Name:_____ Period:_____

Physical Science
Unit 1 – Motion

Unit Objectives:

Objective		Have Initial Understanding	Have Final Understanding
PSc.1.1.1 **Explain Motion in terms of frame of reference, distance, and displacement.**			
PSc.1.1.1	Interpret all motion as relative to a selected reference point. Identify distance and displacement as a scalar-vector pair.		
PSc.1.1.1	Describe motion qualitatively in terms of an object's change of position, distance traveled, and displacement.		
PSc.1.1.2 **Compare speed, velocity, acceleration, and momentum using investigations, graphing, scalar quantities, and vector quantities**			
PSc.1.1.2	Compare speed and velocity as a scalar-vector pair. Velocity is a relationship between displacement and time: $v = \Delta d \div \Delta t$		
PSc.1.1.2	Apply concepts of average speed and average velocity to solve conceptual and quantitative problems.		
PSc.1.1.2	Explain acceleration as a relationship between velocity and time: $a = \Delta v \div \Delta t$		
PSc.1.1.2	Using graphical analysis, solve for displacement, time, and average velocity. Analyze conceptual trends in the displacement vs. time graphs such as constant velocity and acceleration		
PSc.1.1.2	Using graphical analysis, solve for velocity, time, and average acceleration. Analyze conceptual trends in the velocity vs. time graphs such as constant velocity and acceleration		

uiz #1 on _____

#2 on _____

et due on _____

(1)

Physics Unit 1 – Motion Notes

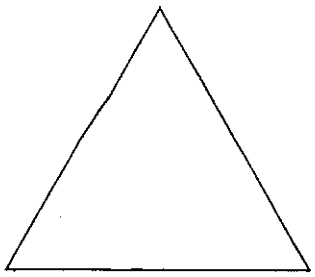
Describing Motion

- Motion: change in position in relation to a reference point.
- **Problem:**
  - Is your desk moving?
    - We need a **reference point**...
      - point from which _____
- Distance – _____
- Displacement - change in position of an object
  - Displacement = _____ minus _____
  - $\Delta x = x_f - x_i$

Distance	Displacement

- Speed & Velocity
  - **Speed**
    - rate of motion
    - _____ traveled per unit _____
    - Equation: _____
    - _____ - no direction
  - **Problem:**
    - A storm is 10 km away and is moving at a speed of 60 km/h. Should you be worried?
      - _____
  - **Velocity**
    - speed in a given direction
    - Can change even when the _____
    - How fast _____ is changing
    - _____ - includes direction

- **Acceleration**
  - the rate of change of _____
  - change in speed or direction
  - ***a***: _____
  - v_f: _____
  - v_i: _____
  - Δt: _____



  - **Positive acceleration**
    - _____
  - **Negative acceleration**
    - _____

- Calculations
  - Your neighbor skates at a speed of 4 m/s. You can skate 100 m in 20 s. Who skates faster?

  - A roller coaster starts down a hill at 10 m/s. Three seconds later, its speed is 32 m/s. What is the roller coaster's acceleration?

  - Sound travels 330 m/s. If a lightning bolt strikes the ground 1 km away from you, how long will it take for you to hear it?

  - How long will it take a car traveling 30 m/s to come to a stop if its acceleration is -3 m/s^2?

- Graphing Motion : **<u>Distance</u> v. Time Graphs OR <u>Position</u> v. Time Graphs**
  - slope = _____
  - steeper slope =_____
  - straight line =_____
  - horizontal line =_____

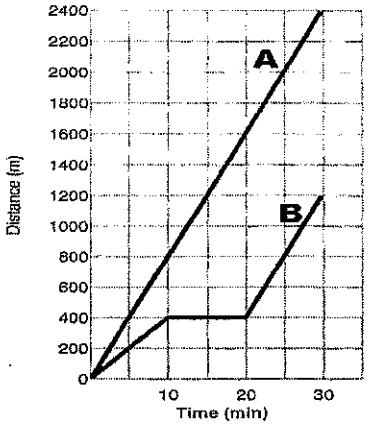
Example Problem:

- Who started out faster? _____
- Who had a constant speed? _____
- Describe B from 10-20 min.

  _____
- Find their average speeds:

  A =

  B =



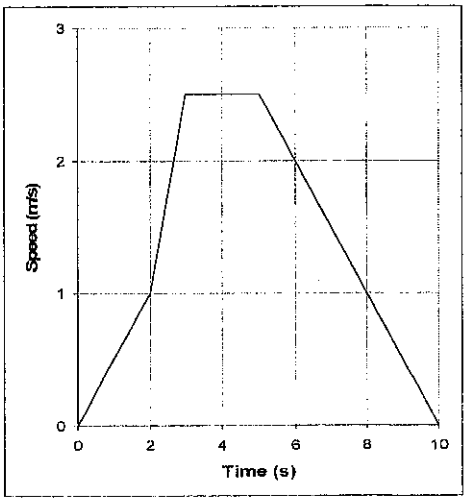
- **Acceleration is indicated by a curve on a Distance-Time graph.**
  - Changing slope = changing velocity

- Graphing Motion : **<u>Speed</u> v. Time Graphs OR <u>Velocity</u> v. Time Graphs**
  - slope = _____
  - straight line = _____
  - horizontal line = _____
  - horizontal line on the x-axis =_____

Example Problem: Specify the time period when the object was...

- slowing down _____
- speeding up _____
- moving at a constant speed

  _____
- not moving _____



Physical Science Warm-up Sheet

Date:_____

Date:_____

Date:_____

Date:_____

Date:_____

Physical Science Warm-up Sheet

Date:_____

Date:_____

Date:_____

Date:_____

Date:_____

Name: _____

Period: _____

Ch. 1:2

Speed and Experiments

Speed

Speed is how fast something is going. Precisely, it is the amount of distance traveled in a certain amount of time. The standard units are meters per second, but any units of distance/time will work.

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 divided by change of time.

$\Delta D = D_2 - D_1$ $\Delta T = T_2 - T_1$

A car 4 meters away for 2 hours has a speed of zero—it hasn't moved. That's why we have to use $\Delta D/\Delta T$ instead of D/T—**the object has to be moving.**

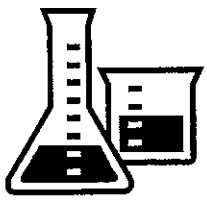
A plane flies 4000 miles in 5 hours. Calculate the plane's speed.		A car travels from 20 meters to 60 meters in 10 seconds. Calculate the car's speed.		A car travels at 60 m/s for 8 seconds. Calculate the distance it travels.	
Step 1: variables S = ? ΔD = 4000 miles ΔT = 5 hours Step 2: formula $S = \Delta D/\Delta T$	Step 3: Solve for unknown variable: Already done: $S = \Delta D/\Delta T$ Step 4: Put in numbers S = 4000 mi/5 hr Step 5: Calculate answer	Step 1: variables Step 2: formula	Step 3: solve for unknown variable: Step 4: Step 5:	Step 1: Step 2:	Step 3: Step 4: Step 5:

Experiments

The Scientific Method:

Really	**R**	Research
Quiet	**Q**	Question
Hippos	**H**	Hypothesis
Eat	**E**	*Experiment*
Dark	**D**	Data
Chocolate	**C**	Conclusions

Experiments are how we gain data (evidence) to prove or disprove a hypothesis.



If experiments are going lead us to knowledge, we better know how to do them correctly so that our data really is proof!

Trials

A **trial** is one time an experiment is run.

Good experiments have several trials. Why? Because to really proof something, and experiment must be repeatable by others. One time through an experiment proves nothing—there might have been a mistake, for instance.

Data from experiments are often recorded in **data tables.**

A Data Table →

Trial	Time (sec)
1	2.5
2	3
3	3.1
4	2.8
5	2.9
Ave Time	**2.86**

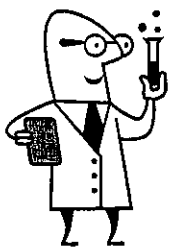
Usually, data changes a bit with each trial. Which one is best?

An **average** is better than an individual trial's data.

Variables

A variable is a part of an experiment that can change.

In most experiments there are many variables. When talking about speed we only need two: distance and time.



Procedures

Your procedure is how you perform an experiment.

Good data requires good experimental procedures. Spending time developing good procedures ensures your data will be accurate and your conclusion believable.

Your procedure is a list of how you did your experiment.

Name: _____

Period: _____

1. Variable	A. How an experiment is actually conducted.
2. Procedure	B. A part of an experiment that can be changed or manipulated.
3. Data Table	C. A setup used to gather data and knowledge.
4. Trial	D. One time an experiment is run.
5. Experiment	E. A list of information from an experiment.

Fill in the math functions

$S\Delta T = S$ _____ ΔT $\quad D_2 - D_1 = D_2$ _____ D_1

$S/T = S$ _____ T $\quad a/\Delta T = a$ _____ ΔT

Match the variables on the left with the quantities on the right

1. a = _____	50 m/s^2
2. S or v = _____	10
3. m = _____	20 meters/sec
4. D = _____	228 meters
5. F = _____	15 kgm/s
6. p = _____	78 sec
7. T = _____	6 newtons
8. E = _____	12 joules
9. MA = _____	36 kilograms

$F = ma$
Solve for "a"

$S = \Delta D/\Delta T$
Solve for "ΔD"

$\Delta D = D_2 - D_1$
Solve for D_2

$a = \Delta S/\Delta T$
Solve for ΔT

A bike moves 50 m in 5 seconds.
Calculate the speed of the bike.

Step 1: variables:
S =
ΔD =
ΔT =

Step 2: Formula:

Step 3: Solve for the unknown variable:

Step 4: Plug in number:

Step 5: Calculate an answer:

A car travels 200 miles in 8 hours.
Calculate the car's speed.

Step 1: _____

Step 2: _____

Step 3: _____

Step 4: _____

Step 5: _____

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

Step 1: _____

Step 2: _____

Step 3: _____

Step 4: _____

Step 5: _____

On holiday, a family travels from Meyerville (10 miles away) to Sprytown (50 miles away), in 3 hours.
Calculate the family's speed.

Step 1: _____

Step 2: _____

Step 3: _____

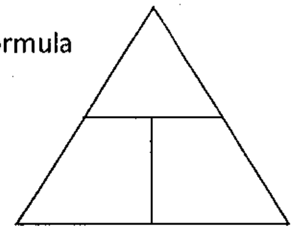
Step 4: _____

Step 5: _____

Problem #_______

Step 1: Variables

Step 2: Formula



Step 3: Equation (Solve for the unknown variable)

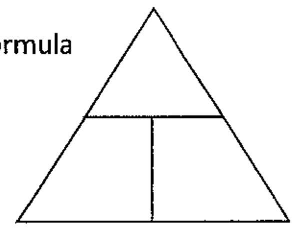
Step 4: Plug in numbers

Step 5: Calculate an answer

Problem #_______

Step 1: Variables

Step 2: Formula



Step 3: Equation (Solve for the unknown variable)

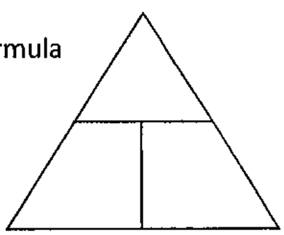
Step 4: Plug in numbers

Step 5: Calculate an answer

Problem #_______

Step 1: Variables

Step 2: Formula



Step 3: Equation (Solve for the unknown variable)

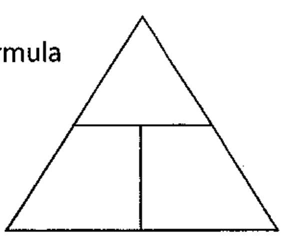
Step 4: Plug in numbers

Step 5: Calculate an answer

Problem #_______

Step 1: Variables

Step 2: Formula



Step 3: Equation (Solve for the unknown variable)

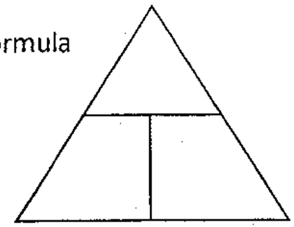
Step 4: Plug in numbers

Step 5: Calculate an answer

Problem #_______

Step 1: Variables

Step 2: Formula



Step 3: Equation (Solve for the unknown variable)

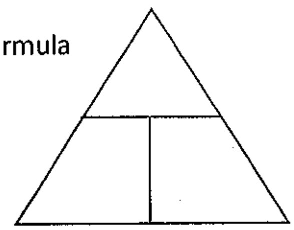
Step 4: Plug in numbers

Step 5: Calculate an answer

Problem #_______

Step 1: Variables

Step 2: Formula



Step 3: Equation (Solve for the unknown variable)

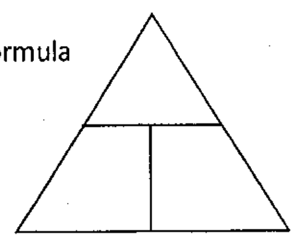
Step 4: Plug in numbers

Step 5: Calculate an answer

Problem #_______

Step 1: Variables

Step 2: Formula



Step 3: Equation (Solve for the unknown variable)

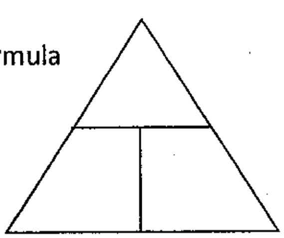
Step 4: Plug in numbers

Step 5: Calculate an answer

Problem #_______

Step 1: Variables

Step 2: Formula

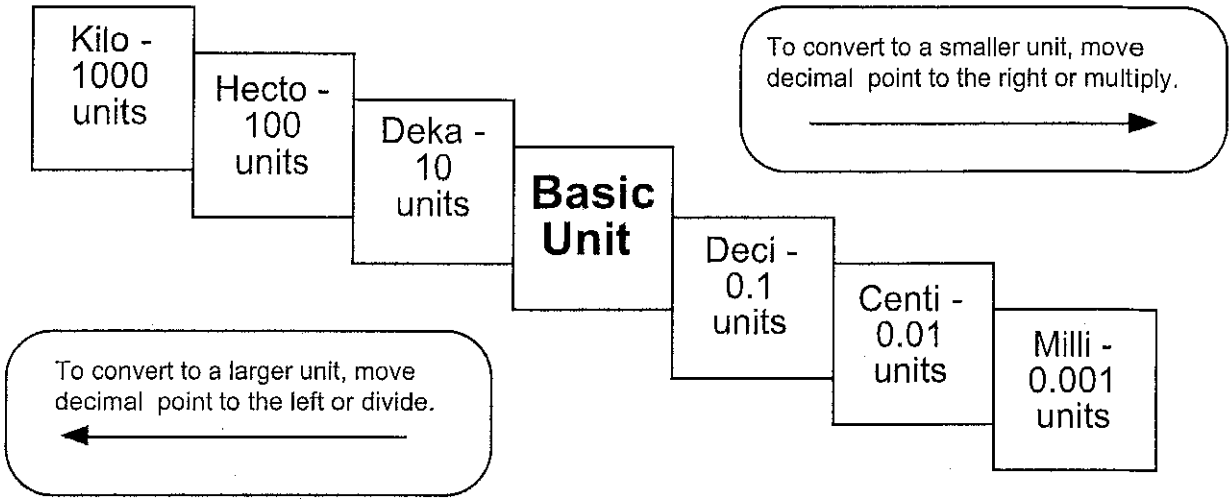


Step 3: Equation (Solve for the unknown variable)

Step 4: Plug in numbers

Step 5: Calculate an answer

Metric Mania
Conversion Practice



Try these conversions, using the ladder method.

1000 mg = _____ g

1 L = _____ mL

160 cm = _____ mm

14 km = _____ m

109 g = _____ kg

250 m = _____ km

Compare using <, >, or =.

56 cm ◯ 6 m

7 g ◯ 698 mg

Metric Mania

Name_____

Conversion Challenge

Write the correct abbreviation for each metric unit.

1) Kilogram _____
2) Meter _____
3) Gram _____
4) Milliliter _____
5) Millimeter _____
6) Liter _____
7) Kilometer _____
8) Centimeter _____
9) Milligram _____

Try these conversions, using the ladder method.

1) 2000 mg = _____ g
2) 104 km = _____ m
3) 480 cm = _____ m
4) 5.6 kg = _____ g
5) 8 mm = _____ cm
6) 5 L = _____ mL
7) 198 g = _____ kg
8) 75 mL = _____ L
9) 50 cm = _____ m
10) 5.6 m = _____ cm
11) 16 cm = _____ mm
12) 2500 m = _____ km
13) 65 g = _____ mg
14) 6.3 cm = _____ mm
15) 120 mg = _____ g

Compare using <, >, or =.

16) 63 cm ◯ 6 m
17) 5 g ◯ 508 mg
18) 1,500 mL ◯ 1.5 L
19) 536 cm ◯ 53.6 dm
20) 43 mg ◯ 5 g
21) 3.6 m ◯ 36 cm

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Directed Reading for Content Mastery

Section 1 ▪ Describing Motion

Directions: *For each of the following, write the letter of the term or phrase that best completes the sentence.*

_____ **1.** A sprinter runs 200 m west and 100 m east. Her displacement is _____.
a. 300 m **b.** 100 m west

_____ **2.** Speed can be calculated by dividing distance by _____.
a. time **b.** displacement

_____ **3.** The speed of a motorcycle at a particular moment is its _____ speed.
a. average **b.** instantaneous

_____ **4.** Earth's plates move only a few _____ per year.
a. centimeters **b.** meters

_____ **5.** Two cars are each traveling at 72 km/h. One car is traveling northeast, and the other is traveling south. The two cars have different _____.
a. velocities **b.** speeds

Speed, Velocity, Distance, and Acceleration Problem Solving 1.
Be sure to include units!

1. _____Object 1 travels 2 km in 5 minutes. What is the speed of the object?

2. _____Object 2 travels 10.5 km in 7 minutes. What is the speed of the object?

3. _____Object 3 travels at 30 m/s for 10 minutes. How far does the object travel?

4. _____Object 4 travels at 100.23 m/s for 2 minutes. How far does the object travel?

5. _____Object 5 travels 5 km at 60 m/s. How long does it take?

6. _____Object 6 travels 20 km at 40 m/s. How long does it take?

7. _____Object 7 travels 5 km in 45 seconds. Its mass is 100 kg. What is the speed of the object? Can you tell me the velocity? Explain.

8. _____Object 13 is moving at 25 meters per second. 3 seconds later the Object is moving at 10 m/sec. What is the acceleration of the object? What does the sign of this value mean?

9. _____ An object goes from 0 km to 60 km south in 9.2 seconds. What is the initial velocity?

   What is the final velocity?

   What is the acceleration of the object?

10. _____Object 12 goes from 5 km to 55 km east in 0.5 hours. What is the initial velocity?

    What is the final velocity?

    What is the acceleration of the object?

(14)

Acceleration Practice

All times are in seconds and all velocities are in m/s. You must provide the units for the missing values.

Equations:

$a = \Delta v / \Delta t$ $\qquad$ $\Delta v = a \times t$

$\Delta v = v_f - v_i$ $\qquad$ $\Delta t = t_f - t_i$

1) Starting velocity: 0 m/s
Final velocity: 10 m/s
Starting time: 0 s
Final time: 5 s
Acceleration :

2) Starting velocity: 10 m/s
Final velocity: 20 m/s
Starting time: 0 s
Final time: 10 s
Acceleration :

3) Starting velocity: 10 m/s
Final velocity: 40 m/s
Starting time: 0 s
Final time: 10 s
Acceleration :

4) Starting velocity: 50 m/s
Final velocity: 70 m/s
Starting time: 10 s
Final time: 15 s
Acceleration :

5) $a = 4\ m/s^2$
$t = 15\ s$
$\Delta v =$

6) $a =$
$t = 10\ s$
$\Delta v = 20\ m/s$

7) $a = 4\ m/s^2$
$t =$
$\Delta v = 100\ m/s$

8) $a = 300\ m/s^2$
$t =$
$\Delta v = 150 m/s$

Name_____

Motion Graphs

Describing the motion of an object is occasionally hard to do with words. Sometimes **graphs** help make motion easier to picture, and therefore understand.

Remember:

- **Motion** is a change in position measured by distance and time.
- **Speed** tells us the rate at which an object moves.
- **Velocity** tells the speed and direction of a moving object.
- **Acceleration** tells us the rate speed or direction changes.

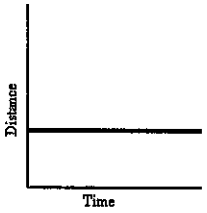
DISTANCE-TIME GRAPHS

Plotting distance against time can tell you a lot about motion. Let's look at the axes:

Time is always plotted on the X-axis (bottom of the graph). The further to the right on the axis, the longer the time from the start.

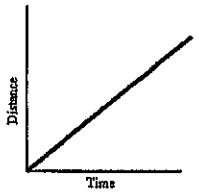
Distance is plotted on the Y-axis (side of the graph). The higher up the graph, the further from the start.

If an object is not moving, a horizontal line is shown on a distance-time graph.



Time is increasing to the right, but its distance does not change. It is not moving. We say it is **At Rest.**

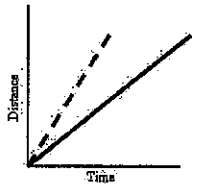
If an object is moving at a constant speed, it means it has the same increase in distance in a given time:



Time is increasing to the right, and distance is increasing constantly with time. The object moves at a **constant speed.**

Constant speed is shown by straight lines on a graph.

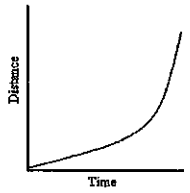
Let's look at two moving objects:
Both of the lines in the graph show that each object moved the same distance, but the steeper dashed line got there before the other one:



A steeper line indicates a larger distance moved in a given time. In other words, **higher speed.**

Both lines are **straight**, so both speeds are **constant.**

Graphs that show acceleration look different from those that show constant speed.



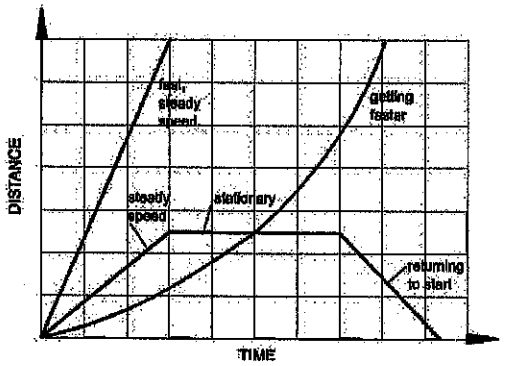
The line on this graph is curving upwards. This shows an **increase in speed**, since the line is getting steeper:

In other words, in a given time, the distance the object moves is change (getting larger). It is **accelerating.**

Summary:

A distance-time graph tells us how far an object has moved with time.

- The steeper the graph, the faster the motion.
- A horizontal line means the object is not changing its position - it is not moving, it is at rest.
- A downward sloping line means the object is returning to the start.



(Graph from:
http://www.bbc.co.uk/schools/gcsebitesize/physics/forces/speedvelocityaccelerationfhrev2.shtml)

In which of the following graphs below are both runners moving at the same speed? Explain your answer.

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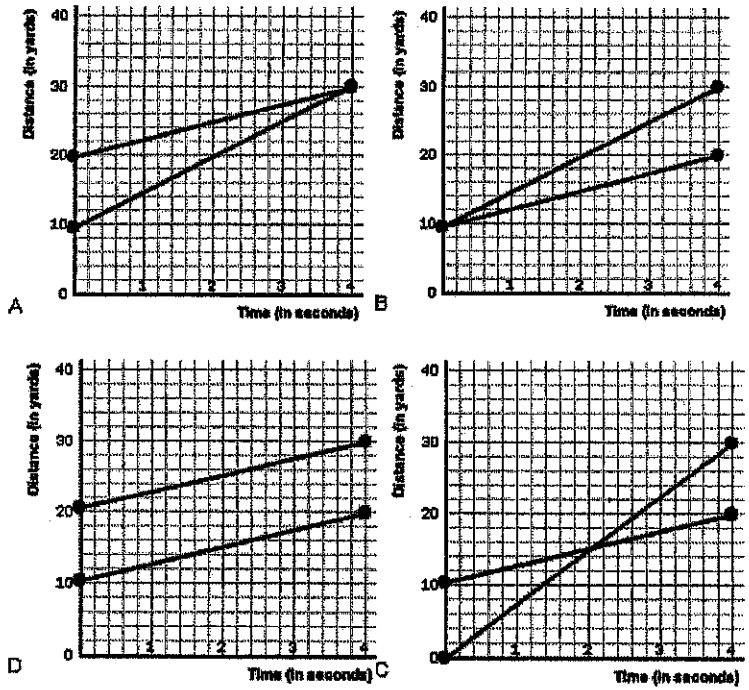
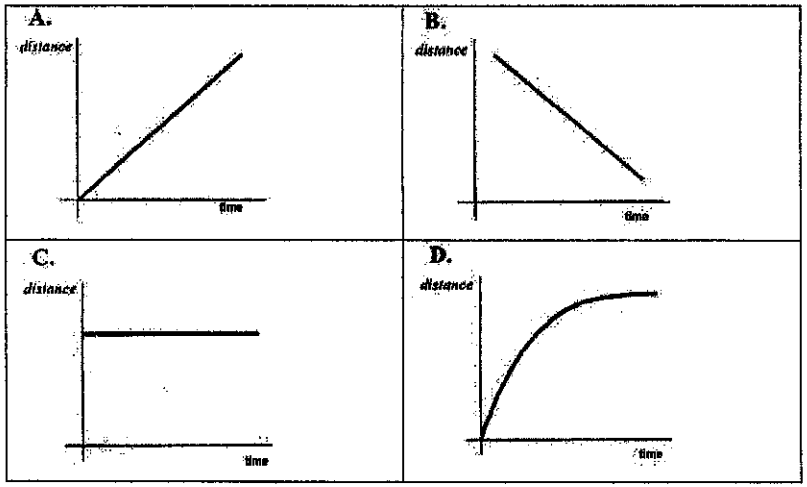


Which of the graphs shows that one of runners started 10 yards further ahead of the other? Explain your answer.

The distance-time graphs below represent the motion of a car. Match the descriptions with the graphs. **Explain your answers.**

Descriptions:

1. The car is stopped.
2. The car is traveling at a constant speed.
3. The speed of the car is decreasing.
4. The car is coming back.



Graph A matches description _____ because _____.

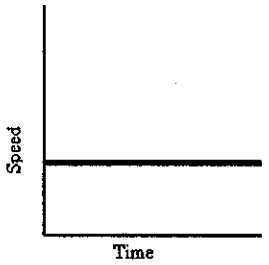
Graph B matches description _____ because _____.

Graph C matches description _____ because _____.

Graph D matches description _____ because _____.

SPEED-TIME GRAPHS

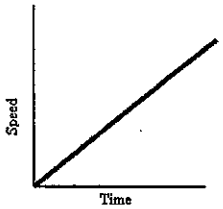
Speed-Time graphs are also called Velocity-Time graphs.



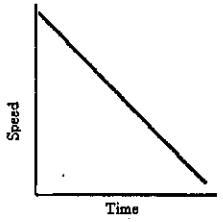
Speed-Time graphs look much like Distance-Time graphs. Be sure to read the labels!! Time is plotted on the X-axis. Speed or velocity is plotted on the Y-axis.

A straight horizontal line on a speed-time graph means that speed is constant. It is not changing over time.

A straight line does not mean that the object is not moving!

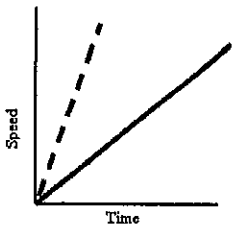


This graph shows increasing speed. The moving object is **accelerating.**



This graph shows decreasing speed. The moving object is **decelerating.**

What about comparing two moving objects at the same time?



Both the dashed and solid line show increasing speed.

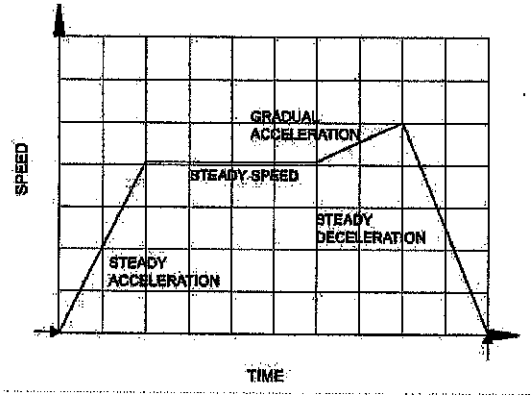
Both lines reach the same top speed, but the solid one takes longer.

The dashed line shows a greater acceleration.

Summary:

A speed - time graph shows us how the speed of a moving object changes with time.

- The steeper the graph, the greater the acceleration.
- A horizontal line means the object is moving at a constant speed.
- A downward sloping line means the object is slowing down.



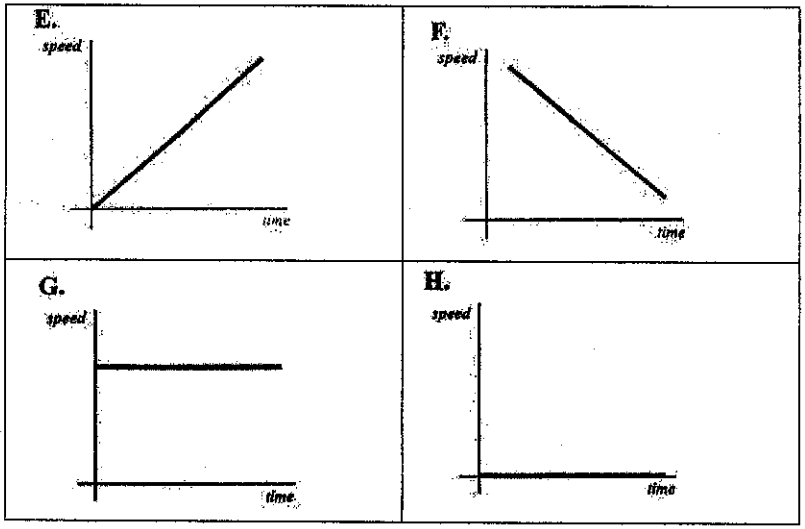
(Graph from:
http://www.bbc.co.uk/schools/gcsebitesize/physics/forces/speedvelocityaccelerationfhrev2.shtml)

9

The speed-time graphs below represent the motion of a car. Match the descriptions with the graphs. **Explain your answers.**

Descriptions:

5. The car is stopped.
6. The car is traveling at a constant speed.
7. The car is accelerating.
8. The car is slowing down.



Graph E matches description _____ because _____.

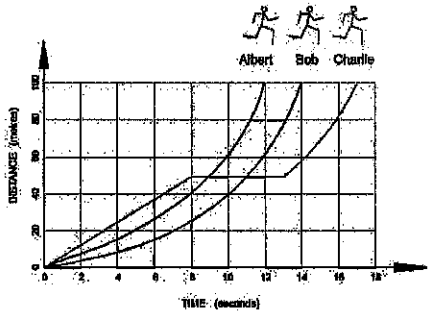
Graph F matches description _____ because _____.

Graph G matches description _____ because _____.

Graph H matches description _____ because _____.

Questions:

(Some questions adapted from
http://www.bbc.co.uk/schools/gcsebitesize/physics/forces/speedvelocityaccelerationfhrev2.shtml)



Look at the graph above. It shows how three runners ran a 100-meter race.

Which runner won the race? Explain your answer.

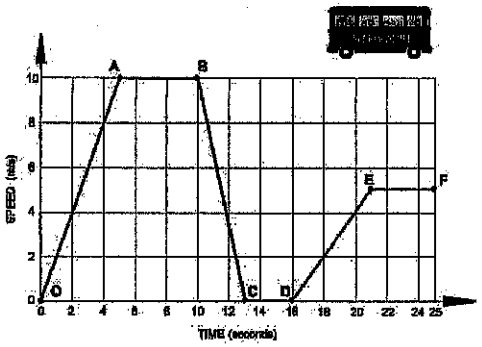
Which runner stopped for a rest? Explain your answer.

How long was the stop? Explain your answer.

How long did Bob take to complete the race? Explain your answer.

Calculate Albert's average speed. (Figure the distance and the time first!)

The graph below shows how the speed of a bus changes during part of a journey



Choose the correct words from the following list to describe the motion during each segment of the journey to fill in the blanks.

- accelerating
- decelerating
- constant speed
- at rest

Segment 0-A The bus is _____. Its speed changes from 0 to 10 m/s in 5 seconds.

Segment A-B The bus is moving at a _____of 10 m/s for 5 seconds.

Segment B-C The bus is _____. It is slowing down from 10 m/s to rest in 3 seconds.

Segment C-D The bus is _____. It has stopped.

Segment D-E The bus is _____.
It is gradually increasing in speed.

20

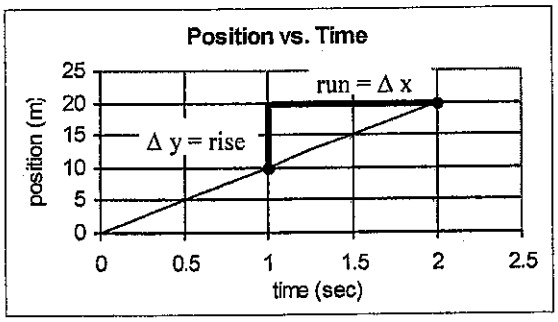
Name: _____

Period: _____

Graphing Speed; Slope

The graph on the right is a ***distance versus time graph.*** That means that it shows how far an object has traveled after so many seconds.

This is what we call a ***linear graph***, because the data creates a **straight line.**



Data

Time (sec)	Distance (m)
0	0
0.5	5
1	10
1.5	15
2	20

Slope has actual meaning in science –

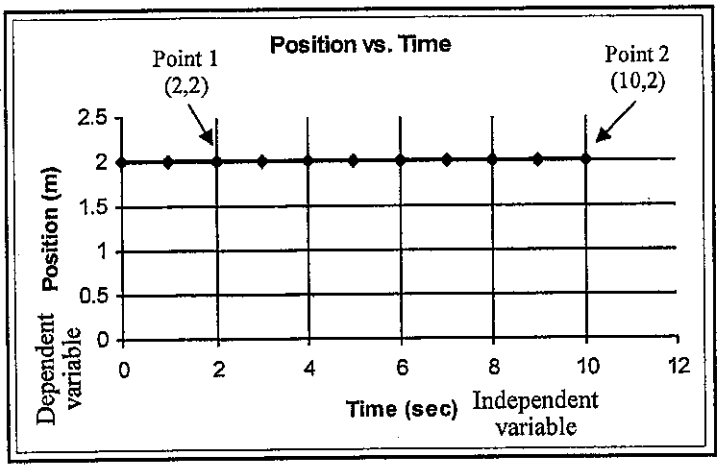
Slope for the above graph:

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{(20 - 10)\text{m}}{(2 - 1)\text{ sec}} = \frac{10\text{m}}{1\text{ sec}} = 10\text{m/s}$$

The slope of a position vs. time graph is <u>SPEED</u>

Graphing Conventions: **The independent variable is always on the x-axis.**
The dependent variable is always on the y-axis.

Time is always an independent variable (x-axis).



Independent variable—Time
Dependent variable—position

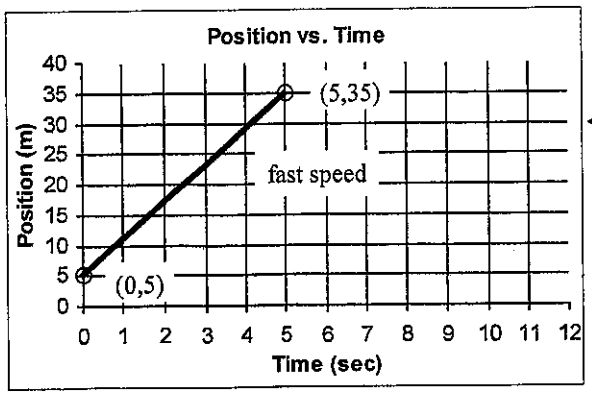
Linear graph.

Position vs. time graph, so slope = speed (position/time)

(Pick any two points)
Slope = rise/run = Δy/Δx =

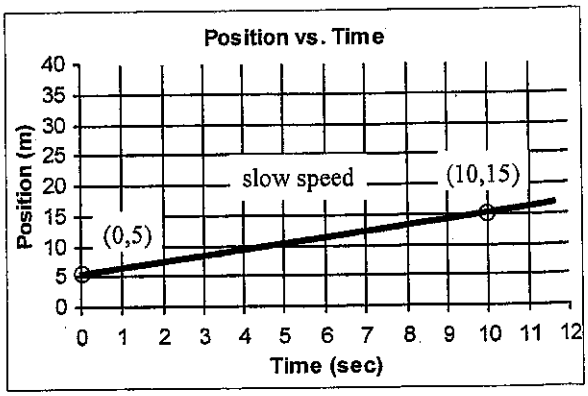
$$\frac{(2 - 2)\text{m}}{(10 - 2)\text{ sec}} = \frac{0\text{ m}}{8\text{ sec}} = 0\text{ m/s}$$

The slope (speed) of a flat line is zero—<u>no speed</u>. The object is at rest.



Steep slope—fast speed

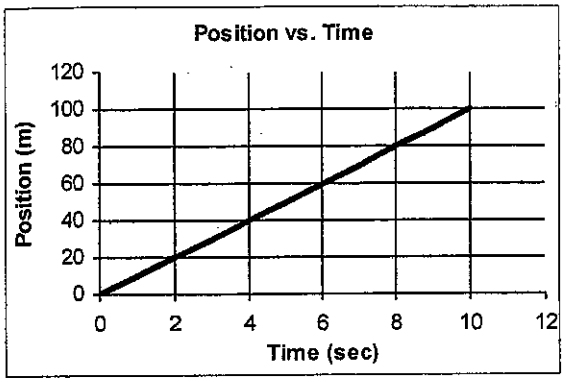
Gradual slope — slow speed



$$\text{slope} = \frac{\Delta y}{\Delta x} = \frac{(35 - 5)\text{m}}{(5 - 0)\text{sec}} = \frac{30\text{m}}{5\text{sec}} = \boxed{6\text{m/s}}$$

$$\text{slope} = \frac{\Delta y}{\Delta x} = \frac{(15 - 5)\text{m}}{(10 - 0)\text{sec}} = \frac{10\text{m}}{10\text{sec}} = \boxed{1\text{m/s}}$$

1. Linear	A. The variable on the vertical axis (y-axis).	Which of the following are units for speed?
2. Independent variable	B. A type of graph that looks like a straight line.	km $\frac{\text{meters}}{\text{sec}}$ meters $\frac{\text{cm}}{\text{sec}}$
3. Dependent variable	C. The measure of the steepness of a line.	sec $\frac{\text{miles}}{\text{hour}}$ $\frac{\text{km}}{\text{min}}$ $\frac{\text{meter}}{\text{sec}^2}$
4. Slope	D. The variable on the horizontal axis (x-axis).	



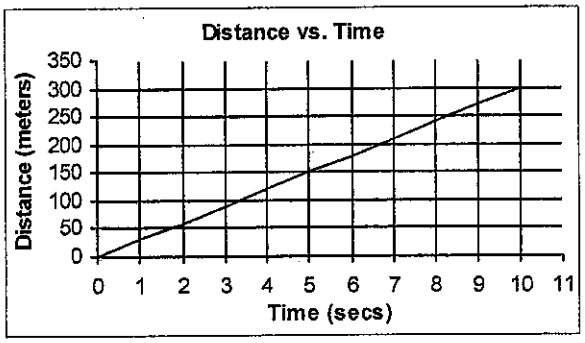
Which is the independent variable? _____

Which is the dependent variable? _____

Where was the object at 4 seconds? _____

Find the slope of the graph (must show work)

What does the slope you just found stand for? _____

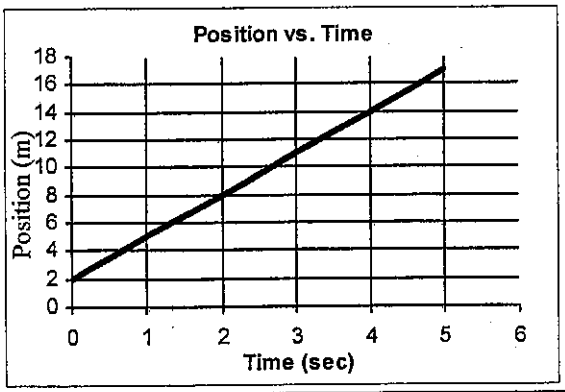


When did the object reach 150 meters? _____

Where was the object at 9 seconds? _____

Find the slope of the graph (must show work) _____

What does the slope you just found stand for? _____



Which is the independent variable? _____

Which is the dependent variable? _____

Where was the object at 4 seconds? _____

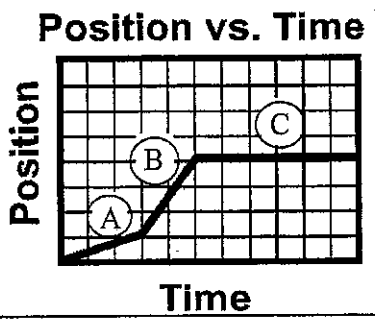
Find the slope of the graph (must show work)

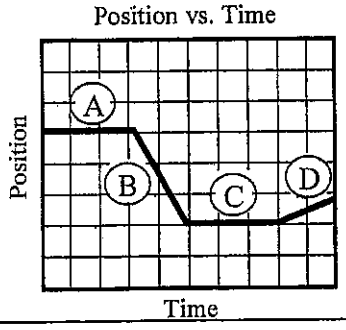
What does the slope you just found stand for? _____

The slope of this graph means:

The segment that shows fast speed:

The segment that shows slow speed:





Which graph segments fit the following:

At rest:

Fast speed:

Slow speed:

Going backwards:

Going forward:

Name: _____

Period: _____

Acceleration and Average Speed

Acceleration

Acceleration is how fast you change speed OR how much the speed changed in a certain amount of time.

Acceleration (in meter/sec^2) → $a = \frac{\Delta V}{\Delta T}$ ← Change of Speed (in meters/sec); Change of Time (in seconds)

Speed equal change of distance divided by change of time.

$\Delta V = V_f - V_i$ $\quad$ $\Delta T = T_2 - T_1$

$a = \Delta S/\Delta T$, not $a = S/T$. Why? If a car is traveling at 60 m/s for 20 sec, S = 60 m/s, but $\Delta S = 0$ m/s. **No change of speed: no acceleration.**

Example: Calculate Acceleration

Ex. A plane starts at rest and ends up going 200 m/s in 10 secs. Calculate acceleration.

Step 1: Variables

$S_1 = 0$ m/s ("*starts at rest*")
$S_2 = 200$ m/s
$\Delta T = 10$ seconds
$a = ?$

Step 2: Find ΔS

$\Delta S = S_2 - S_1$
$= 200 - 0 = 200$ m/s

Step 3: Formula

$a = \Delta S/\Delta T$

Step 4: Solve

$a = (200 \text{ m/s})/(10 \text{ s})$
$= 20 \text{ m/s}^2$

Example: Calculate Deceleration

Ex. A race car starts at 400 m/s and then stops in 20 seconds. Calculate the car's acceleration.

Deceleration means an object is slowing down and has a negative sign.

Step 1: Variables

$S_1 = 400$ m/s
$S_2 = 0$ m/s ("*then stops*")
$\Delta T = 20$ seconds
$a = ?$

Step 2: Find ΔS

$\Delta S = S_2 - S_1$
$= 0 - 400 = -400$ m/s
NOTICE NEGATIVE ΔS

Step 3: Formula

$a = \Delta S/\Delta T$

Step 4: Solve

$a = (-400 \text{ m/s})/(20 \text{ s})$
$= -20 \text{ m/s}^2$

Negative → sign means deceleration.

Average Speed

$$S_{ave} = \frac{D_{total}}{T_{total}}$$

Ex. A person walks 4 miles in 2 hours, then stops for an hour for lunch. After lunch they walk 8 miles in 3 hours. Calculate the person's average speed.

Careful—distance is 0 miles because "*stops ... for lunch*".

	Distance	Time
	4 miles	2 hours
	0 miles	1 hour
	8 miles	3 hours
TOTALS:	12 miles	6 hours

$S_{ave} = D_{total}/T_{total}$
$= 12 \text{ mi}/6 \text{ sec}$
$= 2 \text{ mph}$

Speed vs. Velocity

Speed is a **Scalar**
Velocity is a **Vector**

Speed has no direction; Scalars have no direction.
Velocity has direction; Vectors have direction.

A person walks 4 m/s—speed (no direction).
A person walks 2 m/s north—velocity (direction is given).

A car drives 60 mph toward Dallas—velocity.
A car drives 30 mph—speed.

A 14 newton force pull 30° left of north—vector.
A boat is pulled by a 53 newton force—scalar.

Vectors have magnitude and direction.
Velocity is a vector with magnitude and direction.

Name: _____

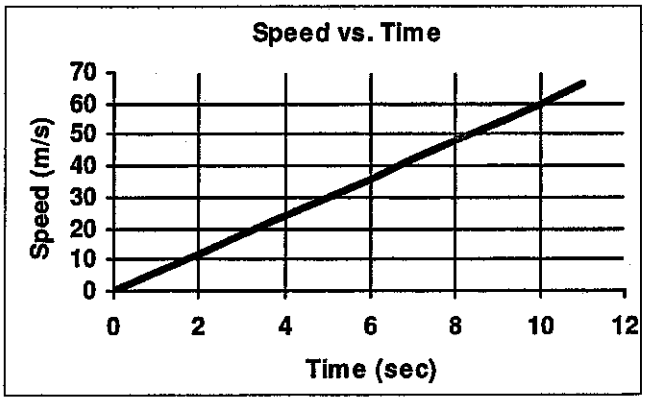
Period: _____

speed vs. time graphs;

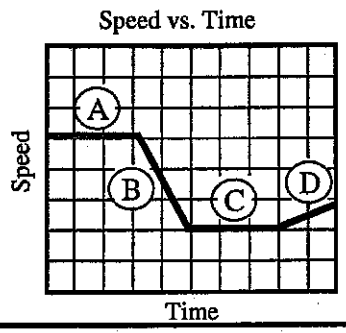
Ch. 2:1

Speed (S) or Velocity (V)	Scalar (S) or Vector (V)	Match the variables with quantities.	
___ A bike goes 25 m/s toward main street.	____40 mph toward Dallas.	1. a = _____	23 kilograms
___ A person walks 4 mph.	____A 25 N force pulls on a wagon.	2. S or v = _____	23 sec
___ A plane flies 200 m/s.	____10 meters up the hill.	3. m = _____	3 m/s^2
___ A bird flies 100 mph due south.	____12 meter per sec^2.	4. D = _____	23 meters/sec
		5. F = _____	23 meters
		6. T = _____	23 newtons

A person starts running from 2 m/s to 6 m/s in 2 seconds. Calculate the person's acceleration.		A plane stops from 250 mph in 25 seconds. Calculate the planes acceleration.	
Variables: Formula:	Solve:	Variables: Formula:	Solve:
A guy bikes 15 miles in 1 hour, then rests for an hour. Then he bikes 25 in 2 hours. What was his average speed for the trip?		A dragster's top acceleration is 60 m/s^2. If it accelerates for 3 seconds from the starting line, how fast will it be going?	
Variables: Formula:	Solve:	Variables: Formula:	Solve:



Find the acceleration for the above graph:



Which graph segments fit the following:

Constant speed:

Deceleration:

Accelerating:

The slope of a position vs. time graph means:

The slope of a speed vs. time graph means:

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Name: _____ Date: _____ Period: _____

Physical Science

End of Unit Home Assessment: Motion

Directions: Matching: Write the letter of the correct answer in front of each statement. Each word is only used once. USE ALL CAPITAL LETTERS

_____1. Any change in position in relation to a reference point.
_____2. Change in position of an object (final position minus initial position).
_____3. A point used as a reference point to describe an object's motion.
_____4. Speed in a given direction.
_____5. The rate of motion; distance traveled per unit of time.
_____6. How far apart objects are.
_____7. The rate of change of velocity; change in speed or direction.

A. Acceleration
B. Displacement
C. Distance
D. Frame of Reference
E. Motion
F. Speed
G. Velocity

_____ 8. What are the units for speed?
A) m B) s C) g D) m/s E) m/s^2

_____ 9. What are the units for distance?
A) m B) s C) g D) m/s E) m/s^2

_____ 10. What are the units for acceleration?
A) m B) s C) g D) m/s E) m/s^2

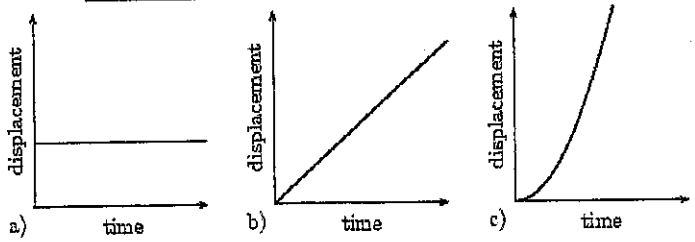
_____ 11. What are the units for time?
A) m B) s C) g D) m/s E) m/s^2

_____ 12. What are the units for velocity?
A) m B) s C) g D) m/s E) m/s^2

_____ 13. What are the units for displacement?
A) m B) s C) g D) m/s E) m/s^2

_____ 14. What does a vector have that a scalar does not?
A) time B) movement C) appearance D) space E) direction

15. _____ Which of the following graphs shows the object moving at constant speed?



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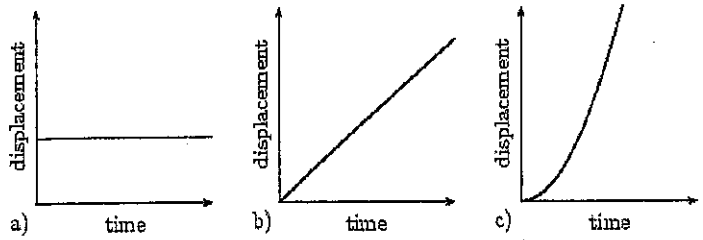
16. _____ Which of the following graphs shows the object not moving?

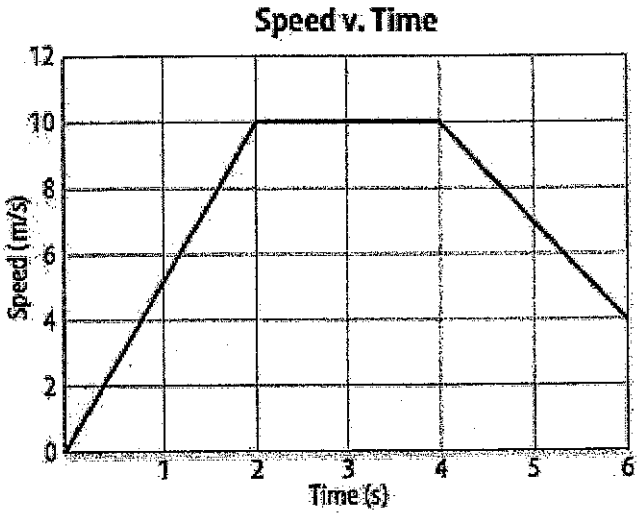


17. _____ A drone is flying at 6 m/s for 2 minutes. How far does the drone travel?
(Hint: watch your units!)
a. 2 m
b. 3 m
c. 6 m
d. 18 m

18. _____ A train accelerates from 60 m/s to 20 m/s in 4 seconds, what is the train's acceleration?
a. 5 m/s^2
b. -10 m/s^2
c. 10 m/s^2
d. 15 m/s^2

19. _____ A motorcycle travels 2 km in 100 seconds. What is its speed?
(Hint: watch your units!)
a. 0.02 m/s
b. 20 m/s
c. 50 m/s
d. 200 m/s

20. _____ What does the slope of a distance-time graph indicate about an object?
a. Speed
b. Distance
c. Time
d. Acceleration



21. ____ What is the acceleration of the object in segment A?
    a. 10 m/s^2
    b. 5 m/s^2
    c. 2 m/s^2
    d. 0.2 m/s^2

22. ____ Which segment is the object moving at constant speed?
    a. A
    b. B
    c. C

23. ____ Which segment is the object slowing down?
    a. A
    b. B
    c. C

24. ____ Which segment is the object speeding up?
    a. A
    b. B
    c. C

25. ____ How fast is the object moving at 4 seconds?
    a. 4 m/s
    b. 6m/s
    c. 8 m/s
    d. 10 m/s