Managing the Soccer Team: A 7th-grade unit on rate and proportionality

Scaling up SimCalc

Managing the Soccer Team

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Managing the Soccer Team

From: Alamo Middle School principal

To:_____ (you!)

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

There is so much to do:

- The players have to keep practicing for the games.
- We need help making sure the transportation goes smoothly and we are spending way too much money on fuel for the van and bus.
- Uniforms and other supplies are needed.

If you do a good job, we will offer you the job on a regular basis.

Are you up for the job?

For the next two 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. (Of course we had to rig them up a bit to get all of the mathematics in.) You will use software called MathWorlds that helps you understand rates and proportionality using simulations, graphs and tables. And you will be learning mathematics important in the TEKS.

Good luck, have fun, work hard!

A Race Day

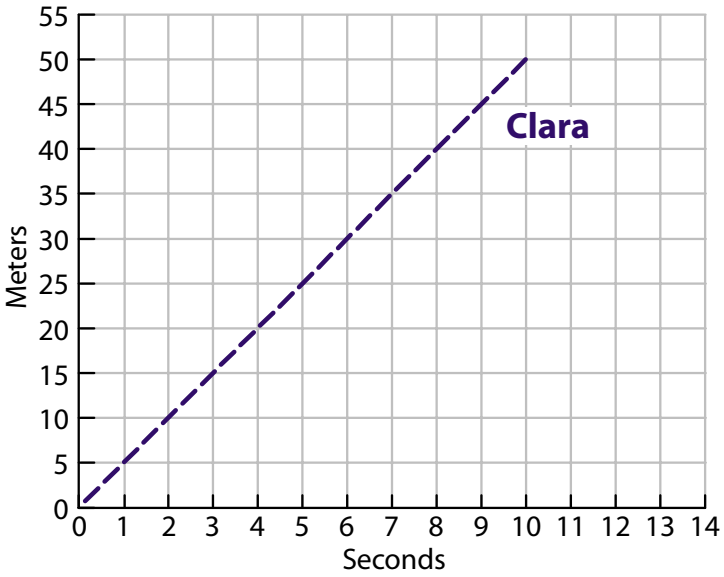
To improve their speed, the soccer team spent a few practices running dashes at the track.

MathWorlds can simulate some of these dashes and make graphs of them.

Carefully watch the simulations and graphs to answer the questions.

1. First up was Clara. Watch the simulation of Clara's dash.

   Open and run the file, araceday1.mw.



   a. What does the simulation show?

What do you think?

What is speed, anyway?

   b. What happens to the graph as the simulation runs?

c. How far did Clara run?

d. Where do we find that distance in the graph?

e. What does the x-axis show us?

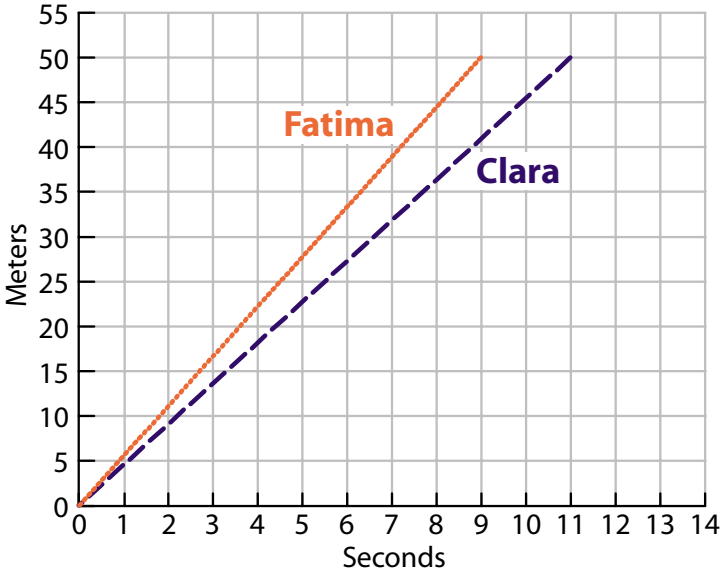
f. How long did it take Clara to complete her dash?

g. How can we figure out her speed?

2. Next, Clara and Fatima ran a race.

Open the file, araceday2.mw, and watch the simulation of their race.

a. What does this simulation show?



b. Who was going faster? Who won the race?

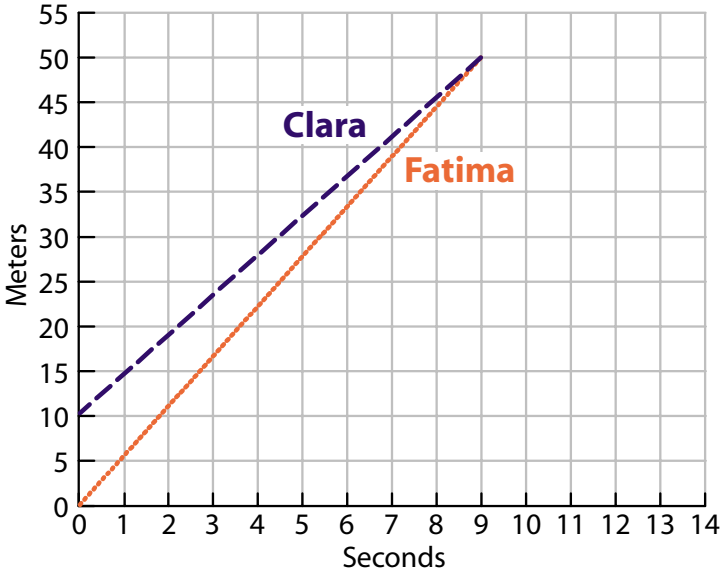
c. What is the total distance of the race?

d. How long did each girl take to complete the race?

e. Find the speed of each girl.

3. Clara and Fatima raced again.

Open the file Araceday3.mw and watch the simulation of their second race.



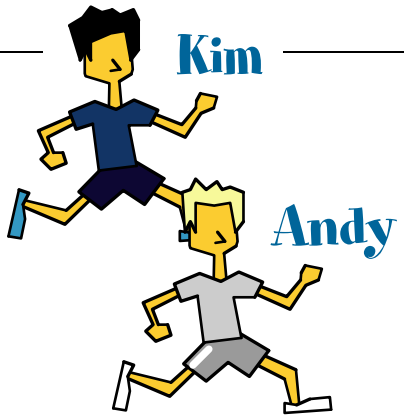
a. What happened in this race?

b. Who is going faster? How do you know?

c. Find the speed of each girl.

4. Compare the dash in 1 and the two races in 2 and 3.
What is the same? What is different?

Another Race Day

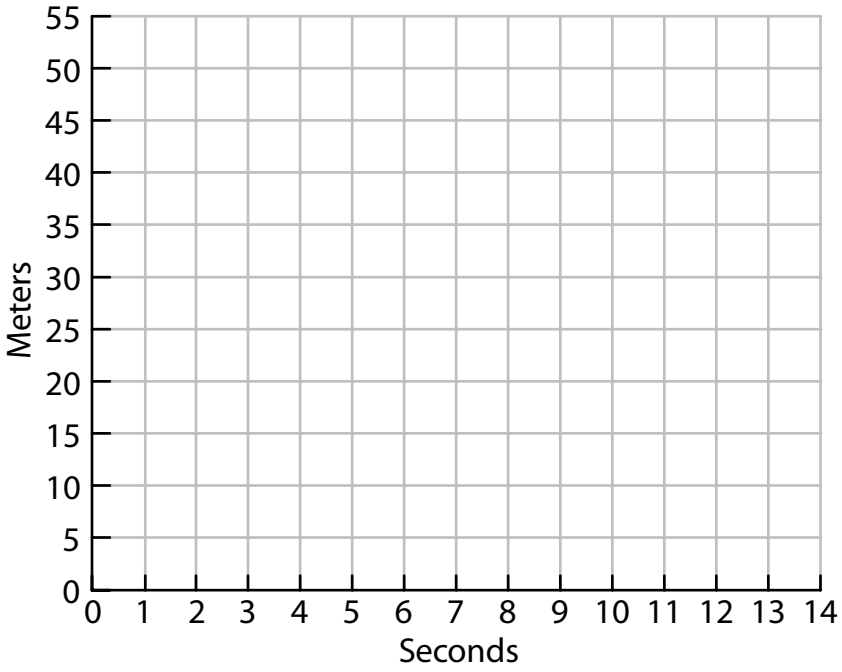


Andy and Kim are the next two players to try the dash.

Open and run the file, nextrace1.mw.

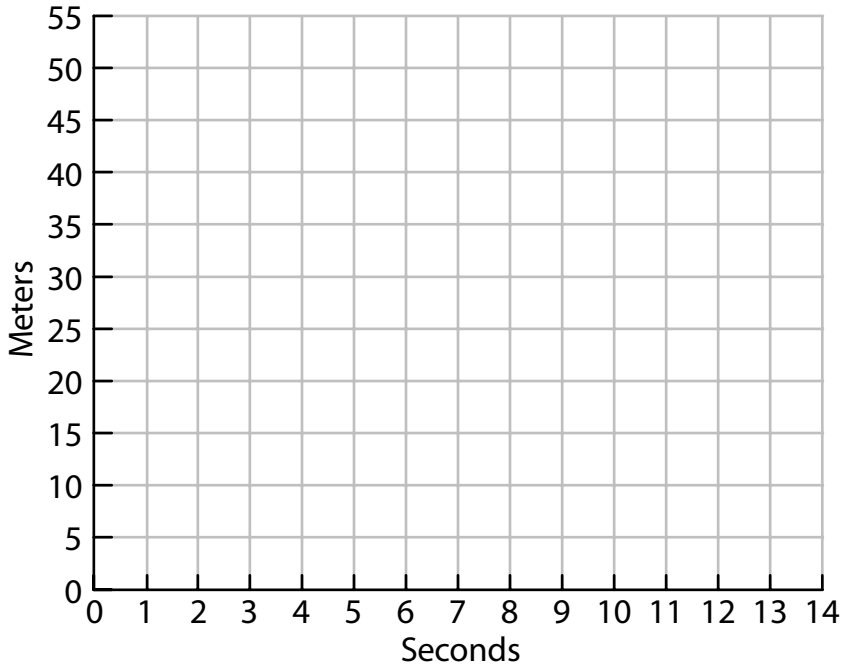
1. Watch the race several times. Use the  step button. Describe what this simulation shows.

2. Predict the graph: on the axes below, sketch a graph of Andy and Kim's dash.



3. Open the file, nextrace3.mw. This shows the runners as dots and gives you more information.

a. Use the step button and other controls to make a graph below that is more precise than your sketch.



b. Label three points in the graph above. List them below and explain what they mean in terms of the race.

Point	In the race

Information Quest: How Fast?

Find out about as many of the speeds below as you can.

Try these resources: Web search, Encyclopedia, Almanac, County Extension agent, a stopwatch.

1. World's record, 100-meter dash

2. Average speed of a black ant

3. Record for high schooler's 100-meter dash

4. Typical walking speed, human

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

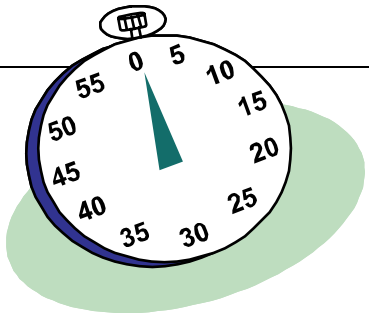
6. Your walking speed

7.

Make up some of your own.

8.

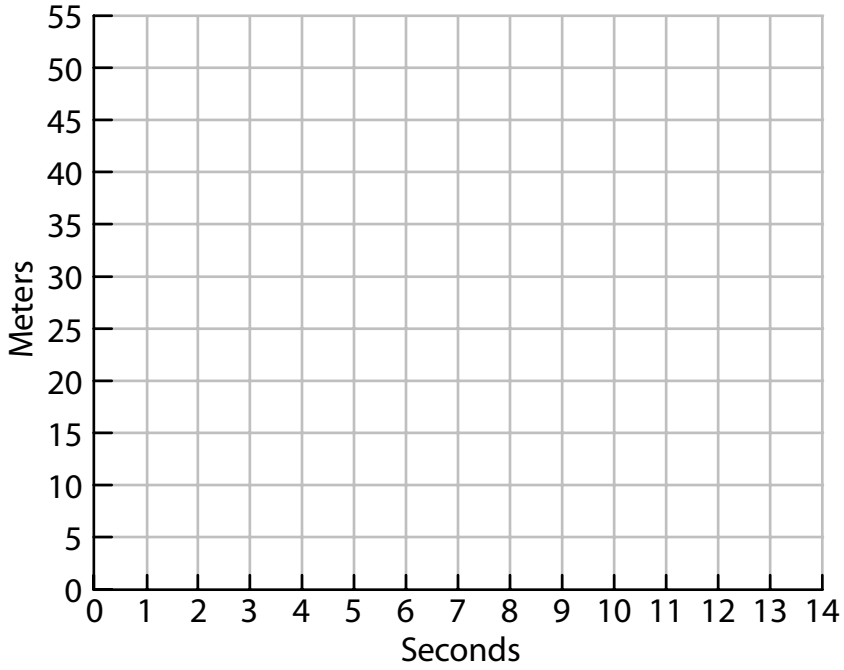
Isabella Improves



Isabella decided to run 50-meter dashes all week, trying to improve her speed.

Her first dash took 14 seconds. For the next three days, she improved her time by 1 second each day.

1. Predict the graph: On the axes below, sketch a graph that shows all four of her dashes.



2. Open the file isabella2.mw. Run the simulation several times. Observe the relationship between the runners and the graph.

   a. Was your prediction right? If not, explain why not.

   b. Describe what this graph and simulation show.

c. Describe patterns you see in the graph.

3. As Isabella's time went down by one second on each dash, what happened to her speed? Let's find out.

a. Fill in this table.

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

b. Describe and explain patterns that you see in the table.

What to do

Describe: Say what you saw.
Explain: Say why.

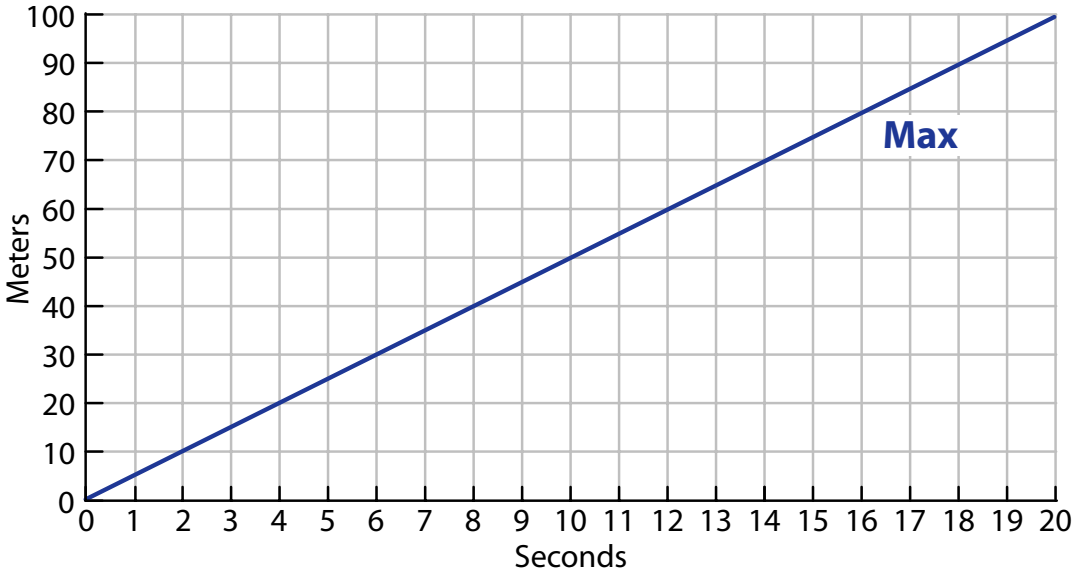
4. Frankie, who manages the track team, heard about your dash graphing and wants to do it too. Give advice on how to do this.

   a. Describe how to graph dashes 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.

Max and Nola are next to run dashes, but they run 100 meters. You keep time and record the following graph for Max.



1. All you know about Nola's time is that she won the race.
   Open the file fastermax1.mw. The blue line shows Max's 100-meter dash.
   The magenta line is for you to model Nola's race.

   a. Make a line that shows that Nola won the race.

   b. Now run the simulation. How far ahead of Max was Nola when she crossed the finish line?

   c. Draw the line representing Nola's run in the graph above, making sure to accurately plot 3 points.

   d. According to the line you drew, how much faster was Nola than Max? Describe how you found out. For your simulation and graph, how much faster was Nola than Max? Describe how you found out.

2. Exchange workbooks with another group or student. Check their work on page 12. Answer the following:

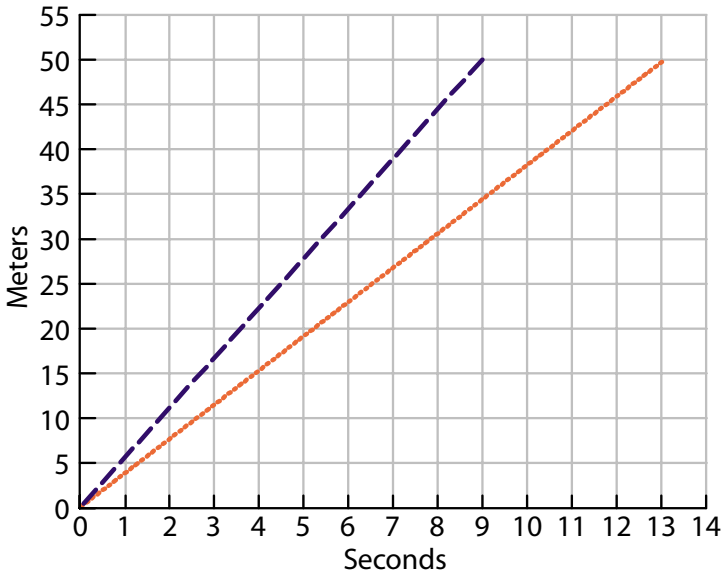
   a. Does the work for 1d match the graph drawn for 1c? Explain.

   b. Did the other student use different ways than you did to find the answer? Describe the difference in your methods.

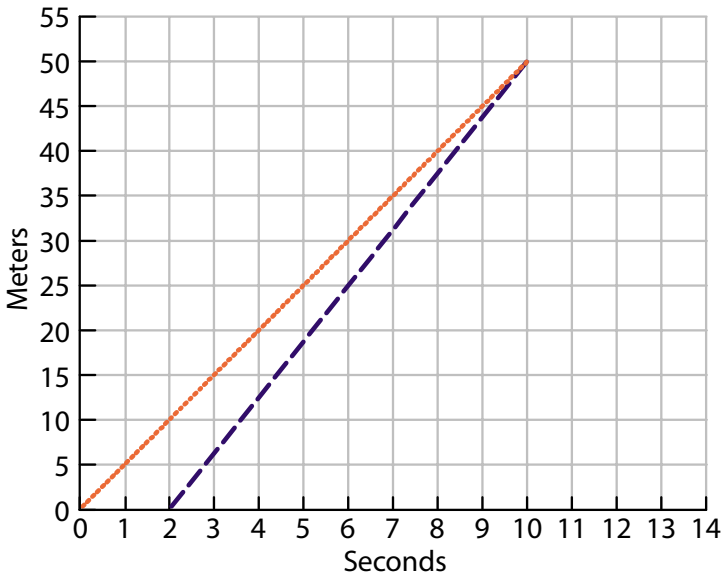
Practice Runs

1. 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.

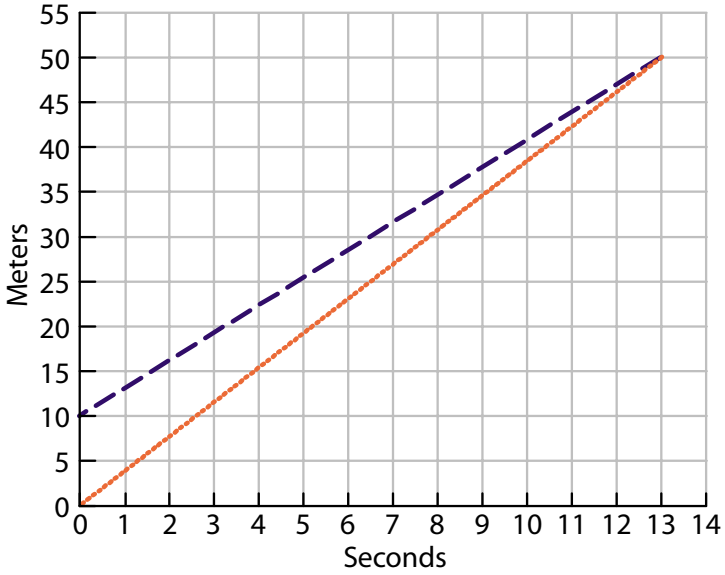
a.



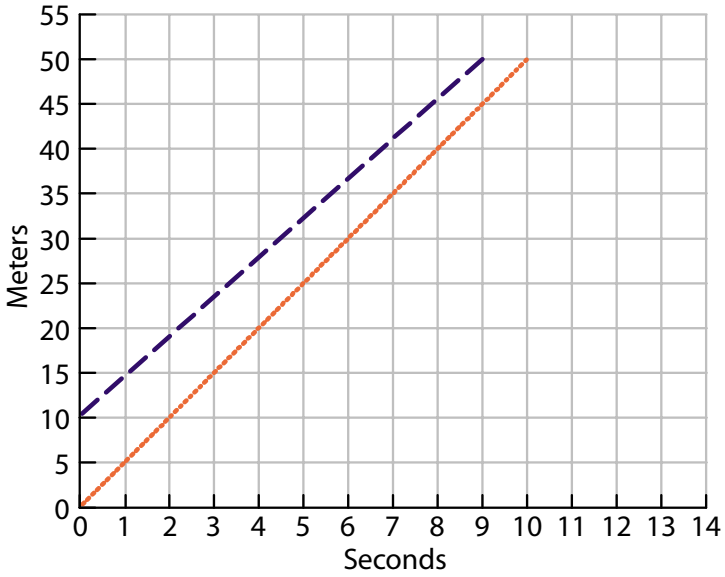
b.



c.

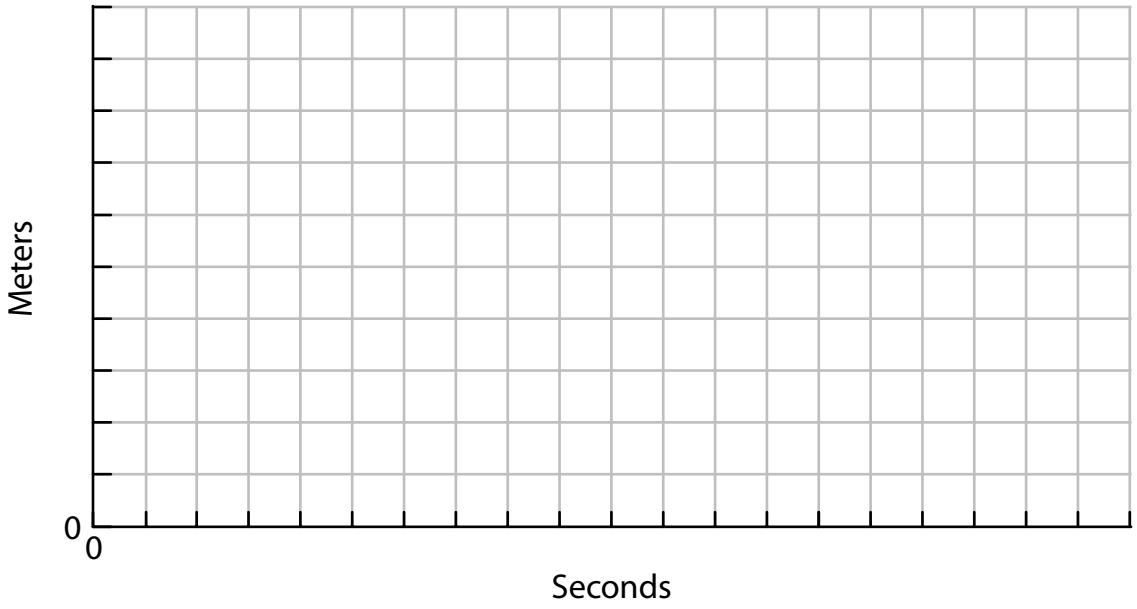

Meters
Seconds
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
0 5 10 15 20 25 30 35 40 45 50 55

d.

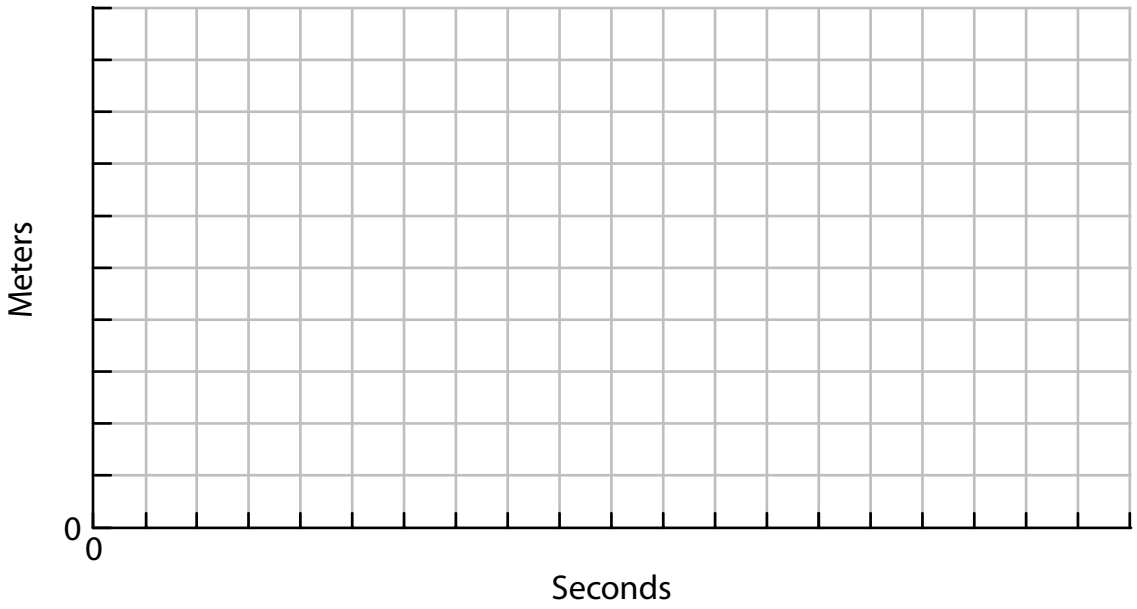

Meters
Seconds
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
0 5 10 15 20 25 30 35 40 45 50 55

2. For each of the following descriptions, sketch a graph that would match the description.

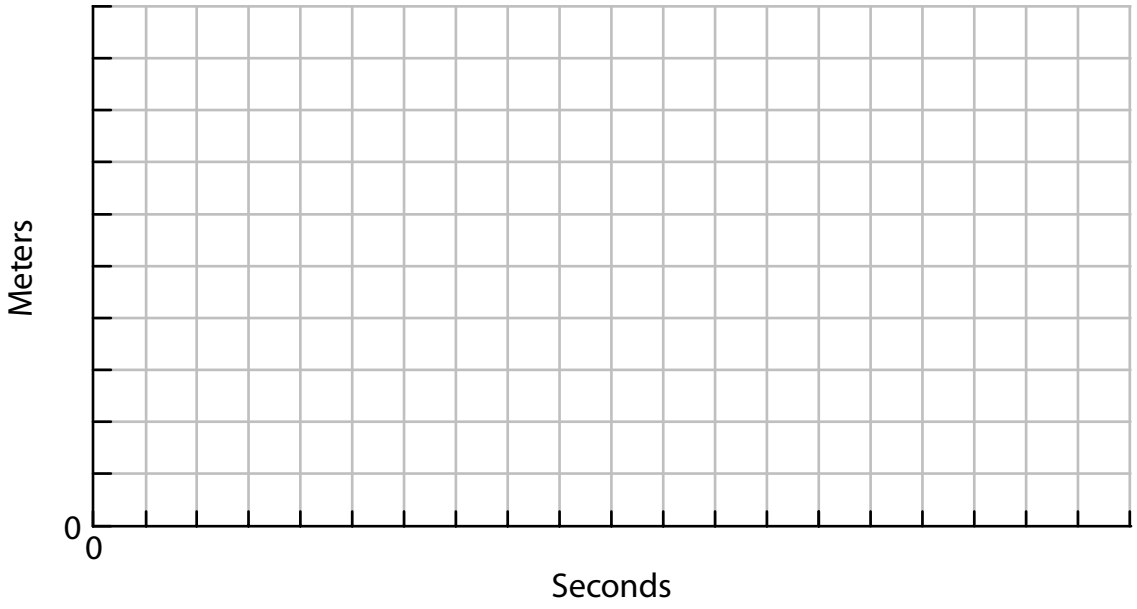
a. Ran 100 meters in 25 seconds



b. Ran 200 meters in 40 seconds

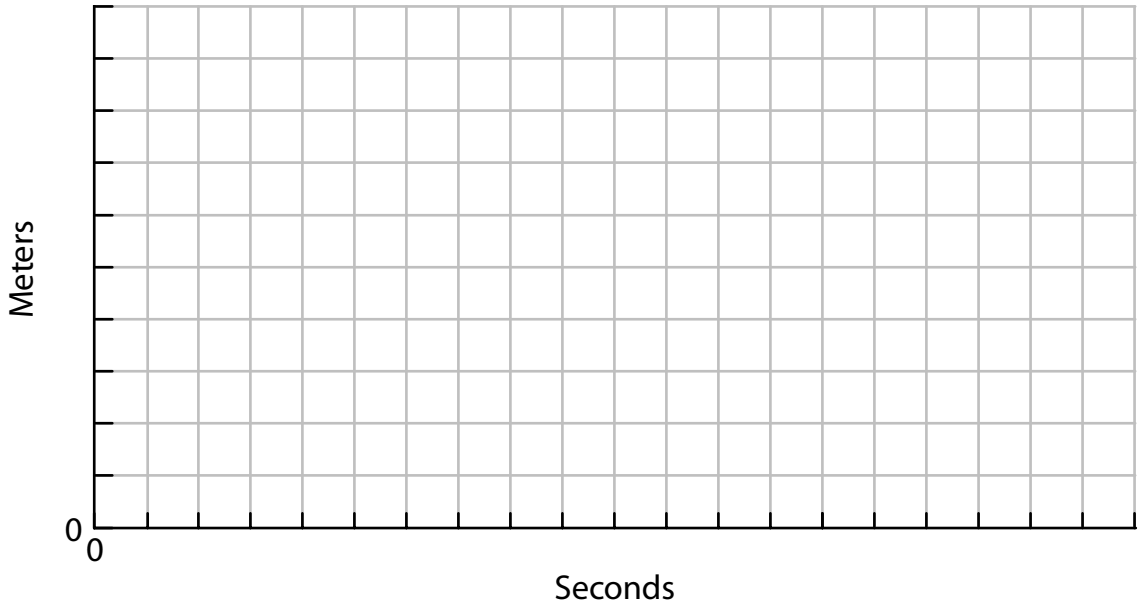


c. Ran 50 meters in 20 seconds

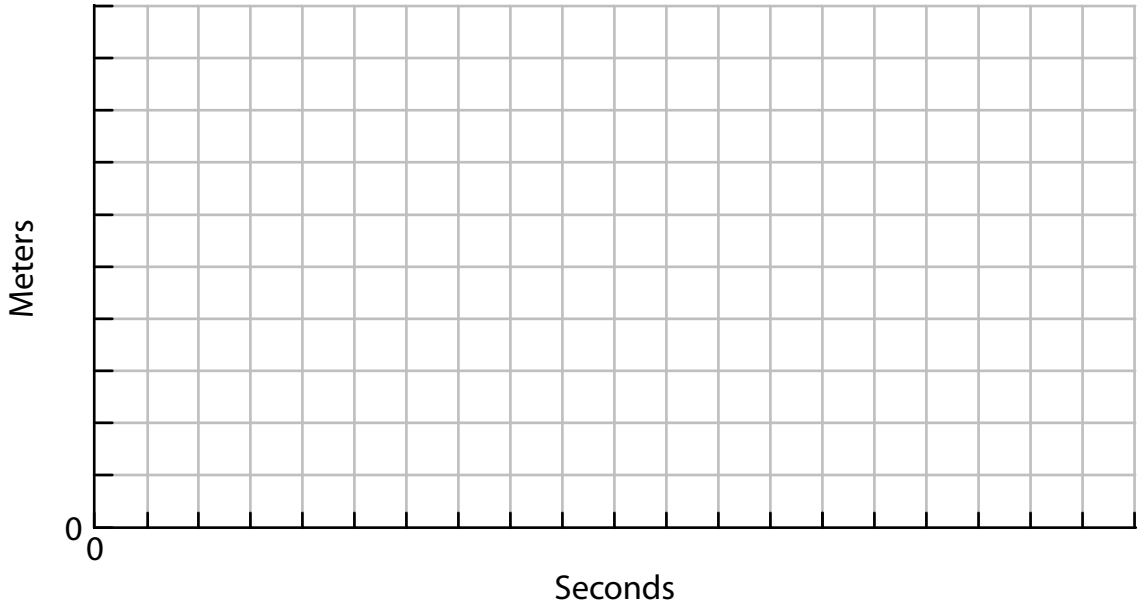


3. Draw graphs for the situations described in the following two problems.

a. Mila and Shawntee ran 150 meters. Mila's time was 30 seconds. Shawntee's time was 25 seconds.



b. Kim and Andy ran 200 meters. Kim did it in 50 seconds. She came in ahead of Andy by 5 seconds.



Run, Jace, Run

1. Open the file runjace1.mw. Watch the simulation and graph of Jace's 100-meter dash.

   a. Use the graph to answer: How many seconds has Jace run when he has gone 25 meters? How many seconds has he run when he has gone 50 meters?

   b. Now fill in the first two rows of the table.

Seconds	Meters
	25
	50
	100
	200
15	
30	

2. Let's assume that Jace can keep running at the same speed for quite a while.

   c. Predict: If Jace keeps going at the same speed (rate), how long will it take him to run 100 meters? How long to run 200 meters?

   d. Use the graph to check your prediction by stretching the line using the grey dot on the x-axis. Were you right? If not, why not?

   e. Fill in the third and fourth rows of the table.

f. Predict: When Jace has run for 15 seconds, how far has he run? What is his distance at 30 seconds?

g. Fill in the fifth and sixth rows of the table.

3. 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. Complete this sentence:
For every second Jace runs, he covers _____ meters.

c. Complete this sentence:
To find the number of meters Jace has run,

d. Write a formula that expresses the relationship between seconds and meters for Jace's speed.

M = ____ S (where M is the number of meters Jace has traveled; S is the number of seconds he has gone).

e. Use your formula to fill in the last three rows of the table with numbers of your choice.

4. Take a few minutes to look at connections and patterns in this lesson.

a. Describe patterns that you see in your completed table.

b. Explain connections between the patterns in the table and the formula you wrote in 3d.

5. Write formulas for the following tables, assuming a constant speed for each table.

a.

Seconds	Meters
100	300
115	345
200	600
4	12
10	30

Formula:

b.

Seconds	Yards
4	20
8	40
10	50
13	65
17	85

Formula:

c.

Seconds	Feet
10	35
11	38.5
12	42
13	45.5
14	49

Formula:

Run, Jace, Run: Revisited

Jace ran with two friends of his, Luke and Mica. Jace was the fastest, and Mica was the slowest. The tables, formulas, and graphs below represent the three runners, but they are all jumbled up. At the bottom of the page, there is a space for you to match them correctly. Below each runner's name, fill in which table, formula, and graph represent that runner.

Table A

Seconds	Meters
10	25
20	50
40	100
80	200

Table B

Seconds	Meters
5	10
10	20
20	40
25	50

Table C

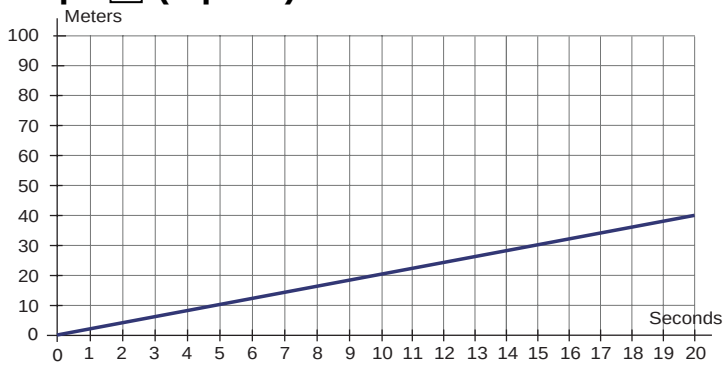
Seconds	Meters
5	25
10	50
20	100
40	200

Formula 1: $y = 5x$

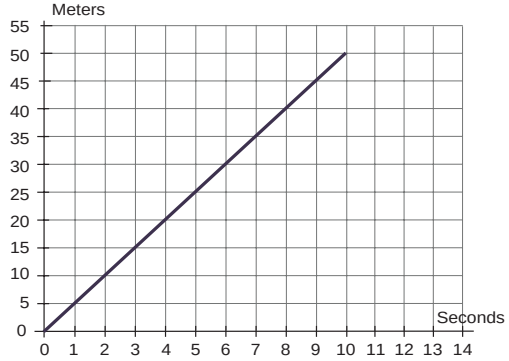
Formula 2: $y = 2x$

Formula 3: $y = 2.5x$

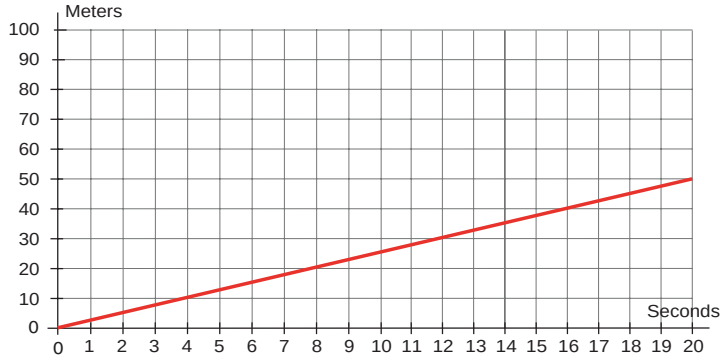
Graph □ (Square)



Graph ● (Circle)



Graph △ (Triangle)



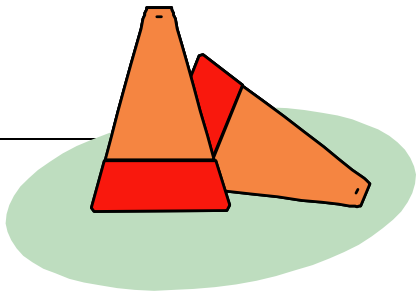
Your answers:

Jace
Table _____
Formula _____
Graph _____

Luke
Table _____
Formula _____
Graph _____

Mica
Table _____
Formula _____
Graph _____

Back at the Office



Managing the team keeps you busy. Back at the office, you have a whole stack of tasks to do. Use what you have learned to take care of some "to do's," below.

1. To do: Buy 50 soccer cones.
   Use office1.mw to help you answer the questions.

> 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

a. Fill in the table to find out how much the different quantities of cones will cost.

Cones	Cost in $
1	
10	
12	$ 9.60
18	
24	

Choose two of your entries and describe how you got the cost.

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

c. Write a formula that relates the number of cones to the total cost, for any number of cones you might want to buy.

2. To do: Set a new ticket price for games. Use the file office2.mw as needed.

a. Fill in the tables to get an idea of how much money the team can bring in for ticket prices of $1.00, $3.00 and $5.00. Ticket sales last year ranged from 20 to 100 per game.

Number Tickets	Total $
20	
40	
60	
80	
100	

Ticket $1

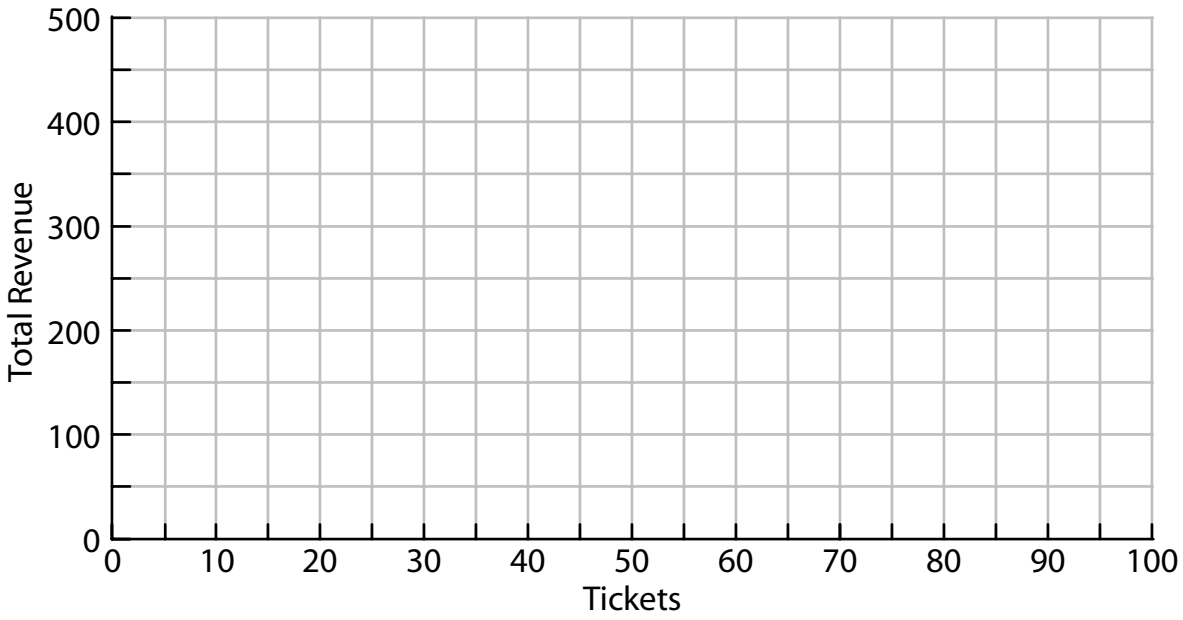
Number Tickets	Total $

Ticket $3

Number Tickets	Total $

Ticket $5

b. Make a graph so it is easy to compare dollars taken in and tickets sold for the 3 ticket prices.



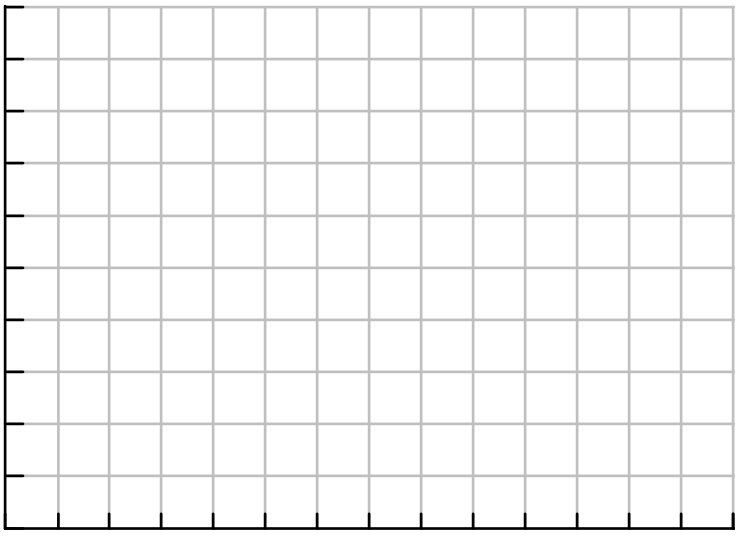
c. How many tickets would have to be sold, at each price, to take in 200 dollars? Estimate from the graph and then find the exact number of tickets.

Price	Graph estimate	Exact number tickets
$1		
$3		
$5		

3. Another “to do”:

a. Make up your own “to do” using the formula $y = 2.50x$.

b. Model it with office3.mw. Sketch the graph below.



Slope and Rate

You used unit rates in the previous activities:

You found the speed of runners. *Meters per one second* is a unit rate.

You used the cost of one item to make formulas, graphs and equations. The cost of one item can be written as a unit rate: $3 per ticket, for example.

KEY IDEAS: Rate and Unit Rate

- A rate compares quantities through division.
- "Meters per *one* second" and "dollars per *one* cone" are unit rates.
- "$9.60 per 12 cones" is not a unit rate.
- "Unit" refers to one.

You learned that for graphs comparing distance and time, or cost and number of items:

The faster the speed, the steeper the line.

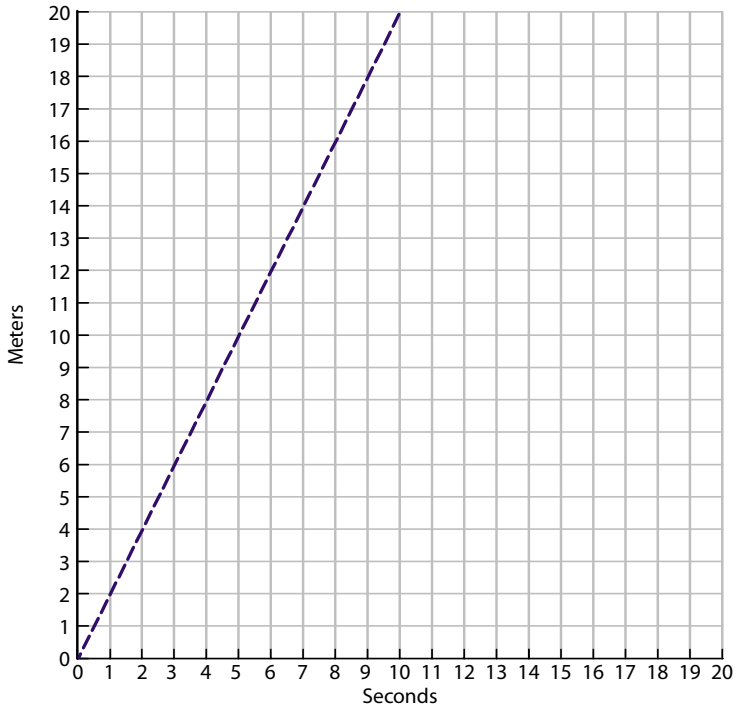
The more expensive the item, the steeper the line.

KEY IDEA: Slope

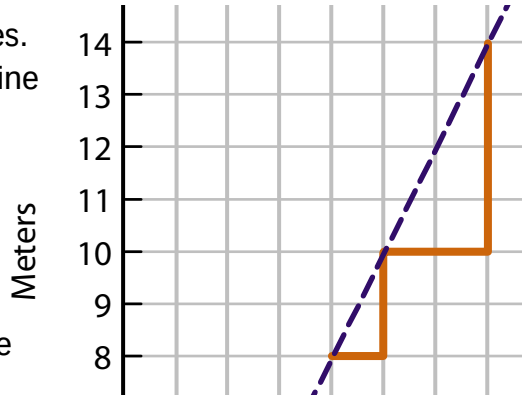
Slope is a number that describes the steepness of a line.

1. Do the following to learn about slope.

   a. What is the speed of Purple Girl (dashed line)? How do you know?



b. Make "stairsteps" on the graph of different sizes. A "stairstep" takes you from one point on the line to another point on the line with a horizontal move and a vertical move.



c. For each "stairstep," record the vertical and horizontal distance in the table. What pattern can you see in the table? Be sure to include the step with horizontal distance of 1.

Vertical	Horizontal
	1

More on Slope

The slope of a line is a number that describes its steepness.

To find the slope of a line:

- Pick two points on the line.
- Find the horizontal and vertical distances between the two points.
- Divide the vertical distance by the horizontal distance.

d. Using the axes on the previous page, draw a green line for Green Runner who went more slowly than Purple Girl. Make a stairstep table for that runner's line below.

Vertical	Horizontal
	1

e. What is the slope of Purple Girl's line? What is the slope of Green Runner's line?

f. What is the speed of Purple Girl? What is the speed of Green Runner?

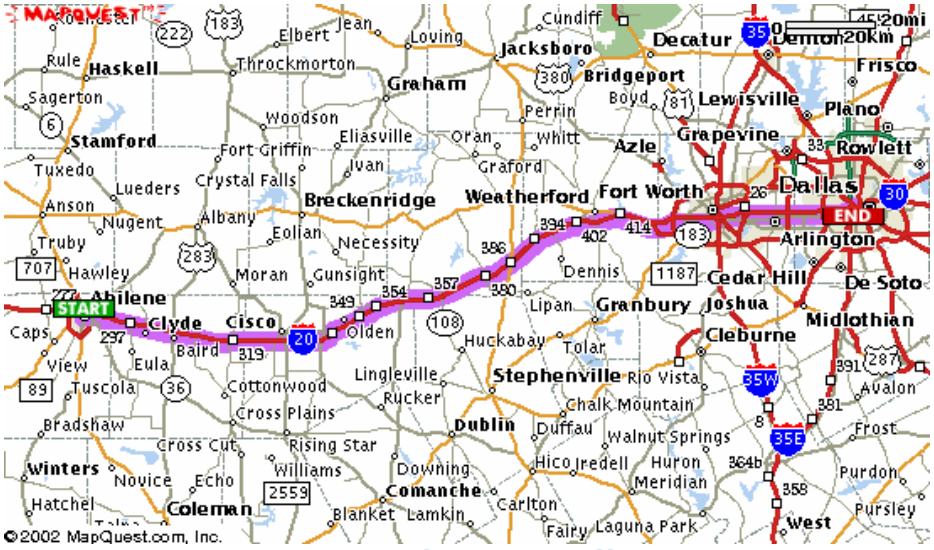
2. Go back to some of the other graphs in this workbook and find the slope of the lines.

3. Create a poster that describes and explains the connection between rate and slope. Sketch an idea for it below.

Every year the team makes the trip from Abilene to Dallas, for a special challenge match. They take both a bus and a van on the trip to accommodate all players and team boosters.

The good news: They have won the challenge match for many years in a row.

The bad news: The trip often has troubles—breakdowns, traffic tie-ups, you name it!

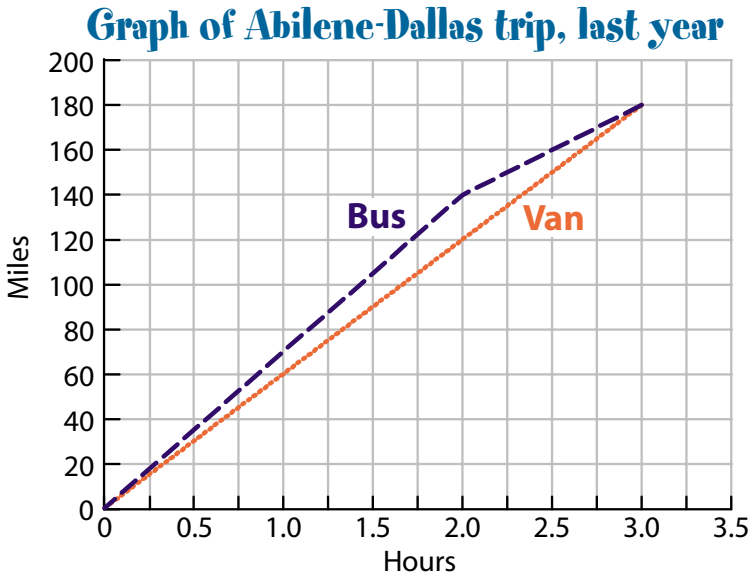


Abilene to Dallas Map

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

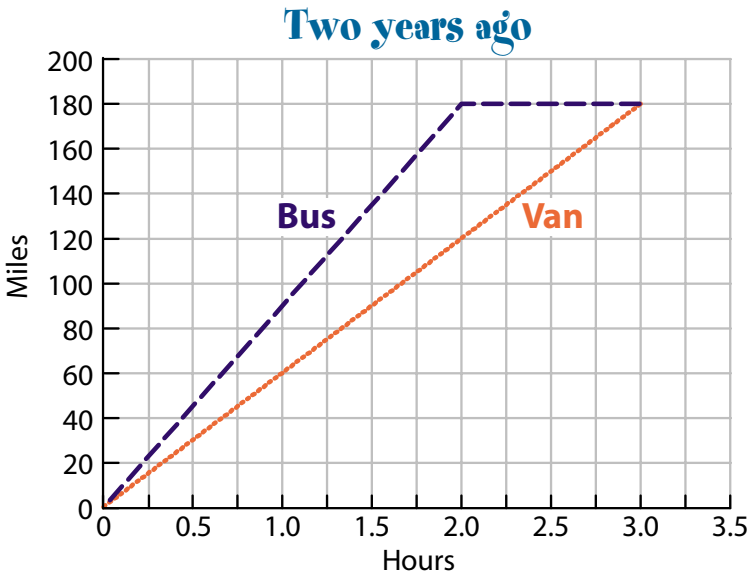
2. Use the file, onroad1.mw, to see what happened on last year's trip. Look at the simulation and the graph. Use the step button as needed so that you understand what happened.

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, and be sure to include the speeds of the vehicles.)



b. Write a paragraph that describes the motion of the bus and the van on the trip.

3. The trip from Abilene to Dallas two years ago went fairly well.

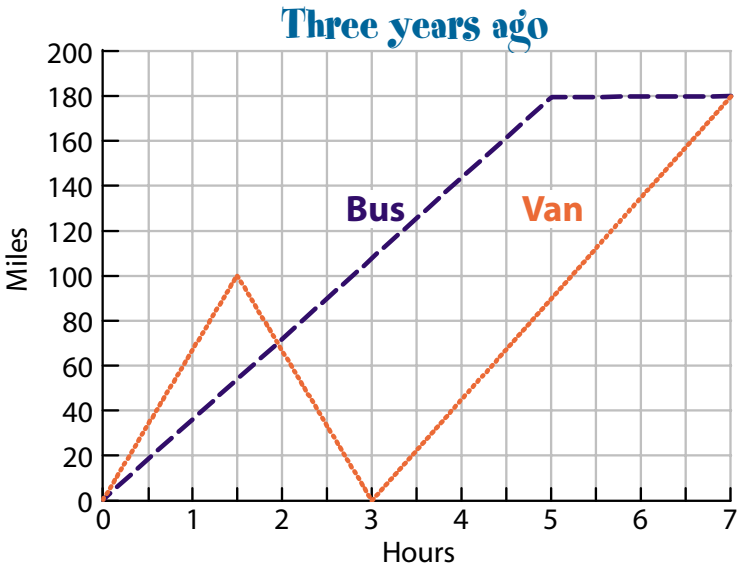


a. Predict from the graph: Which vehicle arrived first? How long did it take each vehicle to make the trip?

b. Run the simulation in the file onroad2.mw. Were your predictions right? Explain any differences.

c. Tell a story that could go along with the graph of two years ago.

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



   a. What did the van do after traveling for one and a half hours?

   b. What happened here? Tell the story of this trip.

   c. Use onroad4.mw to verify your prediction and story.

5. Think about the mathematics you did with the soccer players' dashes and the mathematics you 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.

Road Trip Records

1. There is one more travel record in the files for the Abilene–Dallas trip.

   a. Use MathWorlds to explore the simulation of the trip.

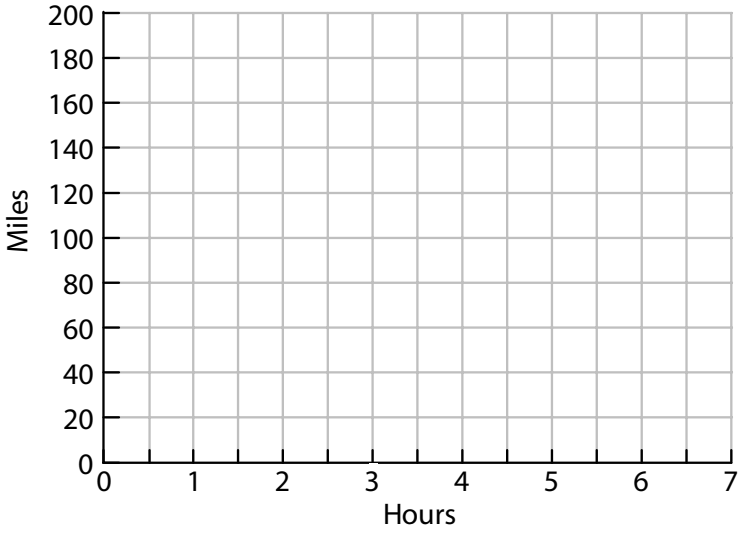
      - Open the file roadtrip1.mw.
      - Run the simulation (Note: the graph is hidden on purpose).

   b. Describe the bus trip and the van trip in a few sentences.

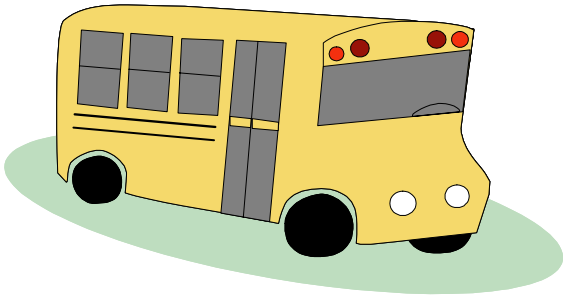
   Bus:

   Van:

   c. Predict what the graph will look like by making a sketch of the van and bus trip. Verify by checking points on the graph and playing the simulation.



2. One old-timer bus driver told about her worst trip from Abilene to Dallas:



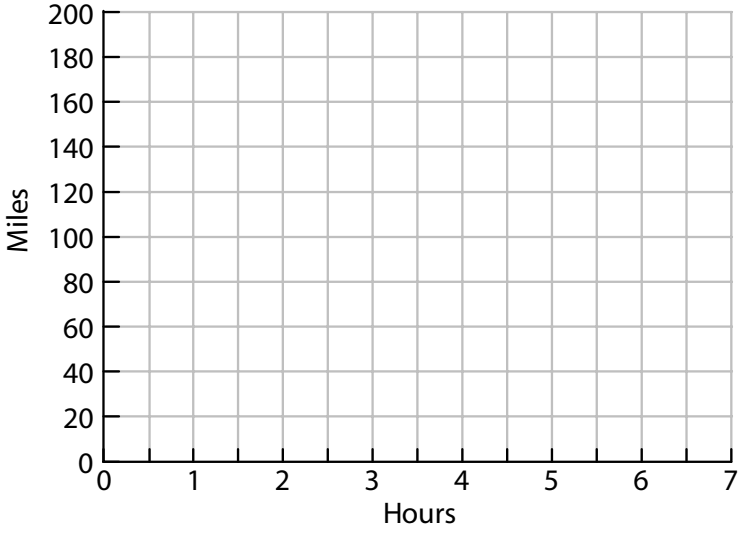
"The team had to take a bus and a van from Abilene to Dallas, once again. The bus left first and traveled at 60 miles per hour (mph). The van left an hour after the bus, and poked along at 40 mph, because of road construction.

"After two hours, the bus broke down and stopped. The bus just sat there for an hour while I looked at the engine. I decided a new fan belt would get us going. (Meanwhile, the van was still traveling at only 40 mph.)

"I was lucky: a call to TAAA got a fan belt delivered and installed in one hour. We got the bus back on the road and kept going at 60 mph. The van kept going at 40 mph.

"I remember all those details like it happened yesterday, but I sure don't know who got there first. And where was that van when we broke down, anyway?"

a. Sketch a graph showing the trip she described.



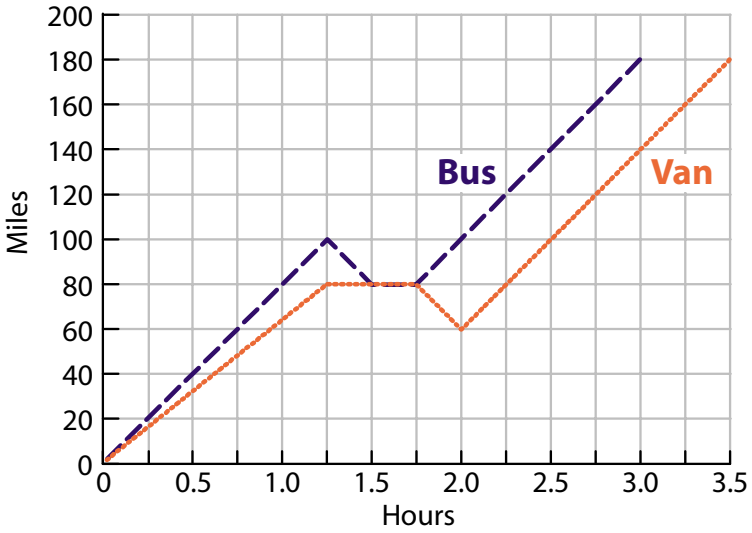
b. Answer the driver's questions.

Who got there first?

Where was the van when the bus broke down?

c. Now use roadtrip2.mw to model and graph the trip.

3. Here is another graph of an Abilene—Dallas bus trip from the past.



a. One hour into the trip, which vehicle had gone farther?

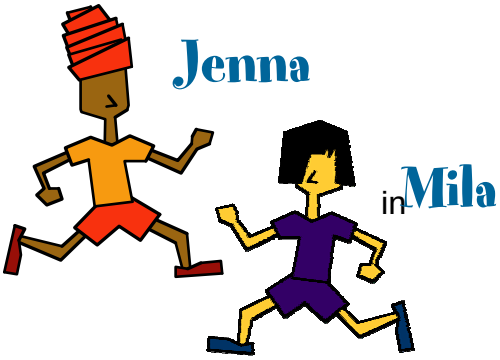
b. When were the vehicles at the same place, at the same time?

c. Which vehicle went back toward Abilene?

d. When were the vehicles going at the same speed at the same time?

e. Pretend you were on the trip. Tell the story of the trip: what happened to the van and the bus?

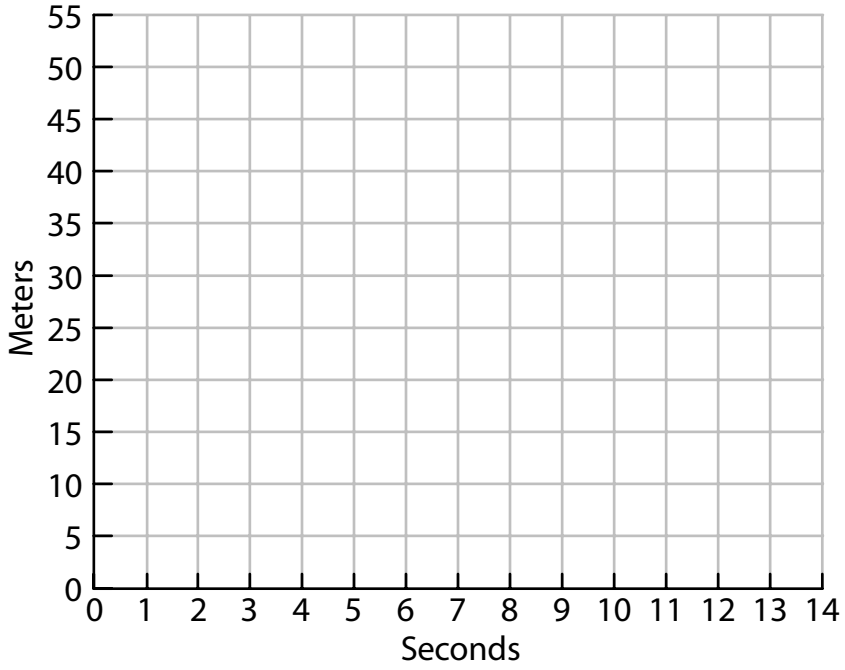
Graphs of Motion



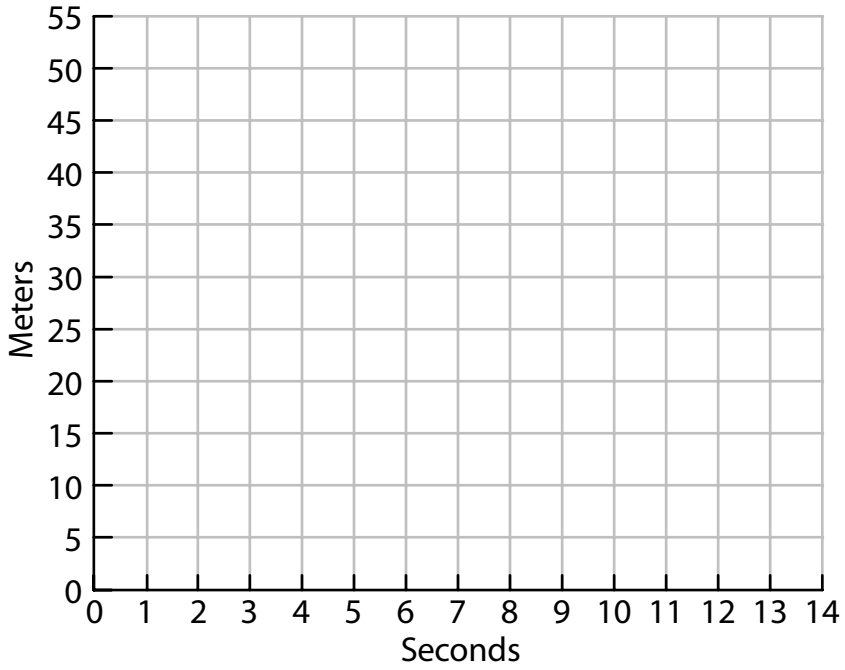
Interpreting and creating graphs are both important skills in mathematics, in and out of the classroom! The following activities give you a chance to practice.

1. Sketch a graph for each of the following 50-meter race stories. Then make your graph in MathWorlds, and run the simulation to see if it fits the story.

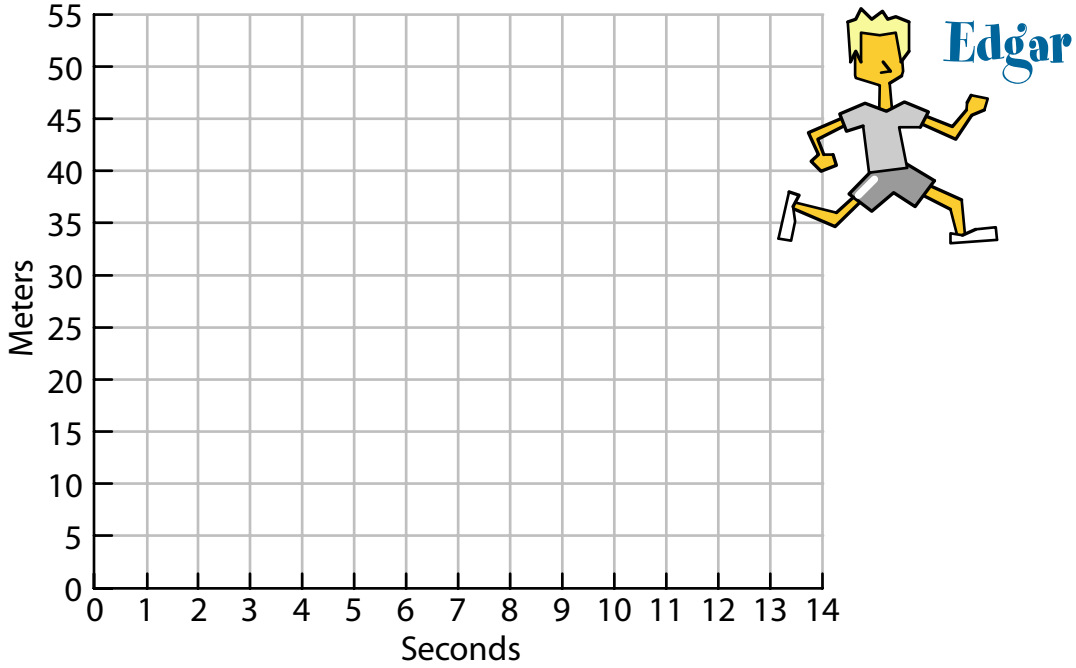
   a. Jenna ran faster than Mila for the first 25 meters. Then Jenna twisted her ankle and fell at 25 meters. She couldn't get up. Mila slowed down, but she kept running across the 50-meter line. Use graphrace1amain.mw to build and check your solution. Use graphrace1a.mw to see an example of a possible solution.



b. Chanda and Shawntee were neck and neck for the first 30 meters. Then Chanda sped up and passed Shawntee, winning by 2 seconds. Use graphrace1bmain.mw to build and check your solution. Use graphrace1b.mw to see an example of a possible solution.

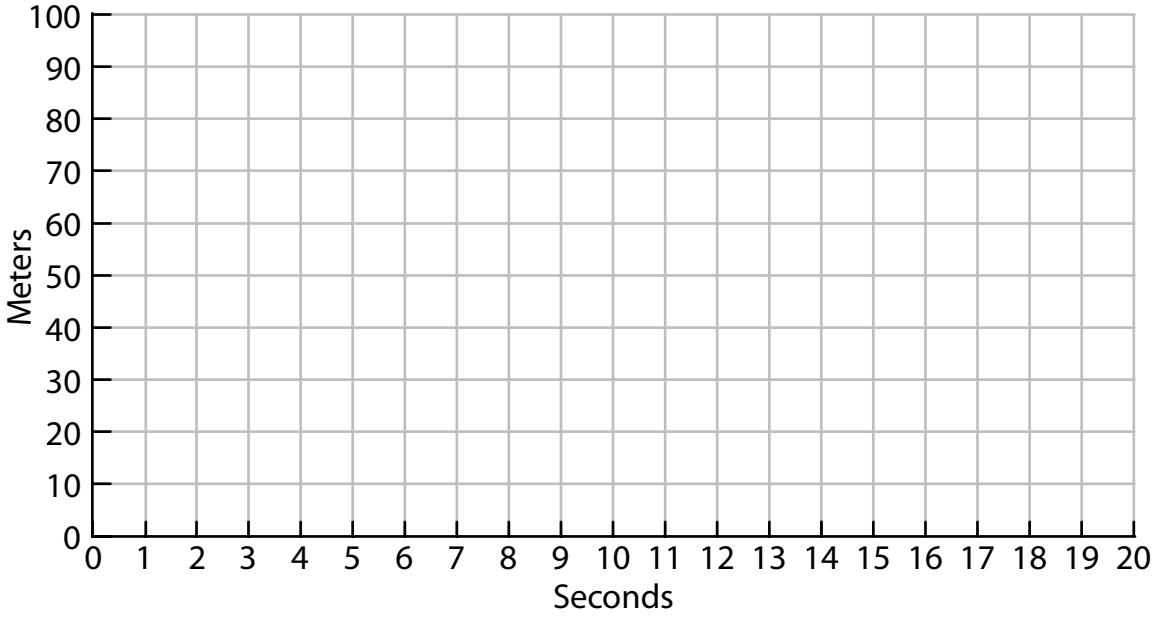


c. When Duane and Edgar raced, Duane was so sure he would win that he gave Edgar a 10-meter head start. Each boy ran the same rate the whole race, and Duane did win. Use graphrace1cmain.mw to build and check your solution. Use graphrace1c.mw to see an example of a possible solution.

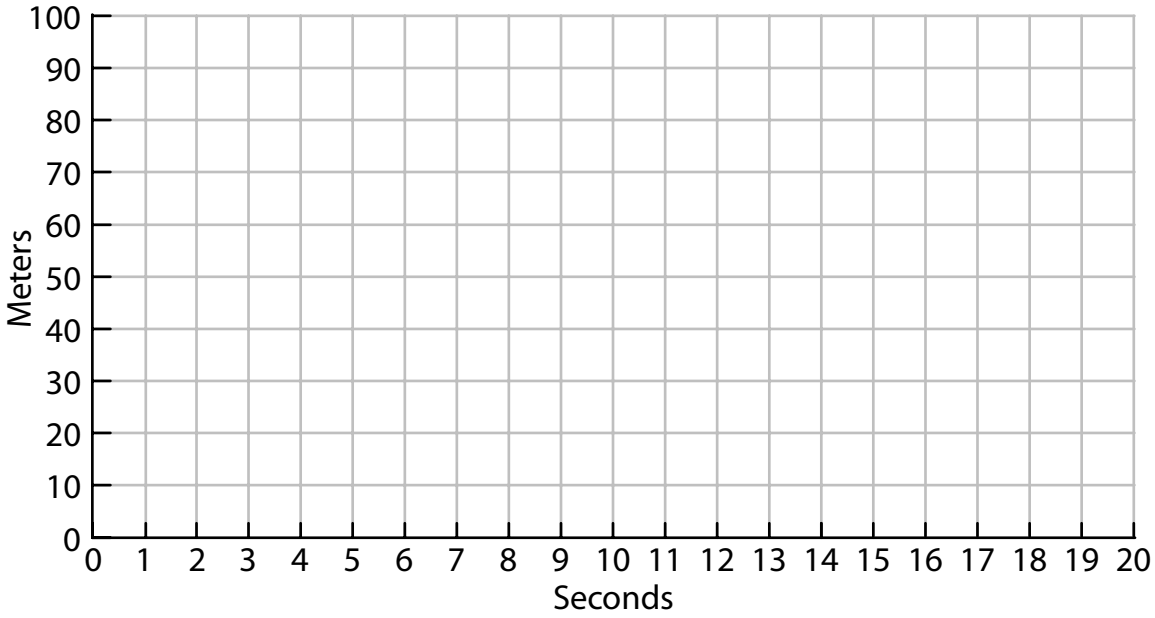


2. Watch each simulation and then sketch a graph on the axes provided.

a. graphrace2a.mw

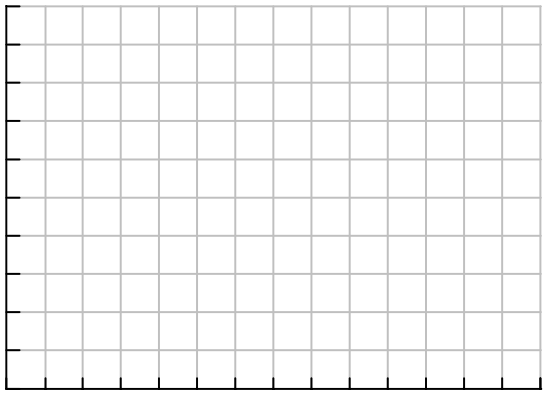


b. graphrace2b.mw

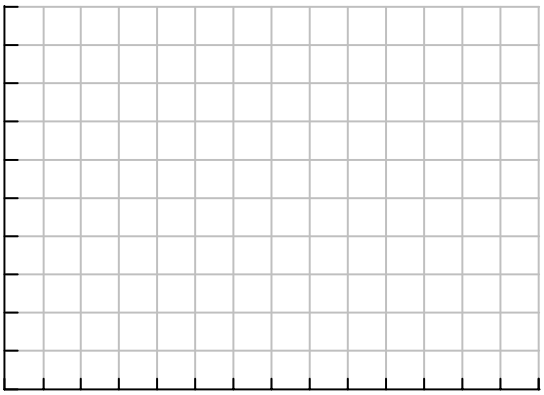


3. In order to quickly understand graphs, it helps to know some “by sight.” Sketch graphs for each of the following situations, so that you will be able to recognize them in future work.

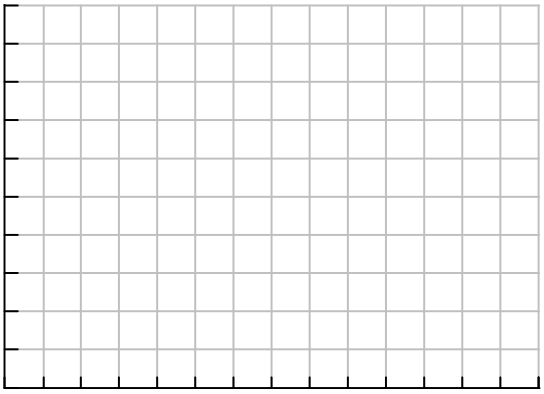
a. Standing still.



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.

Salary Negotiations

Read the memos and answer the questions.

To: Acting team manager
From: Personnel office

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

Double Overtime:
Up to 100 hours—$7.00 per hour
Any hours over 100 in the season—$14.00 per hour
OR
Same Wage:
$10.50 per hour, no matter how many hours worked.

Please let us know which way you prefer, as soon as possible.

1. What should you consider before you decide?

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

3. Compare the two pay options for any number of hours you might work for the season. Use graphs, tables, or formulas.

To: Acting team manager
From: Personnel office

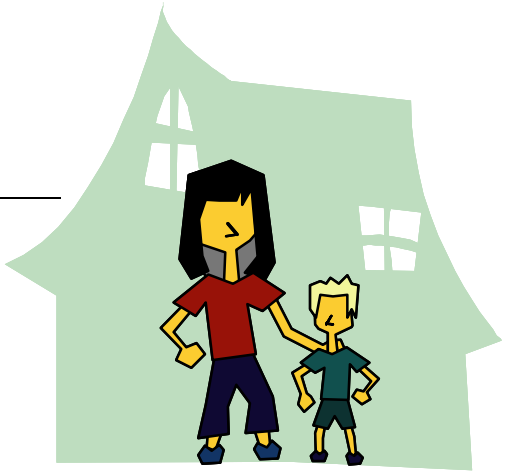
One more payment option: We could also pay you a flat fee.

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

Please let us know which of the three ways you prefer, as soon as possible.

4. Now compare and discuss the three payment options from *both* memos.

Summer Job Advice



You have figured out the best pay option for your job. Now give advice to these jobseekers. You may use the MathWorlds file summer.mw, to help you with each problem, or just use paper and pencil. Do not worry about taxes or other paycheck withdrawals for these problems. (They will have to figure out that part for themselves.)

1. 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 the same number of hours each week. Make a graph or table that compares both ways of getting paid for 0 to 60 hours.

2. Marta has two summer job offers:

helping in her aunt's store for $8.00 per hour

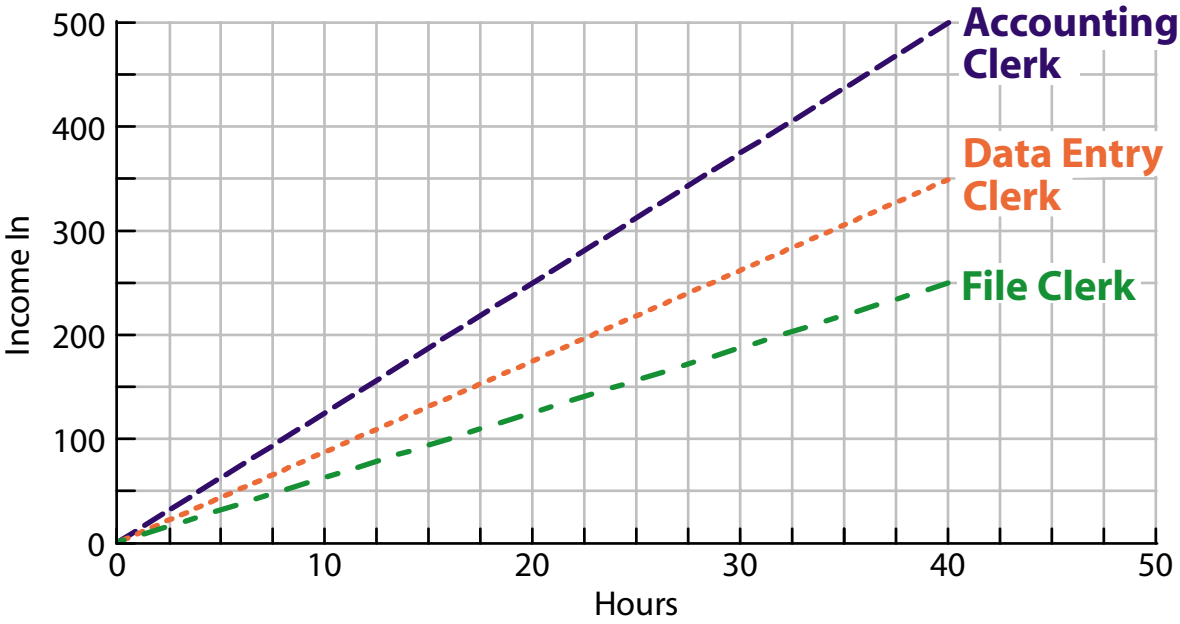
OR

being a preschool aide for $6.50 per hour

Each job lasts 6 weeks and is for 20 hours per week. She really cannot decide which job to take: she wants to help her aunt and the pay is better, but she loves working with small children and thinks the preschool job could look good on her college applications.

Make a graph so Marta can compare the difference in total pay for 0-150 hours.

3. Tony applied for work through SummerHelp, an agency that helps place teens in summer jobs. They 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.

4. Trevonne needs to make at least $1000 this summer. He can make $6.50 an hour working at the donut shop, working as a lifeguard pays $7.75, and the computer store offers $9.25 an hour.

   a. How many hours would Trevonne have to work at each job to earn $1000? Show calculations, formulas, graphs, or tables that you used to get your answers.

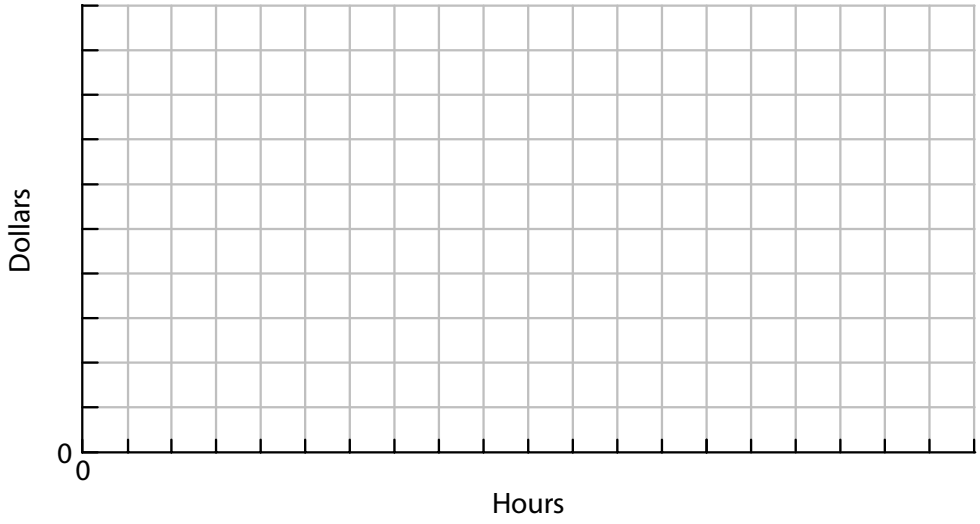
The jobs are in different parts of the city. Trevonne can walk to the donut shop in 5 minutes. To get to the beach for lifeguarding, he can ride with his friend, Jana, and it will take 30 minutes each way. The computer store is three bus rides away, for a total of an hour's travel time each way. Trevonne 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 Trevonne advice about which job to take. (Assume each job requires an 8-hour day.) Again, show your work.

5. The YES program helps teens in Amarillo get summer jobs. (See newspaper article on the following page.) If the teens work in a store, YES pays $2.00 per hour of their wages. If the teens work in a daycare center, YES contributes all of their minimum wage: $5.15 per hour.

   a. Write formulas for each rate of contribution, relating hours worked to total dollars earned.

   b. Create a graph showing the YES contribution to the salaries of the two types of jobs, for 0 to 100 hours.



   c. Write a letter to send with the graph, explaining to employers how much they can expect YES to contribute if they hire a teen this summer.

Amarillo Globe Web posted Wednesday, September 1, 1999

32 student employees recognized for completing summer jobs

10:43 a.m. CT
By KAREN D. SMITH
Globe-News Feature Writer

Thirty-two teen-agers stand on good career foundations because of 21 businesses and the Youth Excelling & Succeeding Project employment program, project officials said on Aug. 12.

"My father would always tell us you have to have a good foundation, because without a solid foundation, the house is not going to stand," Potter County Commissioner Iris Lawrence said to employers and teen workers gathered for the YES Employment and Training Recognition Luncheon at the Black Historical Culture Center. Lawrence, a member of the YES Project oversight committee since its inception, outlined the beginnings of the program for luncheon attendees.

Funded through the Texas Department of Protective and Regulatory Services Community Youth Development Program, YES provides job, recreation, mentoring and educational opportunities for youths living in North and Northeast Amarillo neighborhoods.

At summer's start, the PRPC placed 43 students in jobs with private employers and nonprofit agencies, according to PRPC Executive Assistant Rebecca Rusk. YES funds pay $2 per hour of the wages for youths placed in for-profit businesses and 100 percent of the minimum-wage salaries for youth placed at public and private nonprofit agencies, Globe-News files show.

Of the 32 students who completed the summer program, 20 were female and 12 male. Collectively, they worked more than 10,000 hours and earned combined wages of $50,000, Rusk said.

Lawrence also shared a personal story of opening doors, referring to her introduction when it was noted at the end of a long list of posts that she had even been a clerk at the former downtown Fedway department store in the 1960s.

"I was the first black clerk employed at Fedway," she said, explaining that the store owner approached her pastor at Mount Zion Baptist Church with a plan. "He told (the pastor), 'I would like to hire a Negro to work in our store.' Most blacks at that time had been messengers, janitors and so on."

"He wanted to open the doors here in Amarillo, Texas," Lawrence said. "It was the early '60s, and it was quite hard for a black to get a decent job."

Later, she was the first black female clerical worker hired by another company in Amarillo, where one black male also was employed. "The two of us opened doors again," she said.

Lawrence told the story, she said, to make a point to the teens. "The door has been opened, so it's time now that the young people take advantage of all you have before you," she said.

All about MPG

Miles per gallon (MPG) is an important rate when dealing with motor vehicles—cars, trucks and vans. MPG tells you how many miles you can drive on each gallon of gasoline you put into your vehicle.

MPG information from a new car sticker

Vehicle type	Average MPG
Compact cars	26.1
Vans	15.7
Pick ups	17.1
SUVs	17.3

Average MPG for vehicles of different types from 2003

1. Compute the fuel mileage, or miles per gallon (MPG) for each situation below:

   a. On a recent trip, Sarah's car traveled 339 miles and used 12 gallons of gasoline. What was her MPG for that trip?

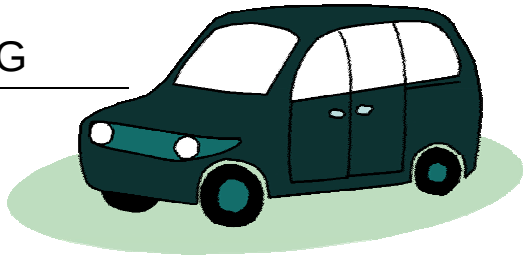
   b. On Monday, Emily filled up her truck's tank and then drove all over town all week. On Friday, she stopped at the service station again. She used 10 gallons to fill the tank, and noticed that she had traveled 156 miles since the last fill up. What was her MPG for the week?

c. Oscar kept a record for his car. Fill in the MPG column.

Date	Miles traveled	Gallons	MPG
3/02/03	252	12	
3/08/03	356	11	

2. Fill in the blank: The higher the MPG of a car, the _____ money you have to spend on fuel for the car.

How Far on How Much? MPG



A big expense for the soccer team is buying fuel for the bus and van used for traveling to “away” games. To try to reduce costs, you investigate the miles per gallon that each vehicle gets.

1. Frida, the van driver, is always worried about running out of gasoline on the way home from a game. She keeps a little chart on the dashboard that tells her how many miles the van can go on how many gallons. It has been on the dashboard so long that some of the numbers have worn off.

Gallons	Miles
0	0
2	30
4	60
6	
8	
18	
	210
22	

   a. Fill in the chart for Frida.

   b. How did you know what numbers to fill in?

   c. According to this chart, how many MPG does the van get? How do you know?

   d. Write a formula that tells you how many miles the van will travel for any number of gallons.

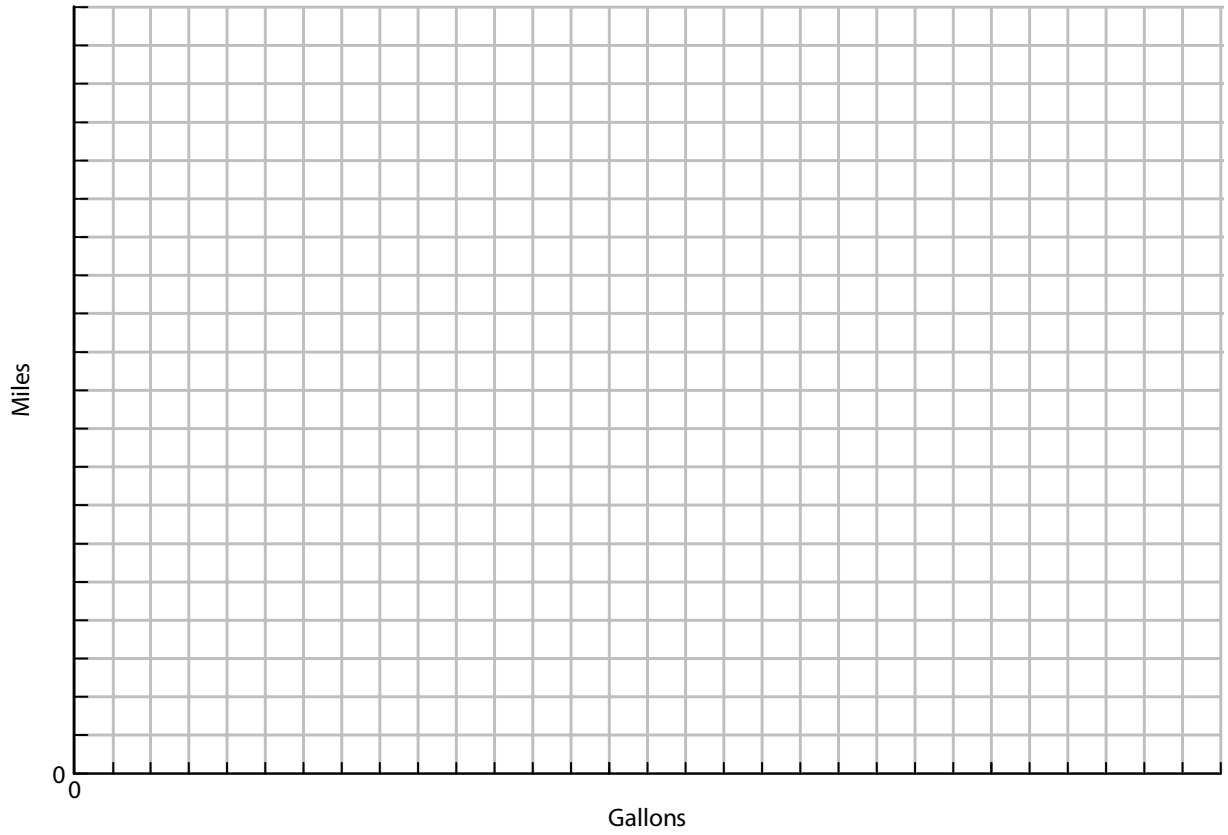
e. Use your formula to determine how many miles the van can go on 4 gallons. Does it match the chart?

f. Use your formula to predict how many gallons of gas are needed for a 450-mile trip.

g. Compare the formula and table: What is each good for? What is each NOT good for?

2. We can use a graph to compare the MPG of the van and MPG of the bus.

   a. Make a graph of the van's MPG for 1 to 30 gallons. (Miles on vertical axis; gallons on the horizontal axis.) You can use mpg.mv.



   b. The bus gets 9 miles per gallon. Sketch the line of the bus' mileage on the axis above and write a formula that represents the relationship between miles traveled and gallons of fuel used for the bus.

c. Write a memo comparing the fuel costs for the van and the bus when they are used to take the soccer team to games. Use this fact: most games are between 50 and 120 miles away from home.

To: School Principal

From: Acting Soccer Team Manager

Re: Fuel costs for soccer team travel.

You have compared the MPG for the bus and the van, assuming that the MPG stays more or less the same all the time. But you know that MPG varies. For example, a vehicle uses more fuel per mile when driven in a city or town than when driven on the highway. This is important for the following problem.

3. Frida the driver calls in from the road: the fuel gauge on the bus is not working, and the team is already late for the Ballinger game. She needs your help to figure out if they can make it to the game without stopping for a fill up.

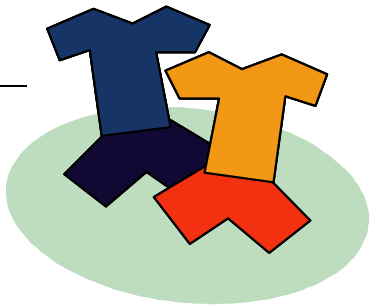
   Here's what you both know:

   - The bus gets 6 mpg in the city, and 10 mpg on the highway.
   - The tank holds 50 gallons of fuel.
   - Frida filled the tank on Monday and has driven 136 miles, around the city, since then.
   - The bus has to travel 55 more miles on the highway to get to the game.

Exactly how far can the bus go with the fuel remaining?

Use graphs, tables, computations and/or formulas to show how you found out. (You may use the MathWorlds file, mpg.mw, if you want.)

Suiting Up



The team's uniforms are looking raggedy and you have some new team members. Time to buy new uniforms! Through the Internet and ads in soccer magazines, you have put together a fair amount of information. Some mathematics will help you find the best deal.

Use the MathWorlds file, suitingup.mw, to help you as needed in the following problems.

1. Uniforms are available from Soccer Universe at the following prices:

If you buy this many uniforms	You pay this price for each
1-10	$50.00
11-20	$45.00
21-40	$40.00

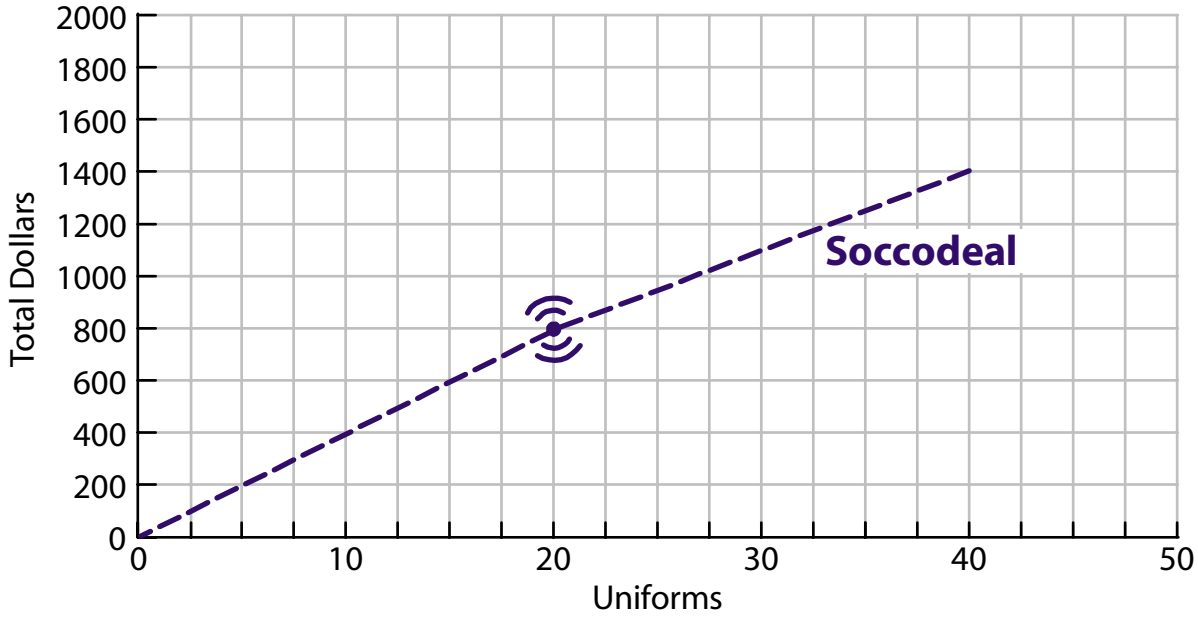
   a. Your assistant says she sees a way to get one uniform for free. How could she do that? Explain your reasoning and show any graphs, tables, or formulas you used.

Soccerama also sells uniforms. Their base price for one uniform is $50. But discounts for buying more are available. Their chart reads as follows:

Number of uniforms	Discount on total order
0-15	0%
16 - 25	10%
Over 25	15%

   b. Which store—Soccer Universe or Soccerama—would be cheaper if you want to buy 10, 20, or 30 uniforms? Explain your reasoning.

2. The purchasing department cannot understand the graph from Soccodeal's website shown below.



Write a memo explaining how they should determine the cost of an order for 1 to 40 uniforms.

Manager's Report

It has been a busy two 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 two 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.

Mathematically Speaking

You have investigated some real-life situations and solved problems using mathematics, developing some important mathematical ideas along the way. It is also important to know the mathematical terms that go with these ideas.

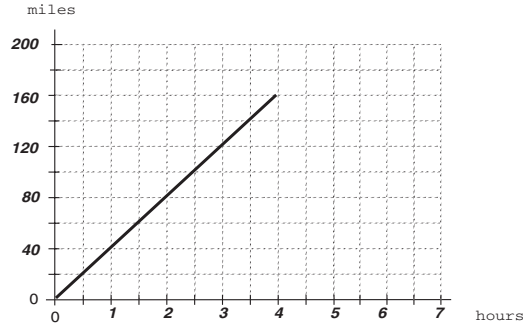
KEY IDEA: Proportion

If you can write a formula $y = kx$ where k is a real number other than 0, for two variables x and y, then we can say that

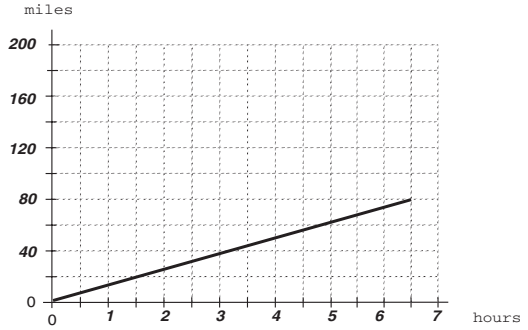
x and y are proportional,
x and y are in proportion,
OR
x and y vary proportionally.

These graphs show variables that are in proportion.

a.

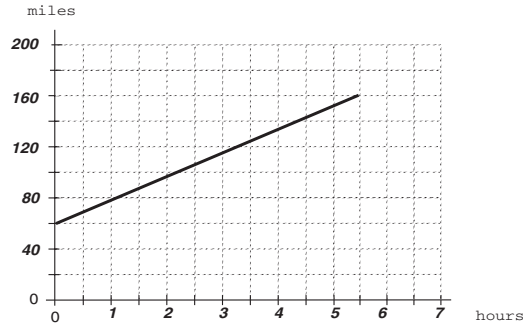


b.

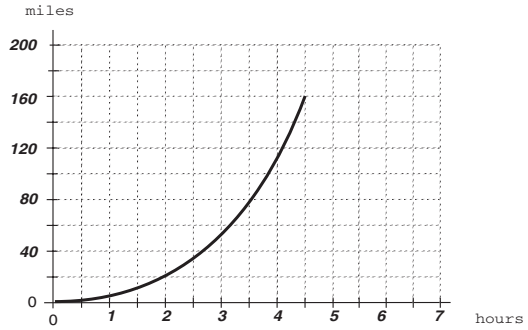


These variables are NOT in proportion.

c.



d.



1. In the graph above, explain why the top two graphs (a and b) show variables in proportion and why the bottom two (c and d) do not.

KEY IDEA: Rate

A rate tells you how many y you get per each x.

Typically, a rate describes how much of something corresponds with something else: miles per gallon, meters per second. It is often useful to consider how many y you get for **one** x; this is called a unit rate. A unit rate tells us—for example—how many miles can be traveled on one gallon; how many meters you can run in one second. This makes it easy to use the rate to think about how many miles you can get from a whole tank of fuel, and how many meters you can cover in 20 seconds.

2. Show different ways to find the unit rate of miles per hour for the top two graphs (a and b) on the previous page. Write the $y = kx$ formula for each graph.

   a.

   b.

3. Give examples of unit rates you have used in your life and in this unit.

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Mapquest

US Department of Energy

http://www.fueleconomy.gov

Michael Griffin

Lynne Peck Theis