CSI BRAMPTON: Who Stole Our Mascot Cardie The RiverHawk?

Suspect 1: "Laughing" Lucy	Suspect 2: Harold "Horn Head"	Suspect 3: "Razor Head" Ramone	Suspect 4: "Dirt Chin" Charlie	Suspect 5: Frankie "Four Eyes"
				
Height: 195 cm Forearm: 30 cm Arm Span: 190 cm	Height: 175 cm : 35 cm Arm Span: 140 cm	Height: 175 cm Forearm: 30 cm Arm Span: 140 cm	Height: 195 cm Forearm: 35 cm Arm Span: 190 cm	Height: 195 cm Forearm: 35 cm Arm Span: 140 cm

UNIT 4: PROBLEM

Name: _____

Teacher: _____

Cardinal Ambrozic C.S.S. Mathematics Department

LINEAR RELATIONSHIPS | Grade 9 Academic Mathematics Student Workbook| MPM1D1

"Making decisions in light of gospel values with an informed moral conscience"

Unit 4: Linear Relationships

MPM1D1

Grade 9 Academic Mathematics: Principles of Mathematics

Tool Number	Lesson Title & Topics	Topics	Homework
4.1	Match This Graph and Graphical Stories	Unit Intro Lesson Intro CBR Match Activity	-2.6 1odds, 2, 3, 4, 5, 7, 9, 11
4.2	Rate of Change	Connecting Stories with Rate	-5.4 #1, 2, 3, 6, 7, 12, 14, 15
4.3	Slope	Slope equation	-5.3 #1, 3, 4, 5, 7, 9c, 11, 12
4.4	Direct and Partial Variation	Concept Attainment TIPS Outfitters Activity	-5.1 #2, 4, 6, 8 -5.2 #1, 4, 6, 7, 8, 11
4.4	Direct and Partial Variation	Concept Attainment TIPS Outfitters Activity	-5.1 #2, 4, 6, 8 -5.2 #1, 4, 6, 7, 8, 11
4.5	Modelling Linear Relations With Equations	Slope equation y = mx + b TIPS support Colour Activity Bridge	-5.6 #2, 4, 6, 8, 10, 11, 13
4.6	Review: Modelling With Carousels	Review	-pg. 288 #2, 4, 5, 6, 9, 10, 11, 13, 15, 16
4.10	Performance Task	Pencil and Paper	

Parent/Guardian Signature: _____

Checklist

I understand and can correctly complete questions involving:

___ Stories from graphs

___ Rate of Change

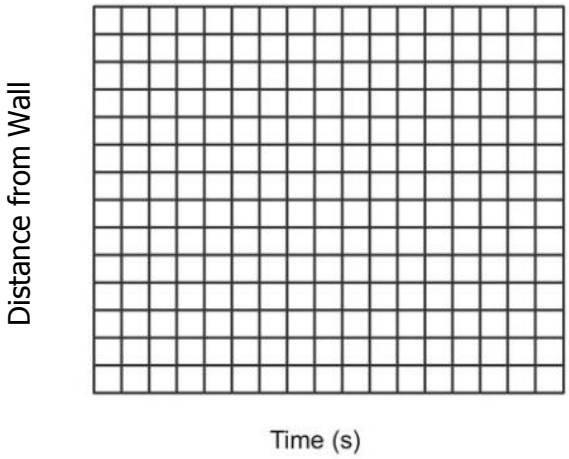
___ Slope as: $\frac{Rise}{Run}$, $\frac{Difference\ in\ y}{Difference\ in\ x}$, $\frac{\Delta y}{\Delta x}$, $\frac{y_2-y_1}{x_2-x_1}$

___ Equation of Linear Relations:

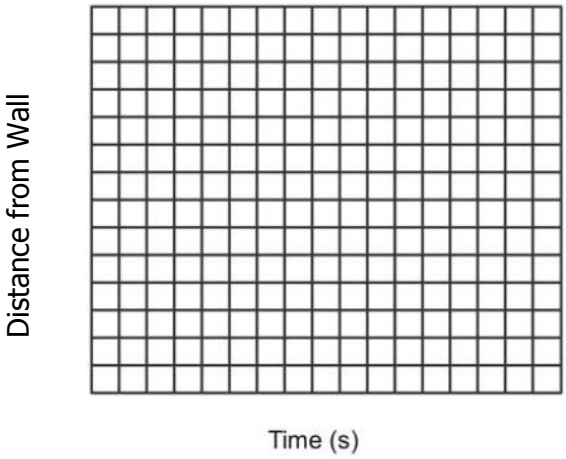
- Dependent = Initial Value + Rate of Change x Independent
- Dependent = Rate of Change x Independent + Initial Value
- y = mx + b

___ Direct Variation: y = mx | Partial Variation: y = mx + b

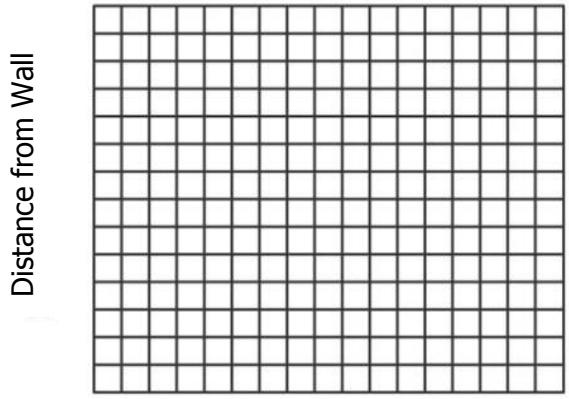
VIDEO 1



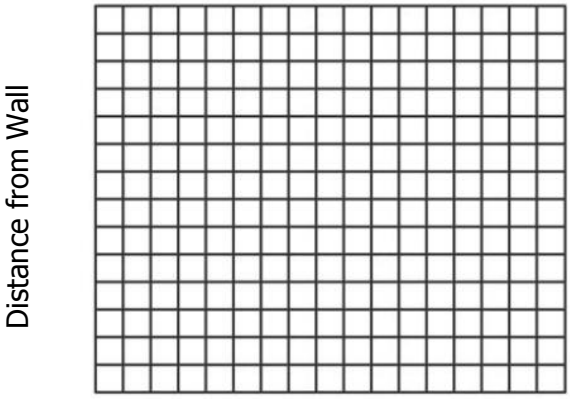
VIDEO 2



VIDEO 3

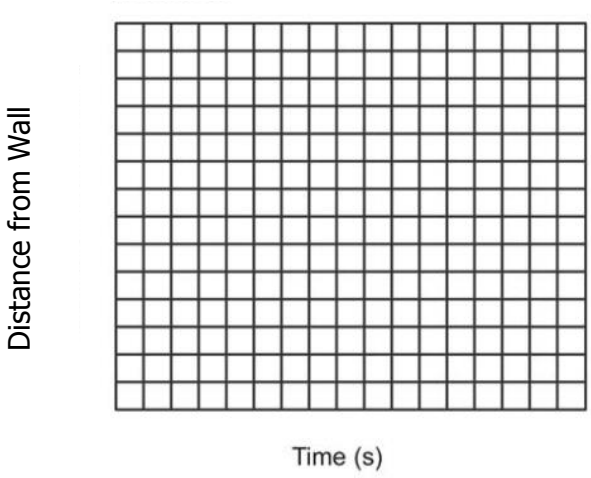


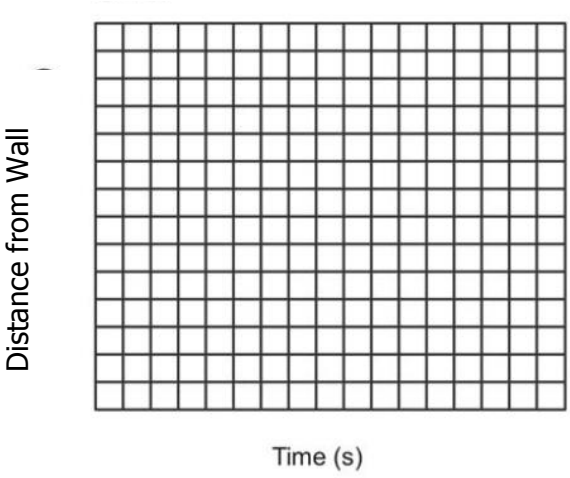
VIDEO 4



VIDEO 5

VIDEO 5





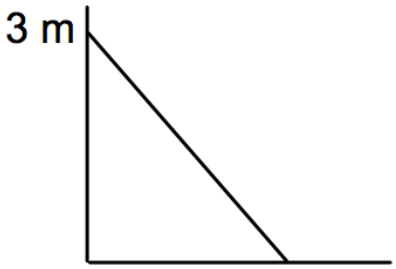
ACTION

Match This Graph

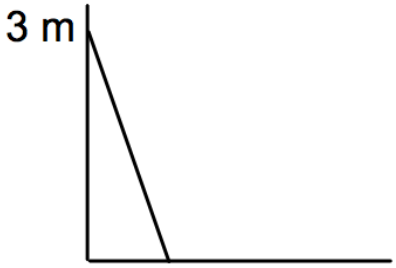
Sparkvue

- Today you will use the SPARK Vue App along with the motion detector to try to product each of the graphs given in the proceeding pages.
- Keep the motion sensor on a table aimed towards your body.
- You will work in groups of 3s

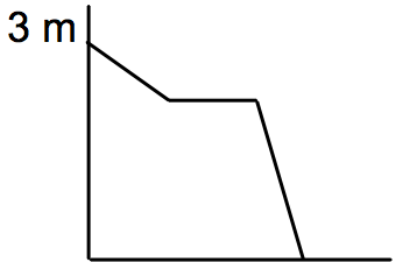
Graph 1



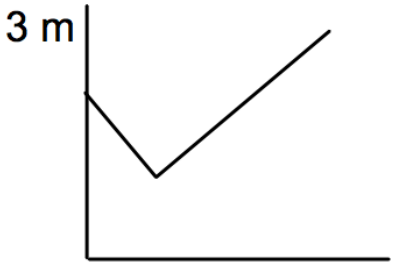
Graph 2



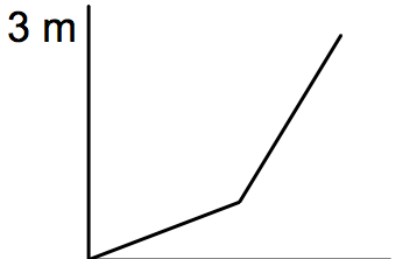
Graph 3



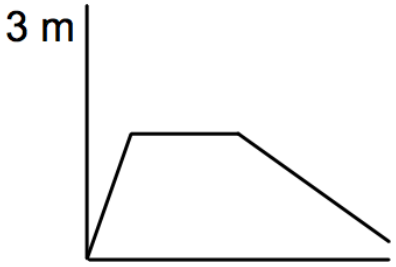
Graph 4



Graph 5

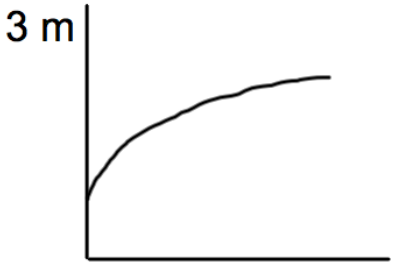


Graph 6



Graph 7

Graph 8

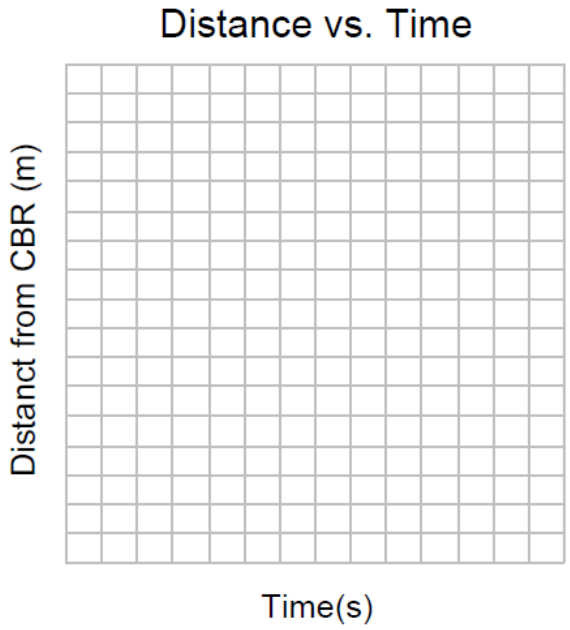


Problems

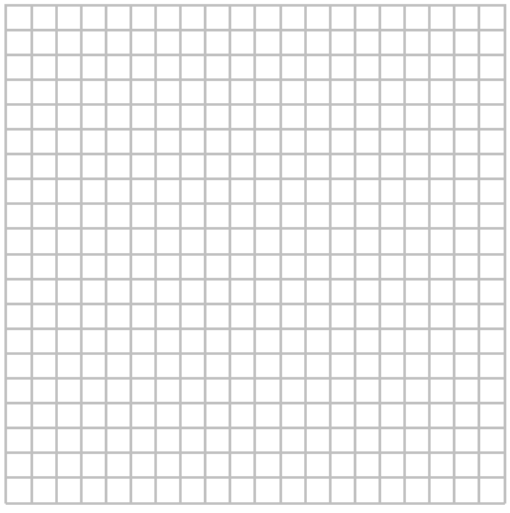
1. Which letters of the alphabet could you **not** create by walking in front of the motion detector? Explain why.

2. Draw a graph to match the following description:

   A student stands 4 metres from the CBR and walks at a constant rate towards the CBR for 5 seconds. They then stand still for 3 seconds, and run back to the starting position.

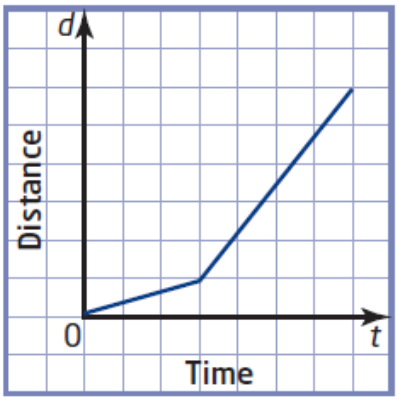


3. Create your own graph and write a description to match it.

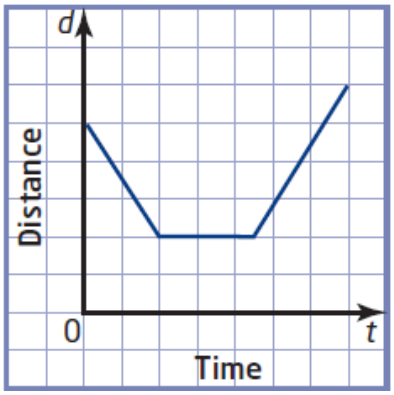


4. Describe a situation that corresponds to each distance-time graph.

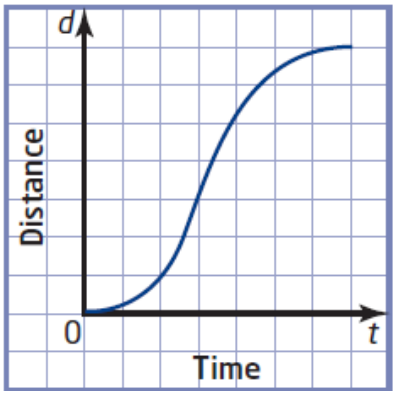
a)



b)



c)



a)
b)
c)

Graphical Story Assignment

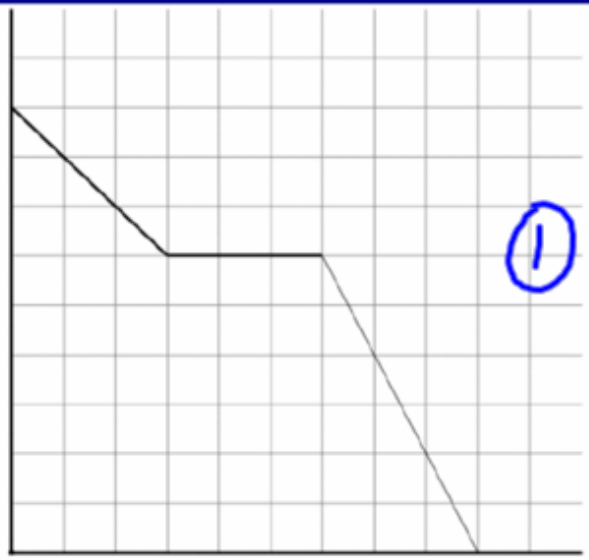
Names:

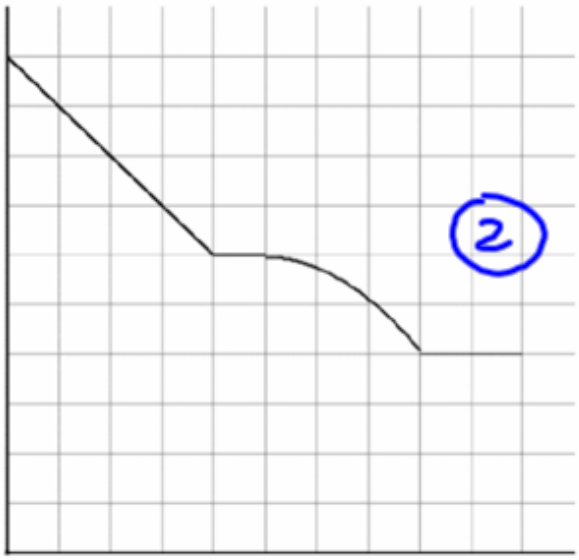
As you create your story: Focus on the rate of change of each section of the graph and determine whether the rate of change is constant, varying from fast to slower or slow to faster or zero.

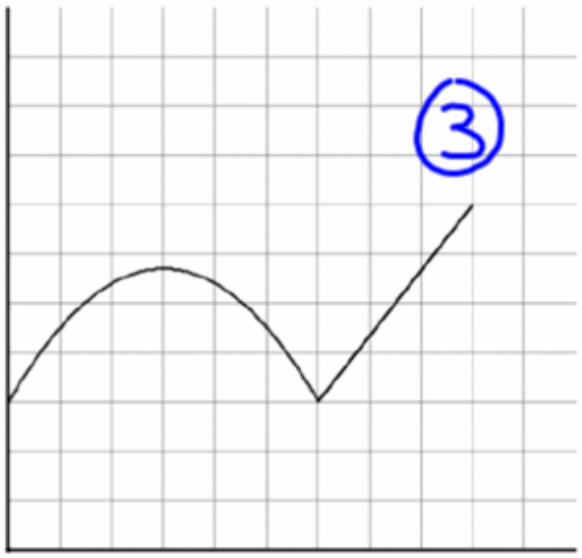
Criteria Does your story include:	Yes ✓
• the description of an action? (e.g., distance travelled by bicycle, change of height of water in a container, the change of height of a flag on a pole)	
• the starting position of the action?	
• the ending position of the action?	
• the total time taken for the action?	
• the direction or change for each section of the action?	
• the time(s) of any changes in direction or changes in the action?	
• the amount of change and time taken for each section of the action?	
• an interesting story that ties all sections of the graph together?	
• The rate of change (i.e. increasing, decreasing, zero)	

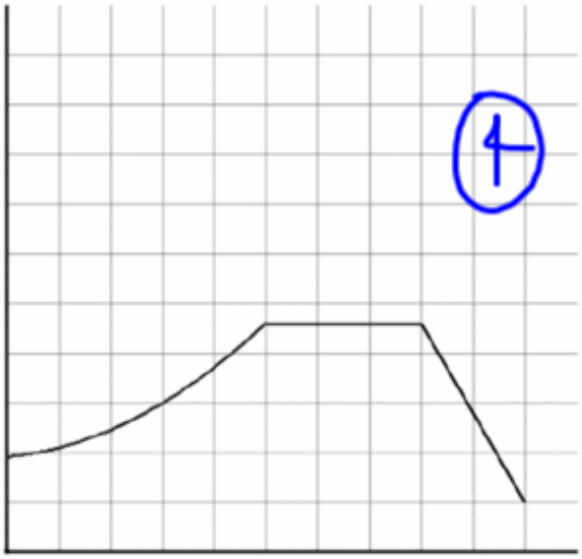
Scale your graph, and label each axis!

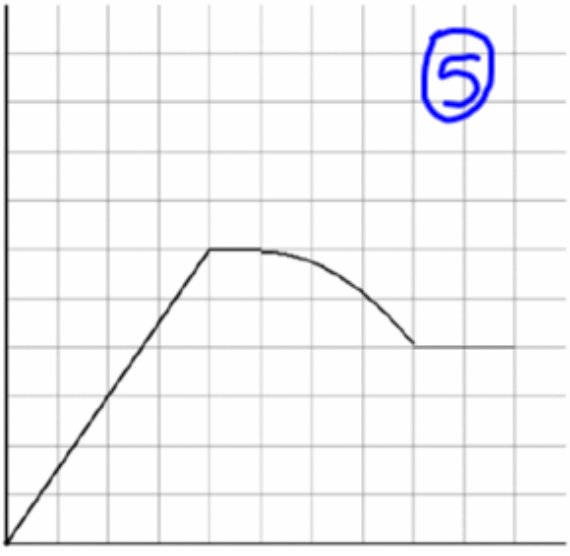
CONSOLIDATE

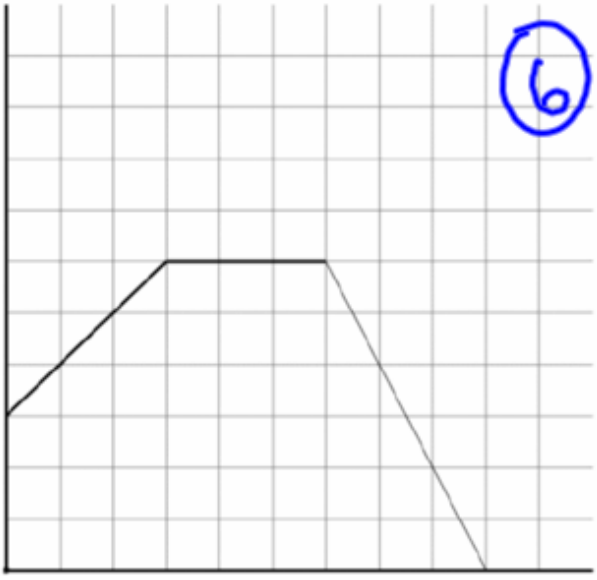






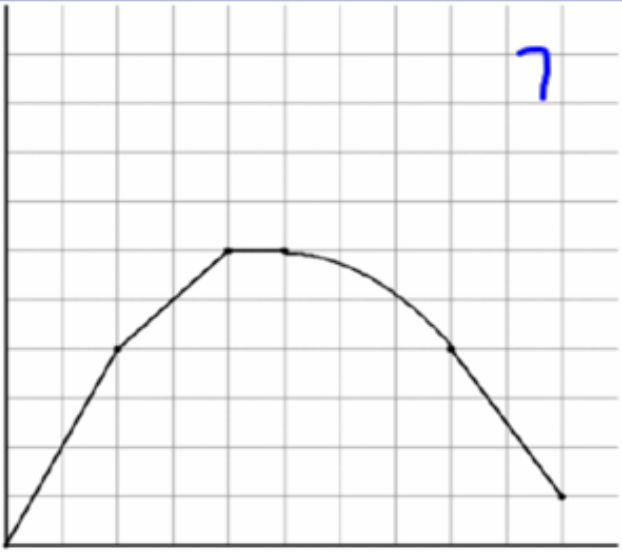






CONSOLIDATE

7



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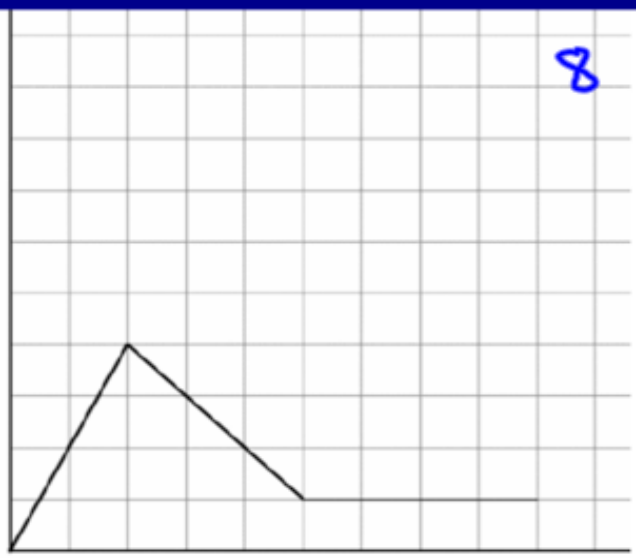

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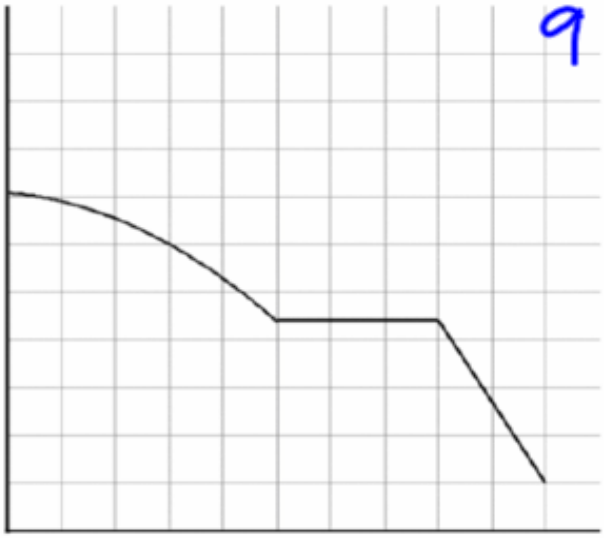

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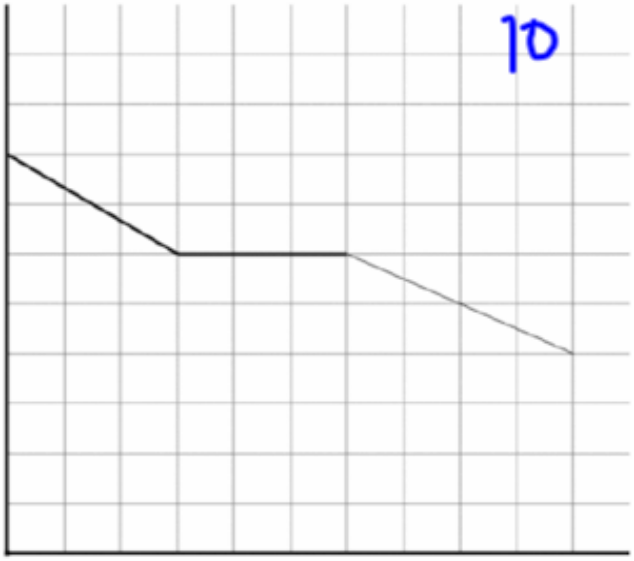


11

12

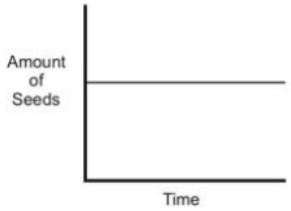
MORE PRACTICE

Sunflower Seed Graphs

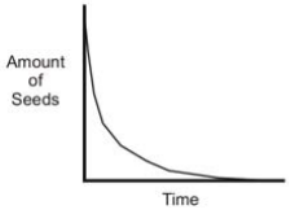
Ian and his friends were sitting on a deck and eating sunflower seeds. Each person had a bowl with the same amount of seeds. The graphs below all show the amount of sunflower seeds remaining in the person's bowl over a period of time.

Write sentences that describe what may have happened for each person.

a)



b)



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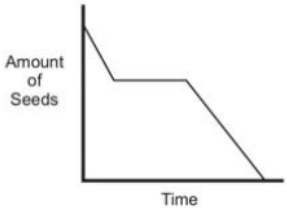
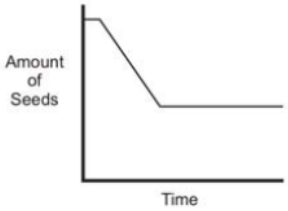


d)

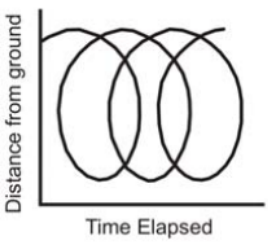


Multiple Choice

Indicate which graph matches the statement. Give reasons for your answer.

1. A bicycle valve's distance from the ground as a boy rides at a constant speed.

a)



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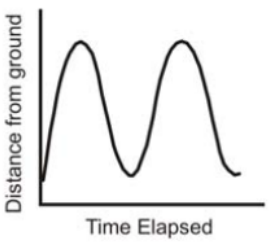

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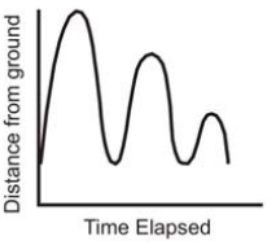
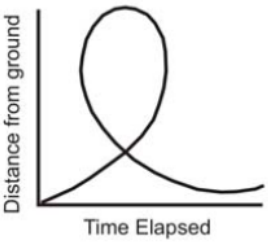
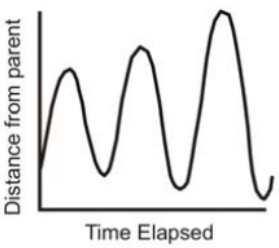


d)



2. A child swings on a swing, as a parent watches from the front of the swing.

a)



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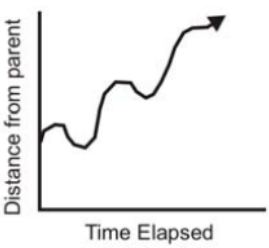

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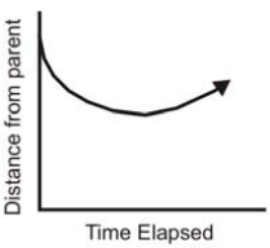

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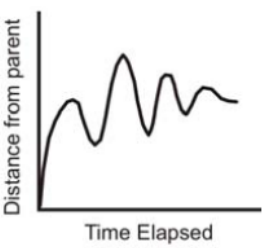
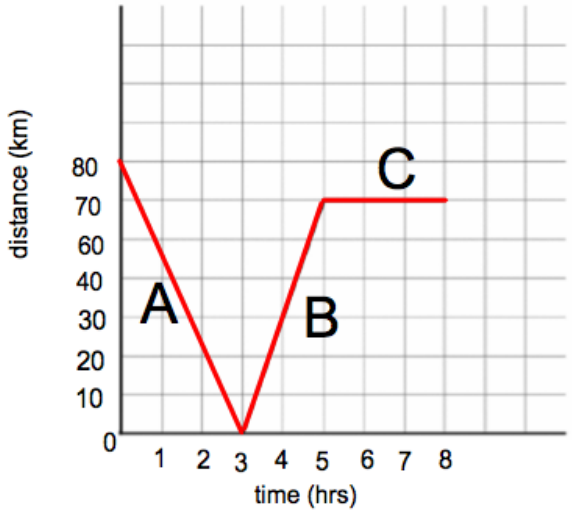


ACTION

Which Part Is Fastest?



Determine a method to calculate the rate of each part of the trip

Summary:

1.

2.

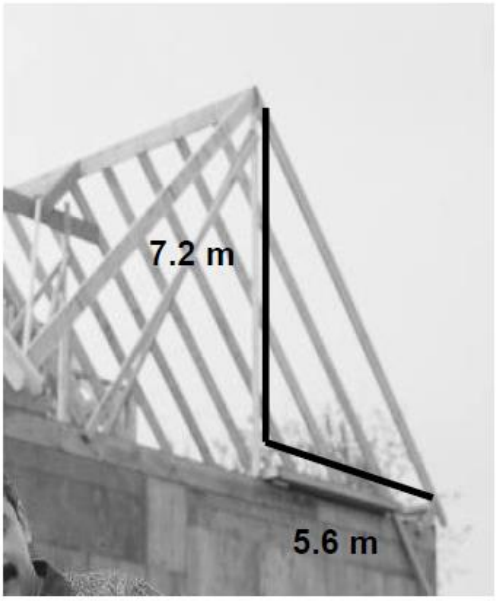
3.

4.

Examples

1. Determine the rate of change for each object.

(a)

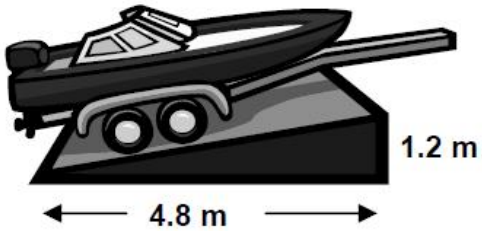


The **pitch** of the roof is the rate of change.

Rate of change = _____

The pitch is

(b)

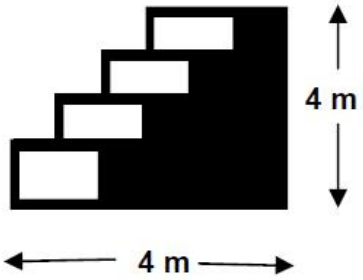


The steepness of the ramp is the rate of change.

Rate of change = _____

The rate of change is

(c)



The steepness of the staircase is the rate of change.

Rate of change = _____

The rate of change is

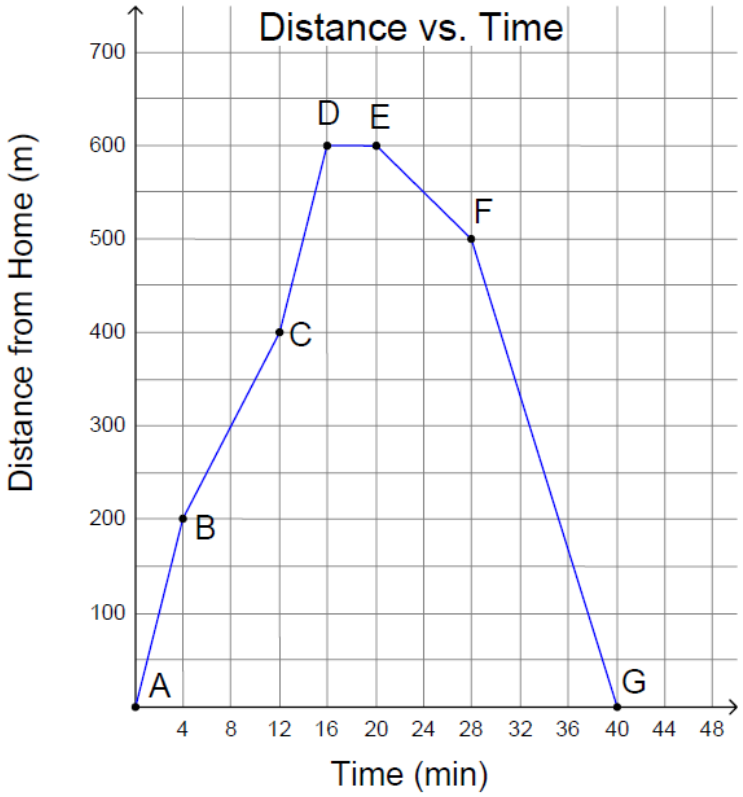
2. If a wheelchair ramp must have a rate of change of $\frac{1}{12}$, determine the horizontal distance required for a ramp that has a vertical distance of 5.2m.

3. The grade of a road is often given as a percent. If the road rises 15 m over a horizontal distance of 180 m, determine the grade as a percent.

4. The pitch of a roof of a house is given by a rate of change of $\frac{5}{6}$. If the horizontal distance is actually 10.5 m, determine the vertical distance of the roof.

The Milk Problem

At 11 o'clock, Micha's mother sends him to the corner store for milk and tells him to be back in 30 minutes. Examine the graph.



1. Why are some line segments on the graph steeper than others?

2. Calculate the rate of change (speed) of each of the line segments:

3. Over what interval(s) of time is Micha travelling the fastest?

   the slowest?

   Compare steepness, not direction.

4. How long did it take Micha to reach the store? How do you know?

5. How long did Micha stay at the store?

6. How long did it take Micha to get home from the store?

7. How can you use the graph to tell which direction Micha is travelling?

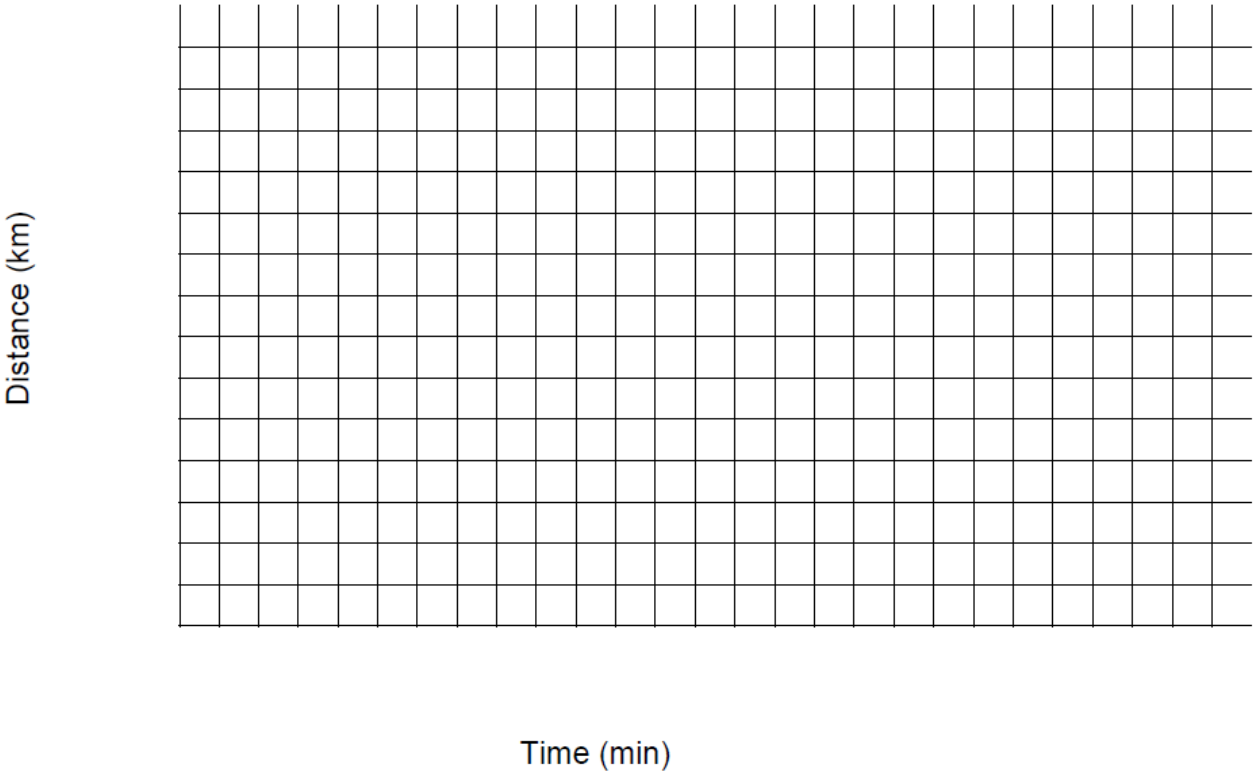
8. Did Micha make it home in 30 minutes? How do you know?

9. Using the information the graph provides, write a story that describes Micha's trip to the store and back.

Practice Problem

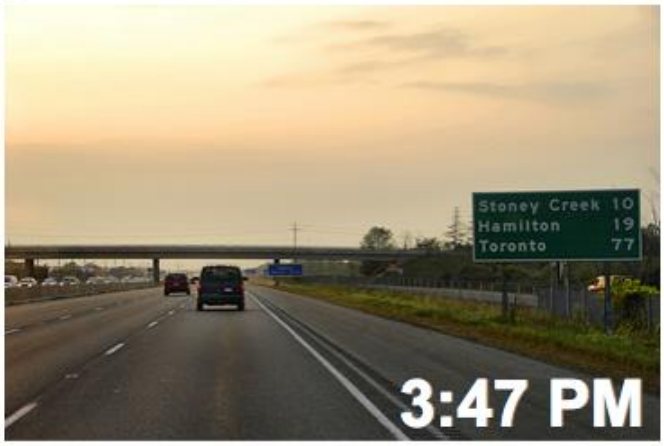
2. Amanjot takes the bus to school. Lucky for her, she is the third last stop on the way to school. The bus arrives to pick up Amanjot and it drives at a constant speed for 5 minutes to the next stop 3 km away. It takes 1 minute for the students to get on the bus. The bus then travels 50km/h to a stop that is 5 km away. 2 minutes later, the bus is on its way to the school. It takes 8 minutes to reach the school which is 6 km away.

   Draw a distance-time graph of Amanjot's bus ride to school.



MINDS ON

What questions can you ask?



With your team, discuss all the possible questions you can ask based on the two photos above.

Come up with the solutions to your questions.

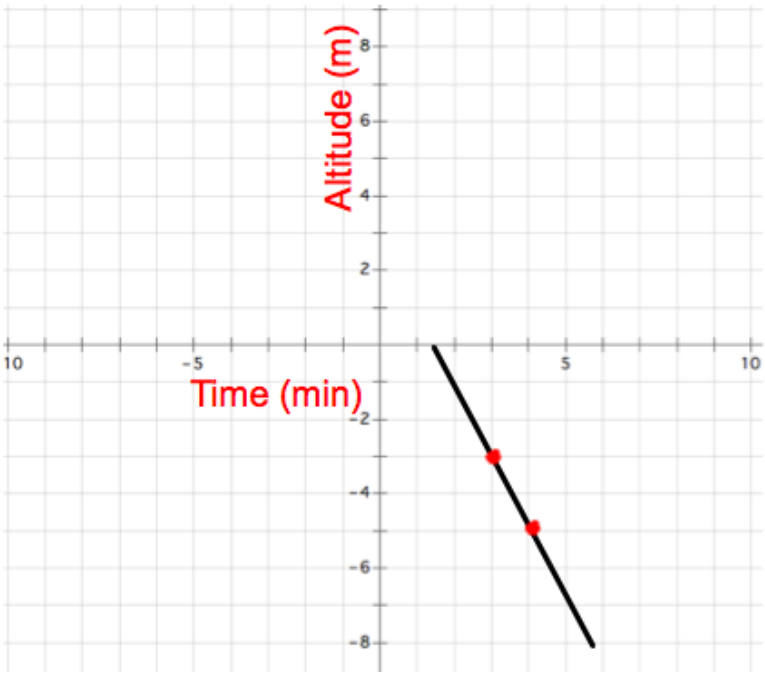
ACTION

Explain the process of calculating the cars's speed in km/hr.

Calculate the car's speed.12

ACTION

Calculate the rate of descent of the submarine as it submerges.



Slope Definition:

The slope of a line is a number that measures its "steepness", usually denoted by the letter m.

Compare the definition of ***slope*** to ***rate of change***.

Reflection:

1. If (x_1,y_1) and (x_2,y_2) are points on a line, determine a formula that calculates the slope of a line.
2. Does it matter which point is labeled as (x_1,y_1) and (x_2,y_2)? Explain.

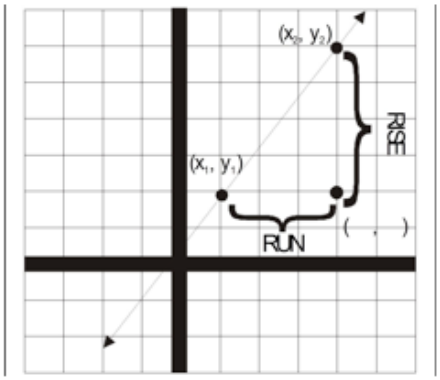
Summary

The Slope of a line, "m", is a measure of the steepness of a line.

The slope of a line is a rate of change

Therefore, the slope of a line can be found using ANY two points on the line. Points on the same line are called collinear points.

To calculate slope we can use any one of the following formulas:



Examples

Problem 1

Calculate the slope of each line segment, where possible. Describe the direction and how it relates to the slope.

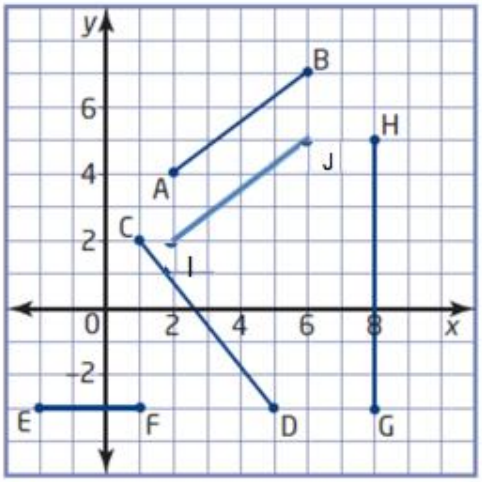
a) AB

b) CD

c) EF

d) GH

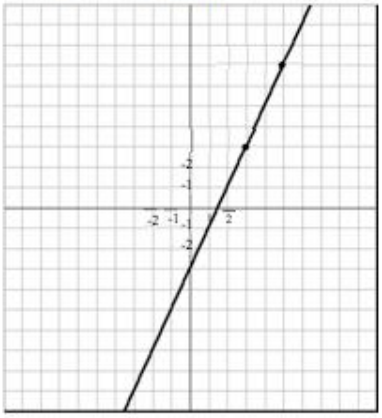
e) IJ



Problem 2

Use the slope formula, $m = \frac{y_2 - y_1}{x_2 - x_1}$ to find the slope of the line passing through points:

a) A(1, 7) and B(8, 2) b) J(-4, -2) and K(3, 5) c)



Problem 3

A line segment has one endpoint, A(4, 7), and slope of $-\frac{5}{3}$. Find the coordinates of another possible endpoint, B.

Minds On-Concept Attainment

Concept Attainment – Hypothesis Sheet

Example 1

What makes these two representations different from each other?

I think Concept A is

_____

I think Concept B is

_____

Example 2

What makes these two representations different from each other?

I think Concept A is

_____

I think Concept B is

_____

Example 3

What makes these two representations different from each other?

I think Concept A is

_____

I think Concept B is

_____

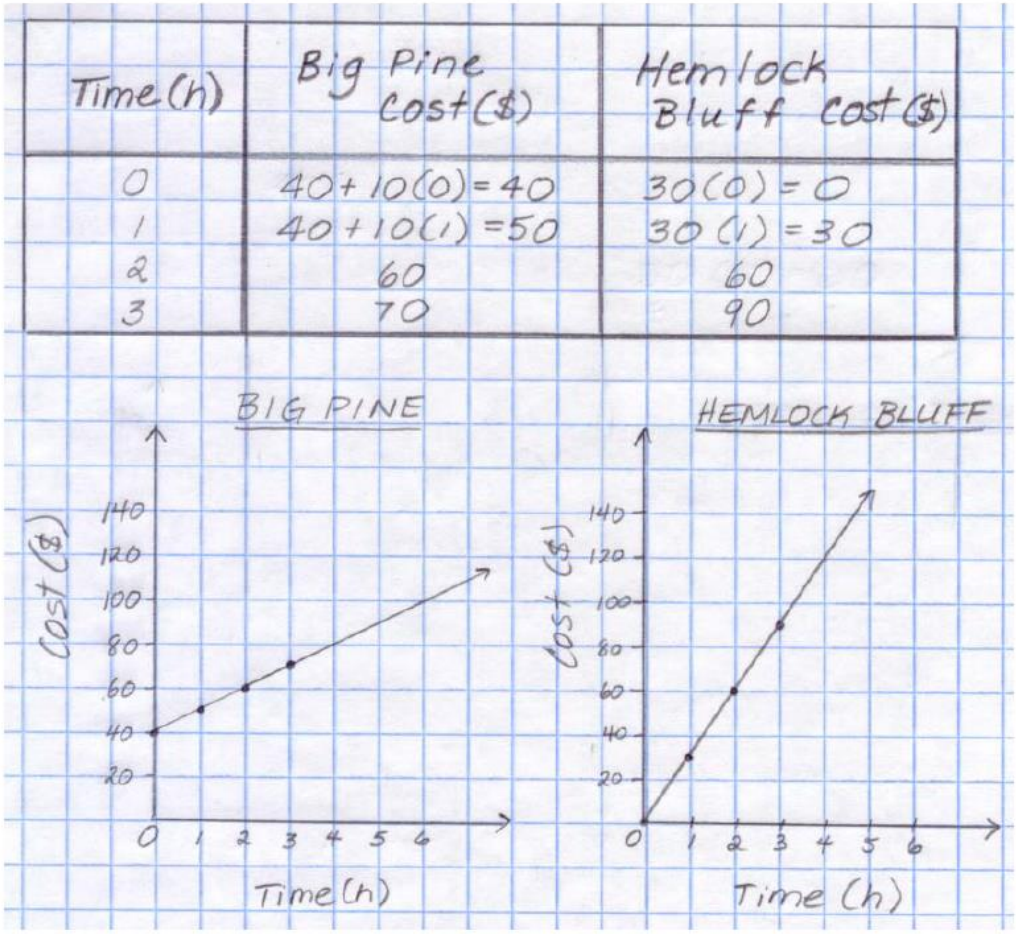
SUMMARY

Action! Direct and Partial Variation

Jaraad wants to rent a canoe for a day trip. He gathers this information from two places and decides to make a table of values and graph each of these relationships.

- Big Pine Outfitters charges a base fee of $40 and $10 per hour of use.
- Hemlock Bluff Adventure Store does not charge a base fee, but charges $30 per hour to use the canoe.

Jaraad's Working Sheet



1. a) What is the cost of each canoe if Jaraad cancels his reservation?

b) Compare the rate of change of cost for Big Pine and for Hemlock Bluff to the cost per hour for each outfitter.

2. Which graph illustrates a proportional relation? How do you know? This is called a direct variation.

3. Which graph has an initial value other than zero? This is called a partial variation.

4. Which outfitter company should Jaraad choose if he estimates he will canoe for 0.5 h?…1.5 h?…2.5 h?

Time (h)	Big Pine Cost ($)	Hemlock Bluff Cost ($)
0.5		
1.5		
2.5		

Explain how you determined your answers.

NOTE: Linear equations follows this format:

Dependent Variable = Initial Value + Rate of Change x Independent Variable

OR Dependent Variable = Rate of Change x Independent Variable + Initial Value

5. Write an equation to model the cost for each outfitter.
Let *C* represent the cost in dollars and *h* represent the time in hours.

Big Pine $C =$

Hemlock Bluff $C =$

6. If Big Pine Outfitters decided to change its base fee to $50 and charge $10 per hour, what effect would this have on the graph?

a) Draw a sketch of the original cost and show the changes on the same sketch.

b) Write an equation to model the new cost.

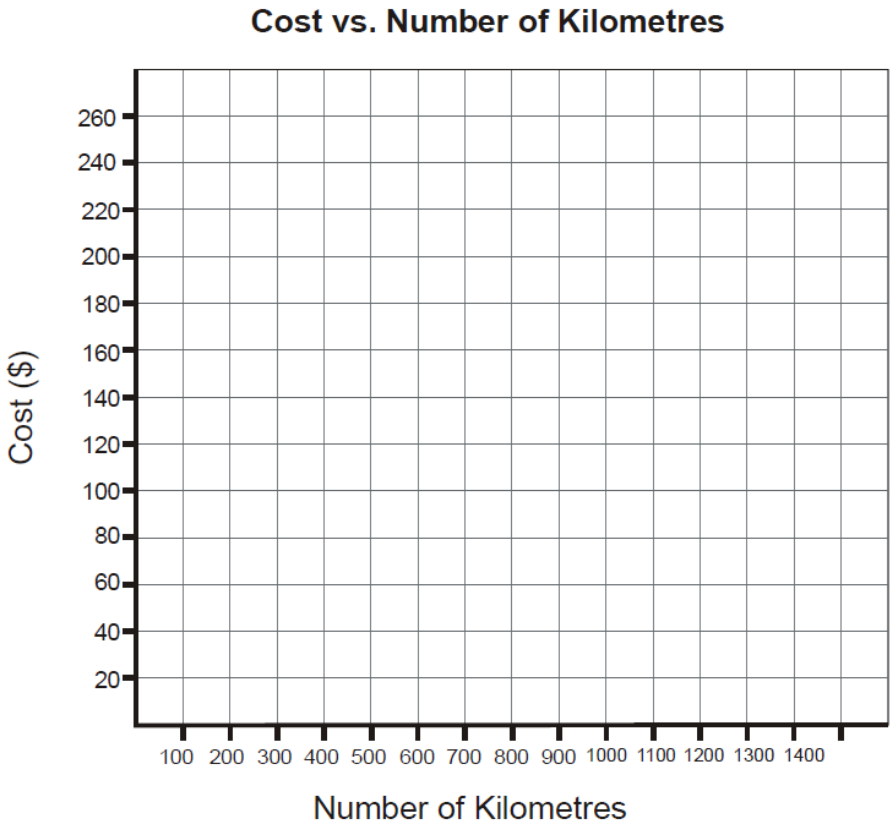
7. If Hemlock Bluff Adventure Store decided to change its hourly rate to $40, what effect would this have on the graph?

a) Draw a sketch of the original cost and show the changes on the same sketch.

b) Write an equation to model the new cost.

1. A rental car costs $50 per day plus $0.20 for each kilometre it is driven.
   a) What is the dependent variable?
   b) Make a table of values for the rental fee up to 1000 km.
   c) Graph the relationship.

Number of Kilometres	Cost ($)
0	
100	
200	



   d) Write an equation to model the relationship. *C* is the cost and *n* is the number of kilometres.

      Dependent Variable = Initial Value + Rate of Change x Independent Variable

      _____ = _____ + _____ x _____

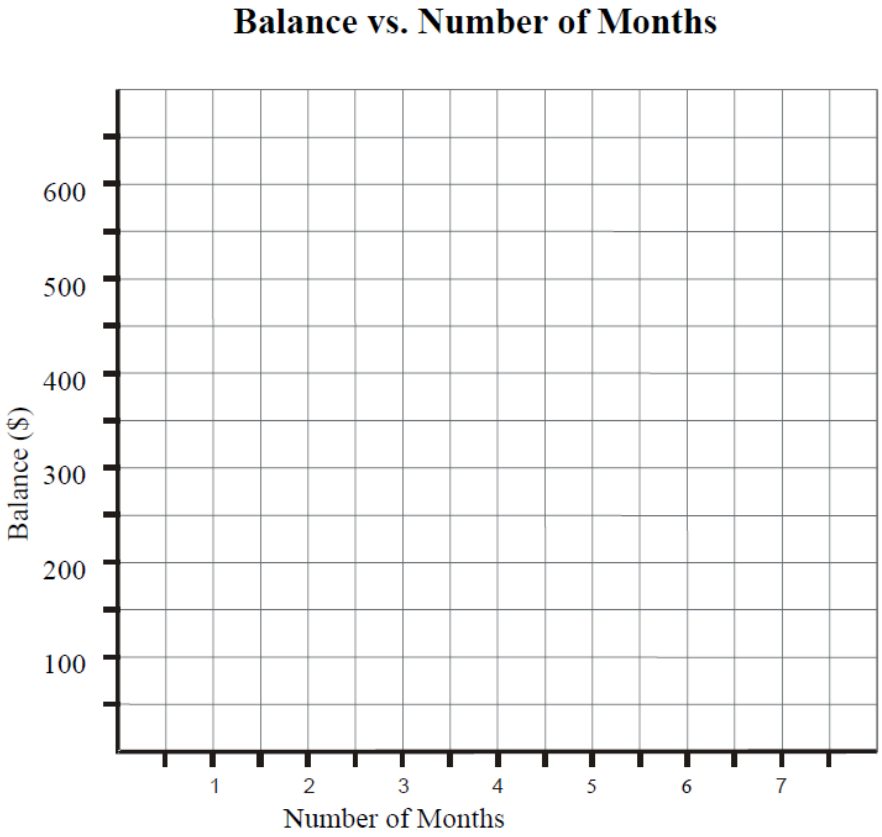
   e) Does this relation represent a partial or direct variation? Explain.

   f) Determine the rental fee for 85 km. Show your work.

2. There is $500 in Holly's bank account. She takes out $50 from her account each month but doesn't put any back in.

   a) Make a table of values for up to 6 months.
   b) Graph the relationship.

0	



   c) Write an equation to model the relationship.

   Dependent Variable = Initial Value + Rate of Change x Independent Variable

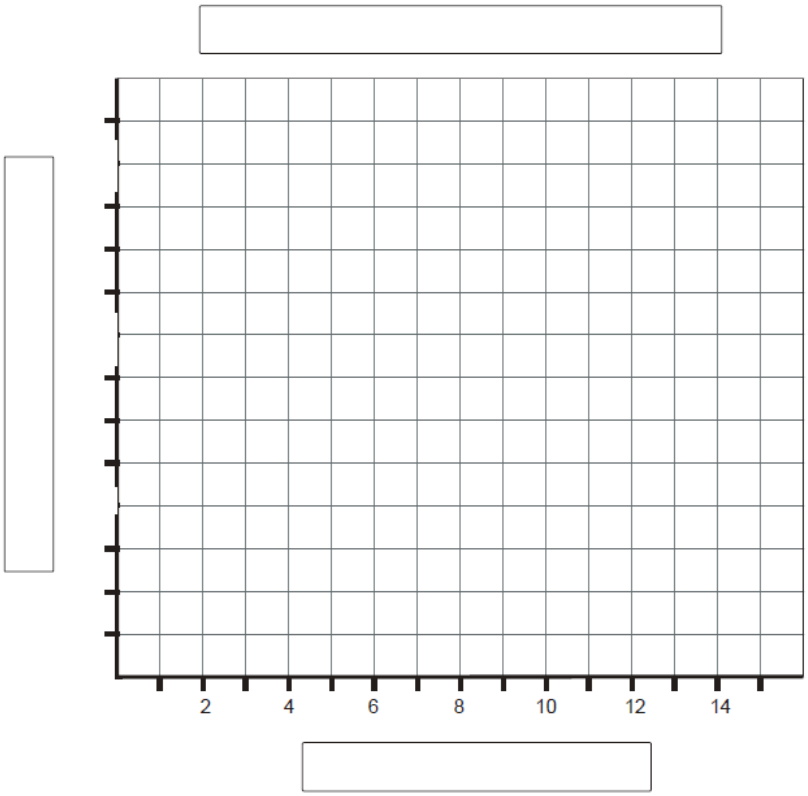
   _____ = _____ + _____ x _____

   d) Does this relation represent a partial or direct variation? Explain.

   e) How much will Holly have in her account after 8 months?

   f) How many months will have passed when Holly has $0 in her account? Explain how you got your answer.

3. Nisha is just learning how to snowboard. White Mountain charges $10/hour for lessons and $40 for the lift ticket and snowboard rental.
   a) Make a table of values for up to 6 hours.
   b) Graph the relationship.



c) Write an equation to model the relationship.

___ = _____

d) Does this relation represent a partial or direct variation? Explain.

e) How much will it cost in total for Nisha to take 2.5 hours of lessons?

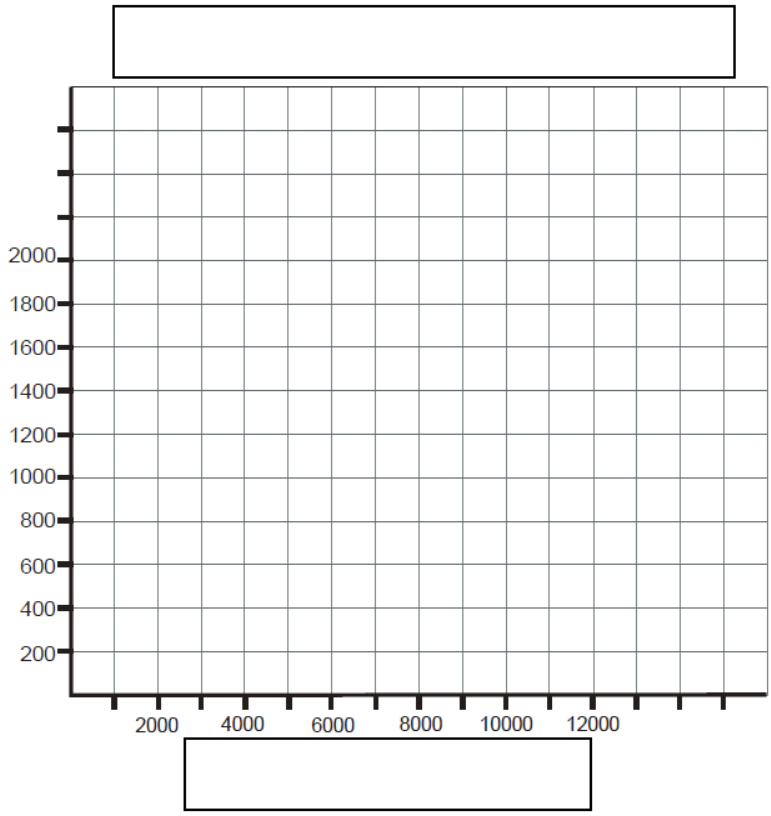
f) If Nisha paid $75, how long was she at the White Mountain getting lessons?

4. Ishmal sells high-definition televisions. He is paid a weekly salary of 20% commission of his total weekly sales.

a) Complete the table of values.

Weekly Sales ($)	Total Pay ($)
0	
1000	
2000	
3000	
4000	
5000	

b) Graph the relationship.



c) Write an equation to model the relationship.

___ = _____

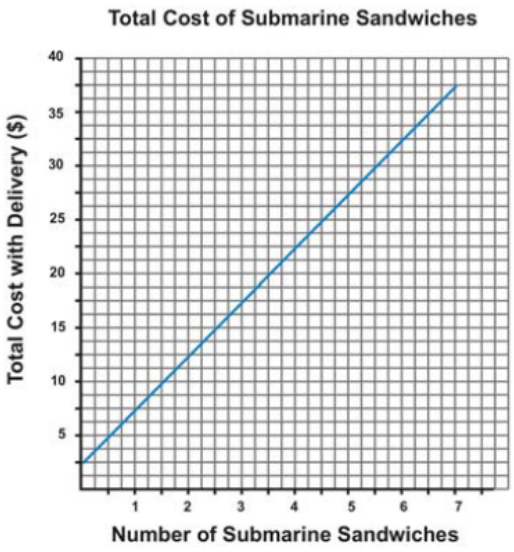
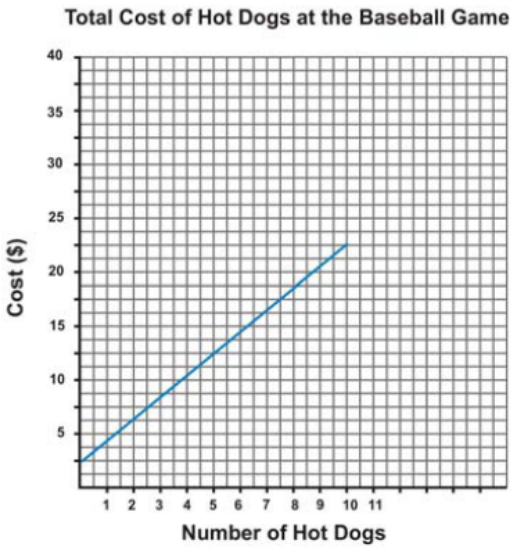
d) Does this relation represent a partial or direct variation? Explain.

e) Determine Ishmal's pay if his sales for the week were $8000.

f) Ishmal made $900. How much were his weekly sales?

A Coaches B

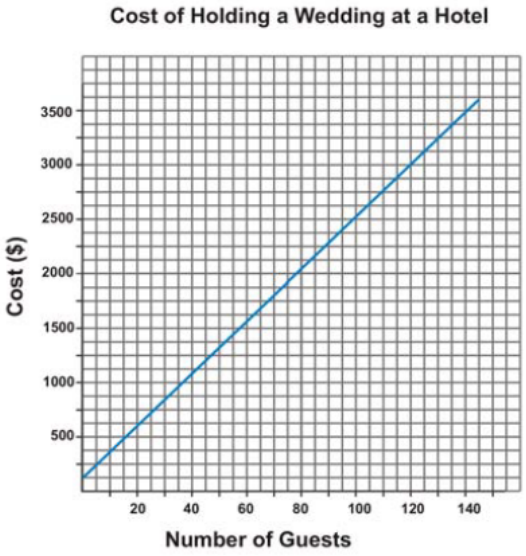
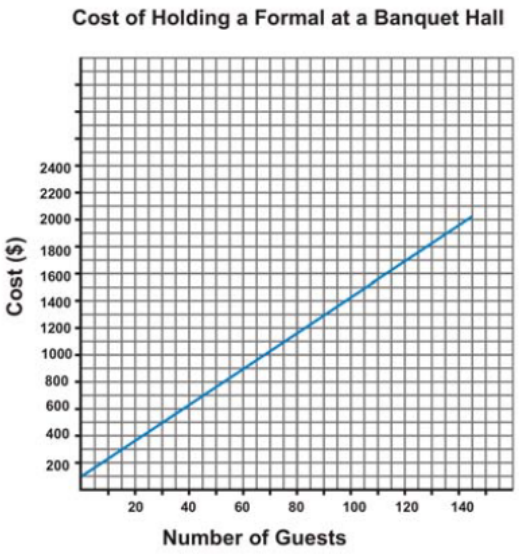
Write the **equation** for each relationship in the space provided. Show any calculations you made. Indicate if the relation is a partial or direct variation and whether the line modelling the relationship is solid or dashed.

A coaches B	B coaches A
1. A family meal deal at Chicken Deluxe costs $26, plus $1.50 for every extra piece of chicken added to the bucket.	2. A Chinese food restaurant has a special price for groups. Dinner for two costs $24 plus $11 for each additional person.
3. 	4. 
5.	6.

Number of Toppings	Cost of a Large Pizza ($)
0	9.40
1	11.50
2	13.60
3	15.70
4	17.80

Number of Scoops	Cost of Ice Cream with Sugar Cone ($)
0	1.25
1	2.00
2	2.75
3	3.50
4	4.25

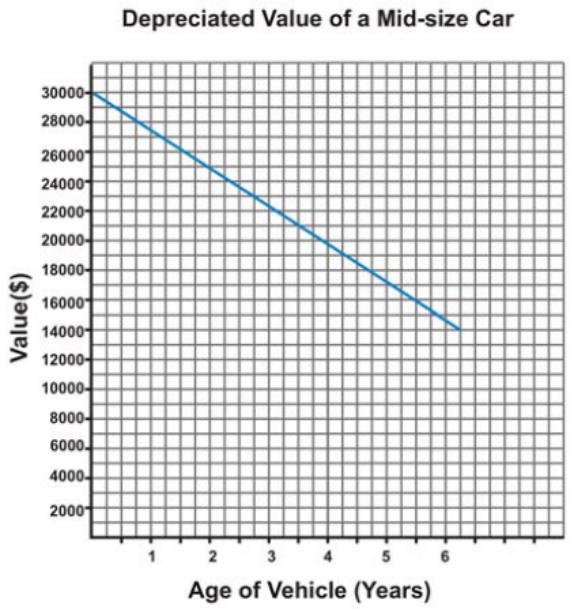
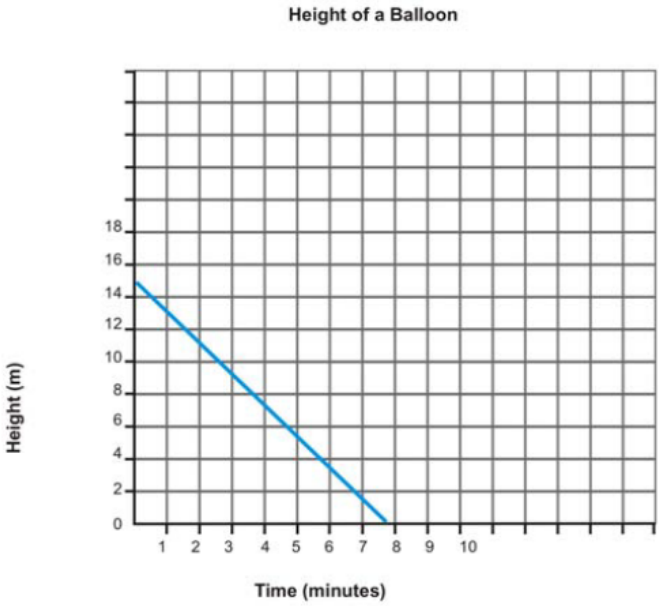
Write the **equation** for each relationship in the space provided. Show any calculations you made. Indicate if the relation is a partial or direct variation and describe why these variables are discrete. **Use your equation to determine the cost for 200 people.**

A coaches B	B coaches A
1. A banquet hall charges $100 for the hall and $20 per person for dinner.	2. The country club charges a $270 for their facilities plus $29 per guest.
3. 	4. 
5.	6.

Number of Athletes	Cost of Attending a Hockey Tournament
1	225
2	450
3	675
4	900

Number of People	Cost of Holding an Athletic Banquet
20	275
40	475
60	675
80	875

Write the equation for each relationship in the space provided. Show any calculations you made. Indicate if the relation is a partial or direct variation and whether the line modelling the relationship is solid or dashed.

A coaches B	B coaches A
1. Rent a car for the weekend costs $50 plus $0.16/km.	2. A race car travels at a constant speed of 220km/h. Write an equation for the total distance travelled over time.
3. 	4. 
5.	6.

Distance (km)	Cost of a Taxi Fare ($)
0	3.50
10	6.50
20	9.50
30	12.50
40	15.50

Distance (km)	Cost of Bus Charter ($)
0	170
100	210
200	250
300	290
400	330

Summary: Representing Linear Relationships

Written Expression Model

Ex) Erika is charged $100 base fee plus $20 per tennis lesson at the Brampton Tennis Club.

Numerical (Table) Model

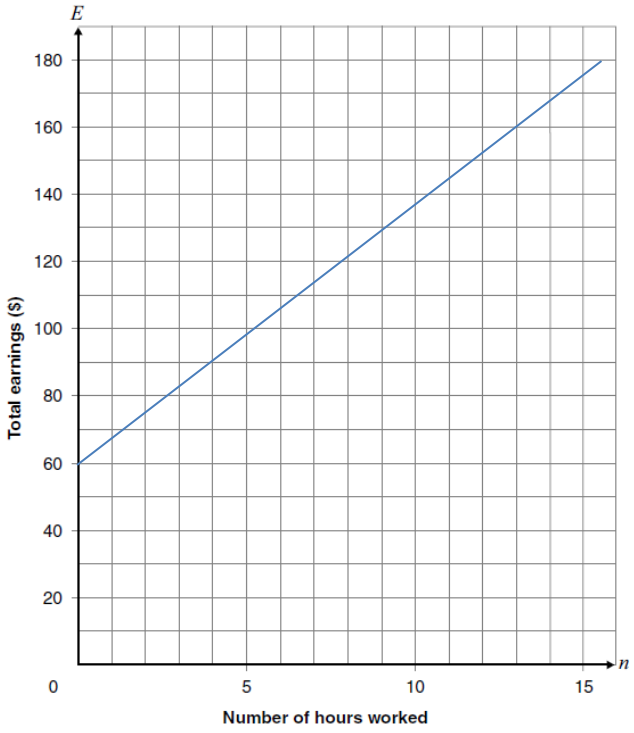
Time Spent Reviewing	Grade
2	50%
3	60%
4	70%
5	80%

Pictorial Model

Don't Pick Your Teeth: Count the Toothpicks

1 2 3

Graphical Model



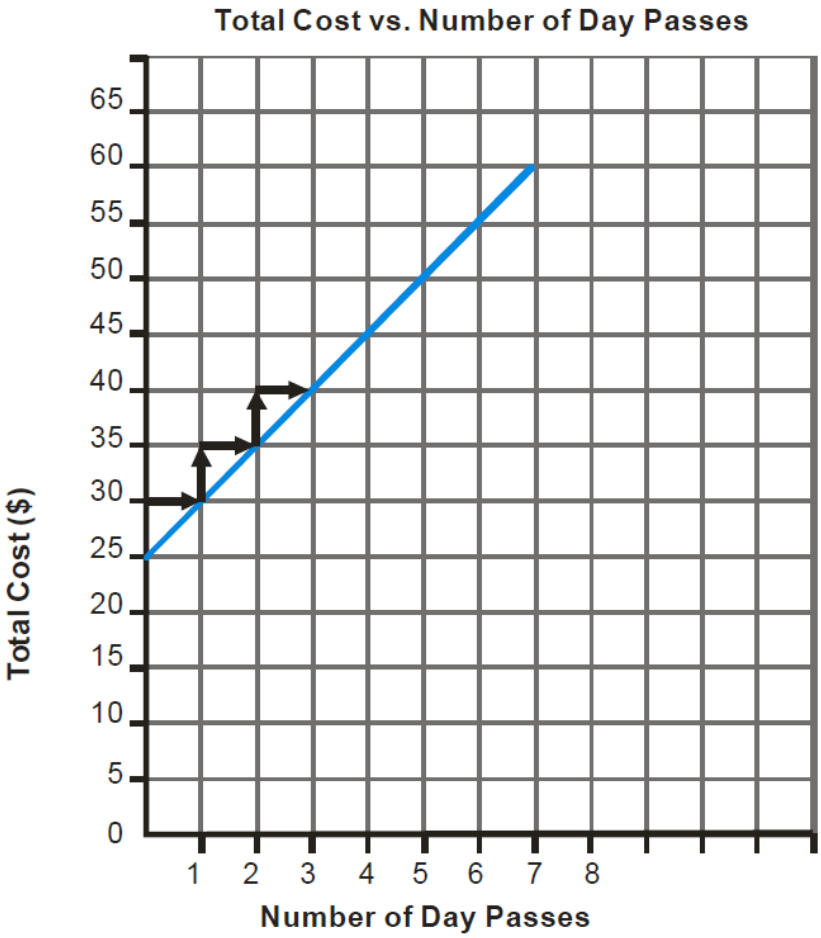
Algebraic Model

NOTE: Linear equations follows this format:

Dependent Variable = Initial Value + Rate of Change x Independent Variable

OR Dependent Variable = Rate of Change x Independent Variable + Initial Value

A tennis club charges $25 initial membership fee plus $5 per day. The equation of this relation is $C = 25 + 5d$, where C is the cost and d is the number of days.



a) Indicate where the rate of change is displayed on the graph.

b) If the initial membership fee is changed to $15 and daily cost to $10, graph the new relation on the same grid.

Indicate the procedure you followed to graph the line.

c) Write the equation of the new line.

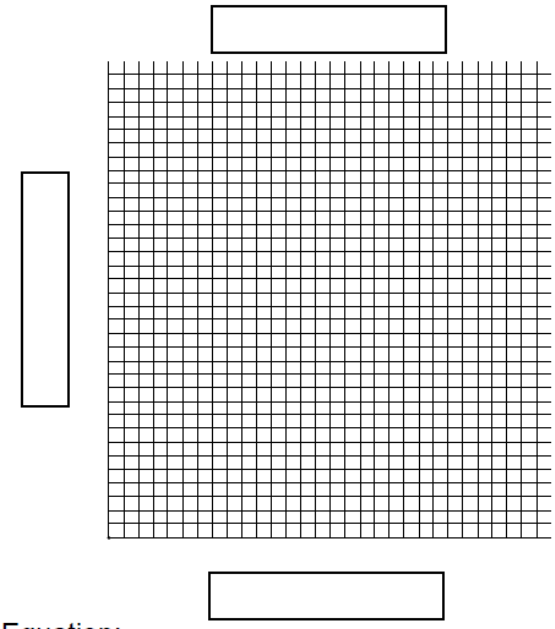
NOTE: Linear equations follows this format:

Dependent Variable = Initial Value + Rate of Change x Independent Variable

OR Dependent Variable = Rate of Change x Independent Variable + Initial Value

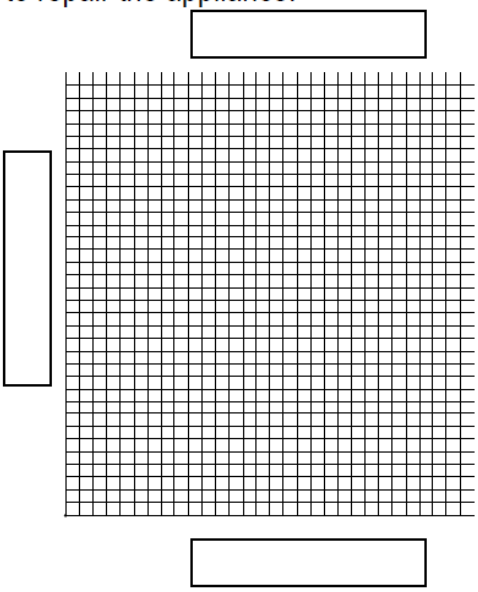
Write the equation for the relationship and graph the relationship.

1. Movie House charges $5 to rent each DVD.



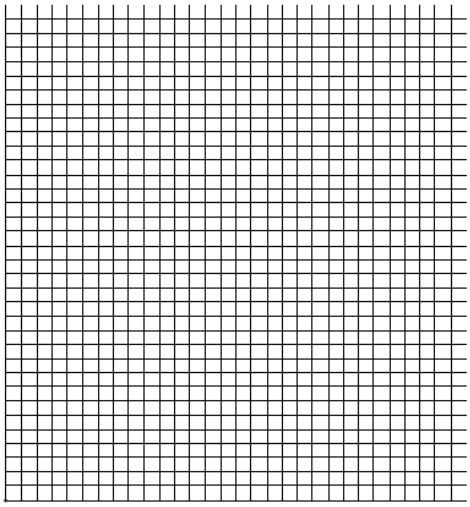
Equation:

2. Repair-It charges $60 for a service call plus $25/h to repair the appliance.



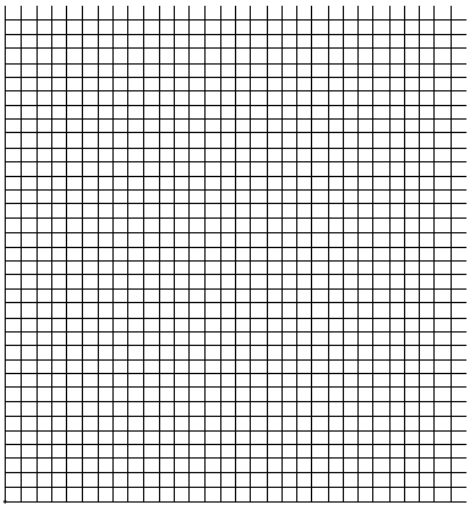
Equation:

3. A golf club charges an annual membership fee of $1000 plus $100 for a green fee to play golf.



Equation:

4. A kite is 15 m above the ground when it **descends** at a steady rate of 1.5 m/s.

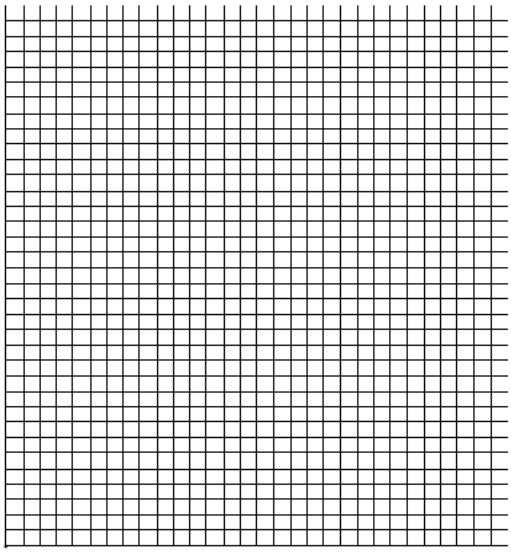


Equation:

Partner A _____ **Partner B**_____

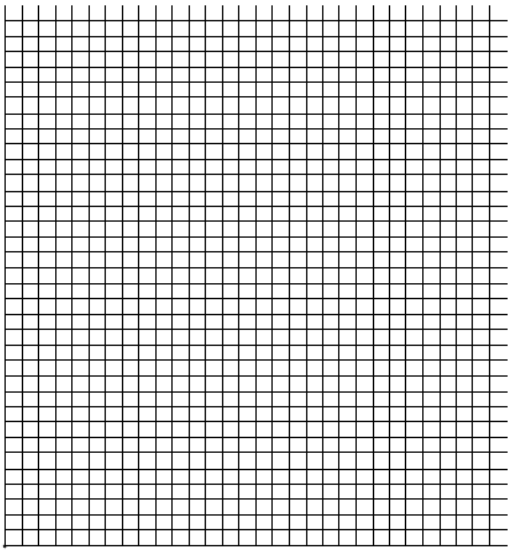
Write the equation for the relationship and graph the relationship.

1. The Recreation Centre charges a monthly membership fee of $20 plus $5 per class. Show the relationship for one month.



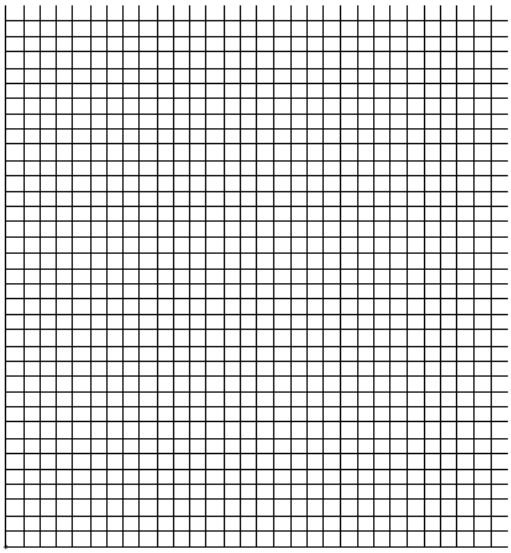
Equation:

2. Repair Window charges a $20 service fee plus $10/h to fix the window pane.



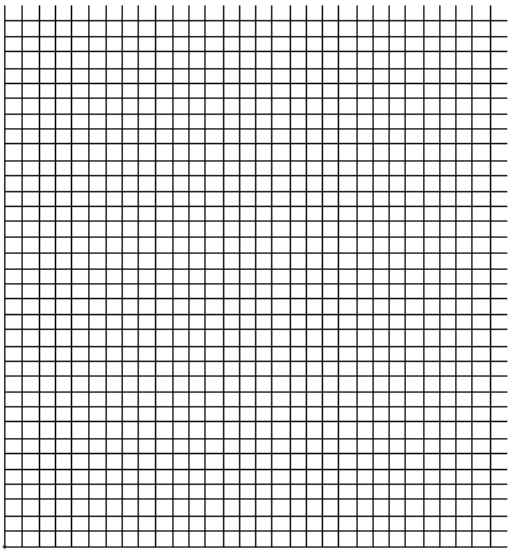
Equation:

3. Yum-Yum Ice Cream Shop charges $0.50 for the cone plus $1 per scoop of ice cream.



Equation:

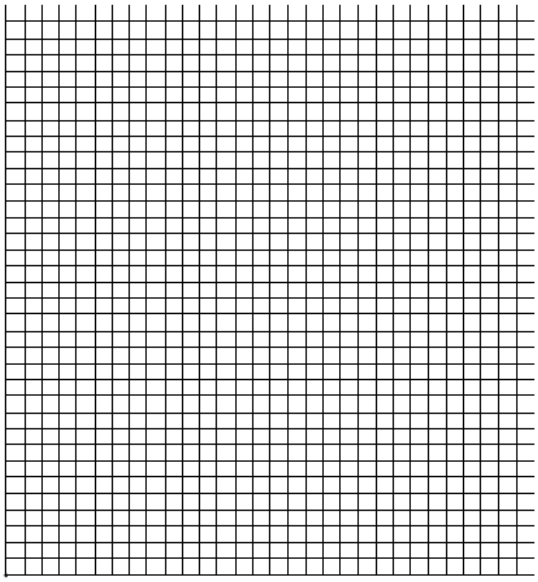
4. A submarine model starts 6.5 m above the bottom of the pool. It gradually descends at a rate of 0.25 m/s.



Equation:

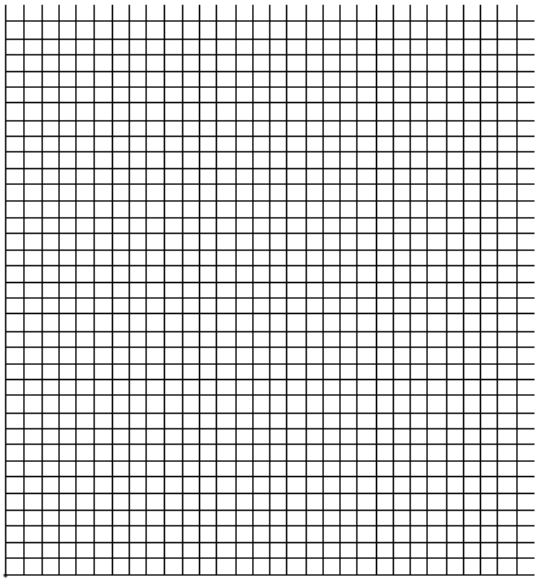
Write the equation for the relationship and graph the relationship.

1. A taxi cab company charges $3.50 plus $0.50/km.



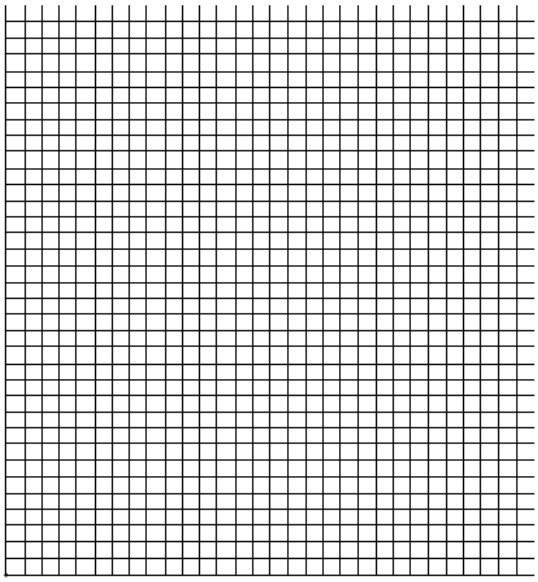
Equation:

2. Shelly has $250 in her bank account. She spends $10/week on snacks.



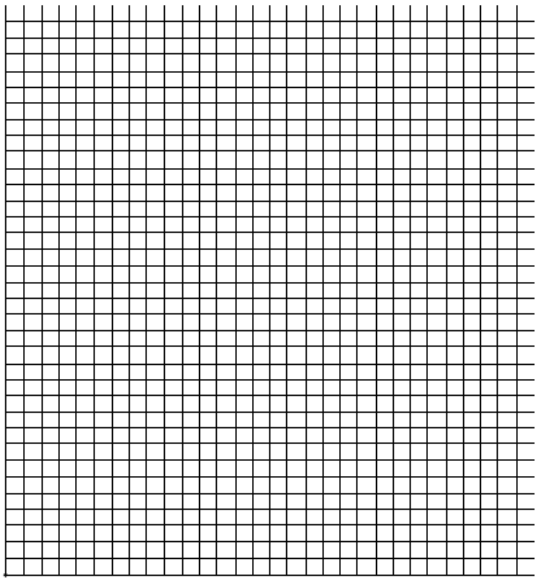
Equation:

3. Dino's Pizza charges $17 for a party-sized pizza plus $2 per topping.



Equation:

4. Katie sells programs at the Omi Arena. She is paid 50 cents for every program she sells.



Equation

1.R Reflecting on My Learning (3, 2, 1)

3 Things I know well from this unit
2 Things I need explained more
1 Question I still have

1.RLS: Reflecting on Learning Skills

Students should be aware of the importance that these skills have on your performance. After receiving your marked assessment, answer the following questions. Be honest with yourself. Good Learning Skills will help you now, in other courses and in the future.

E – Always
G – Sometimes
S – Need Improvement
N – Never

Organization

E G S N I came prepared for class with all materials
E G S N My work is submitted on time
E G S N I keep my notebook organized.

Work Habits

E G S N I attempt all of my homework
E G S N I use my class time efficiently
E G S N I limit my talking to the math topic on hand
E G S N I am on time
E G S N If I am away, I ask someone what I missed,
E G S N I complete the work from the day that I missed.

Team Work

E G S N I am an active participant in pairs/group work
E G S N I co-operate with others within my group
E G S N I respect the opinions of others

Initiative

E G S N I participate in class discussion/lessons
E G S N When I have difficulty I seek extra help
E G S N After I resolve my difficulties, I reattempt the problem
E G S N I review the daily lesson/ideas/concepts

Works Independently

E G S N I attempt the work on my own
E G S N I try before seeking help
E G S N If I have difficulties I ask others but I stay on task
E G S N I am committed to tasks at hand

Yes No I know all the different ways available in my school, where I can seek extra help.

Yes No I tried my best.

What will I do differently in the next unit to improve?

_____
_____
_____
_____