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Managing the Soccer Team

A unit on rate and proportionality

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Managing the Soccer Team

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Warm Up

1. Calculate to the nearest hundredth.

A.	B.	C.
50÷11	50÷9	40÷9

Main

Managing the Soccer Team

For the next 2 weeks, you are the soccer team manager. In this mathematics unit on rate and proportionality, you will solve problems that are very close to what a team manager would actually have to do. You will use software that helps you understand rates and proportionality using animations, graphs, and tables.

From: Sun Bay Middle School principal
To:_____ (you!)

Have we got a job for you! The soccer season is just about to start. The soccer team manager just moved to Georgia. Will you please be our acting soccer team manager?

There is so much to do:

- Keep track of players' running speeds during practice.
- Keep track of fuel costs for the van and bus.
- Find the best deals for uniforms and practice supplies.
- Understand past problems on road trips.

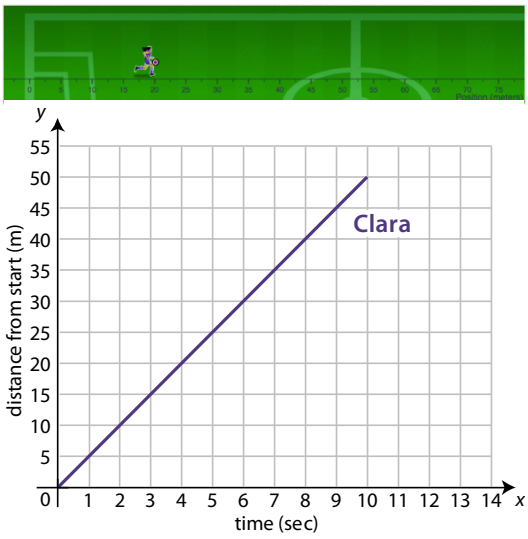
We expect that you'll improve your math skills too!

Welcome to the soccer team!

Good luck, have fun, work hard!

To improve their speed, the soccer players run sprints at the track. Our software shows animations and graphs of these sprints.

2. Clara was the first racer. Open Activity 1.2. Watch the animation of Clara's sprint.



A. Pay attention to the animated world. Describe Clara's sprint.

B. Press Play again. Pay attention to the graph. Describe what happens to the graph as Clara runs.

C. How far did Clara run?

Clara ran ☐ meters.

D. Explain two ways you can find distance in the software.

In the graph: ☐

In the animation: ☐

E. Explain two ways you can find time in the software.

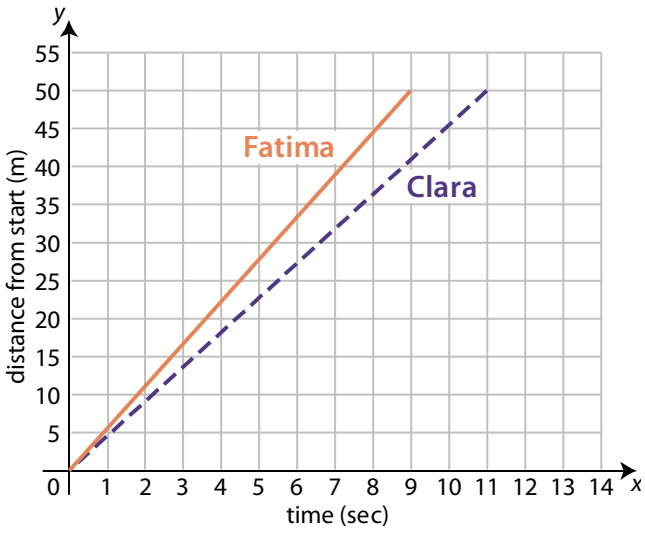
F. How can we calculate her speed?

Speed

Speed describes how fast something is going.
Speed is a rate that relates distance and time.

3. Next, Clara and Fatima ran a race. Use Activity 1.3 to watch the animation of their race.

A. Describe the race.



B. Who ran faster?

C. Who won the race?

D. Explain two ways that you know who won the race.

E. What is the total distance of the race?

[ ] meters

F. What's the total time each girl took to complete the race?

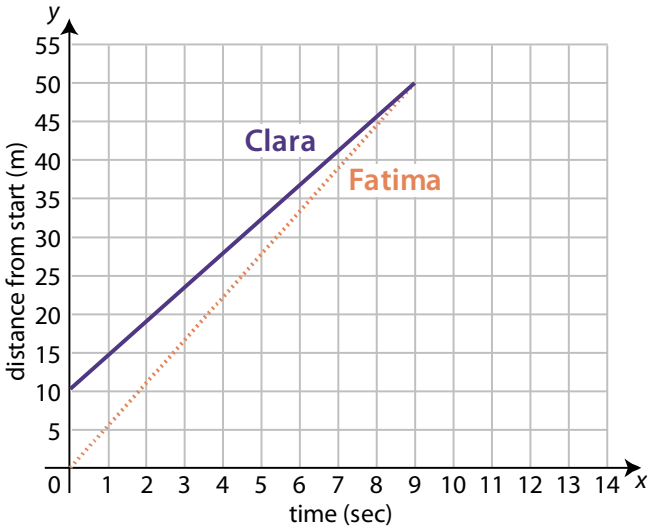
Clara took [ ] seconds to finish the race.

Fatima took [ ] seconds to finish the race.

G. How fast was each girl running?

4. Clara and Fatima raced again. Use Activity 1.4 to watch the animation of their second race.

A. What happened in this race that was different from the other race?



B. Who was running faster? How do you know?

[ ] ran faster.

I know this because...

C. How fast was each girl running?

D. How do you know how fast each girl was running?

E. How can you find the speed of any racer?

Wrap Up

5. Compare and contrast the two races in questions 3 and 4. How were the races similar? How were the races different?

Problem Solving

6. Find out about as many of the speeds below as you can. Use a stopwatch, an Internet search, encyclopedia, or almanac.

A. Your walking speed

B. Typical human walking speed

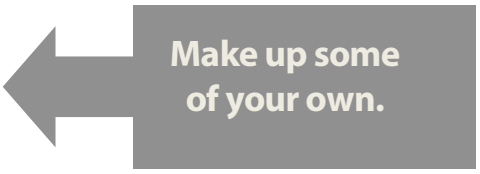
C. Record for high schooler's 100-meter sprint

D. World record, 100-meter sprint

E. Average speed of a black ant

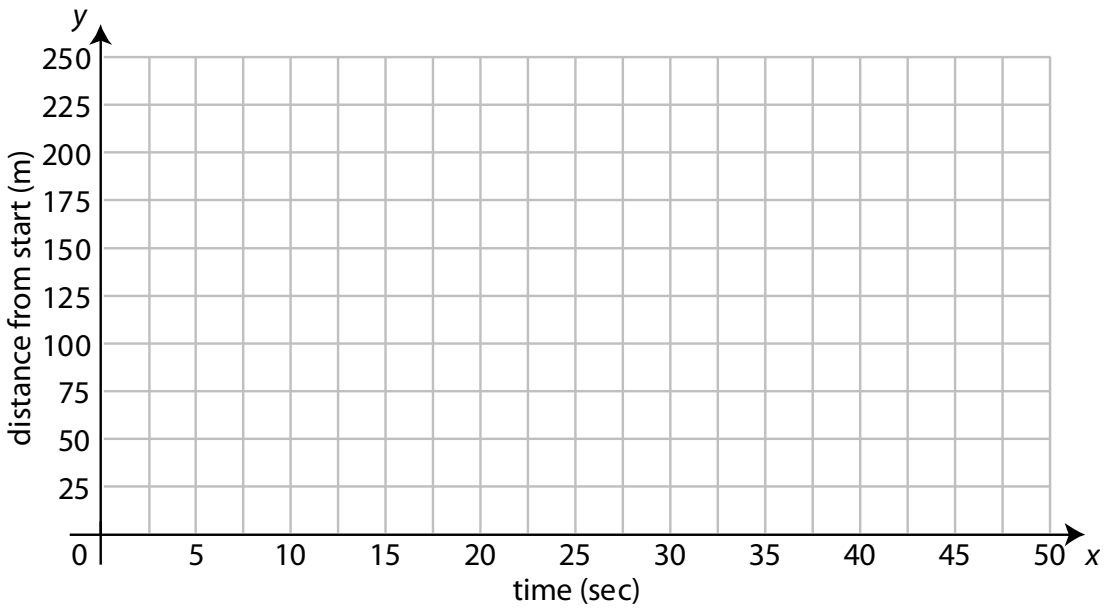
F. Speed limit on the road or street nearest your home

G.

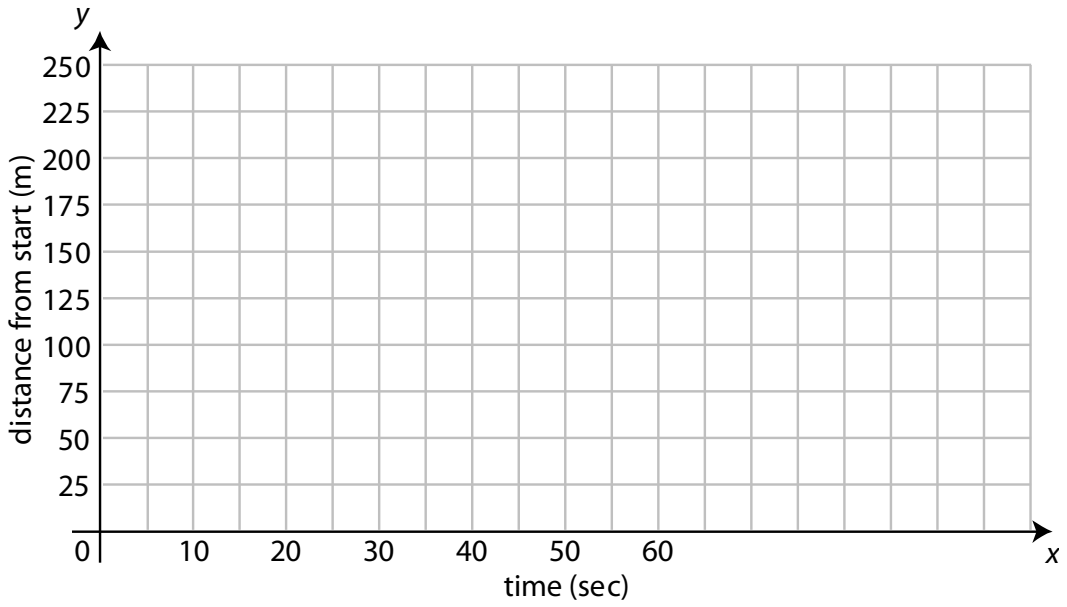


H.

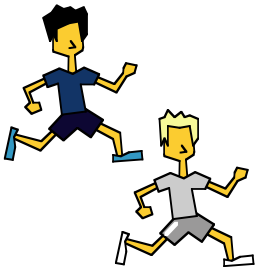
7. Draw graphs for a race in which Mila and Shawntee ran 150 meters. Shawntee finished in 30 seconds. Mila finished in 25 seconds.



8. Draw graphs for a race in which Kim and Andy ran 200 meters. Kim finished in 50 seconds. She came in ahead of Andy by 5 seconds.



Investigation 2: Another Race Day



Warm Up

1. Calculate to the nearest hundredth.

A.	B.	C.
25÷6	50÷10	100÷20

Main

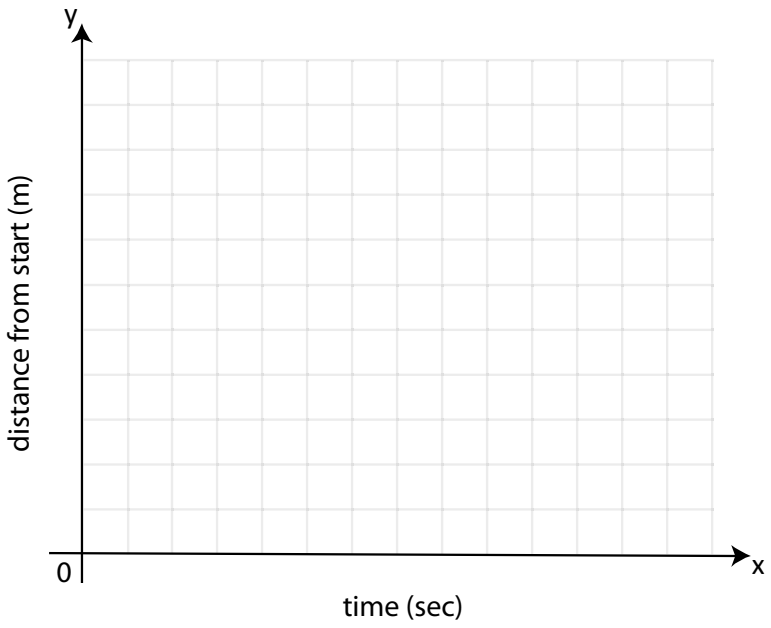
Next, Andy and Kim run sprints. Use Activity 2.1 to watch their race.

2. Watch the race several times. Describe what this animation shows.

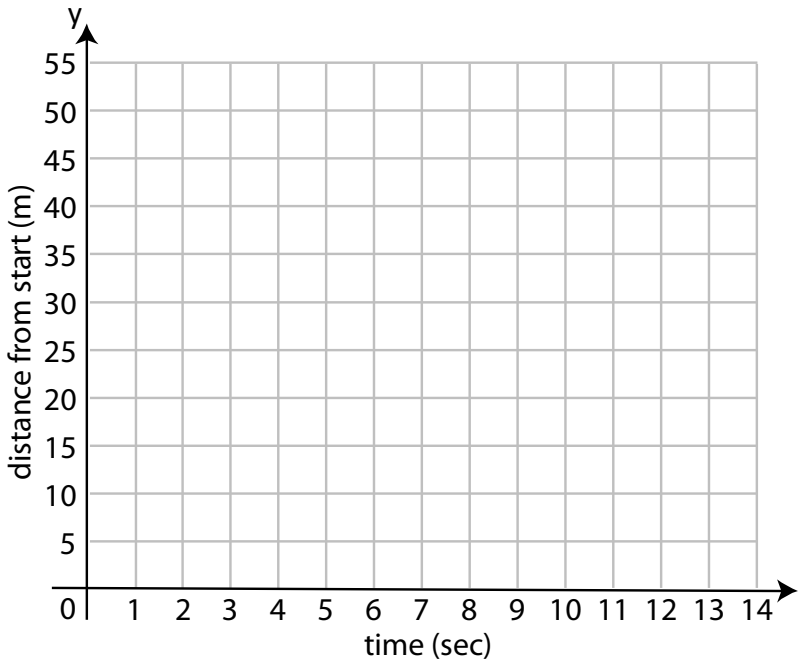
Sketching

When you sketch, you draw an approximate start and endpoint of a line with an approximated slant. This should be quick, like a prediction. If you plot many points and then connect them, it's not a sketch

3. In your notebook, copy the axes below, and *sketch* a graph of Andy and Kim's sprint.



A. In your notebook copy the graph below. Use the Step button and other controls to make a graph below that is more precise than your sketch.



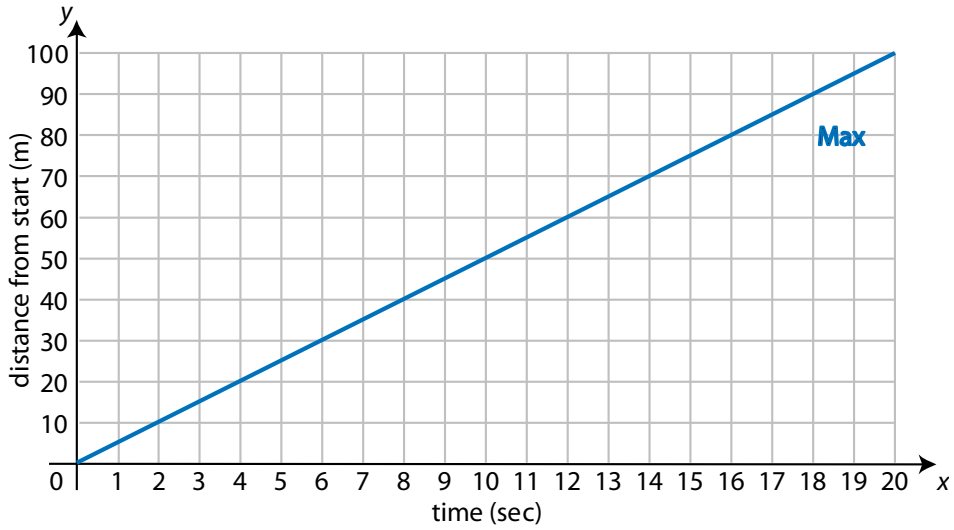
B. In your notebook, copy the table below. On Andy's graph, label 3 points. Then write the coordinate points (ordered pairs) in the table. Explain what they mean in terms of the race.

Points	In the race
(6, 25)	Andy ran 25 meters in 6 seconds.

C. In your notebook, copy the table below. On Kim's graph, label 3 points. Then write the coordinate points (ordered pairs) in the table. Explain what they mean in terms of the race.

Points	In the race

4. Max and Nola run longer sprints next. They run 100 meters. The blue line shows what you recorded for Max's 100-meter sprint. All you know about Nola's time is that she won the race.



A. **Predict.** In your notebook copy the graph. D raw what you think Nola's graph might look like, and label three points.

B. **Check**. Use Activity 2.2 to enter your prediction. Run the animation to view the race.

C. **Explain**. Was your prediction correct? How do you know? If not, change the graph to make Nola win the race.

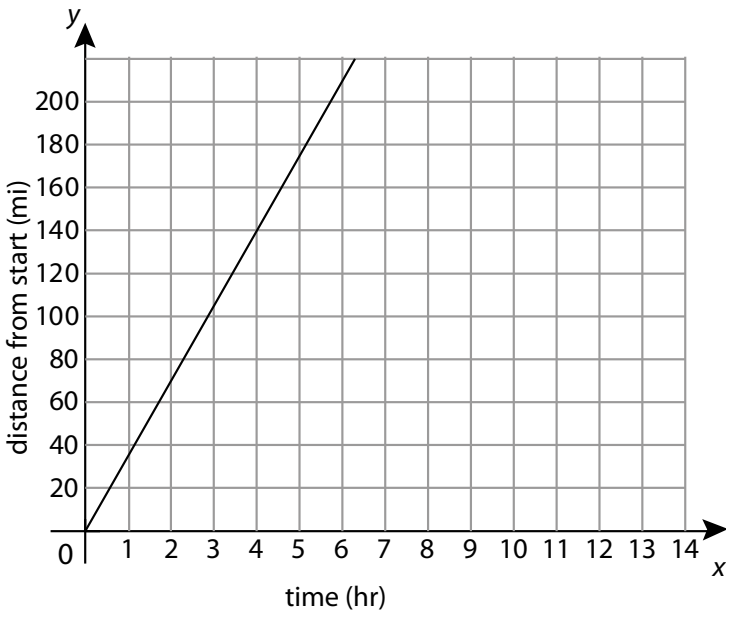
D. How far ahead of Max was Nola when she crossed the finish line?

E. How much faster was Nola than Max? Describe how you found out.

Wrap Up

5. The line represents a car traveling at a constant speed.

A. Pick a point on the line and write the coordinates. What do the coordinates mean in terms of motion?



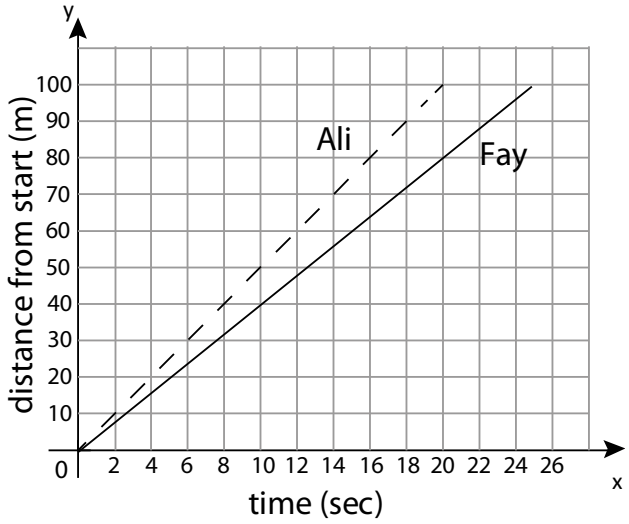
B. Calculate the speed using the point you picked.

C. Describe how you can find speed using the coordinates.

D. Describe how you can find speed using this graph of a line that goes through the origin.

Problem Solving

6. The graph shows Ali and Fay's race.



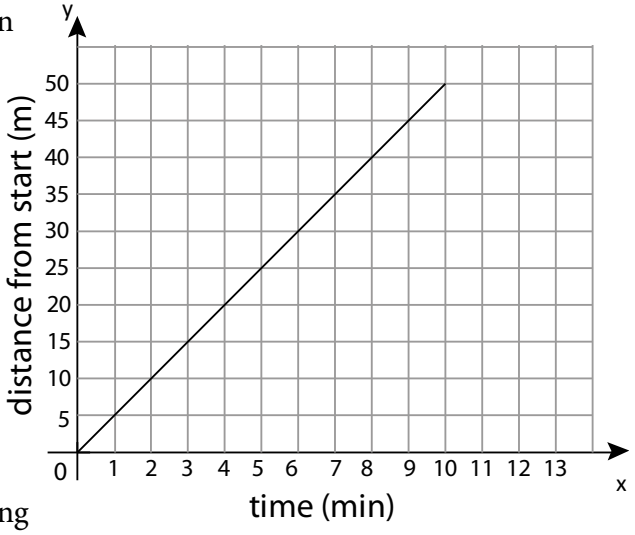
A. Who won the race?

B. At 10 seconds, who was ahead? By how much?

C. At 10 seconds, how fast was Ali running?

D. Find Ali and Fay's speeds.

7. The graph shows a turtle's motion in a race.



A. How fast was the turtle moving at 5 minutes?

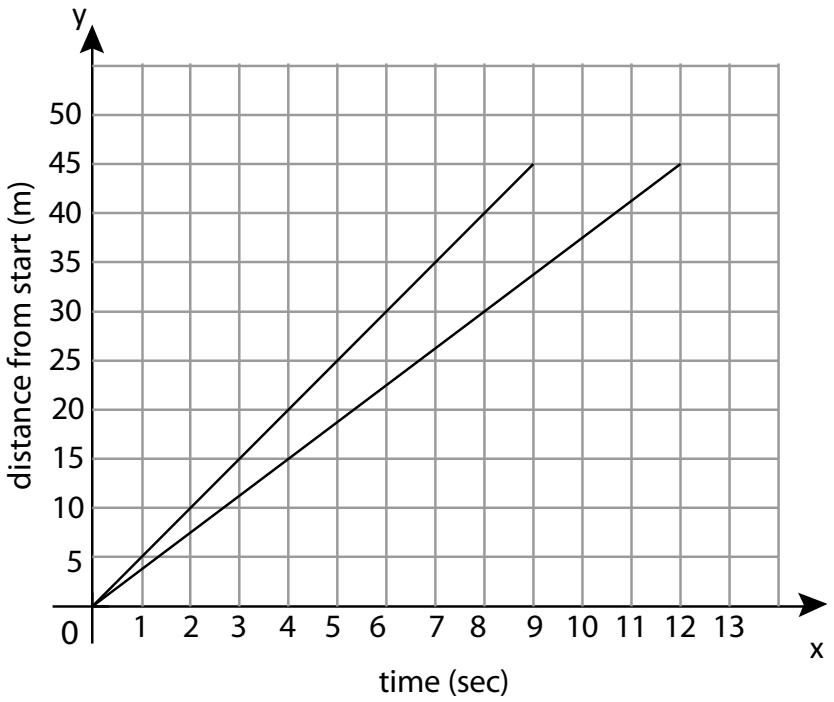
B. How fast was the turtle moving at 8 minutes?

C. Find the speed of the turtle using the endpoint.

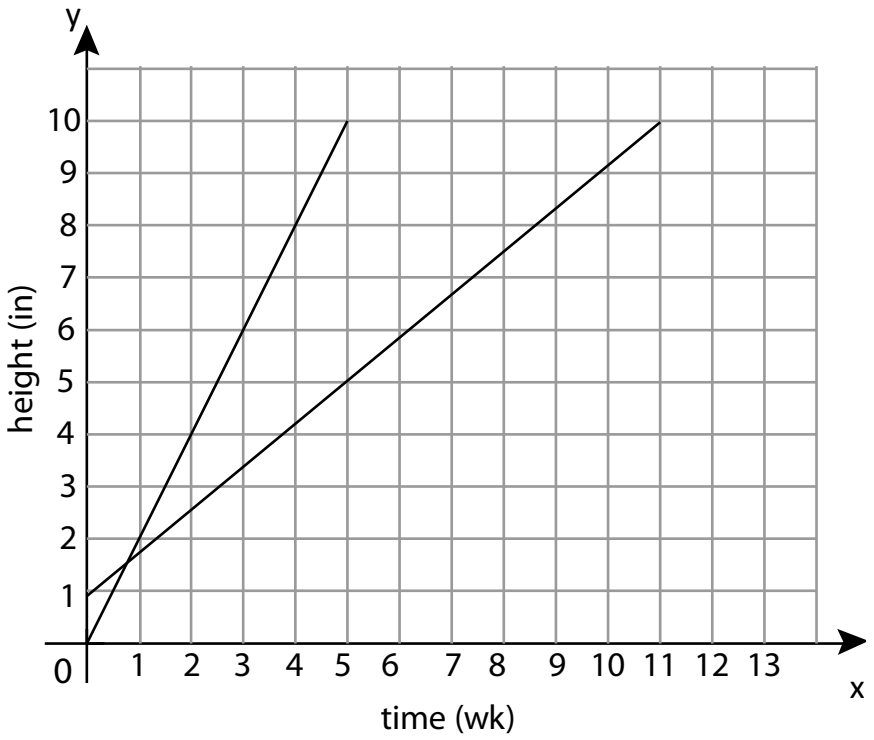
D. Describe the turtle's speed throughout the race.

8. Label the graph lines with the given names:

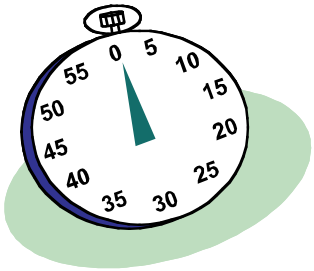
A. Mateo runs faster than Lucas.



B. Plant A grows faster than Plant B.



Investigation 3: Isabella Improves



Warm Up

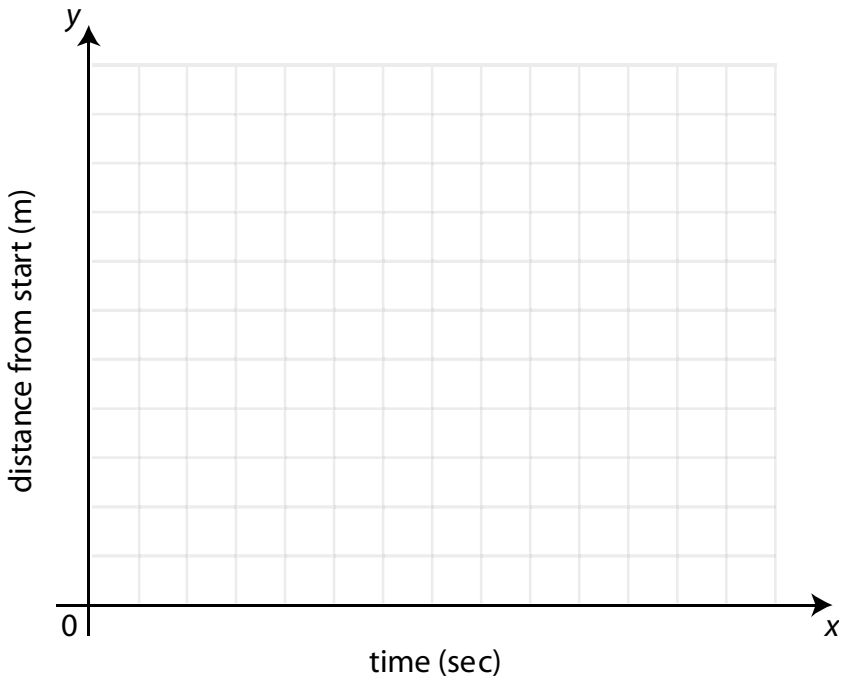
1. Calculate to the nearest hundredth.

A.	B.	C.	D.
50÷14	50÷13	50÷12	50÷11

Main

2. Isabella ran 50-meter sprints all week, trying to improve her speed. Her first sprint took 14 seconds. For the next 3 days, she improved her time by 1 second each day.

A. **Predict**. In your notebook, copy the axes below. *Sketch* a graph that shows all four of her sprints.



B. **Check**. Use Activity 3.1 to run the animation several times. Observe the relationship between the animation and the graphs.

C. **Explain.** Was your prediction right? Why or why not?

D. Describe what the graph and the animation show.

E. Describe patterns you see among the graph lines for the four sprints.

3. As Isabella's time decreased by 1 second on each sprint, what happened to her speed? Let's investigate.

A. In your notebook, copy and complete this table.

Sprint	Distance (in meters)	Time (in seconds)	Speed (in meters/second)
1st			
2nd			
3rd			
4th			

B. Describe and explain the relationship between time and speed in the table.

Wrap Up

4. Frankie, who manages the track team, heard about your sprint graphing and wants to do it too. Tell him how to do it. Be sure to use terms like time and distance, x- and y-axis.

A. Describe how to graph sprints on time and distance axes.

B. Describe how to use the graph to say which runner went faster. Explain why this works.

C. Describe how to calculate the speed of a runner.

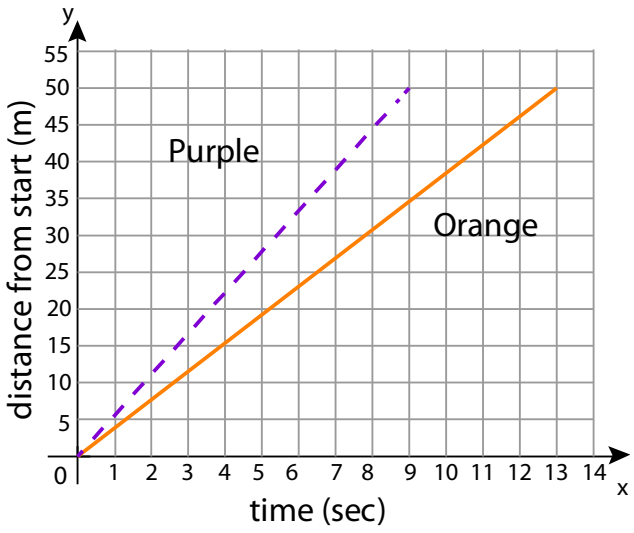
Problem Solving: Practice Runs

The following graphs show two racers, Orange Runner and Purple Runner. Say who is going faster and who won for each race. Explain your reasoning.

5. First Race

D. _____ is going faster, because…

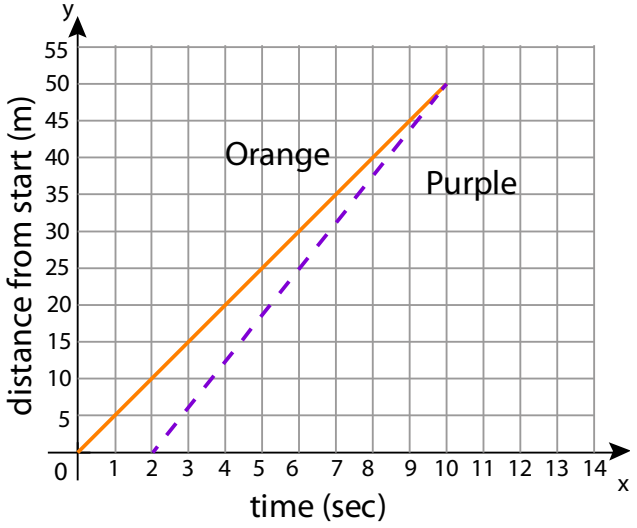
E. _____ won the race, because…



6. Second Race

A. _____ is going faster because…

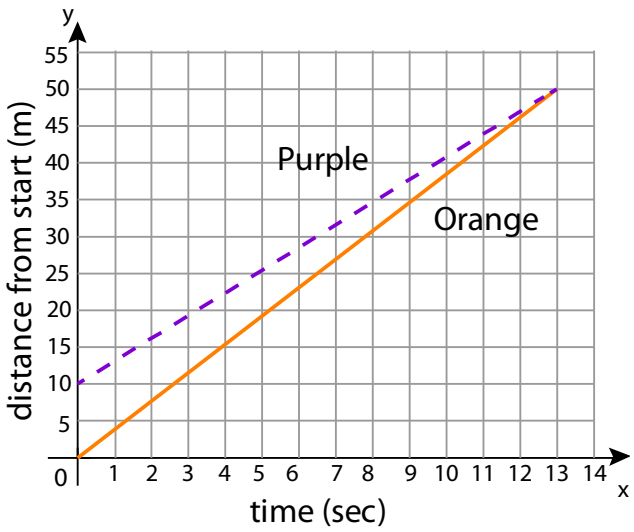
B. _____ won the race because…



7. Third Race

A. [ ] is going faster because…

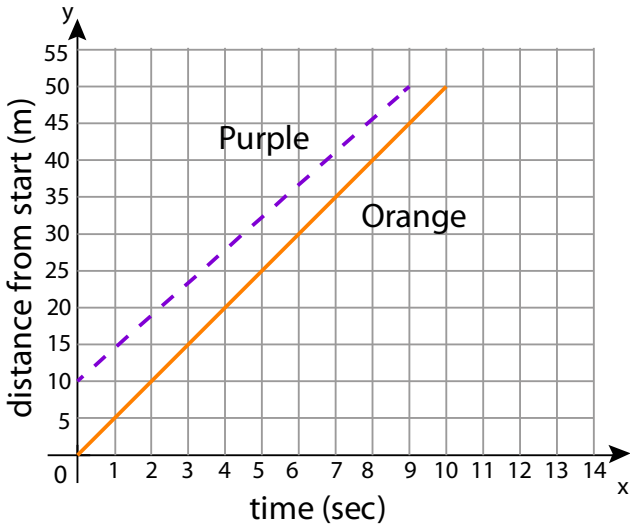
B. [ ] won the race because…



8. Fourth Race

A. [ ] is going faster…

B. [ ] won the race because…



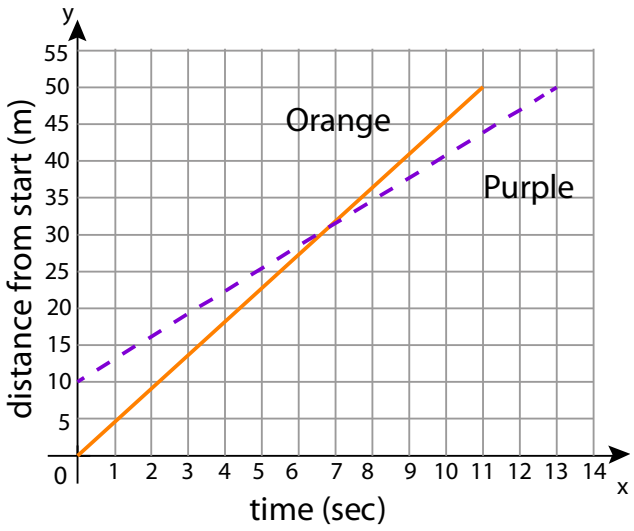
Investigation 4: Run, Jace, Run

Warm Up

1. Calculate to the nearest hundredth.

A.	B.	C.
25÷4	65÷13	42÷12

2. Orange and Purple run a 50-meter race. Who is going faster and who won the race? How do you know?



Main

3. Use Activity 4.1 to watch the animation and graph of Jace's sprint.

A. How many seconds has Jace run when he gets to 25 meters? ☐

B. How many seconds has Jace run when he gets to 50 meters? ☐

C. In your notebook, copy the table on the next page. Fill it in with this information.

4. Let's assume that Jace can keep running at the same speed for a long time. Answer the questions and fill in the table as you go.

A. **Predict**. If Jace keeps going at the same speed (rate), how long do you think it will take him to run…

100 meters? _____

200 meters? _____

Time (seconds)	Distance (meters)
	25
	50
	100
	200

B. **Check.** Use the triangle on the *x*-axis to extend Jace's graph from 8 seconds to your predicted time to check your prediction.

C. **Explain.** Was your prediction correct? Why or why not?

D. When Jace has run for 15 seconds, how far do you think he has run? (This is not in the table.)

5. Use the table and the graph to help you describe Jace's run in words and symbols.

A. What is Jace's speed? Show your work.

B. For every second Jace runs, he travels a distance of ☐ meters. This is the unit rate.

C. What do you do to find the distance Jace has run?

To find the distance Jace has run…

D. Write an equation that expresses the relationship between time (in seconds) and distance (in meters) for Jace's speed.

☐ where d is the distance (in meters) Jace has traveled and t is the time (in number of seconds) he has gone

6. In your notebook, copy the table below. Use your equation to complete the table. This is the same table as in Question 4, with different rows.

Equation

☐

Time (in seconds)	**Distance (in meters)**
4	25
6	
	62.5
	87.5
20	
15	
30	

7. Write equations for the following tables, assuming a constant speed for each table:

A.

Time (in seconds)	Distance (in meters)
100	300
115	345
200	600
4	12
10	30

Equation:

B.

Time (in seconds)	Distance (in yards)
4	20
8	40
10	50
13	65
17	85

Equation:

C.

Time (in seconds)	Distance (in feet)
10	35
11	38.5
12	42
13	45.5
14	49

Equation:

Wrap Up

8. Let's look at the connections and patterns in this lesson.

A. Describe patterns that you see in your completed tables.

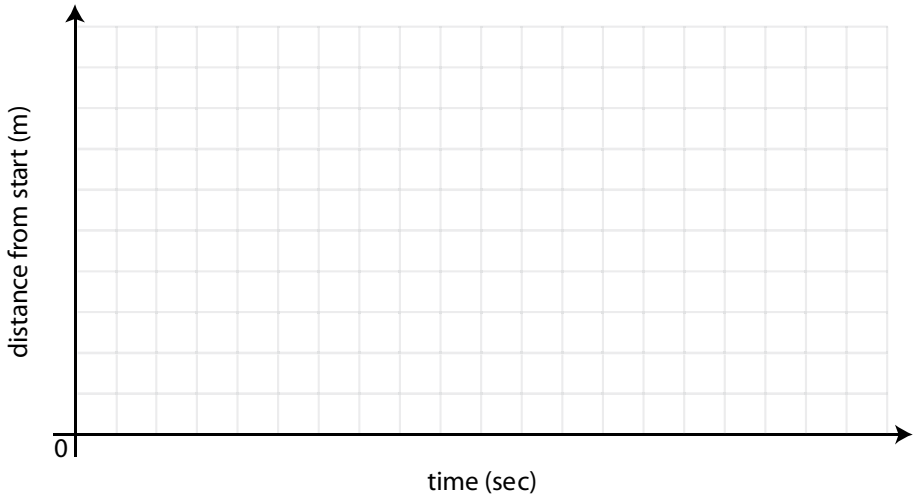
B. Explain connections between the patterns in the table and the equation you wrote in 5D.

Problem Solving: More Practice Runs

Write the equation and *sketch* a graph that would match each description.

9. Ken ran 100 meters in 25 seconds.

GRAPH

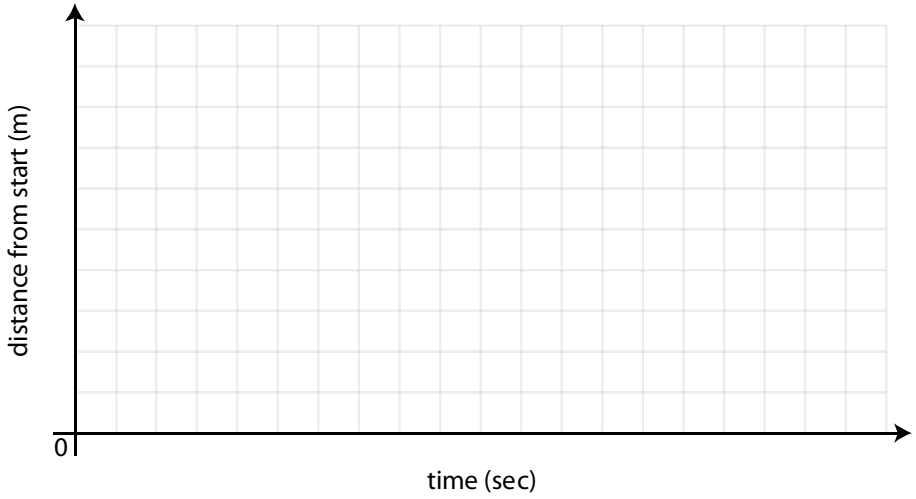


EQUATION

$d = \square t$

10. Robin ran 200 meters in 40 seconds.

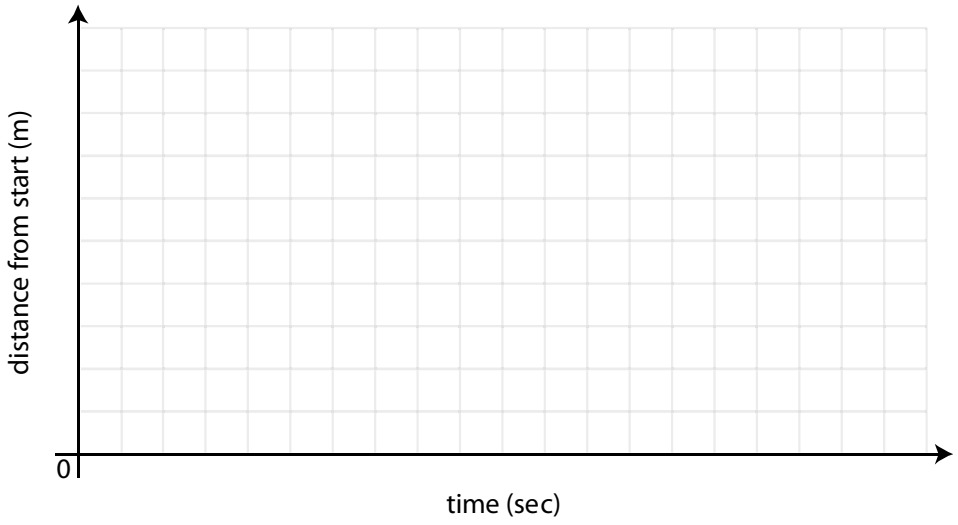
GRAPH



EQUATION

11. Teresa ran 50 meters in 20 seconds.

GRAPH **EQUATION**



12. Fill in missing values and write equations for the following tables, assuming a constant speed for each table:

A.

Time (in seconds)	**Distance** (in meters)
30	90
15	
450	
4	12
	30

Equation:

B.

Time (in seconds)	**Distance** (in yards)
4	28
8	56
	70
13	
17	

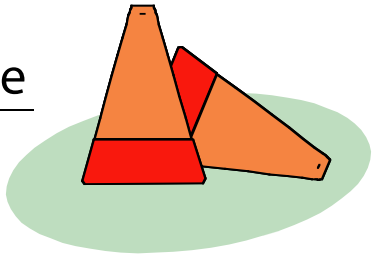
Equation:

C. Challenge.

Time (in seconds)	**Distance** (in feet)
10	45
11	
12	
13	
14	63

Equation:

Investigation 5: Back at the Office



Warm Up

1. Calculate to the nearest tenth.

A.	B.	C.
$8 \div 10$	$9.6 \div 12$	$0.8 \bullet 10$

2. Write down one conclusion about the relationship between stories of motion and their graphs.

Main

Managing the team keeps you busy. Back at the office, you have many tasks to do. Use what you have learned to take care of some tasks below.

> WEEKLY SPECIAL
>
> Soccer cones: $9.60 per dozen. We can break up packages and send as many as you want at the same rate.
> Call now: 1-881-SOCCER

3. We need to buy cones for soccer practice.

A. Use Activity 5.1 to run the animation.

B. In your notebook, copy the table. Complete the table to find out how much the different quantities of cones will cost.
Choose two of your entries and describe how you got the cost.

Quantity (in cones)	Cost (in $)
1	
10	
12	$ 9.60
18	
24	

C. How much would 30 cones cost at the same rate? Explain your reasoning.

D. Write an equation that relates the quantity (number) of cones to the total cost for any number of cones you might want to buy.

4. Set a new ticket price for games.

A. In your notebook, copy the tables. Complete the tables to find how much money the team can earn for ticket prices of $1.00, $3.00 and $5.00. Ticket sales last year ranged from 20 to 100 per game.

Number of Tickets	Total $
20	
40	
60	
80	
100	

Ticket $1

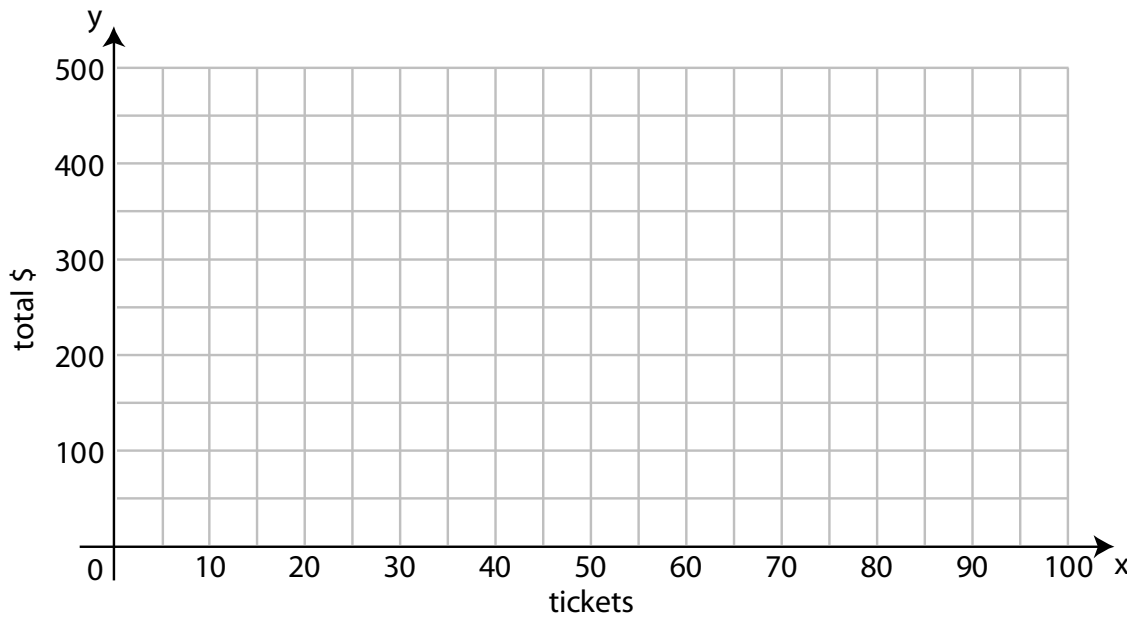
Number of Tickets	Total $
20	
40	
60	
80	
100	

Ticket $3

Number of Tickets	Total $
20	
40	
60	
80	
100	

Ticket $5

B. In your notebook copy the graph below. Draw graph lines so it is easy to compare dollars taken in and tickets sold for the three ticket prices.



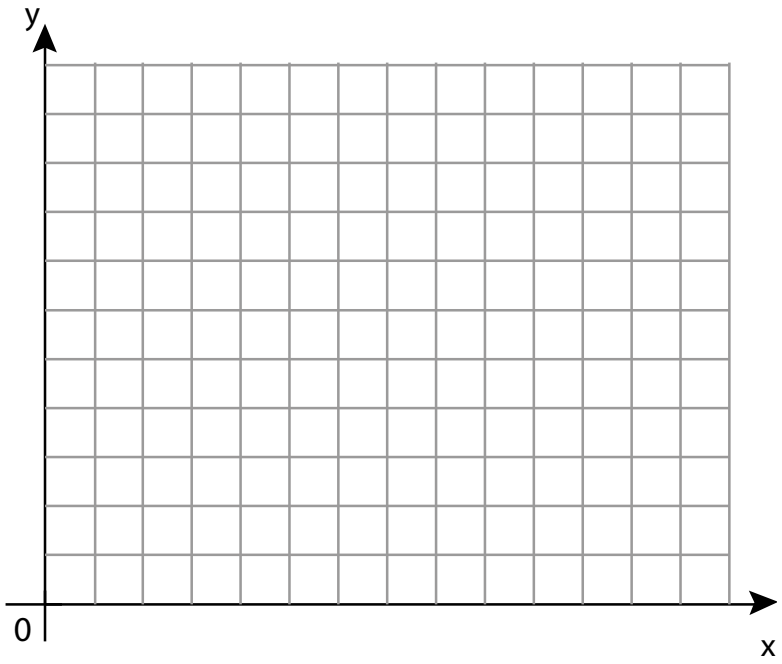
C. Use Activity 5.2 to check your graph. How many tickets would have to be sold, at each price, to take in 200 dollars? Estimate from the graph and then find the exact number of tickets. In your notebook, copy the table below and complete it.

Price per Ticket	Estimate from Graph of Number of Tickets Sold	Exact Number of Tickets Sold
$1		
$3		
$5		

5. Make up your own story using the equation $y = 2.50x$.

A. Write down the story.

B. In your notebook, draw a graph to representsthis equation.



Wrap Up

6. You used the idea of unit rate to fill in the table or find an equation. Let's find out more about unit rate.

A. How does unit rate help you find missing values in the table?

B. How can you write an equation based on unit rate?

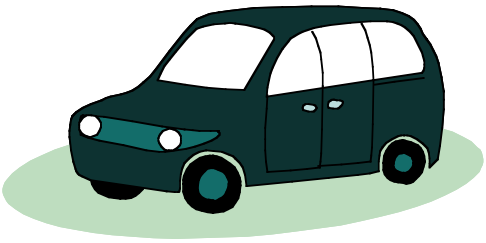
Unit Rate

Rates relate two quantities by division. For example, distance divided by time.

The unit rate tells us how much of one quantity *per* one unit of the other.

For example, a distance of 90 miles traveled in 2 hours gives a unit rate of 45 miles *per* hour.

Problem Solving:



7. A class is going to a museum. We know that two tickets cost $15, and that the cost for every ticket is the same.

A. Fill in the table.

Number of people	2	4	5	10
Cost ($)				

B. Write an equation relating people (p) to the total cost of the tickets in dollars (c).

C. How much would tickets cost for 35 people?

8. The table shows how many miles can be traveled for different amounts of gasoline.

A. Calculate the missing values in the table.

Number of gallons		8	4		7
Number of miles	190	304		114	

B. For this table, what is the unit rate, or how many miles can be traveled per gallon?

9. Frida is always worried about running out of gasoline. She keeps a little chart on her dashboard that tells her how many miles her van can run on how many gallons. It has been on the dashboard so long that some of the numbers have disappeared.

Gallons	Miles
0	0
2	30
6	
8	
18	
	210
22	

A. Fill in the chart for Frida.

B. According to this chart, how many miles per gallon does her van get? How do you know?

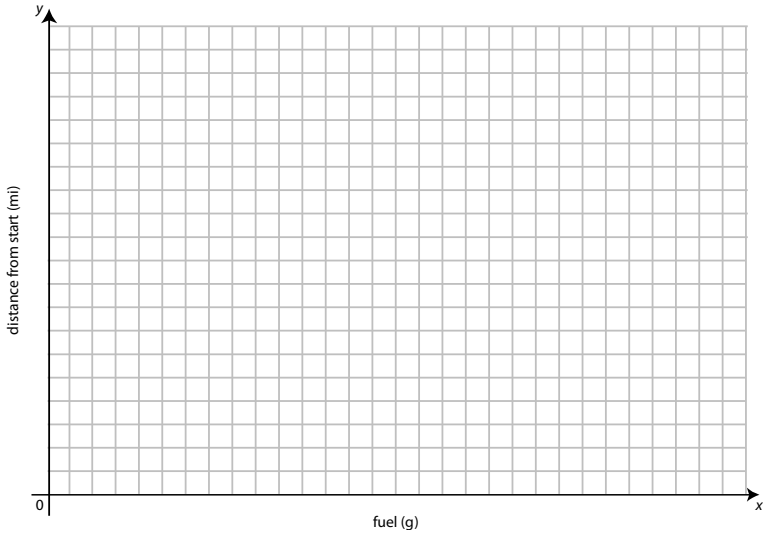
C. Write an equation that tells you how many miles Frida's van will travel for any number of gallons.

D. Use your equation to determine how many miles the van can go on 4 gallons. Does it match the chart?

E. Use your equation to determine how many gallons of gas are needed for a 450-mile trip.

F. Challenge. Compare the equation and table. What are the advantages and disadvantages of each?

G. Graph the miles per gallon (MPG) for Frida's van's for 1–30 gallons. (Distance in miles on *y*-axis; fuel in gallons on the *x*-axis.) You can use Activity 5.4 to check.



H. Challenge. A bus can go 18 miles for every 2 gallons of gasoline used. *Sketch* the line of the bus's mileage on the graph above, and write an equation that represents the relationship between miles traveled and gallons of fuel used for the bus. How does it compare with Frida's van?

Investigation 6: On the Road

Warm up

1. A car is traveling at a constant speed. Calculate the distance it travels.

A.
A car was 140 miles from the start. After some time, the car was 180 miles from the start.

B.
A car stopped for 1 hour.

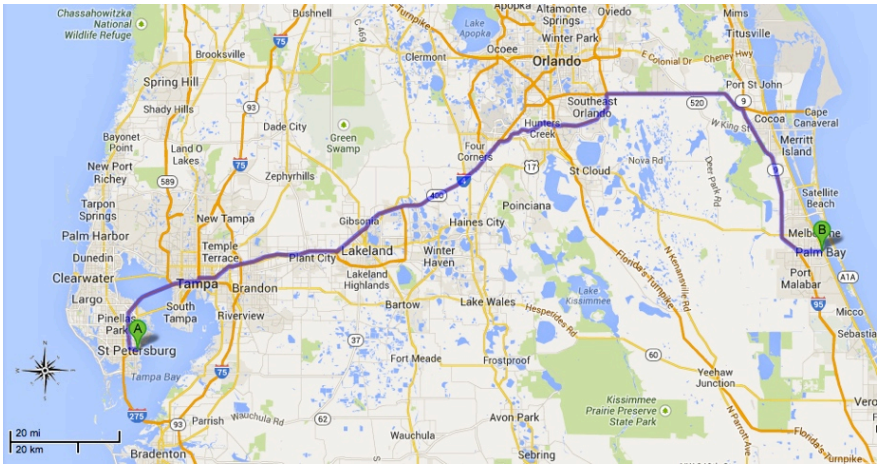
C.
A car was 100 miles from the start. After some time, it traveled back to where it started.

Main

2. Every year the team makes the trip from St. Petersburg to Palm Bay, for a challenge match. Both a bus and a van are used on the trip to accommodate all the players and team boosters.

The good news: The team has won the challenge match for many years in a row.
The bad news: Troubles often arise—breakdowns, traffic jams, you name it!

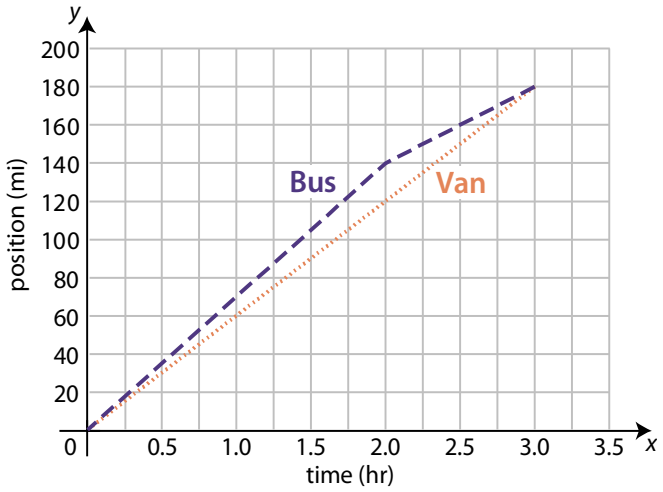
St. Petersburg to Palm Bay Map



What information can you get about the trip from looking at the map above?

3. Use Activity 6.1 to see what happened on last year's trip. Look at the animation and the graph.

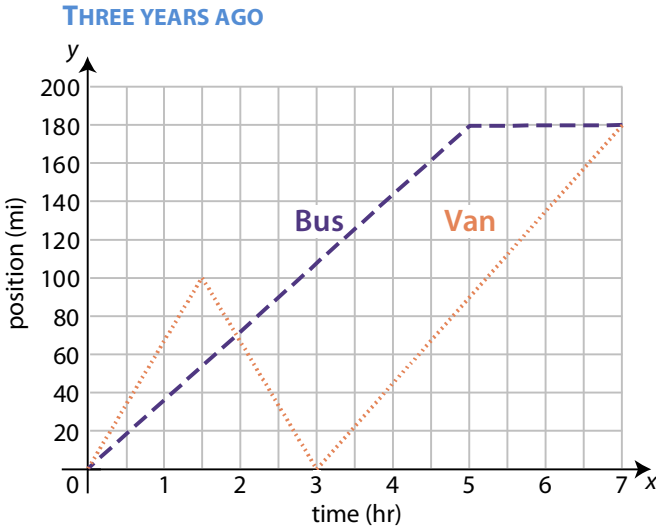
GRAPH OF ST. PETERSBURG-PALM BAY TRIP, LAST YEAR



A. What information can you get about last year's trip from looking at and analyzing the graph? Write down everything you can think of. The map and graph show the same trip, but you can learn different things from each.

B. Make up a story explaining what could have happened to the van and the bus on the trip. Your story *must* include mathematical information—speeds, distances, times—but should also be creative.

4. Three years ago, the trip was not so smooth. Here is the graph of the bus's and the van's travel on that trip.



A. **Predict.** What do you think the van does after traveling for one and a half hours?

B. What do you think the bus does after traveling for five hours?

C. Tell the story of the whole trip. Make sure to include details about both vehicles' times, distances, and speeds.

D. **Check:** Use Activity 6.2 to verify your prediction and story.

E. **Explain** any differences.

Wrap Up

5. Think about the mathematics you did with the soccer players' sprints and the mathematics you just did with the bus and van trips. Write a sentence or two explaining the similarities and differences between the two situations and the mathematics you did with each.

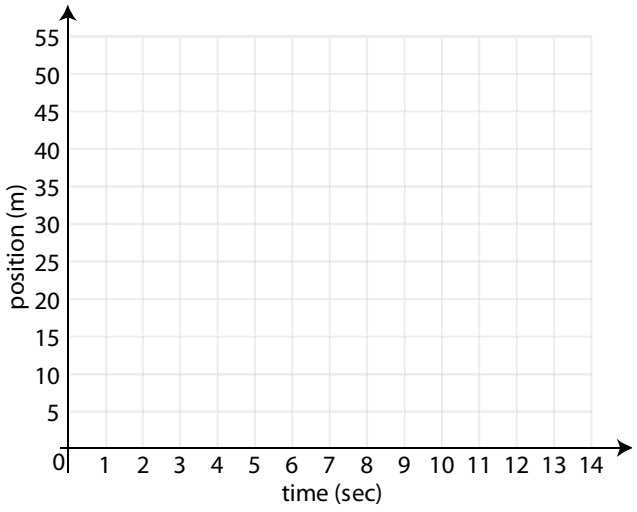
6. You have used graphs that are models of real motions. They are not completely realistic. How are the graphs simplifications of real motion?

Problem Solving: Graphs of Motion

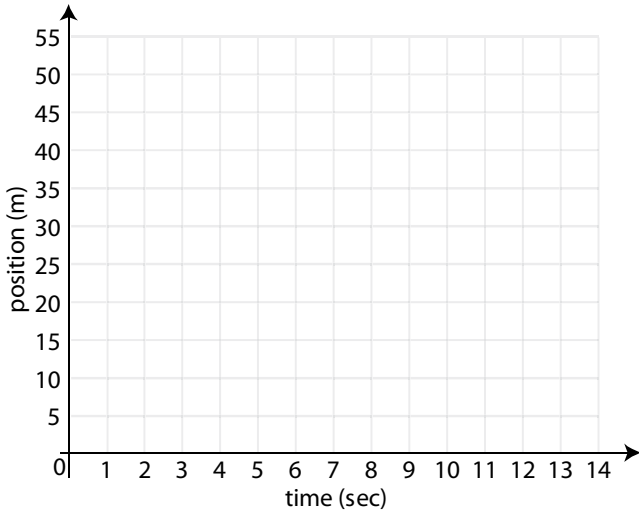
Interpreting and creating graphs are important skills in mathematics, in and out of the classroom! The following activities give you a chance to practice.

Sketch graphs for each of the following 50-meter races.

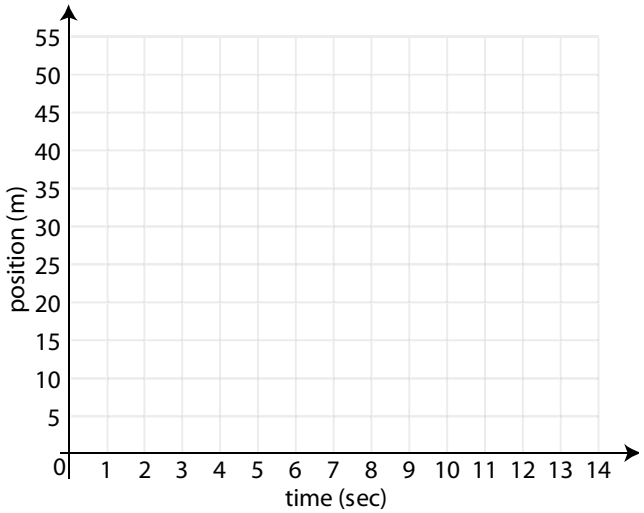
7. Jenna ran faster than Mila for the first 25 meters. Then Jenna twisted her ankle and fell at 25 meters. She couldn't get up. Mila slowed down, but she kept running across the 50-meter line. *Sketch* the graph.



8. Chanda and Shawntee were tied for the first 30 meters. Then Chanda sped up and passed Shawntee. Chanda won by 2 seconds. *Sketch* the graph.

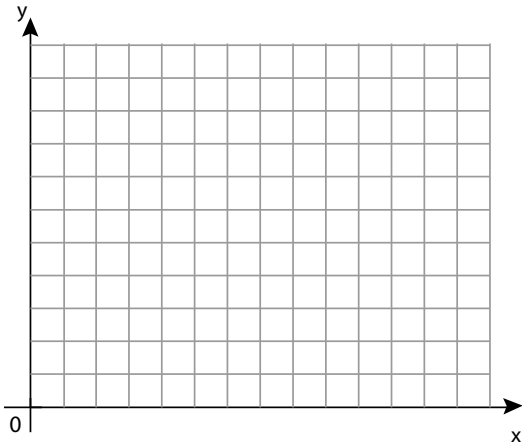


9. When Duane and Edgar raced, Duane was so sure he would win that he gave Edgar a 10-meter head start. Each boy ran at a constant rate the whole race, and Duane was right—he won! *Sketch* the graph.

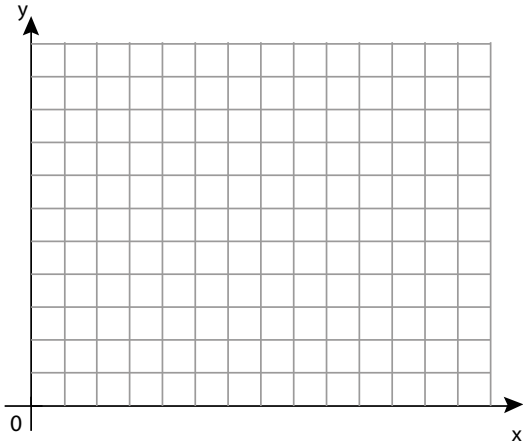


10. To quickly understand graphs, it helps to know some "by sight." *Sketch* graphs for each of the following situations so that you will be able to recognize them in future work. Make sure to label your axes.

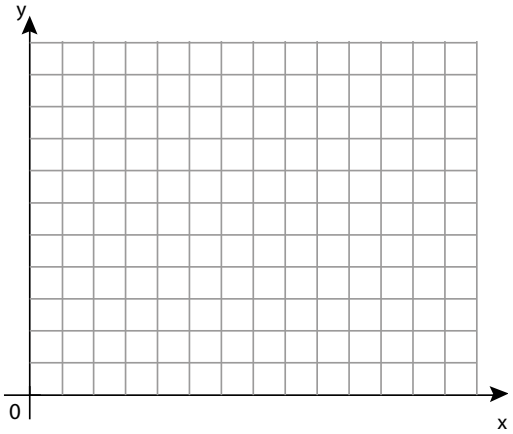
A. Standing still



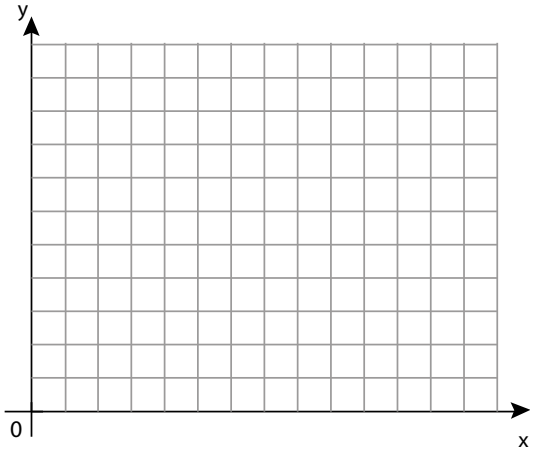
B. Going one rate, then going at a faster rate for the same amount of time



C. Going one rate, then going at a slower rate for the same amount of time



D. Going forward and then backward at the same rate



Investigation 7: Salary Negotiations

Warm Up

1. Are the inequalities true or false?

A.	B.	C.
$100 \bullet 10.25 < 750$	$750 > 7 \bullet 100$	$100 \bullet 10.25 > 100 \bullet 14$

Main

Read the following memo and answer the questions to decide on a salary option for you.

To: Acting team manager
From: Personnel office

If you are hired as official manager, you will need to choose a pay scheme. The season lasts 10 weeks. You have three options for getting paid:

OPTION A - Double Overtime:
Up to 100 hours, the rate is $7.00 per hour. For hours over 100, the rate is $14.00 per hour.

OPTION B - Same Wage:
The rate is $10.50 per hour, no matter how many hours worked.

OPTION C - Flat Fee:
You get $750 for the season, no matter how many hours you work.

Please let us know which option prefer, as soon as possible.

2. What should you consider before you decide on a salary option?

3. Make graphs, tables, OR equations to compare all three options for any number of hours you might work for the season. Use Activity 7.1 if you need a place to test things out.

4. Remember that the season is 10 weeks long. Which pay option will earn the most money if you work 10 hours per week? 20 hours per week?

Wrap Up

5. Which method of comparison did you use? How does using graphs compare with using tables or equations?

Problem Solving

6. For each one, choose which option will be a better deal and explain why.

A. You can wash about 13 cars per day.

Option A: You will earn $10 for each car wash.
Option B: You will earn $100 per day for washing cars.

Which is the better deal? Why?

B. Option A: You will pay $0.20 per text message.
Option B: You will pay $20 per month for text messaging.

If you use 300 text messages per month, what is the better deal?
If you use 425 text messages per month, what is the better deal?
Why?

C. Option A: The individual entrance fee is $3 per person.
Option B: The group entrance fee is $2 per person with an initial fee of $10 per group.

If you have a group of 10 people, which is the better deal?
If you have a group of 20 people, which is the better deal?
Why?

7. Kim wants to earn money for school clothes for next fall. She is going to baby-sit for the Santiago family this summer. She will care for their children 2 days a week, for 4 hours each day, for a total of 6 weeks.

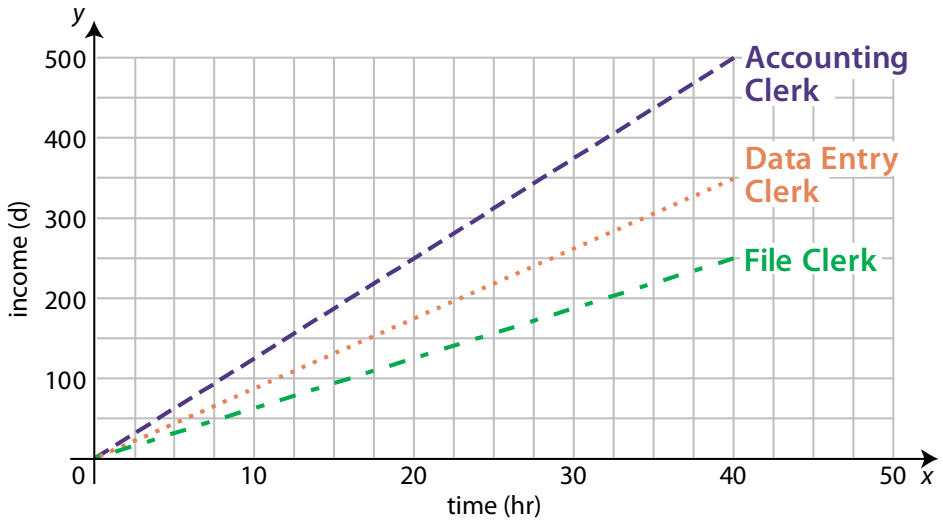
She can get paid one of two ways:

$7.00 an hour
OR
a one-time payment of $350.00 for the whole summer

A. Which pay scheme will give her the most money?

B. Kim isn't really sure the Santiagos will need her for the same number of hours each week. Make a graph or table that compares both ways of getting paid for 0 to 60 hours.

8. Tony applied for work through SummerHelp, an agency that helps place teens in summer jobs. SummerHelp gave him a graph showing the earnings of several kinds of jobs:



A. Make a table for Tony showing how much he would earn for 10, 20, 30, and 100 hours of work in each job.

B. Tell Tony how much each kind of job pays per hour.

9. Challenge. Tyree needs to make at least $1,000 this summer. He has three job opportunities with different wages: $8.60/hour at the donut shop, $10.00/hour as a lifeguard, and $16.00/hour at the computer store.

A. How many hours would Tyree have to work at *each* job to earn $1,000? Show the calculations, equations, graphs, or tables that you used to get your answers. You can use Activity 9.1 to check your solution.

The jobs are in different parts of the city. Tyree can walk to the donut shop in 5 minutes. It will take him 30 minutes to ride with his friend Jana to the beach for the lifeguard position. It will take him 1 hour and 3 buses to get to the computer shop. Tyree wants to spend the least time possible working (including commute time) this summer.

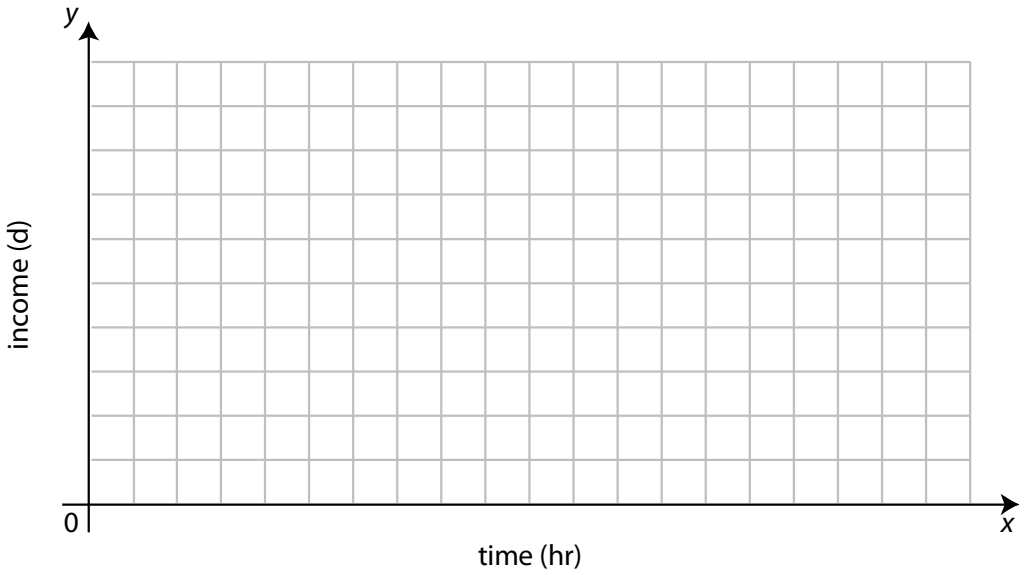
B. Consider the commute times and the working hours, and then give Tyree advice about which job to take. (Assume each job requires an 8-hour day.) Again, show your work.

10. Challenge. Programs like the Youth Employment Program (YEP) organized by the Southwest Florida Workforce Development Board in Lee County helps teens get summer jobs (see newspaper article on the following page.) Often, the program will contribute part or all of the teens' wages.

For this activity, assume the following: If the teens work in a store, YEP contributes $2.00 per hour of their wages. If the teens work in a daycare center, YEP contributes all their minimum wage: $7.79 per hour.

A. Write equations for each rate of contribution, relating hours worked to total dollars earned.

B. In your notebook, create a graph showing the YEP contribution to the salaries of the two types of jobs, for 0 to 100 hours.



C. Write a letter in your notebook to send with the graph, explaining to employers how much they can expect YEP to contribute if they hire a teen this summer.

Stimulus money helps put Lee, Collier students to work this summer

By LESLIE WILLIAMS

LEE COUNTY — The sounds of band saws, keystrokes and practiced chest compressions have filled the halls of South Fort Myers High School this summer.

Students at this school are in the middle of a 4-week career exploration program (by YEP) paid for through the American Recovery and Reinvestment Act.

The Southwest Florida Workforce Development Board received $2.3 million to offer the program in Lee County. The workforce board has helped place 100 people ages 16 to 24 in jobs, from doctors' offices to Big Brothers Big Sisters of Southwest Florida.

"The program is meant to give these youth a meaningful work experience, not just a summer job," said Carmen Woywod, youth program coordinator for the workforce board. "We give them useful information that will help them reconnect with education, and of course, stay in school."

For 300 students in Lee County, the process involves exploring possible careers and learning financial literacy. Students spent the first week preparing resumes, balancing checkbooks and budgeting their expenses accordingly to make rent, car payments and utility bills.

Many students, like Terrika Mobley, were attracted to the program by the promise of a stipend. The $910 she could earn sounded pretty good.

The 300 students in the program are expected to treat their 4-week stint like a real job. They must show up on time and stay for the whole day to get paid.

Students with perfect attendance stand to gain a $100 bonus, with another $50 if they were on time every day. They get bonuses for earning certifications in CPR and first aid, as well as Microsoft technology certifications.

With their hourly wage and the added bonuses, each could earn $910 by the end of the program.

"This has been one of my first real jobs," said Timesha Carter, 15, a sophomore. Timesha opened her first bank account this summer. With the encouragement of her mother, she is holding onto the money she earns, and working toward the goal of being a physical therapist.

"There are going to be a lot of jobs dealing with solar and other renewable energy sources," said Clyde Grant, who has been spending the past few weeks helping students explore green technology. "And these kids are right at the beginning of it, so when it does get going, hopefully, they'll be ready for careers in the field."

Adapted from NaplesNews.com posted July 26, 2009

Investigation 8: Mathematically Speaking

Warm Up

1. Evaluate.

A.	B.	C.
2^3	$2 \cdot 4$	4^3

Main

In this unit, you have seen many examples of two quantities that are related by a constant unit rate. We can say that those two quantities are in a *proportional relationship*. For example, time and distance were related by a rate called speed.

You can tell whether two quantities are in a proportional relationship by their table, their graph, or their equation.

2. Use what you have learned in the previous investigations to say how to recognize proportional relationships.

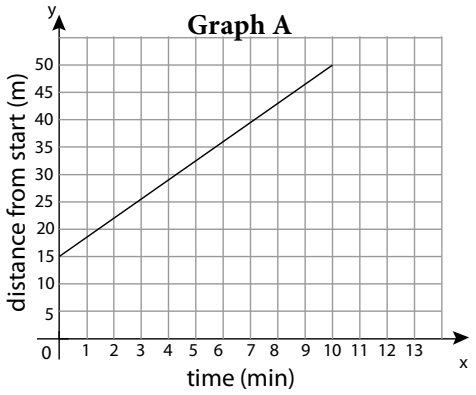
A. Choose the table that shows a proportional relationship. Explain your choice.

Table A	
time (in seconds)	**distance (in meters)**
0	0
5	10
10	20
15	30
20	40

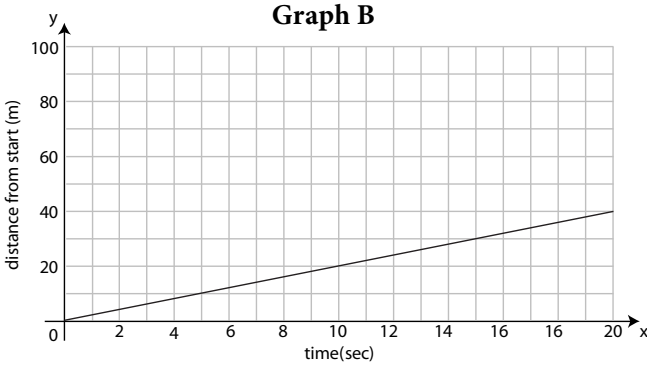
Table B	
time (in seconds)	**distance (in meters)**
0	20
5	35
8	44
10	50

B. Choose the graph that shows a proportional relationship. Explain your choice.

Graph A



Graph B



C. Choose the equation that shows a proportional relationship. Explain your choice.

Equation A	**Equation B**
$y = 2x$	$y = 3x + 20$

Wrap Up

3. How can you tell when a relationship is proportional?

A. Graphs are _____

B. Equations are of the form _____

C. Tables show that there is _____

Constant of Proportionality

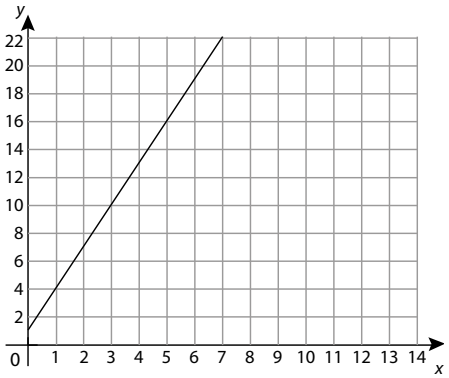
When two quantities are in a proportional relationship, the number in the unit rate is called the ***constant of proportionality***.

Problem Solving

4. Decide whether each pair of a graph and a table represents a proportional relationship and explain why.

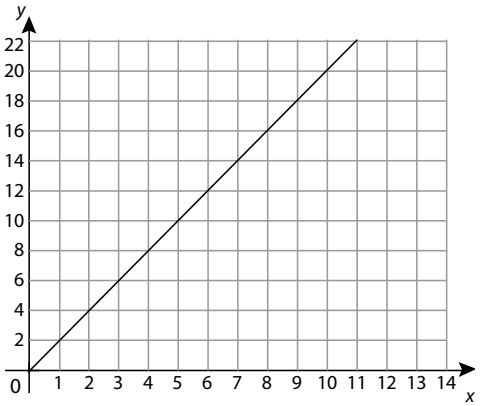
A.

x	y
1	4
3	10
5	16
7	22



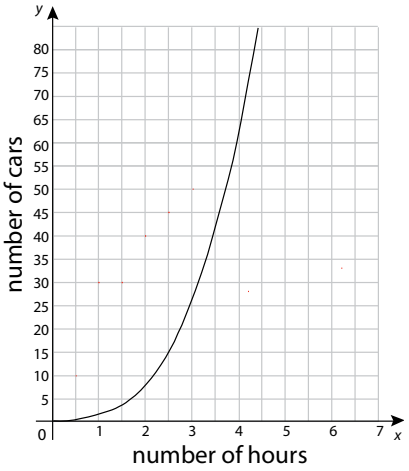
B.

x	y
1	3
2	6
3	9
4	12



C. Challenge.

Number of hours	Number of cars
1	1
2	8
3	27
4	64



5. Which equations represent proportional relationships and why?

A. $y = 3x$

B. $y = 3x + 5$

C. $P = T \bullet 7$

D. $V = S^3$

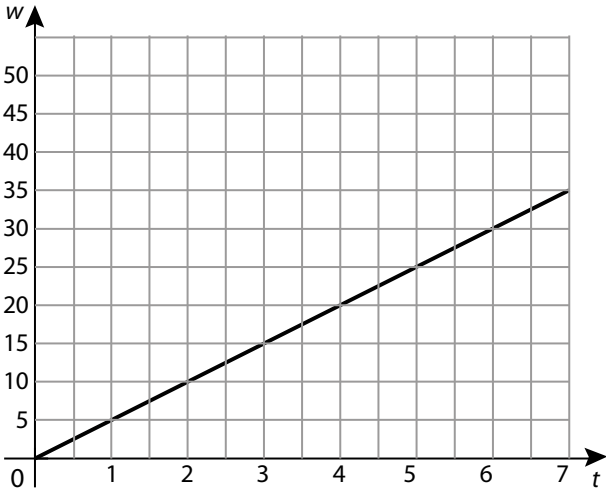
E. $37.5Q = R$

6. Write the constant of proportionality for the relationship in each representation.

A. Constant of proportionality: ☐

x	y
0	0
3	33
9	99
10	110

B. Constant of proportionality: ☐



C. Constant of proportionality: ☐

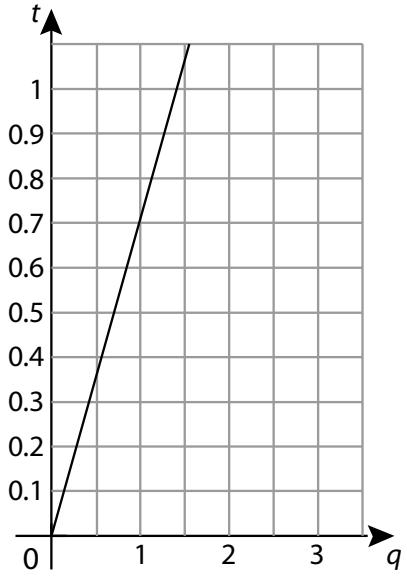
$d = 80t$

7. Write the constant of proportionality for the relationship in each representation.

A. Constant of proportionality: ☐

x	y
0	0
7	3.5
9	4.5
10	5.0

B. Constant of proportionality: ☐



C. Constant of proportionality: ☐

$d = 0.7t$

9. Manager's Report: It has been a busy 2 weeks, and you have accomplished a lot as the acting soccer team manager. Write a memo to the personnel office director describing what you have done. Highlight one problem you solved using mathematics. Explain why they should hire you as the permanent manager.

Dear Ms. Fuentes,

After 2 weeks as acting manager, I have solved many problems for our soccer team.

List them.

My mathematical skills and understanding have been valuable in solving problems. For example,

Explain what you did with mathematics to solve a problem.

I believe I can help the soccer team as the permanent manager. In addition to problem solving, my strengths include

Fill in your best qualities.

I look forward to hearing from you.

Sincerely,

Your name.

Optional Investigation 9: Steepness, Speed, and Slope

Warm Up

1. Find the speed of these objects. Assume a constant speed.

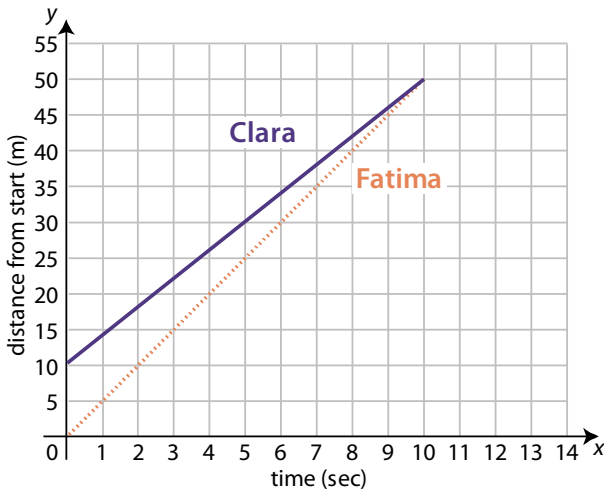
A.
A toy car moves 10 meters every 5 seconds.

B.
A turtle moves 10 inches every 2 minutes.

C.
Joy runs 5 miles in 2 hours.

Main

2. Here is a graph of a race between Clara and Fatima.



A. What are some different ways that you can find out who is going faster in this race? In your notebook, copy the table below, and describe two ways.

To find out who is going faster…	To find out who is going faster…

B. Which line is steeper, Clara's or Fatima's? How do you know?

C. In your notebook, copy the table below. Find the speed of each runner.

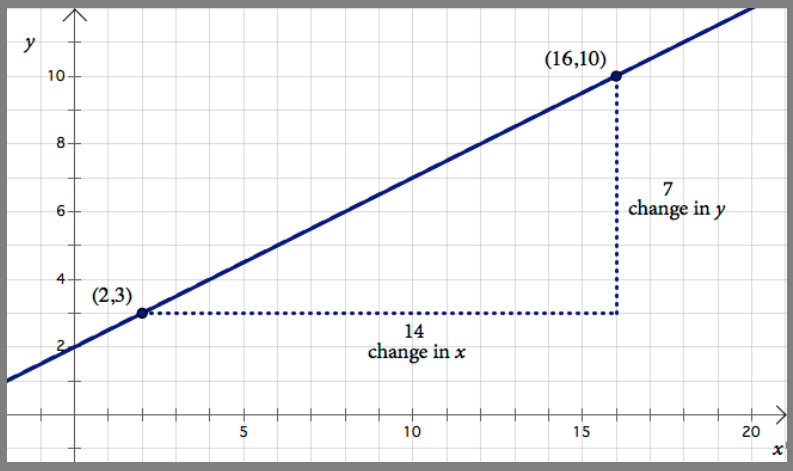
What is Fatima's speed in this race?	What is Clara's speed in this race?

Slope is a mathematical way to describe the steepness of a line on a graph.

Slope

The slope of a line is the amount of change in y (on the vertical axis) divided by the change in x (on the horizontal axis) between two points of the form (x, y) on the line.

$$slope = \frac{change\ in\ y}{change\ in\ x}$$



3. Use this definition to answer these questions.

What is the slope of Fatima's line? Explain.

What is the slope of Clara's line? Explain.

4. Find two places in your workbook where you have already found the speed of a runner using a line graph. Copy the tables into your notebook. Find the slope of each line.

Runner:	
Speed:	
Slope:	

Runner:	
Speed:	
Slope:	

5. How are slope and speed related?

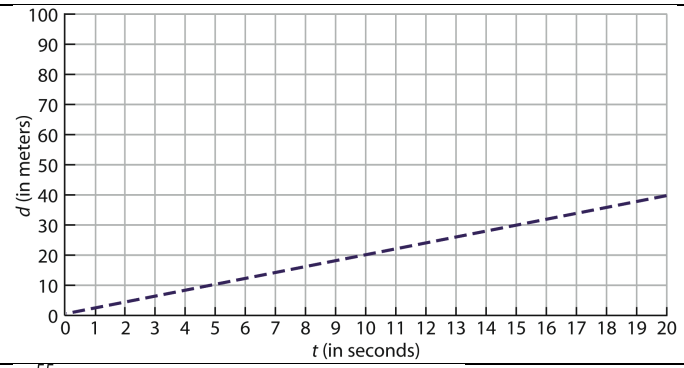
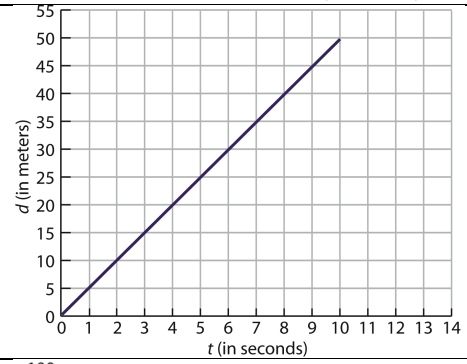
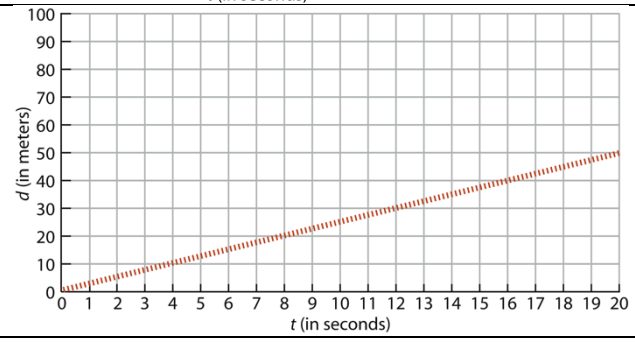
Now you can see the connection between slope and speed. But how are slope and speed different?

Unit Rate and Slope

The unit rate compares the quantities of distance and time. These quantities have units for distance (such as meters) and for time (such as seconds).
Slope is just a number—it has no units.
Their value is the same.

You can find the slope of a graph in its equation.

6. Copy the table below into your notebook. Plot the point that shows the unit rate on each graph. Find the slopes and equations for each graph.

	Graph	Slope	Equation
A.			
B.			
C.			

D. Where do you see slope in each equation? Why would that be?

Wrap Up

7. Describe all the connections you can between slope, unit rate, equations, graphs and tables of proportional relationships.

Predict Check Explain

1. Predict

- Estimate!
- Sketch!
- Make your best guess.
- Be creative.
- Work quickly.
- Listen actively to other people's predictions.
- Predictions don't have to be correct.
- Do mental calculations as needed.

2. Check

- Use the technology or make a calculation to see if your prediction was correct.

3. Explain

- Use the representations to support your reasoning.
- Was your prediction correct? Explain how you know.
- Was your prediction incorrect? Explain why.
- Describe how to get the correct answer.
- Were you surprised? What did you learn?
- Maybe, make a new prediction!

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