Grade 9

Linear Relations: Graphing and Analyzing

Different Forms of Linear Function

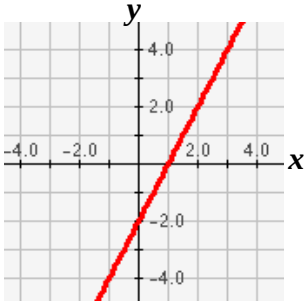
Please go to *http://id.mind.net/~zona/mmts/functionInstitute/linearFunctions/linearFunctions.html* first!
You may also go to *www.wiredmath.ca* for the link.

A table of values represent a linear relationship if:

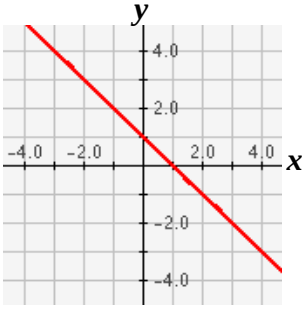
- a straight line is formed when all the points are connected together.
- the finite differences are all the same for every row in the difference table.

1. State if each graph represents a linear or nonlinear relationship?

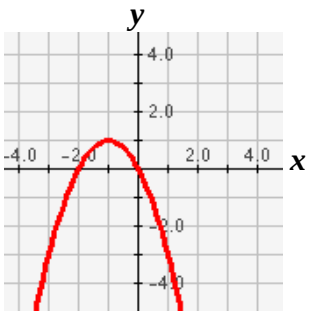
a.



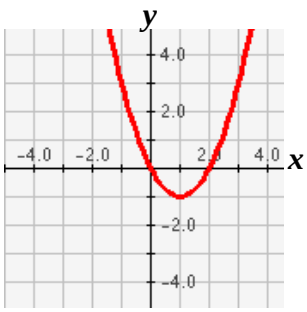
b.



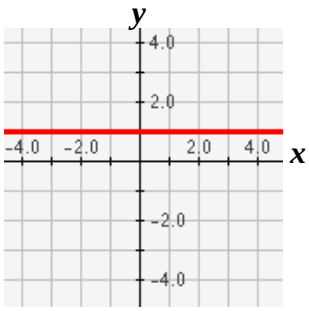
c.



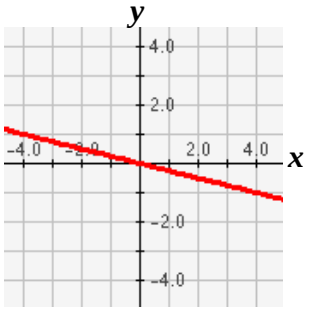
d.



e.



f.



2. Create a difference table for each set of data. Does the data represent a linear or nonlinear relationship?

a.

x	*y*
2	4
3	9
4	14
5	19
6	24

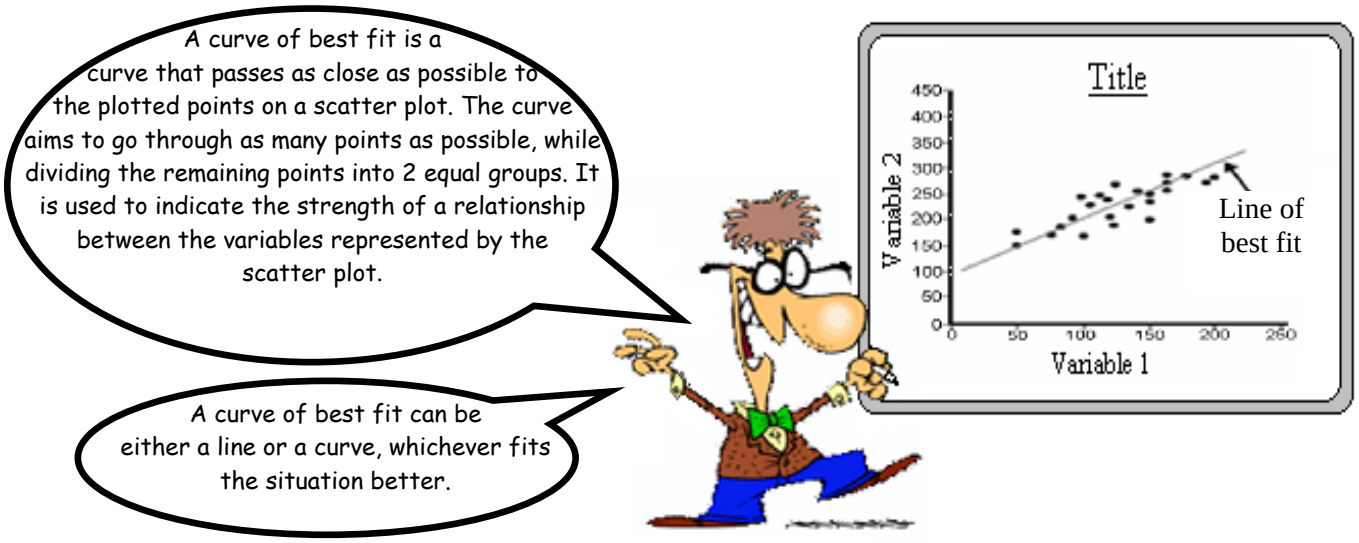
b.

x	*y*
2	4
3	9
4	16
5	25
6	36

c.

x	*y*
5	–3
4	–2
3	–1
2	0
1	1

See how a line of best fit changes with the scatter plot at http://argyll.epsb.ca/jreed/math9/strand4/scatterPlot.htm first. You may also go to *www.wiredmath.ca* for the link.



3. For the following data create an appropriate scatter plot, and determine the curve of best fit.

a. Women's 100 meter dash

Year	Time (s)
1928	12.2
1932	11.9
1936	11.5
1948	11.9
1952	11.65
1956	11.82
1960	11.18
1964	11.49
1968	11.08
1972	11.07
1976	11.08
1980	11.06
1984	10.97
1988	10.54
1992	10.82
1996	10.94
2000	10.75
2004	10.93

b. Wingspread of Birds

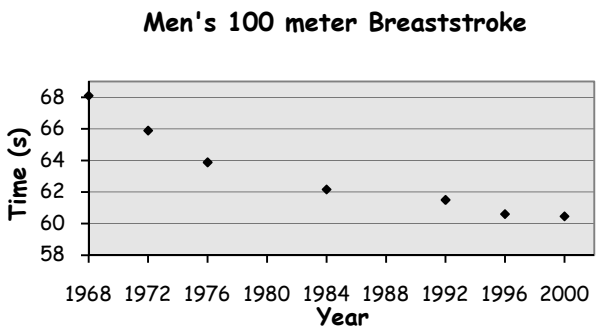
Length (cm)	Wingspread (cm)
123	350
120	300
175	250
78	222
124	157
75	128
17	27
18	50
48	71
62	75
38	76
48	86
47	100
52	100
51	120
56	120
55	127
70	150

c. Estimate of World's Population

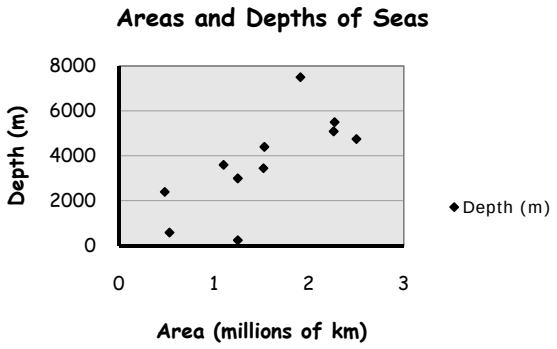
Year	Population (millions)
– 400	160
0	170
200	190
400	190
600	200
800	220
1000	310
1200	360
1400	350
1600	545
1800	980
1900	1650
1920	1860
1940	2300
1960	3020
1980	4430
1990	5260
2000	6070

4. For each of the following scatter plots, create a table of values and draw a curve of best fit.

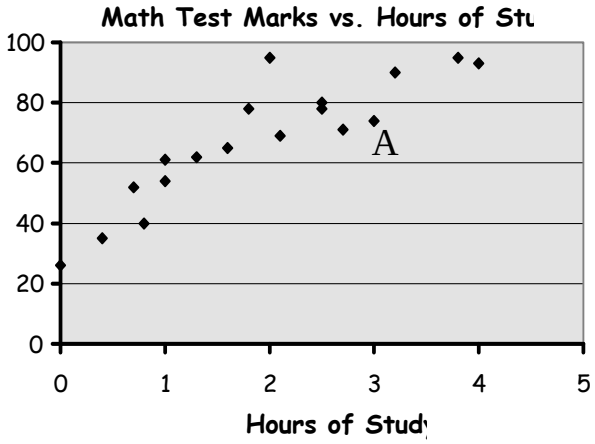
a.



b.



5. A few students got together, and decided to plot the number of hours they spent studying versus their performance on a test.



a. What does point A represent?

b. Draw a line of best fit on the scatter plot.

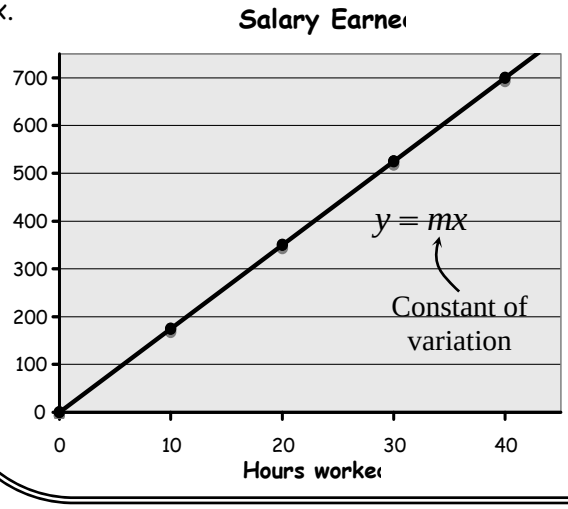
c. Based on this graph, is there a strong relationship between hours of study and a student's mark? Provide reasoning for your answer using a line of best fit.

Direct Variation **vs.** **Partial Variation**

When the ratio of two variables is constant, the variables are said to be in direct variation.

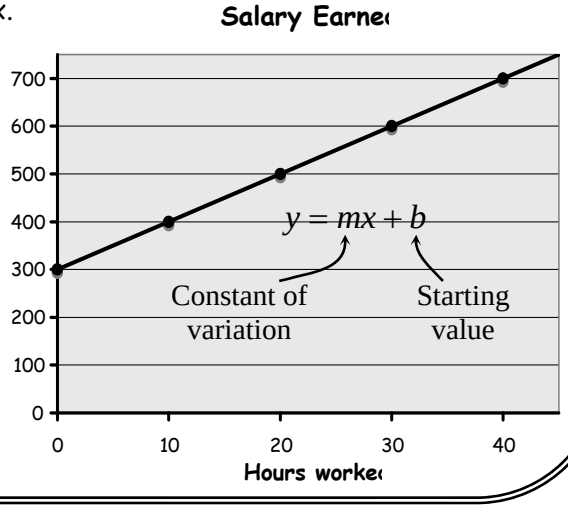
The points of this relationship form a straight line which passes through the origin.

Ex.



Similar to direct variation, the two variables involved change with a constant of variation. Only, in partial variation, there is a fixed starting value other than zero.

Ex.



6. Alexander Helios and Cleopatra Selene are the twin children of Mark Antony and Cleopatra. For Alexander's first birthday, his parents gave him 4 gold coins, and continued giving him the same number of gold coins until his age of 15. Meanwhile, Cleopatra has received 18 gold coins at birth, and 3 coins for every birthday after that, also until the age of 15.

   a. Create a table of values representing the number of coins each twin had received since the day they were born. Then, plot both sets of points on the same graph.
   b. Draw a line of best fit for each set of data, and write an appropriate equation for the line.
   c. At which age will Alexander and Cleopatra have the same number of coins?
   d. If they were to receive coins until the age of 25, who would have more coins? How many more coins?
   e. If Cleopatra were to receive 30 coins at birth, instead of the original 18 coins, who would have received more coins, in total, by the age of 21?

Did You Know?

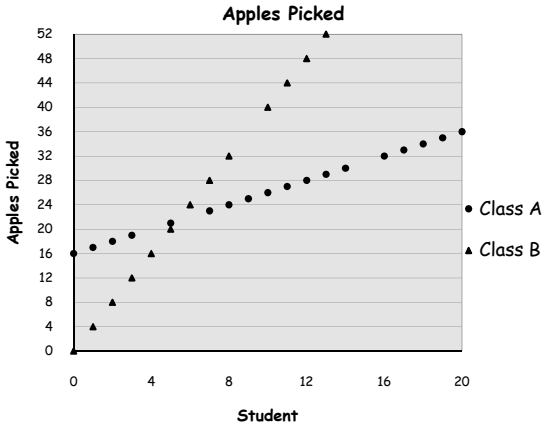
It is believed that the idea of Gravity and its extent were not developed (or even considered), until Sir Isaac Newton started working on the concept after being inspired by a falling apple in 1680's.

7. Create a scatter plot using the side lengths of equilateral triangles as your *x*-values and their perimeters as the *y*-values.

   a. What relationship does the scatter plot show? Write an equation for the relationship?
   b. Use your graph to determine the perimeters of triangles whose side lengths are
      i. 12 units long ii. 45 units long

8. Two classes of 21 students were given 30 minutes each to pick apples. Below is a scatter plot showing how many apples each student picked, where the students are listed in the order they appear on the class list, starting with zero.

   a. Draw a line of best fit for each class. Write the formula for the lines of best fit.
   b. How many apples did students 4, 6, and 15 from class A, and student 9 from class B pick?
   c. How many apples did students 17 through 20 from class B each pick?
   d. A farmer requires 70 apples to make 21 pies. If only the first 5 students from each class give their apples to the farmer, which class would have picked enough apples?
   e. How many more apples will the 20th student from class A will have to pick to catch up to the 20th student in class B?
   f. In class A, 3 more students were added to the end of the class-list. If they continued picking apples at the same rate their classmates did, how many apples would each student pick?



9. Nhean and Alexis are partaking in a 7250 m bike race. Knowing Nhean is a slower biker, Alexis allows him a two-minute head start. Alexis's speed is 290 m/min, while Nhean's speed is 250 m/min.

   a. On the same graph, plot each biker's distance travelled versus time.
   b. Who won the race? By about how many minutes?

TRY THESE!

To practice more for direct and partial variation, visit
http://www.mhhe.com/math/devmath/aleks/wt-ia/student/olc/graphics/author_ed/chp5sec24.htm

CHALLENGE YOURSELF!

10. Dawn got into her car at 8 in the morning. She accelerated at a constant rate to 40 km/h in 5 minutes. She drove for 15 minutes at 40 km/h to the store, and then took 5 minutes to slow down to a stop. She parked in front of the store and was in there for 15 minutes. On the drive home from the store, Dawn accelerated to 70 km/h in 5 minutes and drove toward home, but after 15 minutes, slowed down to a constant rate to 20 km/h in 10 minutes due to traffic, and then drove at that speed for the next 40 minutes until she got home.

    a. Graph the progress of Dawn's car using a time-speed graph.
    b. What time did Dawn get home?

EXTENSION

11. Newton tosses an apple straight up in the air from an initial height of 1 m, and recorded the height of the apple for 4 seconds.

    Here is the table of his findings:

a.

Time (seconds)	0	0.5	1	1.5	2	2.5	3	3.5	4
Height (m)	1	9.75	16	19.75	21	19.75	16	9.75	1

    a. Plot Newton's findings on a scatter, and draw an appropriate curve of best fit.

    b. Will the apple ever reach a maximum height? Explain why, or why not. If so, what will be the maximum height, and when will it occur?