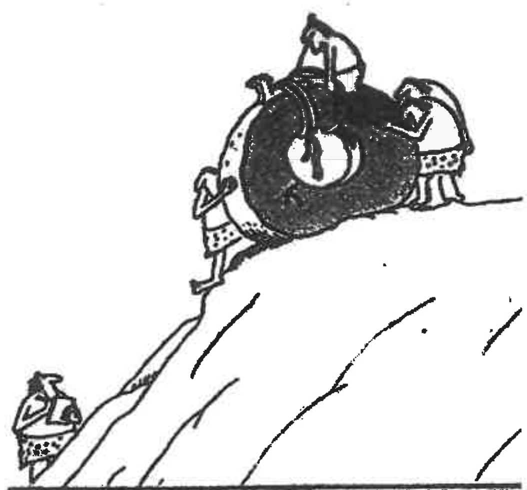
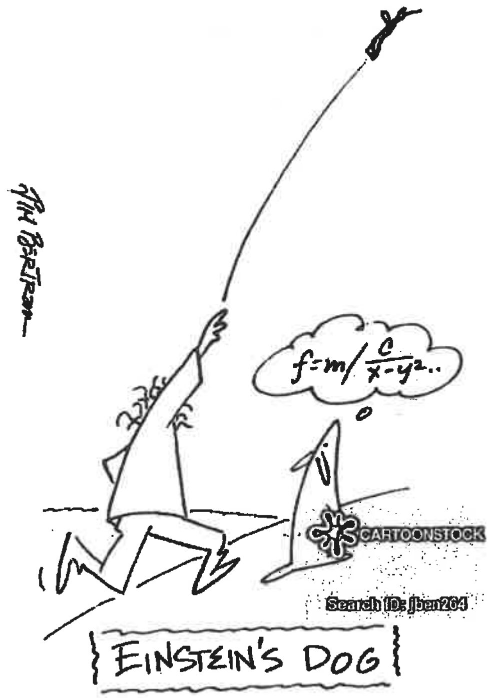
FORCE AND MOTION IN OUR WORLD

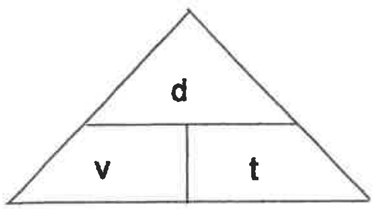


Early experiments in transportation



Why Science teachers are not asked to monitor recess.

MOTION FORMULAS



d is distance
v is velocity or speed
t is time

ACCELERATION

$$a = \frac{V_f - V_i}{\Delta t}$$

a is acceleration
Vf is final velocity (speed)
Vi is initial or starting velocity (speed)
Δt is change in time

WHEN INTERPTRETING A GRAPH:

a) for a distance-time graph the slope of the line is average velocity (speed)

b) for a velocity-time graph the slope of the line is average acceleration

$$\text{Slope} = \frac{\text{rise}}{\text{run}} \quad \text{or} \quad \frac{y_2 - y_1}{x_2 - x_1}$$

Measurement in Science – A Review of the Metric System

- For scientific observations to be meaningful around the world, we use a modernized version of the metric system which was originally developed in France "Systeme Internationale" = International System of Units
- The metric system uses base units for ______________________________
- Basic units are:

  Length -» meter (m)

  Mass -» gram (g)

  Volume-» Litre (or dm^3)

  Time -» seconds (s)

  Temp -» °Celcius (°C)

- The units are __________________________ related to each other (based on 10)
- ____________________ are used to express larger or smaller quantities to reduce the ambiguity of the measurement

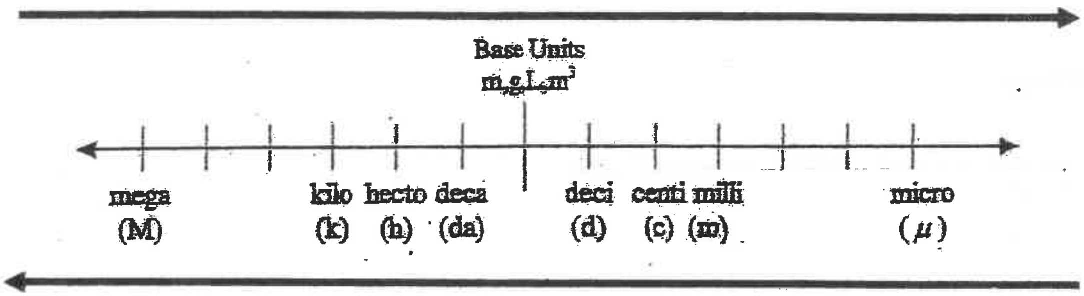
List of the Metric Prefixes

Prefix	Symbol	Numerical	Exponential
yotta	Y	1,000,000,000,000,000,000,000,000	10^{24}
zetta	Z	1,000,000,000,000,000,000,000	10^{21}
exa	E	1,000,000,000,000,000,000	10^{18}
peta	P	1,000,000,000,000,000	10^{15}
tera	T	1,000,000,000,000	10^{12}
giga	G	1,000,000,000	10^{9}
mega	M	1,000,000	10^{6}
kilo	k	1,000	10^{3}
hecto	h	100	10^{2}
deca	da	10	10^{1}
no prefix means:		1	10^{0}
deci	d	0.1	10^{-1}
centi	c	0.01	10^{-2}
milli	m	0.001	10^{-3}
micro	μ	0.000 001	10^{-6}
nano	n	0.000 000 001	10^{-9}
pico	p	0.000 000 000 001	10^{-12}
femto	f	0.000 000 000 000 001	10^{-15}
atto	a	0.000 000 000 000 000 001	10^{-18}
zepto	z	0.000 000 000 000 000 000 001	10^{-21}
yocto	y	0.000 000 000 000 000 000 000 001	10^{-24}

Because the scale is logarithmic based on 10, converting between units can be accomplished by simply ______________________________ and using the chart below:

Metric Conversion Chart

To convert to a smaller unit, move the decimal point to the right or multiply



To convert to a larger unit, move decimal point to the left or divide

Eg. Convert:

a) 27.5cm = 275 mm b) 5.86mm = 0.0000586 hm c) 3m = 30 dm

Using Correct Units

For each of the following commonly used measurements, indicate its symbol. Use the symbols to complete the following.

_____ milliliter	_____ milligram	_____ liter	_____ centimeter
_____ kilogram	_____ millimeter	_____ kilometer	_____ gram
_____ meter	_____ millisecond	_____ microgram	_____ nanometer

REMEMBER→ 1.0 cm^3 = 1.0 mL

Convert:

a. 9200 cm = __________ m	b. 2.0 ML = __________ kL
c. 238 kg = __________ Mg	d. 50.0 cm = __________ mm
e. 706 dag = __________ dg	f. 70.0 hm = __________ m
g. 72 km = __________ m	h. 0.67 kL = __________ mL
i. 1500 m = __________ km	j. 5800 mm = __________ km
k. 0.042 km = __________ dm	l. 12.0 dam = __________ dm
m. 4.601 dam = __________ cm	n. 0.020 m = __________ cm
o. 0.28 mL = __________ cm^3	p. 7.50 μg = __________ mg
q. 142 Mm = __________ km	r. 60.0 ml = __________ cm^3
s. 12.0 μm = __________ cm	t. 65.0 g = __________ mg
u. 750 ml = __________ L	v. 81 000 kg = __________ Mg

M.1 Metric Conversion Worksheet

1. Write the prefixes for the metric system in order, left to right.

Convert the following:

2. 4 m = _____mm
3. 49 cm = _____m
4. 16 kg = _____g
5. 97 cm = _____mm
6. 25 l = _____ml
7. 437 mg = _____g
8. 4.3 km = _____m
9. 5 mm = _____cm
10. 1.6 l = _____ml
11. 87.5 cm = _____m
12. 9762 g = ______kg
13. 8.9 cm = _____mm
14. 3.42 m = _____cm
15. 576 l = _____kl
16. 56 g = _____mg
17. 97.62kg = ______g
18. 2.5 kl = _____l
19. 4.37 mg = _____g

Each of your answers for the above questions has been assigned word.

500	.437	43.7	.97	.49	1600	25000	160	4300	16000	970	4000	.5
pond	to	jump	from	did	Paris	decide	Texas	move	the	frog	why	to

9.762	56000	97.62	25	.875	.00437	57.6	2500	437	.576	342	89	97620
he	served	croak	steak	because	flies	tried	French	bugs	meals	his	wanted	with

In the answer boxes below, write the word that corresponds with the answer to solve the riddle!

2	3	4	5	6	7	8	9	10 ?
11	12	13	14	15	16	17	18	19

M.2 Metric Measurement Conversion

Directions: Write the equivalent measure for each problem.

1. 3770 ml = ______ L	2. 9200 L = ______ kl	3. 37 g = ______ kg
4. 5130 L = ______ kl	5. 3240 mg = ______ g	6. 6300 m = ______ km
7. 24900 kg = ______ g	8. 4300000 g = ______ kg	9. 230 ml = ______ L
10. 412 L = ______ ml	11. 230 L = ______ kl	12. 150 cm = ______ m
13. 210 ml = ______ kl	14. 7283 ml = ______ L	15. 123 cm = ______ mm
16. 520 L = ______ ml	17. 165 m = ______ mm	18. 230 cm = ______ m
19. 417 km = ______ m	20. 723 mg = ______ kg	21. 281 m = ______ mm

Compare using <, >, or =.

25) 63 cm ◯ 6 m	27) 5 g ◯ 508 mg	29) 1,500 mL ◯ 1.5 L
26) 536 cm ◯ 53.6 dm	28) 43 mg ◯ 5 g	30) 3.6 m ◯ 36 cm

Introduction to Motion

What kind of things are in motion?

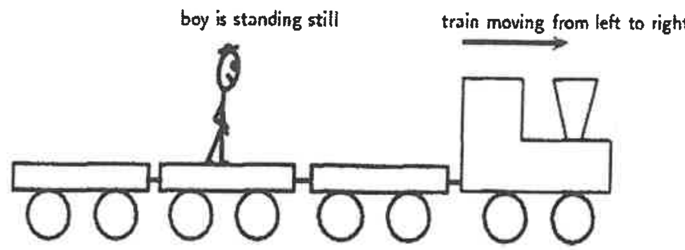
- Answer: ________________!
- All matter is made up of atoms. Atoms are in ____________ ____________!
- The Earth ________ on its axis!
- The Earth ________________ around the sun!

What is Motion?

- any physical movement or change in ________________ or place, relative to a ________________ point

Frame of Reference

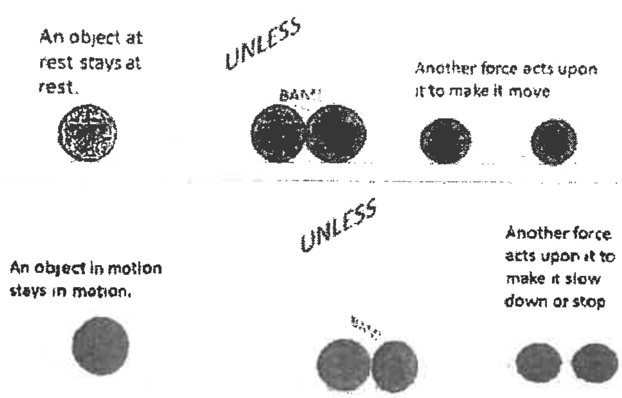
- random ________________ from which the position of an object is being described



From your frame of reference the boy is moving from left to right.

Why do objects move anyway?

- ________ is the term for a complete lack of motion. Objects ________________ unless a ________causes the object to move.
- However, ____.



This is known as Newton's first Law of Motion:

____

____

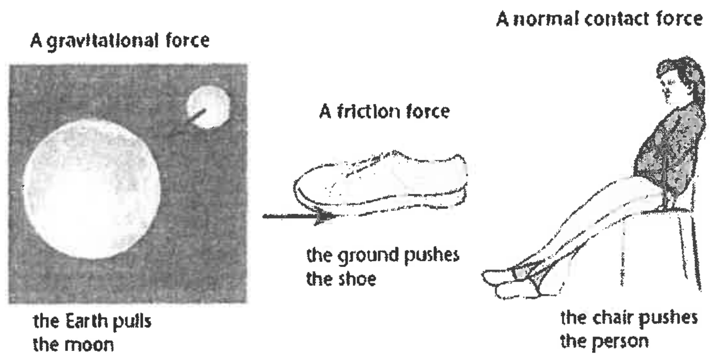
____

UNLESS…

It is acted upon by some net ________!

So...what is force?

- Force is a ________ or a ________
- Forces can make objects start moving, move faster or slower, or cause them to change direction



Newton's First Law

Newton's First Law is sometimes thought of as: ______________________________ ______________________________.

Or in other words, it is the "________ ____ ______________."

The tendency of an object stay at rest or to continue in motion is called ________.

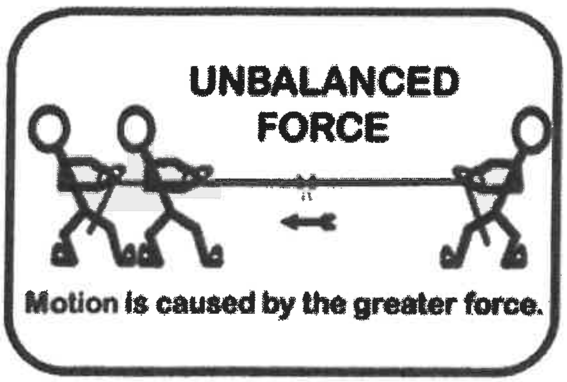
All objects have inertia. The greater the ________ of the object, the greater the ________ or the ability to resist change.

Types of Motion

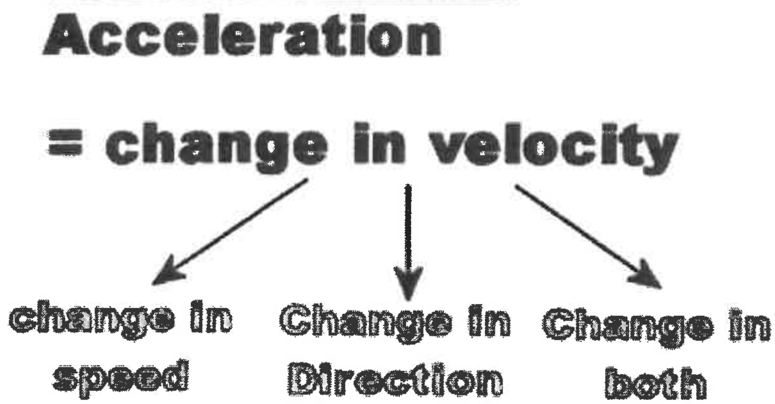
- There are two types of motion: ______________ and ______________.
- Uniform motion is motion at a ______________ ______________ in a ______________ ______________ (i.e. going one direction).
- Non-uniform motion occurs when there is a ____________________________ ____________________________.

How does this relate to force?

- Forces often come in ________
- When forces are equal in size but opposite in direction, they are called ________________ forces.
- Balanced forces cancel out and do ________ cause a change in an object's motion. (The object stays at rest or continues in ________________ motion).



- However, if one force is stronger, the forces are ________________ and a ________________ results.
- This will cause a change in the object's speed and/or direction (otherwise known as ________________ or ________________ motion).



In physics, non-uniform motion is known as ________________

- Why? Acceleration is when an object changes it ________________ or ________________ or

In Summary:

- A force is not needed to keep an object in motion. Objects stay at rest or in motion because of ________________
- ________________ forces cause ________________
- Acceleration, also known as ________________ ________________, is a change in speed AND/OR direction.

1-1

Introduction to Motion - Practice Questions

1. Review: An object at rest ... ____;
   An object in motion .... ______________________________________;
   unless ...____.

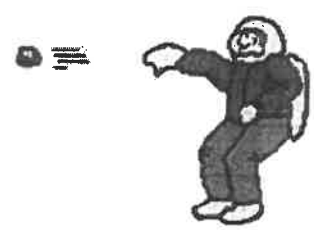
2. Newton's First Law is also thought of as the Law of____________.

3. Inertia is ____.

4. The amount of inertia possessed by an object is dependent solely upon its __________.

5. If a moose were chasing you through the woods, its enormous mass would be very threatening. But if you zigzagged, then its great mass would be to your advantage. Explain why.

6. Imagine a place in the *cosmos* far from all gravitational and frictional influences. Suppose that you visit that place (just suppose) and throw a rock. The rock will



   a. gradually stop.
   b. continue in motion in the same direction at constant speed.

7. Inertia can best be described as _____.
   a. the force that keeps moving objects moving and stationary objects at rest.
   b. the willingness of an object to eventually lose its motion
   c. the force that causes all objects to stop
   d. the tendency of any object to resist change and keep doing whatever it's doing

8. A force is best described as a __________ or a __________.

9. When forces are equal in size but opposite in direction, they are referred to as __________ forces.

10. If the forces acting upon an object are balanced, then the object
    a. must not be moving.
    b. must be moving with a constant velocity.
    c. must not be accelerating.
    d. none of these

11. If the net force acting upon an object is 0, then the object MUST _____. Circle one answer.

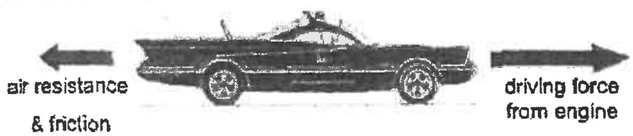
a. be moving
b. be accelerating
c. be at rest
d. be moving with a constant speed in the same direction
e. either c or d.

12. Take a look at the following situations. The car is initially moving to the right at constant speed. The size of the arrow indicates how strong the force is. Identify if the overall forces are balanced or unbalanced?

Example 1

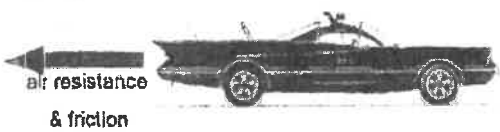
The forces are ______________

Example 2



The forces are ______________

Example 3



The forces are ______________

What is happening to the speed of the car in each example?

Example 1: ____

____

Example 2: ____

____

Example 3: ____

____

13. Which of the following statements are true? Circle all that apply.

a. If a person is moving to the right, then the forces acting upon it are NOT balanced.
b. A balance of forces is demonstrated by an object which is slowing to a stop.
c. It would take an unbalanced force to keep an object in motion.
d. If an object is accelerating, then the forces acting upon the object are balanced.
e. Balanced forces cause stationary objects to remain at rest and moving objects to come to rest.

Describing Motion

Let's Review…

- Uniform motion is ______________________________________.
- Non-uniform motion occurs when ______________________________ ______________________________.

Describing Motion

- The motion of an object is often described using words, equations, diagrams, and graphs.
- Words and phrases such as *going fast*, *stopped*, *slowing down*, *speeding up*, and *turning* are a good start…
- But in physics, we need to also use words like *distance*, *displacement*, *speed*, *velocity*, and *acceleration*. Each of these has a math quantity associated with it.

- The math quantities that are used to describe motion can be divided into two categories: ______________ and ______________.
- Scalars are quantities that are fully described by a ______________ (or number) alone.
- Vectors are quantities that are fully described by both a ______________ and a ______________.

Scalars & Vectors

- ______________ - measurement has size but no direction (e.g. 15m)

- ______________ - measurement involves both size and direction (e.g. 10 km N)

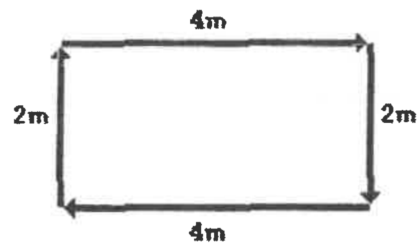
Question: Which measurements are scalar? Which are vector?

a) 15 hm NE ______________
b) 12 s ______________
c) 19 m/s S ______________
d) 1.8 cm ______________

Distance & Displacement

- ________________, d - refers to "how much ground an object has covered" (scalar)
- ________________, $\vec{d}$ - refers to "how far out of place an object is"; it is the object's change in position (vector)
- Note: the arrow over the letter 'd' means "vector"

Question: A physics teacher walks 4 meters East, 2 meters South, 4 meters West, and finally 2 meters North.



1. *What distance has she traveled?* _____
2. *What was her displacement?* _____

General Calculation

$$\Delta d = d_f - d_i$$

or

$$\Delta \vec{d} = \vec{d}_f - \vec{d}_i$$

where:

- the symbol Δ means "change in"
- f stands for final
- *i stands for initial*

Time & Time Interval

- ________________ - describes when an event occurs (scalar)
- ________________ - describes the duration of an event (scalar)

General calculation $\Delta t = t_f - t_i$

where:

- the symbol Δ means "change in"
- f stands for final
- i stands for initial

Speed & Velocity

- ________________, v - refers to "how fast an object is moving" (scalar)
- ________________, $\vec{v}$ - refers to "the rate at which an object changes its position" (vector)

Speed

- is the rate at which an object covers distance.
- A fast speed means a ________________ distance is covered in a ________________ amount of time.
- An object with no movement at all has a zero speed.

Velocity

- is speed with a ________________!
- Speed is 55 km/hr while velocity is 55 km/hr E.
- Speed is a scalar quantity and does not keep track of direction; velocity is a vector quantity and is ________________ ________________.

Average Vs Instantaneous Speed

- ________________, v_{inst} - the speed at any given instant in time
- ________________, v_{ave} - the average of all instantaneous speeds

Acceleration, $\vec{a}$

- the rate at which an object changes its ________________ (vector)
- An object is accelerating if it is changing its velocity (speeding up or slowing down in a specific direction).

1.2

Name: ______________________________ Date: ______________________

Science 10: Physics
Scalar and Vector Quantities Worksheet

Motion can be described using words, diagrams, numerical information, equations, and graphs. Using words to describe the motion of objects involves an understanding of such concepts as position, displacement, distance, rate, speed, velocity, and acceleration.

Vectors vs. Scalars

1. Most of the quantities used to describe motion can be categorized as either vectors or scalars. *A vector is a quantity that is fully described by both magnitude and direction. A scalar is a quantity that is fully described by magnitude alone.* Categorize the following quantities by placing them under one of the two column headings.

displacement, distance, speed, velocity, acceleration

Scalars	Vectors

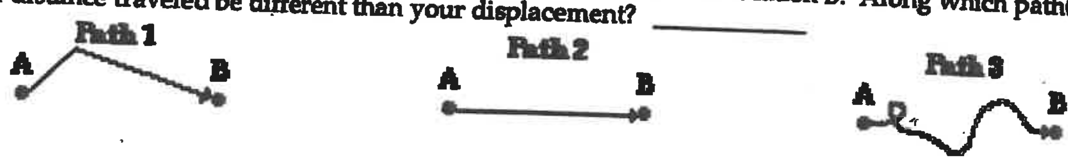
2. A quantity that is *ignorant of direction* is referred to as a ______________.
   a. scalar quantity
   b. vector quantity
3. A quantity that is *conscious of direction* is referred to as a ______________.
   a. scalar quantity
   b. vector quantity

Distance vs. Displacement

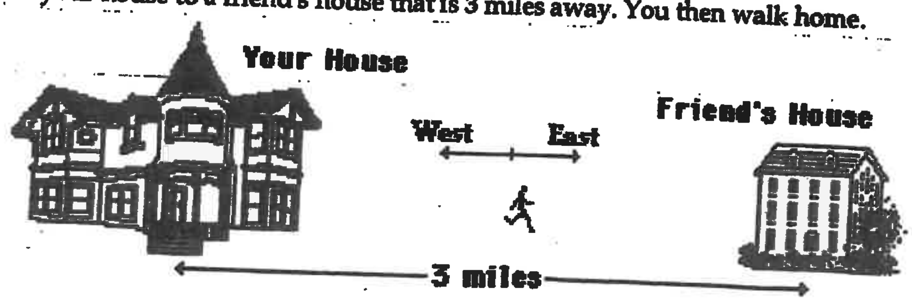
As an object moves, its location undergoes change. There are two quantities that are used to describe the changing location. One quantity - **distance** - accumulates the amount of total change of location over the course of a motion. Distance is the amount of ground that is covered. The second quantity - **displacement** - only concerns itself with the initial and final position of the object. Displacement is the overall change in position of the object from start to finish and does not concern itself with the accumulation of distance traveled during the path from start to finish.

4. True or False: An object can be moving for 10 seconds and still have zero displacement.
   a. True
   b. False
5. If the above statement is true, then describe an example of such a motion. If the above statement is false, then explain why it is false.

6. Suppose that you run along three different paths from location A to location B. Along which path(s) would your distance traveled be different than your displacement? __________



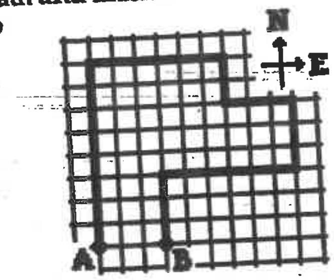
7. You run from your house to a friend's house that is 3 miles away. You then walk home.



a. What distance did you travel? ______________

b. What was the displacement for the entire trip? ______________

Observe the diagram below. A person starts at A, walks along the bold path and finishes at B. Each square is 1 km along its edge. Use the diagram in answering the next two questions.

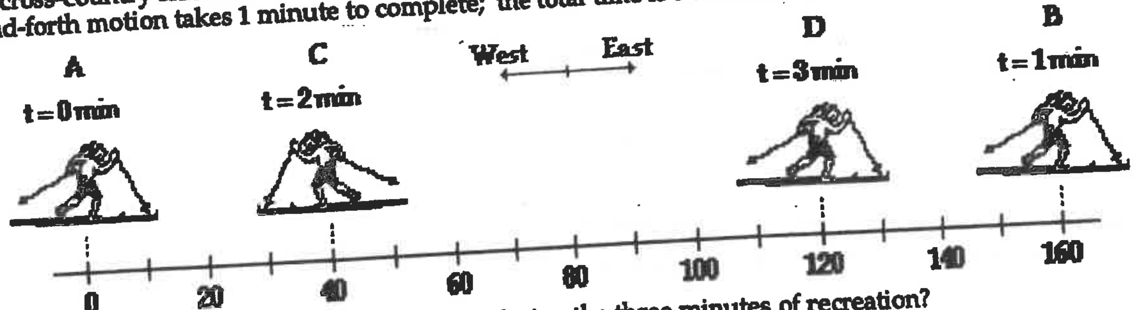


8. This person walks a distance of ________ km.

9. This person has a displacement of ________.

a. 0 km   b. 3 km   c. 3 km, E   d. 3 km, W
e. 5 km   f. 5 km, N   g. 5 km, S   h. 6 km
i. 6 km, E   j. 6 km, W   k. 31 km   l. 31 km, E
m. 31 km, W   n. None of these.

10. A cross-country skier moves from location A to location B to location C to location D. Each *leg* of the back-and-forth motion takes 1 minute to complete; the total time is 3 minutes. (The unit is *meters*.)



a. What is the distance traveled by the skier during the three minutes of recreation?

b. What is the net displacement of the skier during the three minutes of recreation?

c. What is the displacement during the second minute (from 1 min. to 2 min.)?

d. What is the displacement during the third minute (from 2 min. to 3 min.)?

11. Determine if each quantity is scalar or vector.

(a) 5.0m/s
(b) 110km/h [West]
(c) 6 hours
(d) 15km [N]
(e) 32°C
(f) 90m
(g) 60km/h
(h) 13cm [to the right]
(i) 60km/h [E]

12. Complete each vector addition.

(a) $\vec{A}$= 8km[E] and $\vec{B}$=13km[E]
(b) $\vec{R}$= +16m and $\vec{K}$= -10m
(c) $\vec{T}$= 6m[E] and $\vec{U}$= 12m[W]
(d) $\vec{A}$= 125m[S] and $\vec{B}$= 84m[S]
(e) $\vec{X}$= 6m[East] and $\vec{Y}$= 10m[West] and $\vec{Z}$= 14m [East]
(f) $\vec{E}$= +25km and $\vec{F}$= -25km

1-3

CHAPTER 9
REINFORCEMENT

Calculating Time Intervals and Displacements

BLM 9-10

Goal • Practise calculating change in time and displacement.

What to Do

Answer each question in the space provided.

1. Complete each table below.

(a)

t_i	t_f	Δt
1.0 s	5.0 s	
4.56 s	19.71 s	
0 h	3.5 h	
	14.0 s	9.0 s
3 min		5 min

(b)

$\vec{d}_i$	$\vec{d}_f$	$\Delta\vec{d}$
+3.4 m	+7.8 m	
+14.7 m	+3.1 m	
+12.0 km	+15.7 km	
+13.1 m		+102.3 m
	+14.8 cm	+9.1 cm

2. Solve the following problems.

(a) A runner is moving along a straight road. At a time of 0.62 s, the runner's position is +10.6 m. Later, at a time of 9.93 s, the runner's position is +73.9 m. Find the time interval and displacement for the runner.

(b) A person is driving a car along a straight highway. The car's position at 9:00 a.m. is 13 km from home. Its position at 10:30 a.m. is 137 km from home. Find the time interval and displacement for this section of the journey.

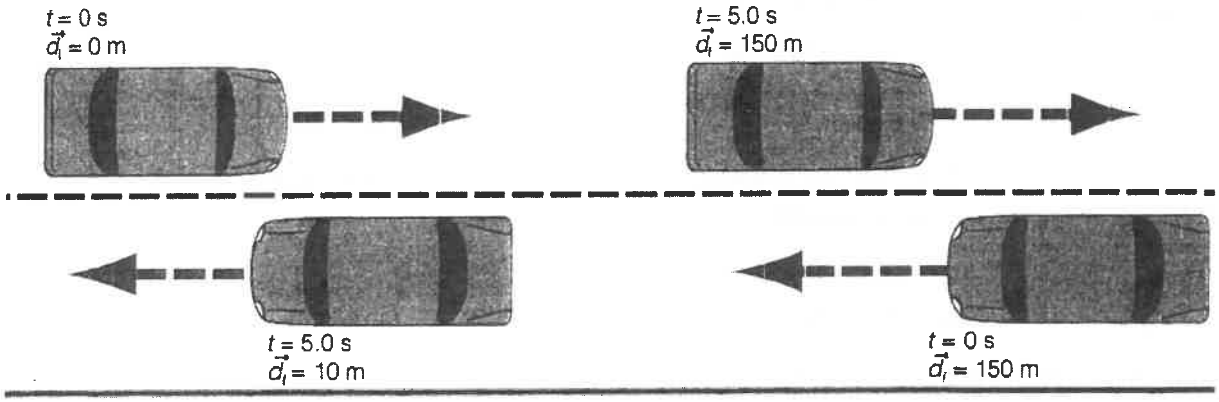
DATE: NAME: CLASS:

CHAPTER 9
REINFORCEMENT

BLM 9-10

Calculating Time Intervals and Displacements (continued)

3. The diagram below shows two cars passing each other on opposite sides of a road.



(a) Complete the following table for both cars.

Car	t_i	t_f	Δt	$\vec{d}_i$	$\vec{d}_f$	$\Delta \vec{d}$	Direction (left or right)
1							
2							

(b) Why is the displacement negative for car 2 and positive for car 1?

____

____

____

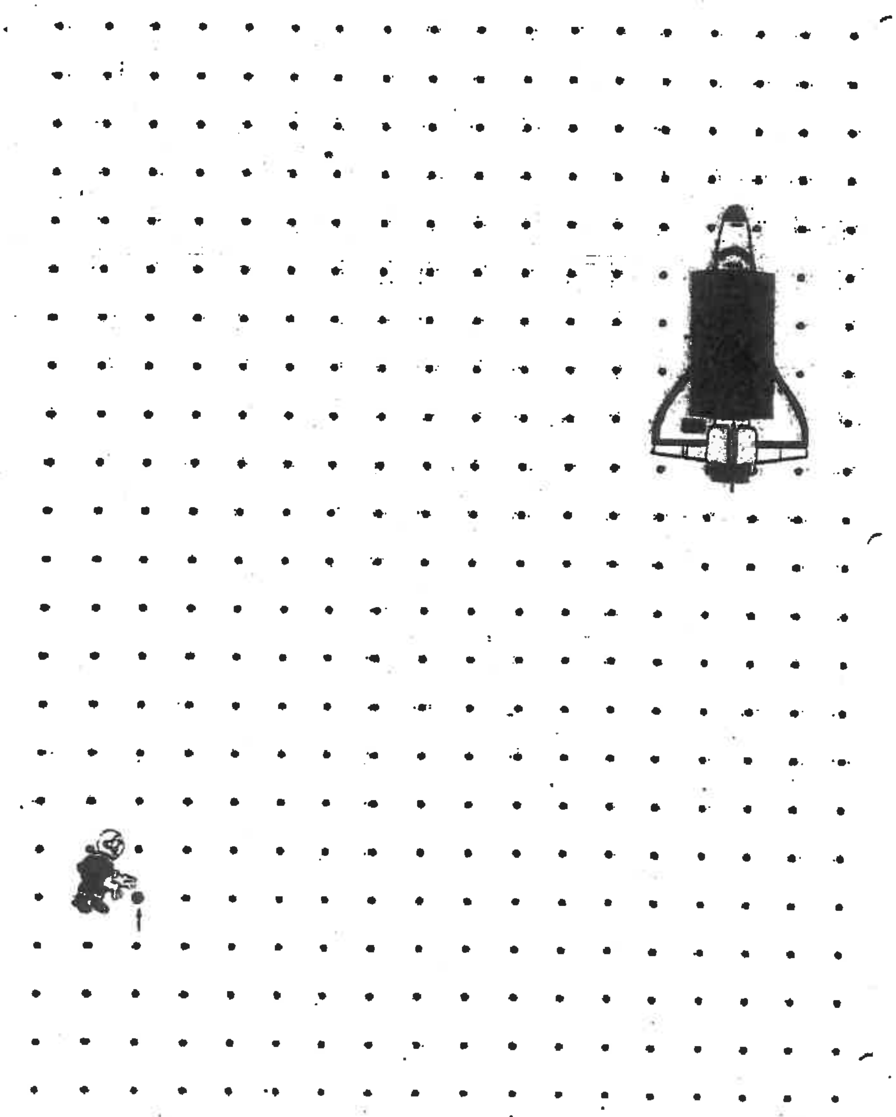
____

DISTANCE VS DISPLACEMENT

To learn the difference between distance and displacement, help the astronaut complete his Space Walk and return to his space ship using the following instructions:

1. Place your pencil on the large dot beside the astronaut.
2. Move up six spaces.
3. Turn right and move 5 spaces.
4. Go up 3 spaces.
5. Turn left and move 4 spaces.
6. Go up 8 spaces.
7. Turn right and move 7 spaces.
8. Go down 5 spaces.
9. Turn right and move 3 spaces.

Space Walk



Describing Motion Using Equations

We've already learned that speed is how fast an object is moving.

Average Speed, V_{av}, is: the ______________ (Δd) divided by the ______________ (Δt) for a trip

For example:

Calculate the average speed of a car that travels from Prince Albert to Saskatoon (141 km) in 1.25 hours.

Solution:

Problem Solving

- Sometimes, it will be difficult to figure out what the question is asking you to find.
- In these instances, it is helpful to use the GRASP method of problem solving.

G Given: Identify the information that is ______________ in the problem statement.

R Required: Identify the information that is ______________. (What are you trying to determine?)

A Analyse: ______________ (figure out) which equation, rule or principle applies to this type of problem.

S Substitute and Solve: If using an equation, ______________ the values given in the problem for the appropriate variables and then ______________ the equation.

P Paraphrase: ______________ (write) your answer in a brief sentence that answers the problem.

- Also, there will be times when the formula you are given will need to be rearranged (manipulated) to solve for another variable.
  - *(For example, you may need to solve for time or distance!)*
- The only rule to follow is: "____!"

For example:

Calculate the distance traveled by a bicycle that traveled at 13 km/h for 1.6 hours.

Solution:

Remember to first ask yourself: *Which variable do I want to isolate?* In this case, we want to isolate ***d***. So we begin by working on moving all other variables to the other side:

1. Multiply both sides by t:

$$v \times t = \frac{d}{t} \times t$$

2. Cancel t's where appropriate:

$$v \times t = \frac{d}{\cancel{t}} \times \cancel{t}$$

The two steps above are exactly what you do when you cross-multiply. If you are more familiar (or comfortable) with doing it this way, please feel free to do so.

3. and you end with an equation for d:

$$v \times t = d$$

If you are more comfortable with the unknown being on the left, you can also rearrange it to read:

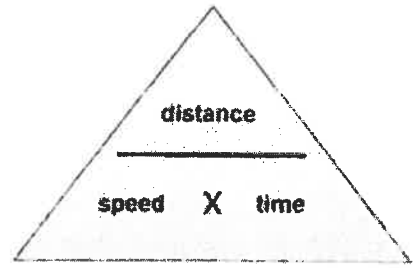
$d = v \times t$.

Speed Equations

$$V_{av} = \frac{\Delta d}{\Delta t}$$

$$\Delta d = V_{av}\, x\, \Delta t$$

$$\Delta t = \frac{\Delta d}{V_{av}}$$



You may find this triangle useful when rearranging the equation to get:
distance = speed x time
time = distance / speed

Velocity Equations

- The speed equations can also be used to find velocity.
- Just don't forget to _______________ _______________ and use _______________ rather than distance.

$$\vec{V}_{av} = \frac{\Delta \vec{d}}{\Delta t}$$

$$\Delta \vec{d} = \vec{V}_{av}\, x\, \Delta t$$

$$\Delta t = \frac{\Delta \vec{d}}{\vec{V}_{av}}$$

Converting between m/s and km/h

- To convert from km/h to m/s
    - Change km to m: 1 km = 1000 m
    - Change h to s: 1 h = 3600 s
- Therefore multiply by 1000 and divide by 3600
    - or
- Divide the speed in km/h by 3.6 to obtain the speed in m/s.

For example, convert 75 km/h to m/s.

$$\frac{75\,km}{1\,h} \times \left(\frac{1000\,m}{1\,km}\right) \times \left(\frac{1\,h}{3600\,s}\right) = 21\,m/s$$

For example: 1. Convert 95 km/h to m/s.

Solution:

For example: 2. A truck's displacement is 45 km north after driving for 1.3 hours. What was the truck's average velocity in km/h & m/s?

Solution:

Practice Problems

1. A canoeist travels 5.2 km in 45 min. What was his average speed as measured in: (a) km/h and (b) m/s?

2. A girl on a long board travels down a 620 m hill in just 49.0 s. What was her average speed in km/h?

3. In a race at a time of 8.2 s, a runner was at a position of 89 m. Just 4.0 seconds later, the same runner was at 143 m. What was her average speed in (a) m/s and (b) km/h?

1-5

General Science 3200 **Name:**________________

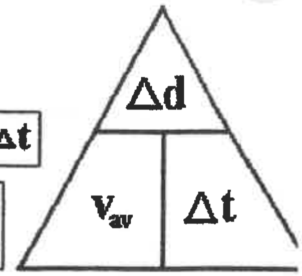
Worksheet 15: Calculating Average Speed, Distance, and Time

Use the average speed equation to calculate the unknown variable. Ask yourself, "What is this question asking me to find?" before you begin your calculation. Remember that "v_{av}" represents speed, "Δd" represents distance, and "Δt" represents time.

$$v_{av} = \frac{\Delta d}{\Delta t}$$

$$\Delta d = v_{av} \Delta t$$

$$\Delta t = \frac{\Delta d}{v_{av}}$$



1. Calculate the average speed of a car that travels 70 km in 1.5 hours.

2. How long does it take a person running at a rate of 4 m/s to run a distance of 260 m?

3. How far would a snowmobiler travel in 0.5 hours at a rate of 25 km/h?

4. Melanie ran the 100 meter race in 12 seconds. What was her average speed?

5. If a boat sailed for 6 hours at an average speed of 55 km/h, what distance did the boat travel?

6. How much time did it take a plane flying at 575 km/h to travel a distance of 1700 km?

1-6

DATE: NAME: CLASS:

CHAPTER 10
PROBLEM SOLVING

Uniform Motion

BLM 10-5

Goal • Use the uniform motion formula to solve motion problems.

What to Do

Solve each problem in the space provided. Show all your work.

1. Use the uniform motion formula to complete the table below.

Δt	$\Delta \vec{d}$	$\vec{v}_{av}$
3.0 s	+12 m	
	+28 m	+4.0 m/s
15.1 s		+2.00 m/s
1.5 h		+50 km/h
1.7 h	+84 km	
	+120 km	+15 km/h

2. (a) A student rides a bicycle along a straight road for 30.0 s. She travels 254 m away from her home. Find her average velocity.

(b) A car is moving east, at 90 km/h, along a straight highway. Find the displacement of the car after 1.2 h.

(c) A person is walking west at 4.2 m/s. How long will it take the person to go 110 m west?

Uniform Motion (continued)

3. A car starts from a position of 18 m at a time of 7.2 s. The velocity of the car is 17 m/s. Find the position of the car at a time of 9.8 s.

4. A student is walking with a constant velocity along a straight sidewalk. At a time of 1.4 s, his position is 31.4 m. Later, at a time of 6.1 s, his position is 9.6 m.

   (a) What is the student's velocity?

   (b) What is his position at 4.4 s?

   (c) At what time is the student's position 12.0 m?

1-7a

Name ____________________

Speed Challenge

Get Ready ...

1. Explain in your own words what speed means.

____

____

2. Suggest a technology or piece of equipment that might be used to measure distance, time, and speed.

____

____

3. List five different ways to travel a distance of 10 km.

____

____

____

____

____

Get Set ...

Step 1: Gather your materials!
Each team needs 2 timers, 1 meterstick, 1 roll of masking tape, and 1 marker.

Step 2: Create your "race" track!
Find a spot in the hallway and measure off a 10 meter race track. Use three pieces of tape to mark the beginning, middle, and end of your track. Mark each distance (0 m, 5 m, and 10 m) on the tape with a marker.

GO!

Each team member will need to perform the following tasks for each distance: hopping, walking backwards, walking (regular rate), and speed walking.

Your team will need people with timers or stopwatches at the 5 meter & 10 meter points.

Record the time it takes to perform each task.

NOTE: Speed walking is going as fast as you can without jogging or running!

Collect That Data!

Record your data from the experiment in the table on the following page. Use this information to calculate the speed for each task and distance. Round answers to the nearest hundredth if needed. Label your answers!

Data Table

Task	Distance	Time	Speed
Hopping	5m		
	10m		
Walking Backward	5m		
	10m		
Walking Regular	5m		
	10m		
Speed Walking	5m		
	10m		

Think About It!

1. Which task and distance resulted in the fastest speed?
   Task = ____________ Distance = ____________ Speed = __________

2. Which task and distance resulted in the slowest speed?
   Task = ____________ Distance = ____________ Speed __________

3. How far could you speed walk in 10 minutes based on your speed for the 10 meter trial? Show your work!

4. How long would it take you to hop 30 meters based on your speed for the 5 meter trial? Show your work!

5. How far could you travel walking backwards in 15 minutes based on your results for the 5 meter trial? Show your work!

6. How long would it take you to walk (regular rate) 1 kilometer (or 1,000 m) based on your speed for the 10 meter trial? Show your work!

7. Are your results accurate? Why or why not?

The Snowmobile: A Canadian Invention

Joseph-Armand Bombardier (1907-1964) liked tinkering. Ten-year-old Armand turned a cigar box and a broken alarm clock into a working model of a tractor. Everything seemed to **stimulate** Armand's inventive mind: he connected an aunt's spinning wheel to a steam engine for greater speed, for example, and converted an old rifle into a miniature cannon. As he got older, Armand dreamed of building a vehicle that could glide over snow – a fitting goal for a boy growing up in rural Valcourt, Quebec. In 1922 when he was only 15, Bombardier built his first snow machine. His father had given him an automobile; Armand removed the engine and mounted it on a sleigh. He attached a hand-made wooden propeller to the engine **drive shaft**. To the astonishment of his neighbours, Armand and his brother raced this strange-looking vehicle through the town. Armand had just tested his first snowmobile.

Bombardier worked as an apprentice mechanic in a local garage by day and studied electrical and mechanical engineering by night. He learned English so he could read technical journals. When he was 19, his father built him his own garage, where he made his own tools and automobile parts.

In 1934 Bombardier's young son died of appendicitis during a winter snowstorm that prevented him from getting to the hospital. Armand approached his winter invention with a new sense of urgency. In 1935 he finally assembled a vehicle that ran on rubber and cotton caterpillar tracks and could hold three passengers. This was a technological breakthrough. The following year, he increased the capacity to seven passengers and invented a sophisticated suspension system. Bombardier converted his garage into a manufacturing company, Auto-Neige Bombardier. He hired farm labourers from Valcourt and trained them as specialized workers. Assisted by Bombardier's family, the company launched a promotional campaign and built a new plant. The first people to purchase his patented snowmobiles were country doctors, ambulance drivers, and priests in remote areas.

Responding to the changing world, Joseph-Armand Bombardier built transport vehicles for the Canadian Armed Forces in the Second World War, and later manufactured school buses, caterpillar vehicles for oil exploration, and the Muskeg, which could travel through swamps, forests, and ice fields. In 1959 Bombardier introduced a two-passenger Ski-Doo, which revolutionized life in northern communities. ★

Bombardier posted revenues of $17.5 billion this year. It has 60,000 employees and a presence in 60 countries on five continents. Their first snowmobile was supposed to be called Ski-Dog but a printer put down Ski-Doo by accident and the name stuck.

Stimulate: Stir up, cause to act. **Drive Shaft:** A mechanical device that transfers power from the engine to the place where work is done – e.g. the wheel axle, so the power can turn the wheels.

Questions

1. What was Armand's very first snow machine like? What inspired Armand to get serious about snow machines?

2. What technology was added to the original snow machine to make it more usable?

3. Who were the first users of the snowmobile?

4. What do you find out from this story about Armand's personality? What other qualities does an inventor/entrepreneur need to be successful?

5. List some of the things Armand Bombardier did to get his company growing. What questions or ideas do you have about what it takes to start a successful company?

1-8

Speed Machines

1. Nascar driver, Jeff Gordon, has a car that is one of the fastest on the circuit. If it travels 960 km in 4 hours, what is his cruising speed?

2. The fastest car on earth, a German-made *Thrust SSC*, would win every Nascar race in America. If it takes 0.5 hours (30 minutes) to travel 608 km, what is its speed?

3. The fastest train on Earth, the *TGV* from France, can travel at faster speeds than trains in the Canada. During a speed test, the train traveled 1280 km in 2.5 hours. What is its speed?

4. *Spirit of Australia*, a hydroplane boat, made speed records by traveling 382.4 km in 0.75 hours. What is its record-breaking speed?

5. The fastest plane ever made, the *Lockhead SR71*, was able to travel 3520 km per hour. Based on this speed, how far could it travel in:

   a) 2 hours? B) 3 hours? C) 5 hours?

6. Challenge: Out of all the machines on this worksheet, which one is the fastest?

7. Fill in the boxes and use a calculator to determine how long it would take each machine to get to travel 96 kilometers.

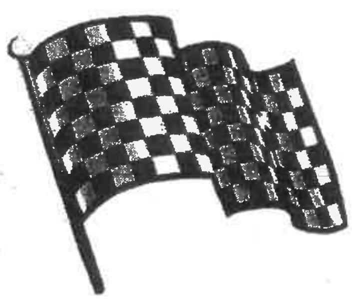
A. Jeff Gordon's Car = ________________

B. *Thrust SSC* Car = ____________________

C. *TGV* (France) Train = _________________

D. *Spirit of Australia* Boat = ________________

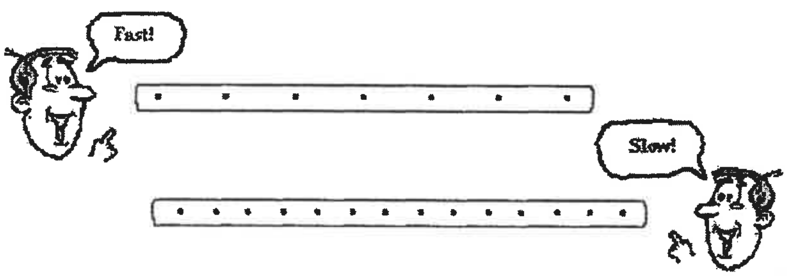
E. *Lockhead SR71* Airplane = ________________



Representing Motion

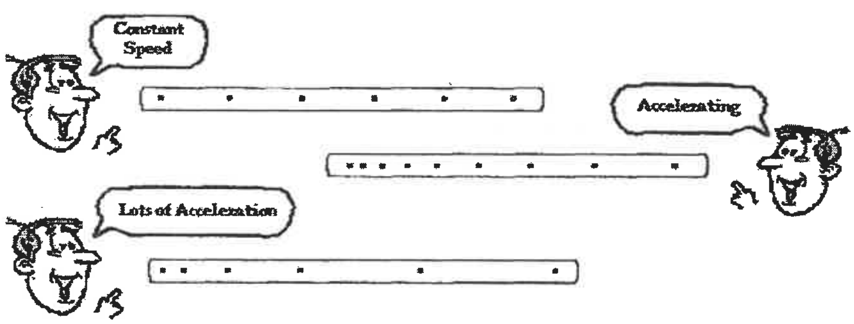
Ticker Tape Diagrams

- A *tape* is attached to an object and threaded through a device that places a tick at regular intervals of time.
- As the object moves, it drags the tape through the "ticker," thus leaving a trail of dots.
- The distance between dots represents the object's position change during that time interval.



- A ________________ distance between dots indicates that the object was moving ________________ while a ________________ distance means the object was moving ________________.

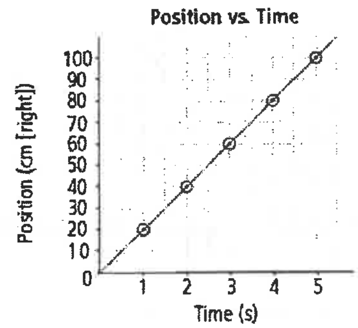
- A ________________ distance between dots indicates a changing velocity and thus an ________________.
- A ________________ distance between dots represents a constant velocity and therefore ________________.



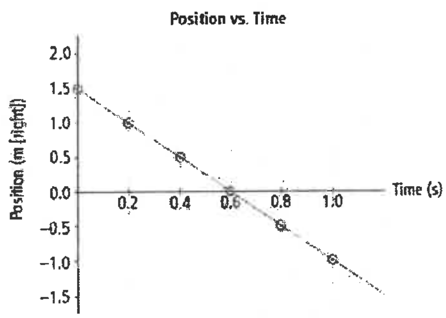
Graphing Motion

- A position-time graph plots position data on the vertical axis (y-axis) and time on the horizontal axis (x-axis).
- Uniform motion is represented by a ________________ on a position-time graph.

- ________________ Slope:
    - Slants up to the right.
    - Indicates an object travelling in the positive direction (ie: North, East, to the right, up, etc.)



- ________________ Slope:
    - Horizontal line.
    - Indicates that the object is stationary.

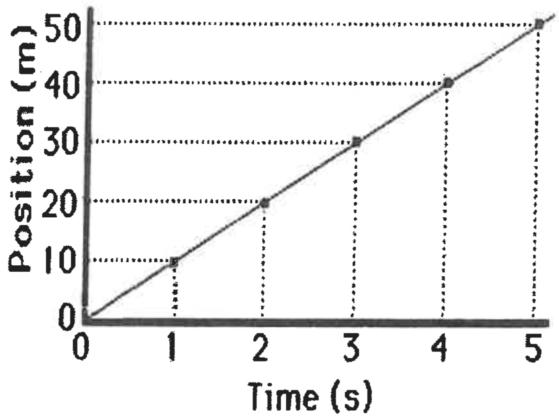


- ________________ Slope:
    - Slants down to the right.
    - Indicates an object travelling in the negative direction (ie: South, West, to the left, down, etc.)

<u>Calculating Slope of a P-T Graph</u>

- The slope of a graph is represented by:

1. Pick two points on the line and determine their coordinates.
2. Determine the difference in y-coordinates (*rise*).
3. Determine the difference in x-coordinates (*run*).
4. Divide the difference in y-coordinates by the difference in x-coordinates (rise/run or slope).



For points (5 s, 50 m) and (0 s, 0 m):

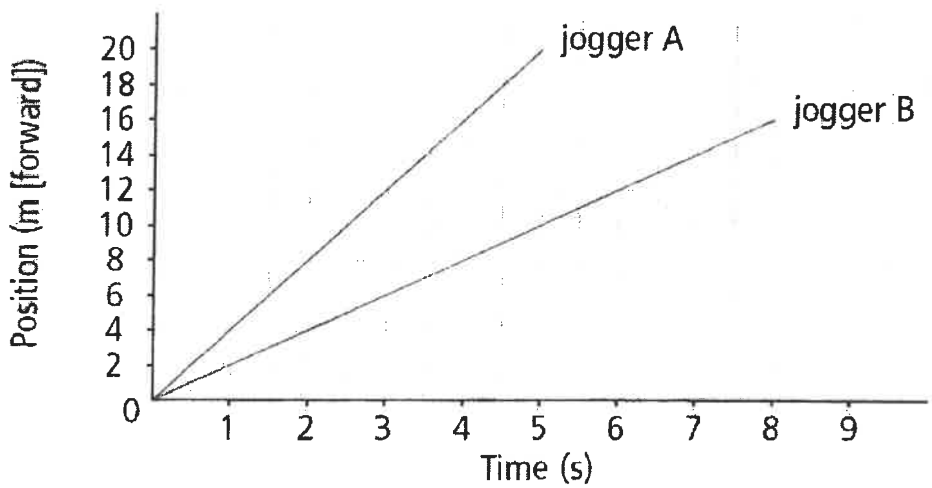
$$\text{slope} = \frac{50\,m - 0\,m}{5\,s - 0\,s} = 10\ m/s$$

For points (5 s, 50 m) and (2 s, 20 m):

$$\text{slope} = \frac{50\,m - 20\,m}{5\,s - 2\,s} = 10\ m/s$$

For example: Which jogger's motion has a greater slope?
Which jogger is moving faster?
What is the slope of each line?
What is each jogger's speed?

Position vs. Time



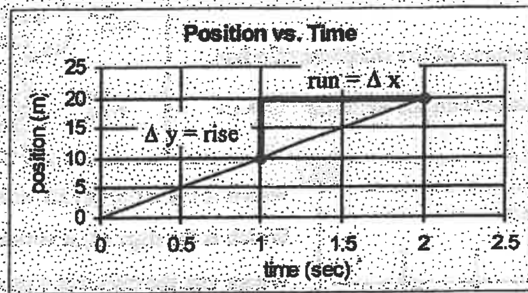
Solution:

*Note: On a position-time graph the slope is the change in position divided by the change in time. We know this as <u>speed!</u> *

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 –

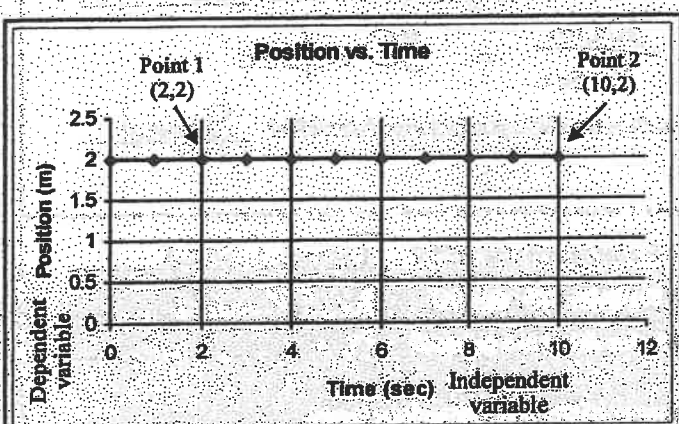
Slope for the above graph:

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

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

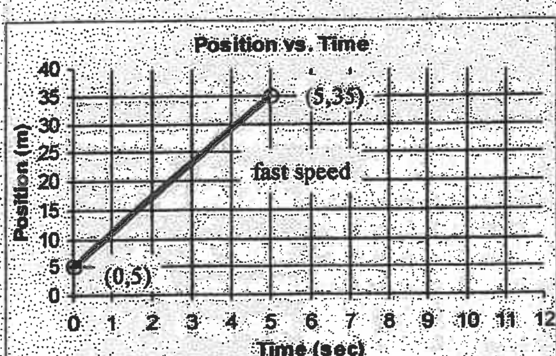
Linear graph.

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

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

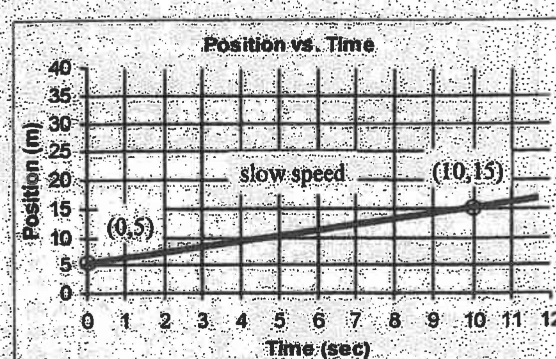
$$\frac{(2 - 2)\text{m}}{(10 - 2)\text{ sec}} = \frac{0\text{ m}}{8\text{ sec}} = 0\text{ m/s}$$

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



Steep slope—fast speed

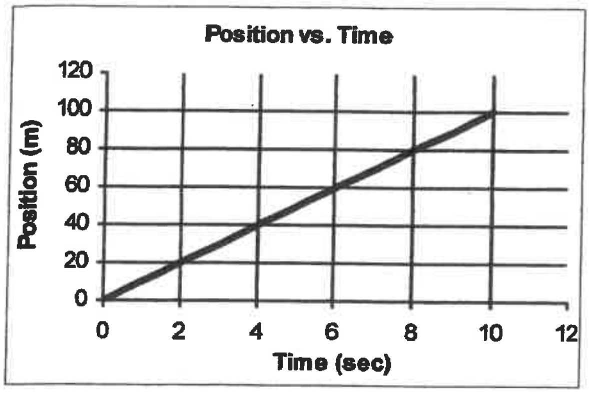
Gradual slope—slow speed



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

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

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 meters/sec meters cm/sec
3. Dependent variable	C. The measure of the steepness of a line.	sec miles/hour km/min $\frac{meter}{sec^2}$
4. Slope	D. The variable on the horizontal axis (x-axis).	



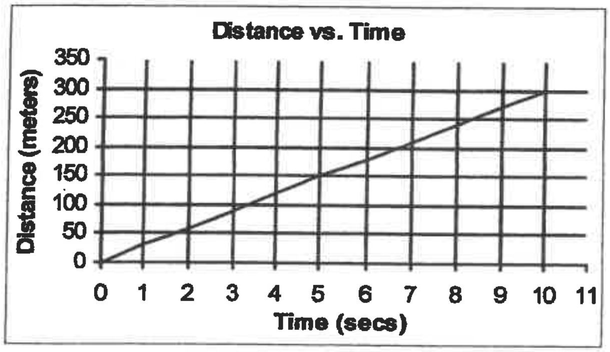
Which is the independent variable? ____________

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? ____________

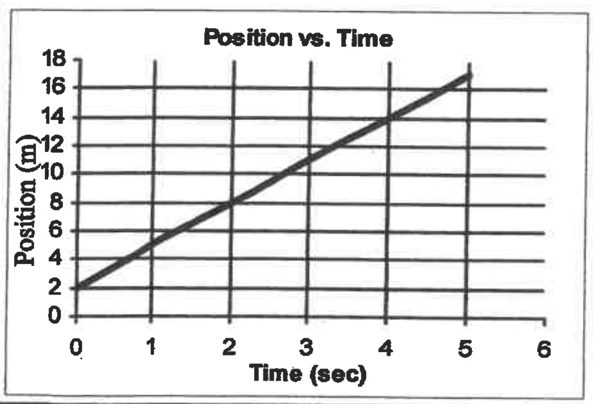


When did the object reach 150 meters? ____________

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? ____________

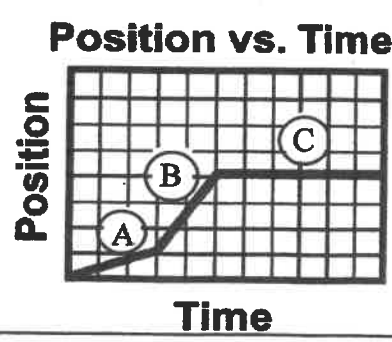
Find the slope of the graph (must show work)

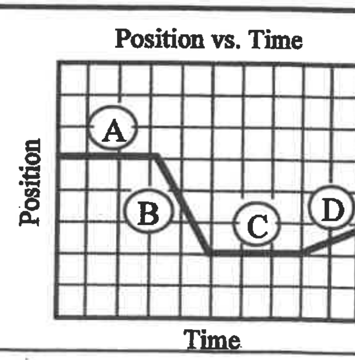
What does the slope you just found stand for? ____________

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:

1-10

Understanding Concepts

1. Explain, in your own words, why a graph is sometimes more useful than an equation.
2. What does the slope of a distance–time graph represent?
3. What interpretation can be made about a moving car if the line on a distance–time graph for the car has the following characteristics?
   (a) a high or steep slope
   (b) a low or less steep slope
   (c) a zero slope
   (d) a short line on the graph
   (e) a long line on the graph
4. Sketch a distance–time graph for a car cruising at 80 km/h.
5. A car leaves Borden-Carleton, PEI, on its way across the Confederation Bridge into New Brunswick. The distances and times from the toll booth in PEI are listed in **Table 4**. They include a short stretch of road beyond the end of the 12.9-km bridge.

Table 4 **Car Crossing Confederation Bridge**

Time (min)	Distance (km)
0.0	0.0
2.0	2.4
4.0	4.8
6.0	7.2
8.0	9.6
10.0	12.0
12.0	14.4

   (a) Plot a distance–time graph using the information in **Table 4**. Draw a best-fit straight line.
   (b) Using your graph, find the distance travelled after 5.0 min.
   (c) Using your graph, find the time required to cross the bridge.
   (d) Was the speed constant during the car's trip across the Confederation Bridge? How do you know?
   (e) Calculate the slope of the graph. What does this slope represent?
   (f) What is the speed of the car in kilometres per hour?
6. In **Figure 5**, the motion of two bicycle riders, Tom and Jerry, is described on a distance–time graph.

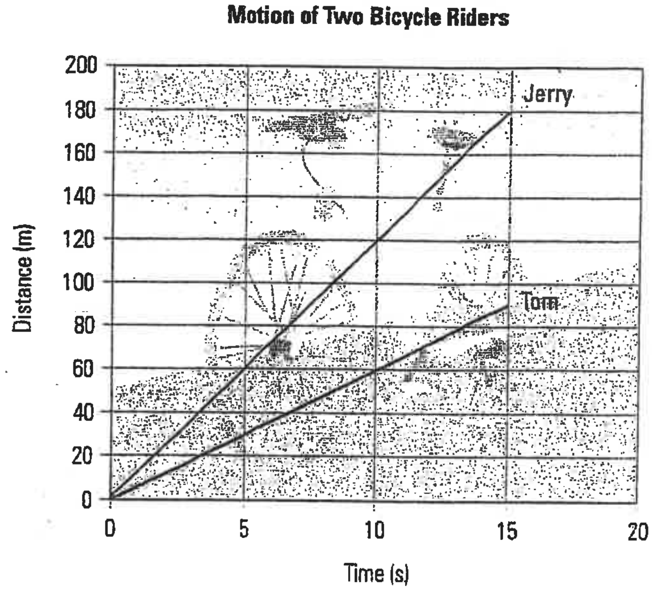


Figure 5
These two cyclists are travelling at different speeds.

   (a) From a qualitative observation of the lines on the graph, which rider has the greater speed?
   (b) Calculate the speed of each rider by determining the slope of each line. Does this quantitative result match your answer to (a)?
   (c) If one of the bicycle riders suddenly stopped, how would the graph of that rider change?

Reflecting

7. When studying motion in physics, it is customary to plot time on the horizontal axis and distance on the vertical axis even if distance is the independent variable in a particular experiment. Suggest a reason for this general rule.

Work the Web

Visit www.nelson.science.com and follow the links from Science 10, 9.7 to research the times for the top five finishers in the most recent Toronto Indy race. Compare their average speeds. Other than the characteristics of each car, what are some factors that affect the average speed over the whole race?

Challenge

3 You will need to create graphs to illustrate how cars, travelling at different speeds, cover different distances in the same amount of time. What will be plotted on each axis? What units will you use?

Graphing

Graph Paper for #5

1–11

DATE: NAME: CLASS:

CHAPTER 9
REINFORCEMENT

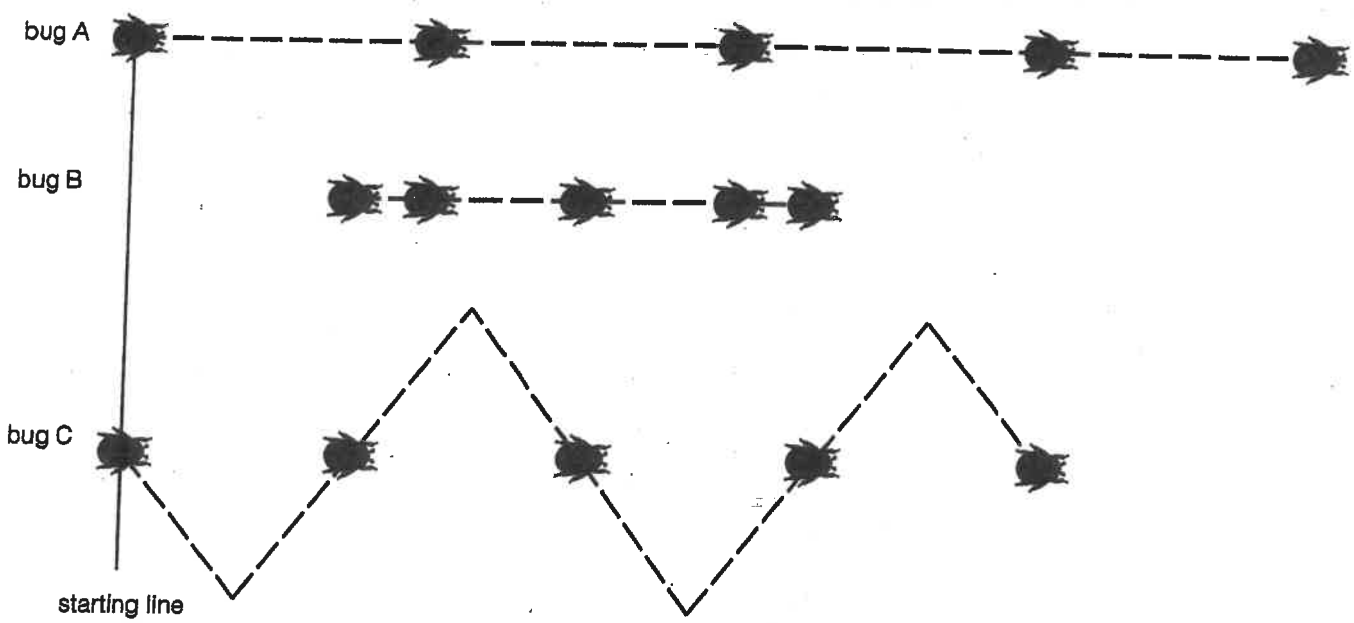
The Bug Race

BLM 9-11

Goal • Investigate the terminology of motion, and practise calculating distance and displacement.

What to Do

The diagrams below show three bugs as they move across a table. The time interval between each picture is 1.0 s. The first picture of each bug is at time 0 s. The dotted line indicates the path taken by each bug.



1. Fill in the following table with the time and position of each bug at each picture. Use a ruler to measure carefully. Make all your measurements from the starting line (displacement 0 m).

Time (s)	Position (cm)		
	Bug A	Bug B	Bug C
0			
1			
2			
3			
4			

The Bug Race (continued)

2. Draw a position-time graph for each bug on the same set of axes. Use a different colour for each bug.

The Bug Race (continued)

3. (a) Calculate the displacement of each bug, from its starting position, after 4 s.

Displacement of bug A =

Displacement of bug B =

Displacement of bug C =

(b) Which bug had the greatest displacement? ____________________

(c) Which bug had the greatest speed? ____________________

(d) Are your answers to parts (b) and (c) the same? Explain why or why not.

4. (a) Use your ruler to find the total distance (length of the path travelled) for each bug. Be careful when measuring the distance for bug C.

Distance for bug A = ____________________

Distance for bug B = ____________________

Distance for bug C = ____________________

(b) Which bug travelled the greatest distance? Why?

5. Which bug(s) was/were accelerating? How can you tell?

6. The information for bug C in the table and graph does not tell the whole story. Explain.

The Bug Race (continued)

7. Why are the spaces between the pictures of bug A bigger than the spaces between the pictures of bug B?

8. Why do the spaces between the pictures of bug A stay the same?

9. Why do the spaces between the pictures of bug B change?

10. (a) How can you tell when an object is speeding up?

(b) How can you tell when an object is slowing down?

(c) How can you tell when an object has a constant velocity?

1-1.2

DATE: NAME: CLASS:

CHAPTER 10
REINFORCEMENT

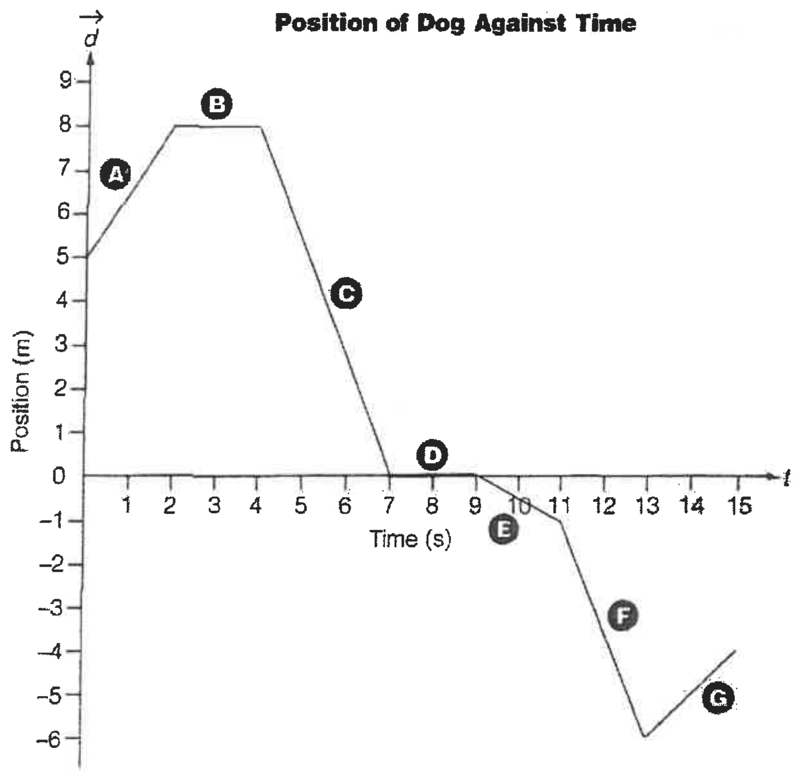
Describing Position-Time Graphs

BLM 10-1

Goal • Describe the motion represented on a position-time graph.

What to Do

A dog starts to walk from a position that is 5.0 m to the right of its owner. A graph of the dog's motion is below.



Examine the position-time graph carefully. Write one sentence to describe the motion of the dog in each section. Describe both speed and direction.

A. ______________________________

____

B. ______________________________

____

C. ______________________________

____

D. ______________________________

____

Describing Position-Time Graphs (continued)

E. ____

____

F. ____

____

G. ____

____

Acceleration

Acceleration is ____

Acceleration can result from a change in speed (________________________), a change in direction (back, forth, up, down left, right), or changes in both.

The pitcher throws. The ball speeds toward the batter. Off the bat it goes. It's going, going, gone! A home run!

Before landing, the ball went through several changes in motion. It sped up in the pitcher's hand, and lost speed as it traveled toward the batter. The ball stopped when it hit the bat, changed direction, sped up again, and eventually slowed down. Most examples of motion involve similar changes. In fact, rarely does any object's motion stay the same for very long.

In science, ____

____

Examples:

- A car decelerates when it stops at a red light. A water skier decelerates when the boat stops pulling.

- A softball accelerates when it changes direction as it is hit.

Calculating Acceleration

$$\text{Acceleration} = \frac{\textit{change in velocity}}{\textit{time taken}}$$

$$\text{Acceleration} = \frac{\textit{final velocity} - \textit{initial velocity}}{\textit{time taken}}$$

$$a = \frac{Vf - Vi}{t}$$

Examples:

1. As a roller-coaster car starts down a slope, its speed is 4 m/s. But 3 seconds later, at the bottom, its speed is 22 m/s. What is its average acceleration?

2. A roller coasters velocity at the top of the hill is 10 m/s. Two seconds later it reaches the bottom of the hill with a velocity of 26 m/s. What is the acceleration of the coaster?

3. The velocity of a train is 39 m/s. At an acceleration of $-2.0\ m/s^2$, how much time is required for the train to decrease its velocity to 8.5 m/s ?

4. A snowboarder, starting at rest, accelerates at $2.1\ m/s^2$. How fast is the snowboarder going at 12 seconds?

DATE: NAME: CLASS:

CHAPTER 11
SCIENCE INQUIRY

BLM 11-2

Recognizing Accelerated Motion

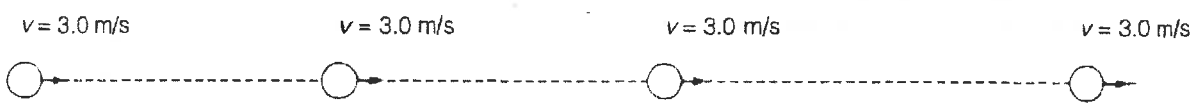
Goal • Determine whether an object is accelerating or moving with uniform motion.

What to Do

Answer each question in the space provided.

1. Carefully examine each diagram below. Decide whether the diagram represents accelerated or uniform motion, and explain your reasons. Any dotted lines indicate the path of the object.

(a)

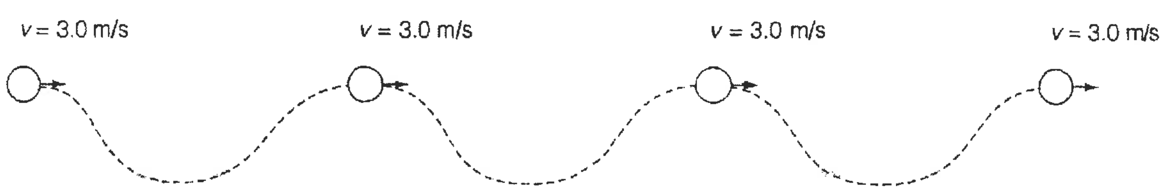


Type of motion: ______________________

Explanation: ______________________

____

(b)



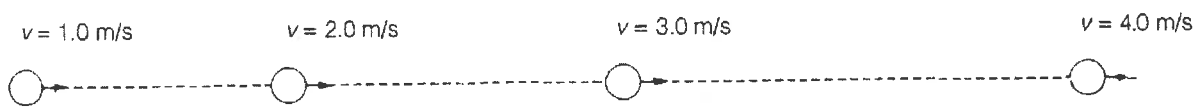
Type of motion: ______________________

Explanation: ______________________

____

Recognizing Accelerated Motion (continued)

(c)

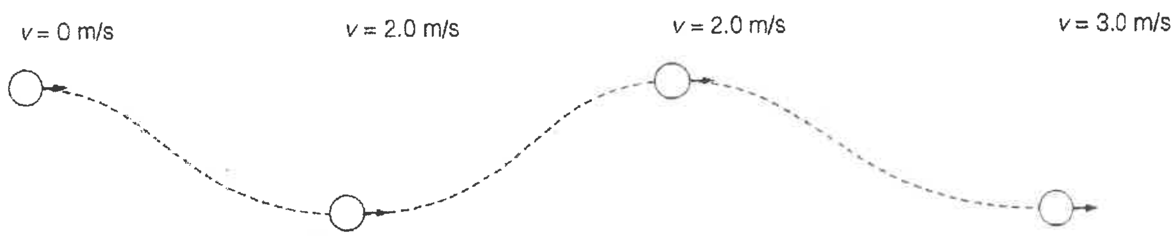


Type of motion: ____________________

Explanation: ____________________

____

(d)

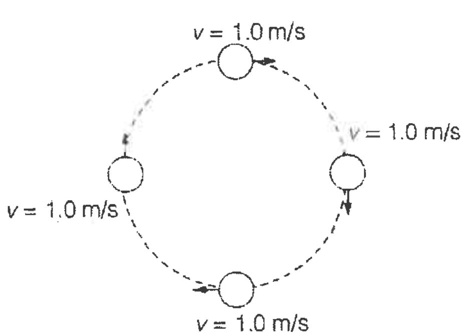


Type of motion: ____________________

Explanation: ____________________

____

(e)



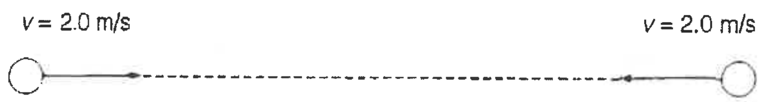
Type of motion: ____________________

Explanation: ____________________

____

Recognizing Accelerated Motion (continued)

(f)



Type of motion: ______________________________

Explanation: ______________________________

____

2. (a) Under what conditions is an object moving with uniform motion?

____

____

____

(b) Under what conditions is an object accelerating?

____

____

____

1-14

Acceleration Assignment

Equations:

$$\text{Acceleration} = \frac{\text{Final velocity} - \text{Initial velocity}}{\text{Time}} \qquad \text{Time} = \frac{\text{Final Velocity} - \text{Initial Velocity}}{\text{Acceleration}}$$

1. The Concorde jetliner achieves a lift-off speed of 112m/s in 20.0s, starting from rest. What is the acceleration?

2. A motorboat accelerated from rest to a final speed of 6.0m/s in a time of 3.0s. What is the acceleration of the motorboat?

3. A bottle-nosed dolphin is cruising along at 2.2m/s, and accelerates to 9.7m/s in 15s. What is the dolphin's acceleration?

4. A driver is traveling at 12.0m/s, and sees a light turn red. The driver applies the brakes, and the car accelerates at $-6.20 m/s^2$ until it stops. How long does it take the car to stop?

5. The velocity of a train is 26.4m/s. At an acceleration of $-1.50 m/s^2$, how much time is required for the train to decrease its velocity to 9.72m/s?

6. A skier, starting from rest, accelerates at $1.6 m/s^2$. How fast is the skier going after 5.0s?

7. A water balloon is dropped from a building. It starts at rest and accelerates at $9.8 m/s^2$ due to gravity. How fast is the balloon going after 3 seconds?

8. A roller coaster car rapidly picks up speed as it rolls down a slope. As it starts down the slope, its speed is 4 m/s. But 3 seconds later, at the bottom of the slope, its speed is 22 m/s. What is its average acceleration?

9. A cyclist accelerates from 0 m/s to 8 m/s in 3 seconds. What is his acceleration ? Is this acceleration higher than that of a car which accelerates from 0 to 30 m/s in 8 seconds?

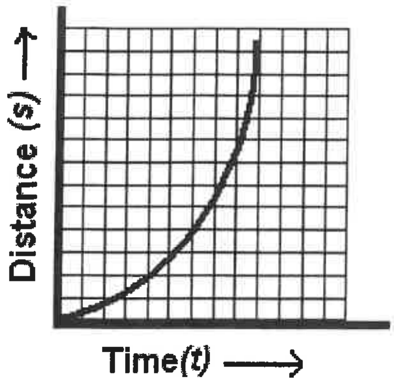
10. A car advertisement states that a certain car can accelerate from rest to 70 km/h in 7 seconds. Find the car's average acceleration.

14. A lizard accelerates from 2 m/s to 10 m/s in 4 seconds. What is the lizard's average acceleration?

12. If a Ferrari, with an initial velocity of 10 m/s, accelerates at a rate of 50 m/s/s for 3 seconds, what will its final velocity be?

Representing Acceleration: Velocity - Time Graphs

- Recall: When graphing non-uniform motion on a distance - time graph we get the resulting type of graph

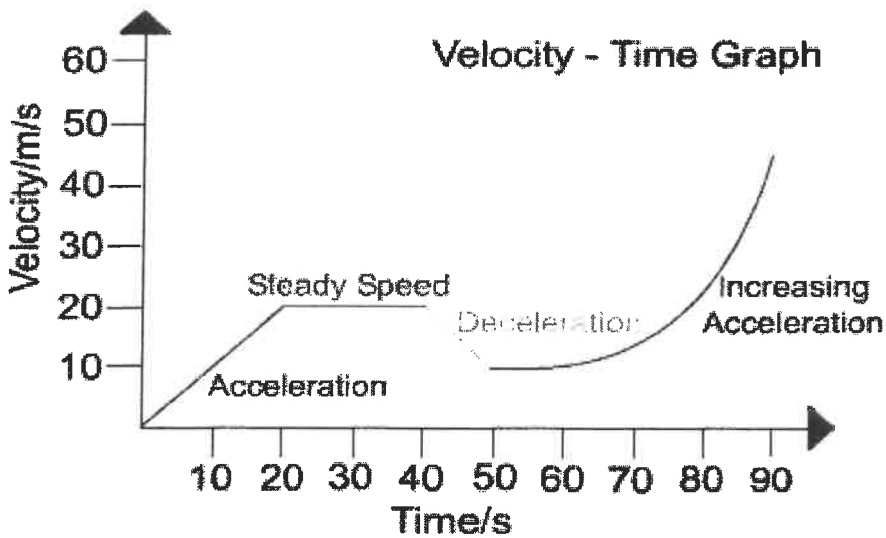


Distance-time graph for a car moving with non-uniform speed

- Curved lines are much more difficult to work with (we know the car's speed is increasing, but by how much)
- To simplify analysis, we plot non-uniform motion on a

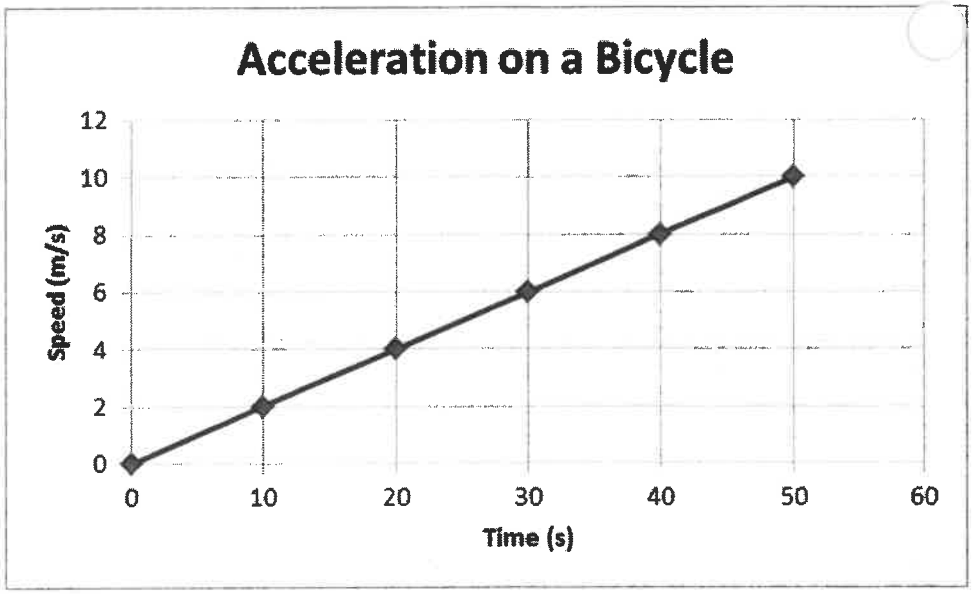
____

- **Velocity-Time Graph:** shows the relationship between velocity (speed) and time
  : __________is plotted on the y-axis and ________is plotted on the x-axis
  : the resulting line represents the ________________________



- Example: Acceleration on a Bicycle

Time (s)	Speed (m/s)
0.0	0.0
10.0	2.0
20.0	4.0
30.0	6.0
40.0	8.0
50.0	10.0



- A velocity-time graph can be used to:
    - ______________________________
    - ______________________________

Understanding Concepts

1. How can you tell from a speed–time table whether an object is accelerating?
2. How can you tell from a speed–time graph whether an object is accelerating?
3. Sketch a speed–time graph with two separate labelled lines for
   (a) high positive acceleration;
   (b) low negative acceleration.
4. What feature of a speed–time graph communicates
   (a) the acceleration?
   (b) the distance travelled?
5. Two runners, Cathryn and Keir, take part in a fundraising marathon. The graph in **Figure 7** shows how their speeds change for the first 100 s from the start of the marathon.

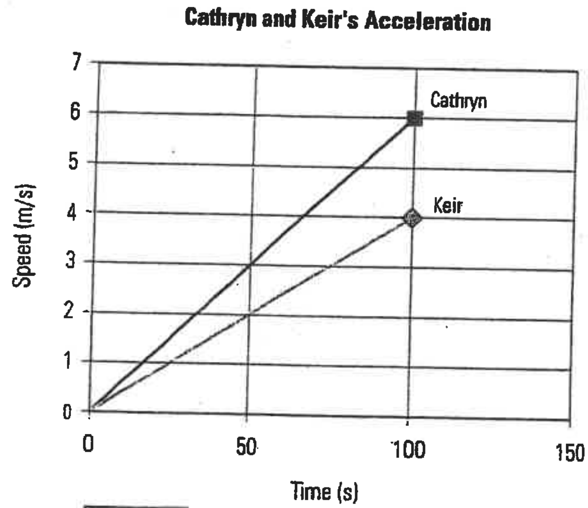


Figure 7

   (a) Which runner has the greater acceleration? Show this by calculating the acceleration of each.
   (b) Which runner is ahead after 100 s? Calculate and compare the distance travelled by each.
6. The cheetah is the fastest land animal and can accelerate rapidly in an attack. **Table 3** shows some typical speeds and times for a cheetah.
   (a) Draw a speed–time graph using the information in **Table 3**.
   (b) Using your graph, calculate the average acceleration of the cheetah.
   (c) Using your graph, calculate the total distance travelled by the cheetah by the end of 2.0 s.

Table 3 Acceleration of Cheetah

Time (s)	Speed (m/s)
0.0	0.0
0.5	5.0
1.0	10.0
1.5	15.0
2.0	20.0

7. Create a scientific question about the acceleration characteristics of different vehicles. State the variables clearly.
8. Sketch and label distance–time and speed–time graphs for constant speed and a speed–time graph for constant acceleration (three graphs in total).
9. Why does $\Delta d = v_{av}\Delta t$ but $A = \frac{1}{2}hb$? Where does the half (1/2) come from? If $\Delta d = A$ and $\Delta t = b$, then why does $v_{av} = \frac{1}{2}h$?
10. Draw a speed–time graph for your movements as you go from your desk in the classroom to the pencil sharpener.
11. Clayton sets out on his motorcycle. His speed at different times is shown on the graph in **Figure 8**.

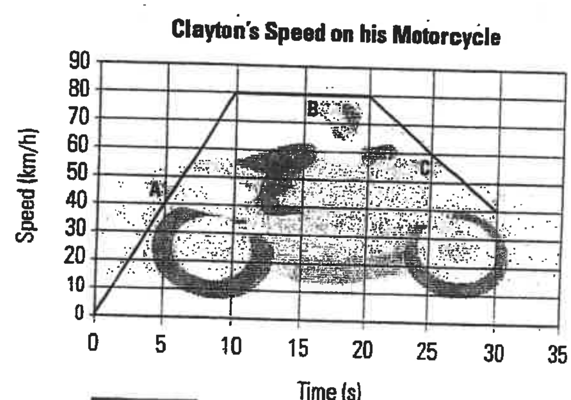


Figure 8

   (a) Calculate the accelerations during each of the time intervals, A, B, and C.
   (b) Without calculating, list the time intervals during which the distances travelled are, in order, from largest to smallest.

Reflecting

12. What assumption have you been making about acceleration in this chapter?

Graphing   Asking the Questions

1-15

DATE: NAME: CLASS:

CHAPTER 11
SCIENCE INQUIRY

BLM 11-10

Velocity-Time Graphs

Goal • Examine the relationships between velocity-time graphs and acceleration.

What to Do

Answer each question in the space provided. A motion detector was used to gather all the data in the tables.

1. Use the data in each table to draw a velocity-time graph. Then calculate the slope of the graph.

(a)

t (s)	$\vec{v}$ (m/s)	$\vec{a}$ (m/s^2)
0	0	2
1	2	2
2	4	2
3	6	2
4	8	2
5	10	2

Slope of velocity-time graph =

How does the slope of the line compare with the acceleration of the object?

____

DATE: NAME: CLASS:

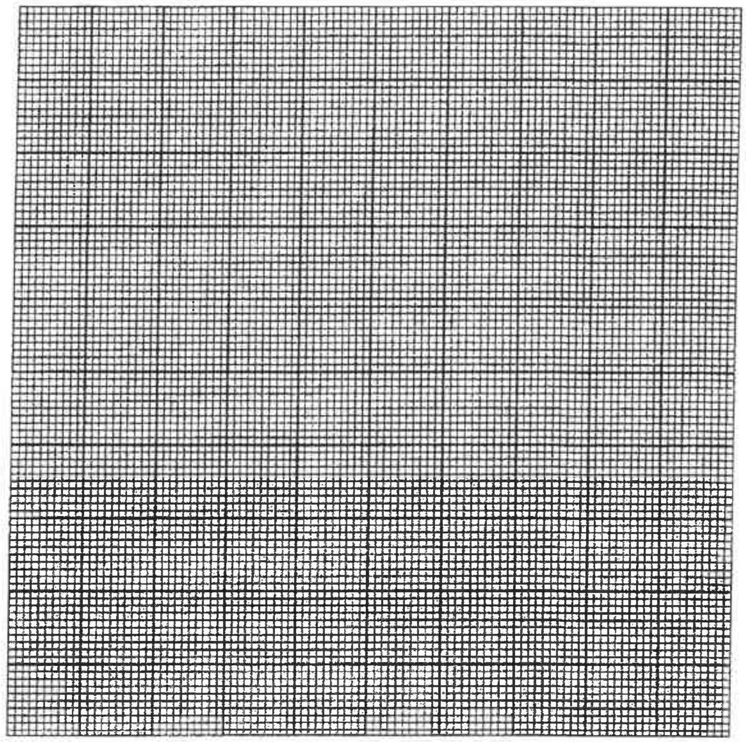
CHAPTER 11
SCIENCE INQUIRY

Velocity-Time Graphs (continued)

BLM 11-10

(b)

t (s)	$\vec{v}$ (m/s)	$\vec{a}$ (m/s²)
0	30	–5
1	25	–5
2	20	–5
3	15	–5
4	10	–5
5	5	–5



Slope of velocity-time graph =

How does the slope of the line compare with the acceleration of the object?

____

Science 10 Review -- Motion In Our World

1. Distinguish between the following:
   A. Distance and displacement
   B. Average speed and instantaneous speed
   C. Velocity and acceleration
   D. Uniform and non-uniform motion

2. Explain how an object can be both at rest and in motion at the same time.

3. The data below represents the motion of a cruise ship.

Time(s)	Distance from a buoy (m)
0	0
10	80
20	155
30	225
40	290
50	345
60	390
70	447
80	560
90	635
100	700

a) Graph the data. b) Use the graph to calculate the average speed.

4. Jacob roller-blades to school, a total distance of 4.5 km. He has to slow down twice to cross some busy streets, but overall the journey takes him 0.62 h. What is his average speed?

5. In 1997, Thrust SSC, the world's fastest jet-engine car, traveled 604 m at an average speed of 341 m/s. What length of time did this take?

6. A downhill skier moving at 2.5 m/s accelerates to 20.0 m/s in a time of 3.8s. Calculate the acceleration of the skier.

7. A baseball player running at 6.0 m/s slides into home plate and stops in 2.5s. What is the acceleration?

8. Jason is coasting on his skateboard at 1.4 m/s and decides to speed up. If he accelerates at 0.50 m/s^2 for 7.0s, what is his final speed?

9. The following data represents the Launching a Space Shuttle

Time (s)	Speed (m/s)
0.8	4.6
1.6	7.2
2.4	10.4
3.2	12.1
3.6	14.2
4.0	15.0
4.4	16.1
4.8	17.3
5.2	191.0

a) Graph the data
b) Use the graph to calculate the average acceleration.
c) Using the graph, calculate how far the shuttle travelled in 4.0 seconds.