Chapter 1

Introduction

CLASS ACTIVITY:

Tapping into Prior Knowledge

The rotational graffiti activity will stimulate discussion about the concepts of motion that the students have already acquired. The context of vehicles and traffic provides an avenue for students to relate motion to their everyday personal experience.

Car Crash – Who Is to Blame?

This class activity provides a problem to which the students will return as their knowledge of motion increases. Terms such as speed, acceleration, force, friction, momentum, and energy will be discussed. At this time, there is no need to clarify the terms, as this will be done all in good time.

SUGGESTED ACTIVITY:

From their everyday experience, students should have some understanding of speed, distance, and time interval. Before vector quantities like velocity and displacement are studied, a class activity relating speed, distance, and time interval can be performed.

A battery-operated toy truck or tractor is allowed to move across the floor. In small groups, students are asked to describe the motion. Then they are to share their descriptions with the class. They are encouraged to use whatever words they can that are related to motion.

The students are asked how they would measure this motion. The procedure should involve measuring the time required for the toy to travel a certain distance. This information can be used to calculate speed using the speed-equals-distance-traveled-over-time interval.

This is a good place to introduce some symbolism. The relationship for speed is:
speed = distance traveled/time interval **or** $v = \Delta d/\Delta t$.

The fact that the speed remains constant indicates that the speed is uniform and we call this uniform motion.

Once speed has been measured, the speed equation can be used to predict the distance traveled in a given time. Also, the speed equation can be used to calculate the time required for the toy to travel a certain distance. Students should realize that equations are very useful tools that allow us to make predictions for the outcome of events based on the given information.

While the emphasis for the *In Motion* cluster is not mathematical calculations, it is useful to lay the groundwork for problem solving. Using the speed relationship, students can be instructed in a systematic method of problem solving. Links should be made to the students' mathematics knowledge. If a pattern is developed that the students can follow, it will ensure success in their endeavours.

Speed, Distance Traveled, Time

1. Jose rides his bicycle from his home to school. He travels 6.25 km in 0.550 hour. What is his average speed for the trip?

2. Kevin is warming up for the basketball game. He does three laps around the gym. Each lap is 75.0 metres. It takes Kevin 42.8 seconds to run the three laps.

a. What distance did Kevin run?

b. What was his average speed?

3. April and Ashleigh run a 100-m race. April finishes the race in 13.25 s and Ashleigh takes 13.50 s. What is the average speed with which April and Ashleigh each run the 100 m?

4. Matt skateboards at 3.25 m/s for 55.0 s. How far did he travel?

5. Edward rollerblades around Kildonan Park. He skates at 7.75 m/s for 12.5 minutes.

a. How many seconds was he skating?

b. How far did he skate?

6. Edgar travels to the mall at an average speed of 28.0 km/h. The mall is located 8.00 km from Edgar's home. How long in hours does it take Edgar to travel from his home to the mall?

7. A ladybug is crawling across the floor in a straight line at 1.25 cm/s. The ladybug crawls 3.25 m.

a. What distance in cm does the ladybug crawl?

b. How long does the ladybug take to crawl this distance?

8. You and your family are traveling from Winnipeg to Brandon. The distance from Winnipeg to Brandon is 200 km. If you travel at a speed of 105 km/h, how long will it take to travel from Winnipeg to Brandon?

9. When you get to Brandon, you stop for lunch. This takes one hour. You then travel from Brandon to Regina, a distance of 385 km, in 3.75 hours. What was your average speed?

10. a. How far is it from Winnipeg to Regina?

b. How long did it take you and your family to travel from Winnipeg to Regina? (Hint: state the total time, including while you were eating.)

c. What was your average speed for this whole trip from Winnipeg to Regina?

In Motion Worksheet—Speed, Distance, Time

Note: Three significant digits are used in the final answer.

1. $\Delta d = 6.25$ km

$\Delta t = 0.550$ hours

v = __________

$v = \Delta d/\Delta t$

$v = 6.25$ km / 0.550 h

$v = 11.36 = 11.4$ km/h

2. 1 lap = 75.0 m

Kevin runs 3 laps

$\Delta t = 42.8$ s

a. Δd = ________

Kevin runs 3 laps x 75.0 m/lap = 225 m

b. v = ________

$v = \Delta d / \Delta t = 225$ m / 42.8 s

$v = 5.2570 = 5.26$ m/s

3. $\Delta d = 100$ m

April's time = $\Delta t_{April} = 13.25$ s

Ashleigh's time = $\Delta t_{Ashleigh}$ 13.50 s

v_{April} = __________

$v_{Ashleigh}$ = __________

$v_{April} = \Delta d / \Delta t_{April} = 100m / 13.25$ s

$v_{April} = 7.547 = 7.55$ m/s

$v_{Ashleigh} = \Delta d / \Delta t_{Ashleigh} = 100m / 13.50$ s

$v_{Ashleigh} = 7.4074 = 7.41$ m/s

4. $v = 3.25$ m/s

$\Delta t = 55.0$ s

Δd = __________

$v = \Delta d / \Delta t$

3.25 m/s = Δd / 55.0s

3.25 m/s x 55.0 s = Δd

$\Delta d = 178.75 = 179$ m

5. $v = 7.75$ m/s

$\Delta t = 12.5$ minutes

Δd = __________

a. 1 minute = 60 s

12.5 minutes = 12.5 min x 60s/min = 750 s

b. $v = \Delta d / \Delta t$

7.75 m/s = Δd / 750 s

7.75 m/s x 750 s = Δd

$\Delta d = 5812.5 = 5810$ m

6. $v = 28.0$ km/h
$\Delta d = 8.00$ km
$\Delta t =$ __________

$v = \Delta d / \Delta t$
28.0 km/h $= 8.00$ km $/ \Delta t$
28.0 km/h x $\Delta t = 8.00$ km
$\Delta t = 8.00$ km $/ 28.0$ km/h
$\Delta t = 0.28571 = 0.286$ h

7. $v = 1.25$ cm/s
$\Delta d = 3.25$ m
$\Delta t =$ __________

a. Δd in metres
1 m = 100 cm
3.25 m = 3.25 m x 100 cm/m = 325 cm

b. $v = \Delta d / \Delta t$
1.25 cm/s $= 325$ cm $/ \Delta t$
1.25 cm/s x $\Delta t = 325$ cm
$\Delta t = 325$ cm $/ 1.25$ cm/s $= 260$ s

8. $\Delta d_{W-B} = 200$ km
$v_{W-B} = 105$ km/h
$\Delta t_{W-B} =$ __________

$v_{W-B} = \Delta d_{W-B} / \Delta t_{W-B}$
105 km/h $= 200$ km $/ \Delta t_{W-B}$
105 km x $\Delta t_{W-B} = 200$ km
$\Delta t_{W-B} = 200$ km $/ 105$ km/h
$\Delta t_{W-B} = 1.90476 = 1.90$ h

9. $\Delta d_{B-R} = 385$ km
$\Delta t_{B-R} = 3.75$ h
$v_{B-R} =$ __________

$v_{B-R} = \Delta d_{B-R} / \Delta t_{B-R}$
$v_{B-R} = 385$ km $/ 3.75$ h $= 102.666 = 103$ km/h

10. **a.** $\Delta d_{W-B} = 200$ km
$\Delta d_{B-R} = 385$ km
$\Delta d_{W-R} =$ __________

$\Delta d_{W-R} = \Delta d_{W-B} + \Delta d_{B-R}$
$\Delta d_{W-R} = 200$ km $+ 385$ km $= 585$ km

b. $\Delta t_{W-B} = 1.90$ h
$\Delta t_{lunch} = 1.00$ h
$\Delta t_{B-R} = 3.75$ h

$\Delta t_{total} = \Delta t_{W-B} + \Delta t_{lunch} + \Delta t_{B-R}$
$\Delta t_{total} = 1.90$ h $+ 1.00$ h $+ 3.75$ h $= 6.65$ h

c. $v_{ave} = \Delta d_{W-R} / \Delta t_{total} = 585$ km $/ 6.65$ h $= 87.9699$
$v_{ave} = 88.0$ km/h