people estimate the measurements on a ruler differently		
When external forces (such as friction) act on the experiment		
When timing something that is moving so fast it is difficult to be sure		
The cloth tape meaure that you use has been stretched out over the years		
Measuring the length of the classroom with your hand		

Ticker Tape

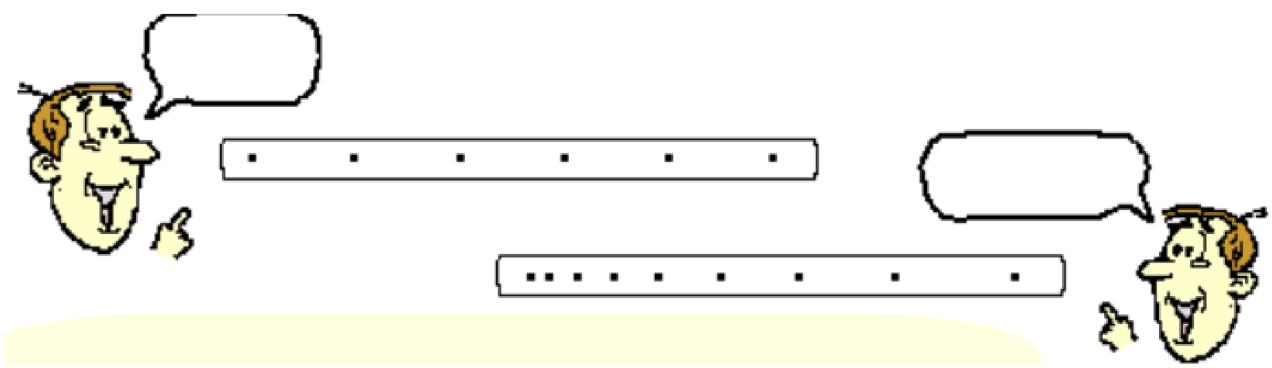
- A device used to measure the motion of an object.
- As the object moves the "ticker" leaves a trail of dots on the tape
- Places a tick on the tape every 6 th (or 0.6) of a seconds

Which one is fast? Which one is slow?

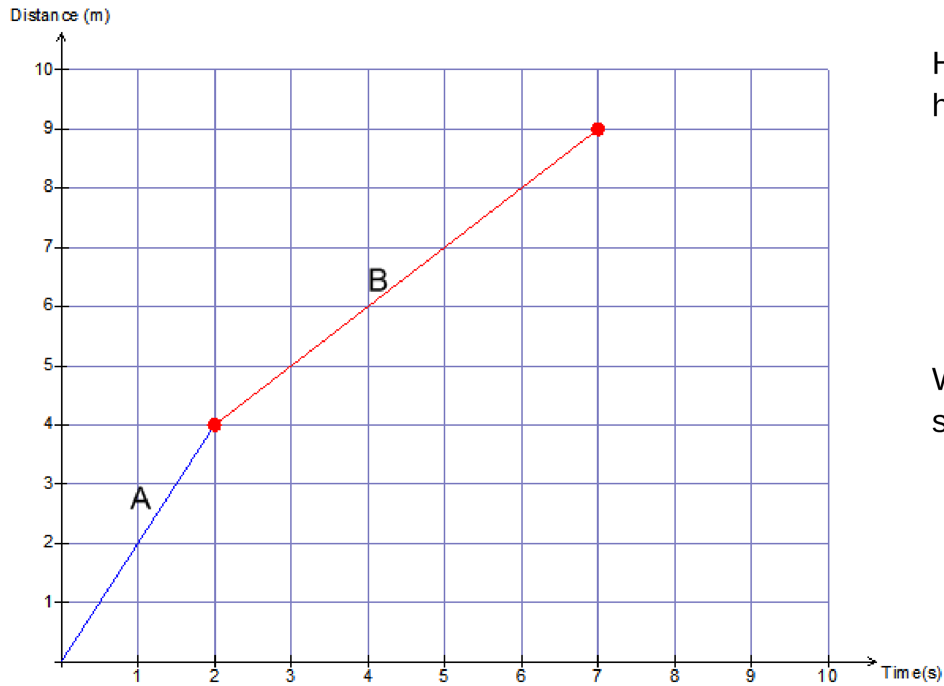


Why?

Which tape shows a constant speed? Which tape shows acceleration?

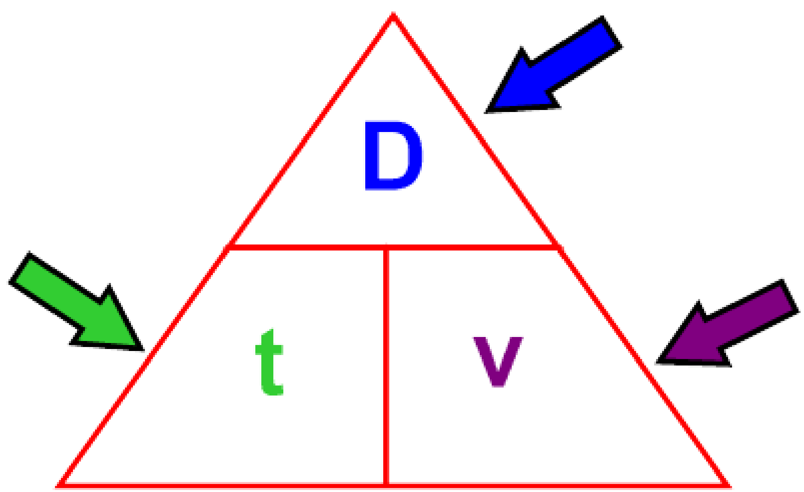


Why?



How much time has passed when he is at a distance of 6 m?

What distance is he at when 4.5 seconds has past?



NOTE: *Always consider significant digits when doing these calculations!*

Speed Problems

1. Willey Coyote must cover 300.0 m in 50.0 seconds in order to catch road runner. How fast is he travelling?

2. Rony is going to pick up Jacob for their date. If Jacob lives 5000.0 m away and Rony promised she would be there in 1000.0 seconds how fast must she travel?

3. Laura and Toni are out for a walk. When they are 2.0 km from home they start to smell supper. If it takes them 8.0 minutes to get home how fast were they travelling? (Give your answer in m/s)

Time Problems

1. Gladys sprints a 5.00x10 m race at a speed of 5.00 m/s. How long did it take Gladys to finish the race?

2. The school bus is 1200.0 m from school and travels at a speed of 15.0 m/s. If school starts in 2 minutes will the bus make it on time?

3. Paul and Berry are betting on a turtle race. The race is 1.0 meter long. Paul's turtle travels at 0.223 m/s and Berry's turtle travels at 0.167 m/s. How long did it take each turtle to finish the race?

Distance problems

1. If Bethany is hiking across Canada and travels at a constant speed of 10.8 m/s for 12 500 s how far does she travel?

2. Ben is in a strong man contest and must pull a truck as far as possible. If he moves at a rate of 0.80 m/s and moves for 34.0 s how far does he move the truck?

3. Wilber wants to know how far his toy car will travel before its batteries run out. The box says the car moves at a rate of 3.0×10^2 m/s and the batteries will last 4 hours. How far will the car travel?

Vector Problems: