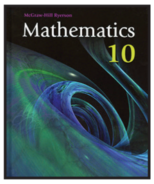
Enhance Your Understanding

Lesson 6.1: Graphs of Relations

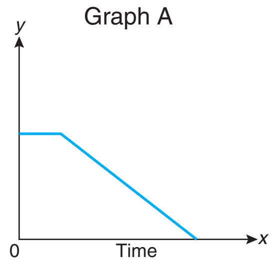


Refer to pages 274 and 330 in *Mathematics 10* for more practice.

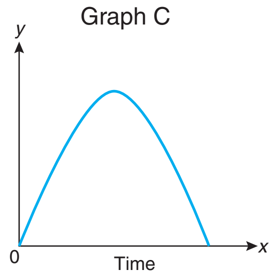
- Page 274, #2a, 3, 4, 7, 8, 13, and 14
- Page 330, #2 and 3

Question 2, page 274

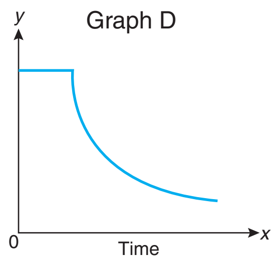
a. i. The train travels at a constant speed before slowing down at a constant rate. Graph A shows a short horizontal distance, which represents a constant speed, and then a steady decline, which represents a constant decreasing rate.



ii. Graph C shows an increase in height until a maximum height is reached. This is followed by a decrease in height. This curve represents the changing height of the football as it rises in the air and then falls back to the ground.

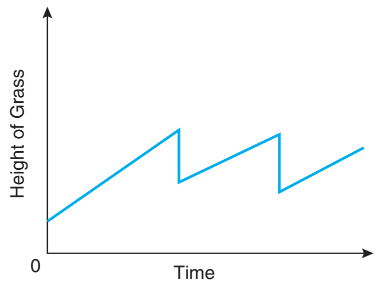


iii. Until the popcorn maker heats up, no kernels will pop, so the number of un-popped kernels remains constant as shown by the horizontal section in graph D. When the correct temperature is reached, the kernels start popping, but not at a constant rate. The smooth decreasing curve in graph D shows the number of un-popped kernels decreasing.

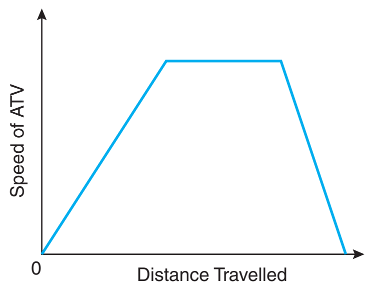


Question 3, page 274

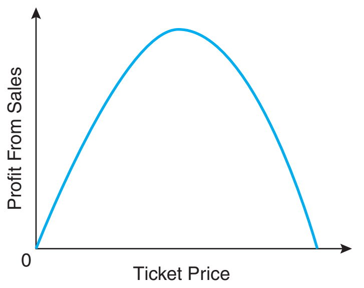
a. The graph's horizontal axis is labelled Time and the vertical axis is labelled Height of Grass. The graph shows a constant increase, which represents the grass growing over time. Then, a vertical segment represents the grass being cut. This pattern continues.



b. The graph's horizontal axis is labelled Distance Travelled and the vertical axis is labelled Speed of ATV. The graph shows a constant speed increase. Then, the horizontal line represents a constant speed. The constant decrease represents the ATV slowing down to a stop.



c. The graph's horizontal axis is labelled Ticket Price and the vertical axis is labelled Profit from Sales. The graph shows that as the ticket price increases, profits from sales increase until a maximum profit is reached. After that maximum profit is reached, as the ticket price increases, profits decrease.



Question 4, page 274

a. The horizontal axis is time and the vertical axis is distance from home. The constant decrease shows a jogger jogging home. The short horizontal section shows that the jogger is at home for a short time. The constant increase indicates the jogger walking away from home.

b. The horizontal axis is time and the vertical axis is speed. The decrease shows a car's speed slowing down over time until the car stops. The increase shows the speed increasing until a constant speed has been reached, as represented by the horizontal section.

c. The horizontal axis is time and the vertical axis is height. The smooth increasing curve indicates a ball's height as it is thrown up in the air. The top of the curve indicates the maximum height it reaches. The smooth decreasing curve indicates the ball's height as it falls to the ground. The ball bounces, and its height increases, but not as high as the first time. This pattern continues, with the maximum height that the ball reaches each time decreasing until the ball stays on the ground.

Question 7, page 275

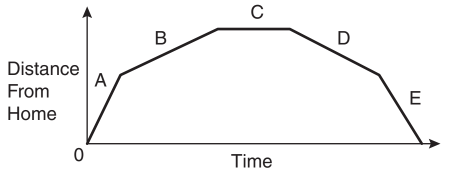
Section A: The first graph shows that Uriash was moving away from home at a constant speed. The second graph shows that he was on level ground.

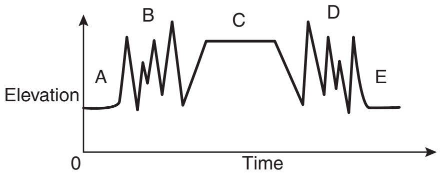
Section B: The first graph shows that he was moving away from home, but at a slower speed than in section A. The second graph shows that he was going up and down hills.

Section C: The first graph shows that his position didn't change. The second graph shows that he was at a constant elevation.

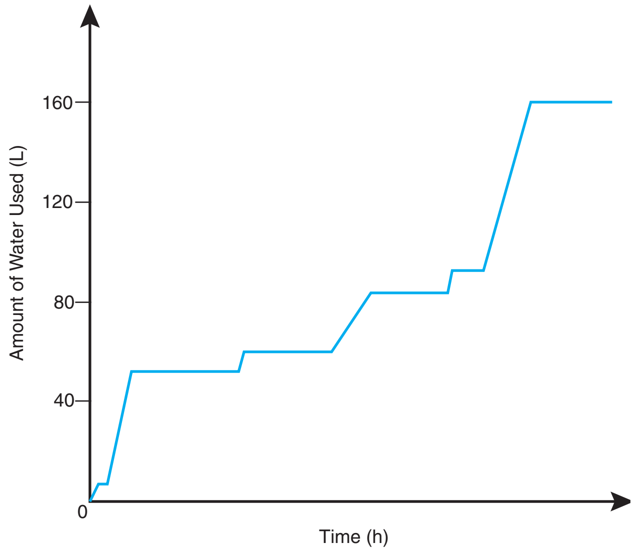
Section D: The first graph shows that he was heading back toward home, at a constant speed. The second graph shows that he was going up and down hills.

Section E: The first graph shows that he was heading toward home, at a faster speed than in section D. The second graph shows that he was on level ground.





Question 8, page 275

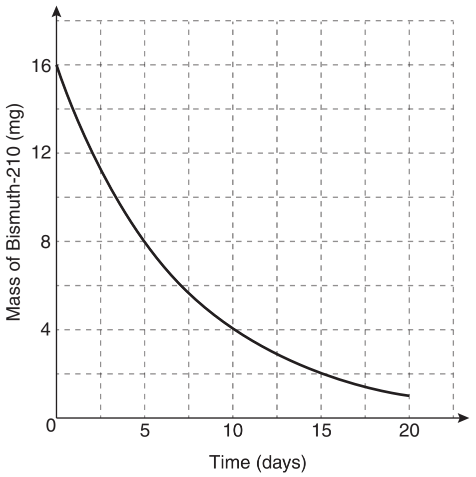


Let the horizontal axis represent time, in hours, and let the vertical axis represent the amount of water used, in litres. The first increase represents flushing the toilet and washing my hands. The second, sharp, increase represents taking a shower. The horizontal section represents no water use for a time. Then, the next short rise represents flushing the toilet and washing my hands again. The next horizontal section represents no water use for a time. The next rise represents running the dishwasher. Another horizontal section represents no water use for a time. Another short rise represents flushing the toilet and washing my hands again, followed by a short time of no water use, and then a sharp rise that represents running a bath. Finally, a horizontal section represents no water use for a time.

Question 13, page 277

a. The half-life of the isotope is the time required for its mass to decrease to half of its starting mass. The starting mass is 16 mg, so its half-life is the time it takes for the mass to reach 8 mg. According to the graph, this occurs at 10 000 years.

b. Label the horizontal axis as time, in days. The vertical axis represents the mass of Bismuth-210, in milligrams. If the starting mass is 16 mg and Bismuth-210 has a half-life of 5 days, its mass would be 8 mg after 5 days. After 5 more days, or 10 days from the beginning, its mass would be half of 8 mg, or 4 mg. At 15 days from the beginning, its mass would be 2 mg. After 20 days, its mass would be 1 mg. The graph is shown below.



Question 14, page 277

The cost is constant for each interval of time. For example, the cost is $1 for any part of the first hour, up to and including one hour, $2 for just after one hour up to and including two hours, and $3 for just after two hours up to and including three hours. This cost pattern continues.

Question 2, page 330

The green line represents televisions. As people age, they tend to watch more television. The red line represents cell phones. Older generations were not raised with access to cell phones, so fewer seniors have them. The blue line represents computers. The younger groups are more comfortable with and dependent on computers, because they were raised with them.

Question 3, page 330

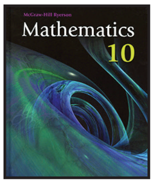
Container 1 matches graph A because it would fill up at a constant, but gradual rate since the container is wide, but not very tall.

Container 2 matches graph D because it would fill up at a constant, but fast rate since the container is narrow and tall.

Container 3 matches graph B because the lower portion of the container would fill up more slowly due to its width, but then the upper part would fill more rapidly due to that part of the container being narrower.

Container 4 matches graph C because it would fill up more quickly at the narrow bottom and more slowly at the wider top.

Lesson 6.2: Domain and Range



Refer to pages 288, 301, and 332 in *Mathematics 10* for more practice.

- Page 288, #3
- Page 301, #1, 2, 3, 4, 5, 6, and 7
- Page 332, #7 and 8

Question 3, page 288

a. The area, A, is the dependent variable and the radius, r, is the independent variable.

b. V is the dependent variable and t is the independent variable.

c. A is the dependent variable and n is the independent variable.

d. The profit is the dependent variable and the year is the independent variable.

e. The number of eggs, e, is the dependent variable and the number of chickens, c, is the independent variable.

Question 1, page 301

a. The number line indicates the real numbers between –8 and 30, inclusive. In interval notation, this is $[-8, 30]$. In set-builder notation, this is $\{n | -8 \leq n \leq 30, n \in R\}$.

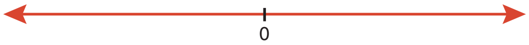
b. The number line indicates the real numbers less than or equal to zero. In interval notation, this is $(-\infty, 0]$. In set-builder notation, this is $\{n | n \leq 0, n \in R\}$.

c. The number line indicates the real numbers greater than or equal to -2. In interval notation, this is $[-2, +\infty)$. In set-builder notation, this is $\{n | n \geq -2, n \in R\}$.

d. The number line indicates the real numbers greater than 50 and less than or equal to 100. In interval notation, this is $(50, 100]$. In set-builder notation, this is $\{n | 50 < n \leq 100, n \in R\}$.

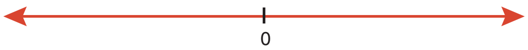
Question 2, page 302

a. The domain is all real numbers.

The domain as a number line is 

The domain in interval notation is $(-\infty, +\infty)$ and in set-builder notation is $\{x \mid x \in R\}$.

The range is all real numbers.

The range as a number line is 

The range in interval notation is $(-\infty, +\infty)$ and in set-builder notation is $\{y | y \in R\}$.

b. The domain is all real numbers greater than or equal to 2 and less than or equal to 8.

The domain as a number line is 

The domain in interval notation is $[2, 8]$ and in set-builder notation is $\{x | 2 \leq x \leq 8, x \in R\}$.

The range is all real numbers greater than or equal to 1 and less than or equal to 7.

The range as a number line is 

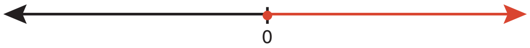
The range in interval notation is $[1, 7]$ and in set-builder notation is $\{y | 1 \leq y \leq 7, y \in R\}$.

c. The domain is all real numbers greater than or equal to –4.

The domain as a number line is 

The domain in interval notation is $[-4, +\infty)$ and in set-builder notation is $\{x| x \geq -4, x \in R\}$.

The range is all real numbers greater than or equal to 0.

The range as a number line is 

The range in interval notation is $[0, +\infty)$ and in set-builder notation is $\{y| y \geq 0, y \in R\}$.

d. The domain is all real numbers greater than or equal to –2 and less than or equal to 2.

The domain as a number line is 

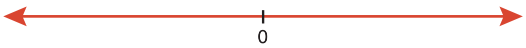
The domain in interval notation is $[-2, 2]$ and in set-builder notation is $\{x|-2 \leq x \leq 2, x \in R\}$.

The range is all real numbers greater than or equal to –5 and less than or equal to –1.

The range as a number line is 

The range in interval notation is $[-5, -1]$ and in set-builder notation is $\{y|-5 \leq y \leq -1, y \in R\}$.

e. The domain is all real numbers.

The domain as a number line is 

The domain in interval notation is $(-\infty, +\infty)$ and in set-builder notation is $\{x| x \in R\}$.

The range is all real numbers less than or equal to 7.

The range as a number line is 

The range in interval notation is $(-\infty, 7]$ and in set-builder notation is $\{y| y \leq 7, y \in R\}$.

f. The domain is all real numbers less than 1.

The domain as a number line is 

The domain in interval notation is $(-\infty, 1)$ and in set-builder notation is $\{x| x < 1, x \in R\}$.

The range is all real numbers less than –1.

The range as a number line is 

The range in interval notation is $(-\infty, -1)$ and in set-builder notation is $\{y| y < -1, y \in R\}$.

Question 3, page 302

a. The domain for the graphed points is the set of x-coordinates of the ordered pairs: $\{-4, 0, 1, 2, 3\}$. The range for the graphed points is the set of y-coordinates of the ordered pairs: $\{-1, 0, 1, 4, 5, 6, 7\}$.

b. The domain is the set of values in the left column of the table: $\{-4, -2, 0, 2, 4, 6\}$. The range is the set of values in the right column of the table: $\{5, 7, 9\}$.

c. The domain is the set of x-coordinates of the ordered pairs: $\{50, 100, 150, 200\}$. The range is the set of y-coordinates of the ordered pairs: $\{10, 20, 30, 40\}$.

Question 4, page 302

a. Substitute m with 0 to find the lower limit of the range.

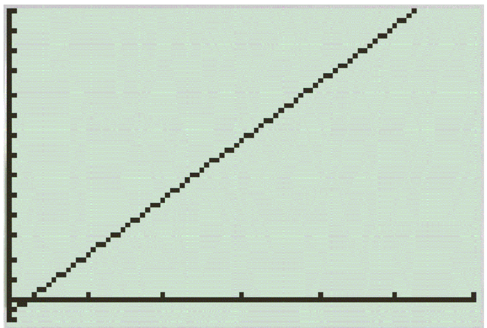
$$k = 2.8m - 3.5$$
$$k = 2.8(0) - 3.5$$
$$k = 0 - 3.5$$
$$k = -3.5$$

Substitute m with 25 to find the upper limit of the range.

$$k = 2.8m - 3.5$$
$$k = 2.8(25) - 3.5$$
$$k = 70 - 3.5$$
$$k = 66.5$$

The range of the relation is $[-3.5, 66.5]$.

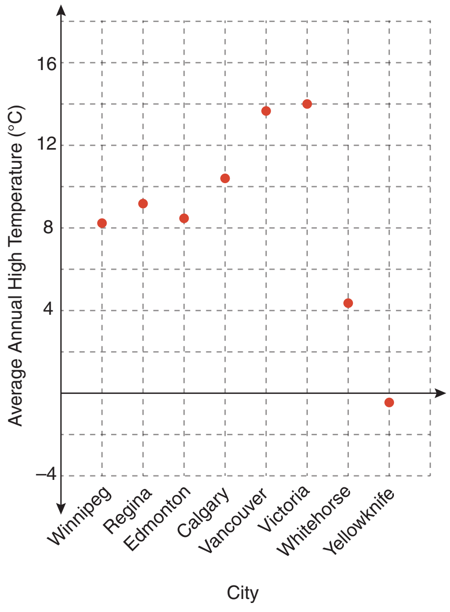
b. Using window values of $X\min = 0$, $X\max = 30$, $Y\min = -5$, $Y\max = 70$



Question 5, page 303

a. The domain is the set of cities in the left column of the table: {Winnipeg, Regina, Edmonton, Calgary, Vancouver, Victoria, Whitehorse, Yellowknife}. The range is the set of values in the right column of the table: {–0.2, 4.5, 8.3, 8.5, 9.1, 10.5, 13.7, 14.1}

b. The cities are labelled on the horizontal axis. Temperatures, in degrees Celsius, are labelled on the vertical axis.



Question 6, page 303

a. The domain of the blue oval is the set of x-coordinates of the points that form the oval. The x-coordinate at the far left end of the blue oval is 2.5 and the x-coordinate at the far right end is 11.5. The domain is $[2.5, 11.5]$.

The range of the blue oval is the set of y-coordinates of the points that form the oval. The y-coordinate at the bottom of the oval is 0 and the y-coordinate at the top is 6. The range is $[0, 6]$.

b. The domain of the red oval is the set of x-coordinates of the points that form the oval. The x-coordinate at the far left end of the red oval is 1 and the x-coordinate at the far right end is 13. The domain is $\{x | 1 \le x \le 13, x \in \mathrm{R}\}$.

The range of the red oval is the set of y-coordinates of the points that form the oval. The y-coordinate at the bottom of the oval is 0 and the y-coordinate at the top is 6. The range is $\{y | 0 \le y \le 6, y \in \mathrm{R}\}$.

c. To find the dimensions of the blue pool, find the difference between the largest value and smallest value for both the domain and the range. The difference in the domain values is $11.5 - 2.5$ or 9 m. The difference in the range values is $6 - 0$ or 6 m. So, the dimensions of the blue pool are 9 m by 6 m.

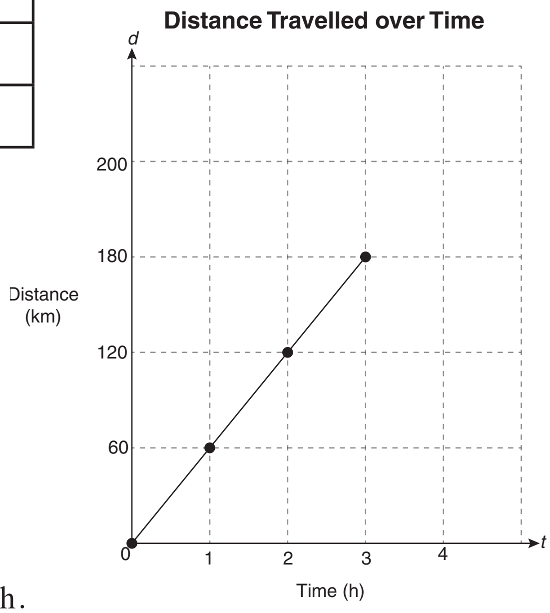
To find the dimensions of the red pool, find the difference between the largest value and smallest value for both the domain and the range. The difference in the domain values is $13 - 1$ or 12 m. The difference in the range values is $6 - 0$ or 6 m. So, the dimensions of the red pool are 12 m by 6 m.

Question 7, page 303

a. Create a table of values for the relation using the values of 0, 1, 2, and 3 in the domain.

t	d	Ordered Pair
0	$d = 60(0) = 0$	$(0, 0)$
1	$d = 60(1) = 60$	$(1, 60)$
2	$d = 60(2) = 120$	$(2, 120)$
3	$d = 60(3) = 180$	$(3, 180)$

Plot the data from the table, placing Time, t, on the horizontal axis and distance, d, on the vertical axis. Join the points to form a continuous graph because it is possible to have fractions of an hour as the domain and fractions of a kilometre as the range. Because the car can only travel 193 km on a full charge the range will stop at 193 km.



b. The car can travel 193 km in $\frac{193 \text{ km}}{60 \text{ km/h}} \doteq 3.22 \text{ h}$.

The domain could be described using words as the times between 0 h and approximately 3.22 h, inclusive. The domain could also be stated in interval notation as $[0, 3.22]$.

The range could be described using words as the distance between 0 km and 193 km, inclusive. The range could also be stated in interval notation as $[0, 193]$.

Question 7, page 332

a. The domain is the set of x-values of the relation. So, the domain is $\{-9, -5, 0, 2\}$. The range is the set of y-values of the relation. So, the range is $\{5, 8\}$.

b. The domain is the set of x-values of the relation. So, the domain is $\{-1, 0, 1, 2, 3\}$. The range is the set of y-values of the relation. So, the range is $\{-3, -1, 1, 3, 5\}$.

Question 8, page 332

a. The domain as a number line is 

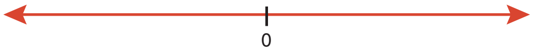
The domain in interval notation is $(-5, 5)$ and in set-builder notation is $\{x | -5 < x < 5, x \in \mathrm{R}\}$.

The range as a number line is 

The range in interval notation is $(1, 5)$ and in set-builder notation is $\{y | 1 < y < 5, y \in \mathrm{R}\}$.

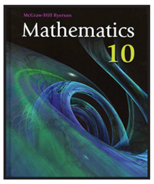
b. The domain as a number line is 

The domain in interval notation is $(-\infty, 4]$ and in set-builder notation is $\{x| x \leq 4, x \in \mathrm{R}\}$.

The range as a number line is 

The range in interval notation is $(-\infty, +\infty)$ and in set-builder notation is $\{y| y \in \mathrm{R}\}$.

Lesson 6.3: Linear Relations



Refer to pages 287, 325, and 331 in *Mathematics 10* for more practice.

- Page 287, #1, 5, 7, 8, 11, and 12
- Page 325, #1, 2, 3a, 3c, 3f, 5, 6, 8, and 9
- Page 331, #4a, 4b, 4d, 4e, and 5

Question 1, page 287

a. The ordered pairs (m,n) taken from the table are

$(-2,5), (-1,6), (0,7), (1,8), (2,9), (3,10),$ and $(4,22)$.

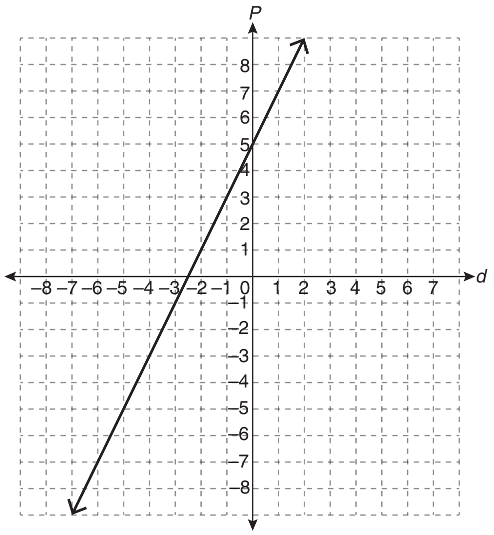
b.

x	y
0	0
1	1
1	–1
2	2
2	–2
3	3
3	–3

c. Create a table of values for the relation $P = 2d + 5$ by using the values of 0, –1, –2, –3, and –4 for *d*, in the domain.

d	$P = 2d + 5$	Ordered Pair
0	$P = 2(0) + 5 = 5$	$(0, 5)$
–1	$P = 2(-1) + 5 = 3$	$(-1, 3)$
–2	$P = 2(-2) + 5 = 1$	$(-2, 1)$
–3	$P = 2(-3) + 5 = -1$	$(-3, -1)$
–4	$P = 2(-4) + 5 = -3$	$(-4, -3)$

Draw a graph with the horizontal axis labelled as *d* and the vertical axis labelled as *P*. Plot the points from the table.



Question 5, page 288

a. This is a linear relation. For each additional bushel of wheat sold, the amount of money received increased by \$6.

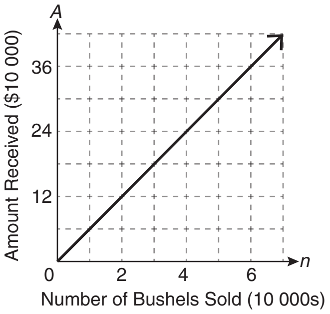
b. Let *A* represent the amount of money received. *A* is the dependent variable because the amount of money received is dependent on the number of bushels sold. The number of bushels sold, *n*, is the independent variable.

c. In the table, the value for n, the number of bushels sold, is entered in increments of 10 000 bushels. The amount received is determined by multiplying the number of bushels sold by \$6. For example, for 10 000 bushels sold, the amount received is \$6(10 000) or \$60 000.

Number of Bushels Sold, n	Amount Received, A (\$)
0	0
10 000	60 000
20 000	120 000
30 000	180 000
40 000	240 000
50 000	300 000

d. The data would be discrete because fractions of bushels cannot be sold. However, because a single bushel is such a small unit compared to the 10 000 bushel increments in the table, the relation would appear to be continuous on a graph.

e. The number of bushels sold is placed on the horizontal axis. The vertical axis represents the amount of money received. Plot the values from the table in part c.



Question 7, page 289

a. The equation $D = 0.75d$ is a linear relation, because for every depth increase of 1 m, there is an apparent depth increase of 0.75 m.

b. D, the apparent depth, is the dependent variable and d, the actual depth, is the independent variable.

c. To determine the apparent depth of the coin when the water is 2 m deep, substitute 2 for d in the equation $D = 0.75d$

$D = 0.75(2)$

$D = 1.5$

The coin appears to be 1.5 m deep.

d. To determine the apparent depth of the coin when the water is 2.8 m deep, substitute 2.8 for d in the equation $D = 0.75d$

$D = 0.75(2.8)$

$D = 2.1$

The coin appears to be 2.1 m deep. Fractions of a metre are reasonable and can be used, so the relation is continuous.

Question 8, page 289

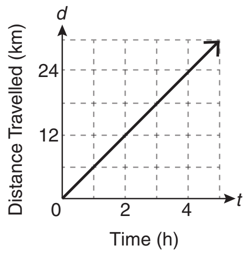
a. The dependent variable, *d*, represents the distance travelled, in kilometres. The independent variable, *t*, represents time, in hours.

To create a set of ordered pairs for the relation, complete a table of values using domain values of 0, 1, 2, 3, 4, and 5.

t	d	Ordered Pair
0	$d = 6(0) = 0$	$(0, 0)$
1	$d = 6(1) = 6$	$(1, 6)$
2	$d = 6(2) = 12$	$(2, 12)$
3	$d = 6(3) = 18$	$(3, 18)$
4	$d = 6(4) = 24$	$(4, 24)$
5	$d = 6(5) = 30$	$(5, 30)$

b. The relation is continuous. The whale can swim for a fraction of an hour or cover a distance that is a fraction of a kilometre.

c. In the graph, the horizontal axis represents time, in hours. The vertical axis represents distance travelled, in kilometres. Plot the ordered pairs from part c. Join the points.



d. The relation is linear because the graph of the relation is a straight line.

Question 11, page 291

a. The table represents a linear relation. As the values of x increase by 2, the values of y increase by k. If k is replaced with a number, such as 1, the table would be as shown.

x	y
1	1
3	2
5	3
7	4

b. The table represents a linear relation. As the values of x increase by 1, the values of y increase by $3n$. If m is replaced with a number, such as 1, and n is replaced with a number, such as 1, the table would be as shown.

x	y
1	0
2	3
3	6
4	9

Question 12, page 291

a. Graph A is linear and Graph B is non-linear. In Graph A, the differences between adjacent range values are constant. In Graph B, the differences between adjacent range values are increasing.

b. For simple interest, the interest calculation is a certain percentage of the original investment amount, so the amount added each year is the same, as shown in Graph A. For compound interest, the interest is added to the value of the investment each year, so the interest earned each year increases, as shown in Graph B.

Question 1, page 325

Line a) has a negative slope because the line falls from left to right.

Line b) has a positive slope because the line rises from left to right.

Line c) has a positive slope because the line rises from left to right.

Line d) has a slope of zero because it is horizontal.

Line e) has a negative slope because the line falls from left to right.

Question 2, page 325

a. To move on the line from the point of (–6, 0) to the point (0, 4), count 4 units up and 6 units to the right. This means the rise is 4 and the run is 6. The slope is $\frac{4}{6}$ or $\frac{2}{3}$.

b. To move on the line from the point (0, 0) to the point (–4, 4), count 4 units up and 4 units to the left. This means the rise is 4 and the run is –4. The slope is $\frac{4}{-4}$ or -1.

Question 3, page 325

a. Let (x_1, y_1) be the point $(2, 4)$ and let (x_2, y_2) be the point $(9, 8)$. Substitute these points into the slope formula.

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{8-4}{9-2} \\ &= \frac{4}{7} \end{aligned}$$

c. Let (x_1, y_1) be the point $(-2, -5)$ and let (x_2, y_2) be the point $(1, -7)$. Substitute these points into the slope formula.

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{-7-(-5)}{1-(-2)} \\ &= \frac{-2}{3} \end{aligned}$$

f. Let (x_1, y_1) be the point $(3.9, 10.6)$ and let (x_2, y_2) be the point $(10.3, 13.8)$. Substitute these points into the slope formula.

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{13.8-10.6}{10.3-3.9} \\ &= \frac{3.2}{6.4} \\ &= \frac{1}{2} \end{aligned}$$

Question 5, page 326

To determine the average rate of change, find the slope of the line.

Find the difference in the two known y-values, which represents temperature change, $-55-(-16)=-39°C$.

Find the difference in the two known x-values, which represents altitude change, $11-5=6$ km.

Set up the rate as $\frac{\text{rise}}{\text{run}}=\frac{-39°\text{C}}{6\text{ km}}=-6.5°\text{C/km}$.

The rate of change is $-6.5°\text{C}$ per kilometre.

Question 6, page 326

To determine the average rate of change, find the difference in the two known y-values, which represents the change in height, $25-0=25$ m.

Find the difference in the two known x-values, which represents the change in time, $0-3=-3$ s.

Set up the rate as $\frac{\text{rise}}{\text{run}}=\frac{25\text{ m}}{-3\text{ s}}=-8.333...\text{m/s}$.

The rate of change is approximately -8.3 metres per second.

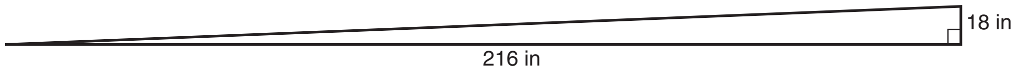
Question 8, page 326

a. Since the maximum slope allowed is $\frac{1}{12}$, this means that for every inch of rise there is a run of at least 12 inches. Set up a proportion using the given slope and the rise to Marjorie's front door. Let x represent the shortest allowable run.

$$\frac{1}{12}=\frac{18}{x}$$
$$\frac{1}{12}\cdot x=\frac{18}{\cancel{x}}\cdot\cancel{x}$$
$$\frac{x}{12}=18$$
$$\frac{x}{\cancel{12}}\cdot\cancel{12}=18\cdot 12$$
$$x=216$$

The shortest run is 216 inches.

b. Use the Pythagorean theorem, $a^2 + b^2 = c^2$, with legs a and b of the right triangle being the rise, 18 inches, and the run, 216 inches. The hypotenuse, c, is the length of the ramp.



$$\begin{aligned} a^2 + b^2 &= c^2 \\ 18^2 + 216^2 &= c^2 \\ 324 + 46\,656 &= c^2 \\ \sqrt{46\,980} &= \sqrt{c^2} \\ 216.748...\text{in} &= c \end{aligned}$$

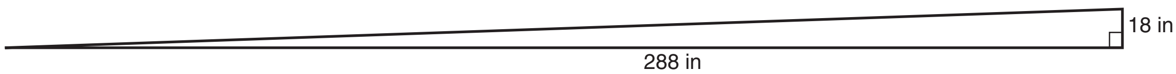
The length of the ramp is approximately 216.75 inches.

c. Since the slope is now $\frac{1}{16}$, for every inch of rise, there is a run of 16 inches. Set up a proportion using the given slope and the rise to Marjorie's front door. Let x represent the shortest allowable run.

$$\begin{aligned} \frac{1}{16} &= \frac{18}{x} \\ \frac{1}{16} \bullet x &= \frac{18}{\cancel{x}} \bullet \cancel{x} \\ \frac{x}{16} &= 18 \\ \frac{x}{\cancel{16}} \bullet \cancel{16} &= 18 \bullet 16 \\ x &= 288 \end{aligned}$$

The run is 288 inches.

Use the Pythagorean theorem, $a^2 + b^2 = c^2$, with legs a and b of the right triangle being the rise, 18 inches, and the run, 288 inches. The hypotenuse, c, is the length of the ramp.



$$\begin{aligned} a^2 + b^2 &= c^2 \\ 18^2 + 288^2 &= c^2 \\ 324 + 82\,944 &= c^2 \\ \sqrt{83\,268} &= \sqrt{c^2} \\ 288.561... &= c \end{aligned}$$

The length of the ramp is approximately 288.6 inches.

Question 9, page 327

a. A slope of 8% is equivalent to $\frac{8}{100}$. The slope of the hill is $\frac{8}{100}$ or $\frac{2}{25}$.

b. For every 100 units of horizontal distance travelled, 8 units of elevation are lost.

Question 4, page 331

a. The relation is non-linear. The distance from the sun would not increase or decrease at a constant rate. There would be times when the distances repeat, thus preventing a straight line from being drawn through the points on a graph representing time versus distance.

b. The relation is linear. The values of x are increasing by 5 each time, while the corresponding values of y are constantly increasing by 5 each time.

c. The relation is non-linear. The values of x are increasing at a constant rate, but the values of y are not.

d. The relation is non-linear because the graph is not a single straight line.

Question 5, page 331

To compare the relations, represent each relation in the same format; in this case, as a table of values.

Relation A

x	y
–2	–1
0	1
2	3
4	5

Relation B

x	y
–2	0
0	2
2	4
4	6

Relation C

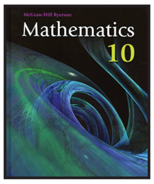
x	y
–2	–4
0	0
2	4
4	8

Relation D

x	y
–2	0
0	2
2	4
4	6

Based on the tables above, Relations B and D are the same.

Lesson 6.4: Linear Functions



Refer to pages 311 and 332 in *Mathematics 10* for more practice.

- Page 311, #1, 3, 4, 6, 7, and 8
- Page 332, #9, 10, 11, and 13

Question 1, page 311

a. The relation is a function. Each value of x has one value of y.

b. The relation is a function. Each value of x has one value of y.

c. The relation is a function. Each value of x has one value of y.

d. The relation is not a function. For $x = 1$, $x = 4$, there are two corresponding values for y.

e. The relation is a function. Each name has one age.

f. The relation is a function. The graph passes the vertical line test.

g. The relation is not a function. The graph fails the vertical line test.

Question 3, page 311

The function written as a formula is $C = 3n + 50$, where C represents cost, in dollars, and n represents number of shirts.

Question 4, page 311

a.
$$f(x) = 10x - 8$$
$$f(2) = 10(2) - 8$$
$$f(2) = 20 - 8$$
$$f(2) = 12$$

b.
$$f(x) = 10x - 8$$
$$f(-3) = 10(-3) - 8$$
$$f(-3) = -30 - 8$$
$$f(-3) = -38$$

c. $f(x) = 10x - 8$

$$42 = 10x - 8$$
$$42 + 8 = 10x - \cancel{8} + \cancel{8}$$
$$50 = 10x$$
$$\frac{50}{10} = \frac{\cancel{10}x}{\cancel{10}}$$
$$5 = x$$

Question 6, page 311

a. $p(x) = -4x + 2$

$$p(0) = -4(0) + 2$$
$$p(0) = 0 + 2$$
$$p(0) = 2$$

b. $p(x) = -4x + 2$

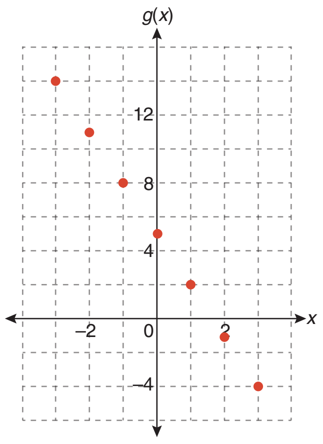
$$-2 = -4x + 2$$
$$-2 - 2 = -4x + \cancel{2} - \cancel{2}$$
$$-4 = -4x$$
$$\frac{-4}{-4} = \frac{\cancel{-4}x}{\cancel{-4}}$$
$$1 = x$$

Question 7, page 312

a.

x	$g(x) = -3x + 5$	Ordered Pair
–3	$g(-3) = -3(-3) + 5$ $= 9 + 5$ $= 14$	$(-3, 14)$
–2	$g(-2) = -3(-2) + 5$ $= 6 + 5$ $= 11$	$(-2, 11)$
–1	$g(-1) = -3(-1) + 5$ $= 3 + 5$ $= 8$	$(-1, 8)$
0	$g(0) = -3(0) + 5$ $= 0 + 5$ $= 5$	$(0, 5)$
1	$g(1) = -3(1) + 5$ $= -3 + 5$ $= 2$	$(1, 2)$
2	$g(2) = -3(2) + 5$ $= -6 + 5$ $= -1$	$(2, -1)$
3	$g(3) = -3(3) + 5$ $= -9 + 5$ $= -4$	$(3, -4)$

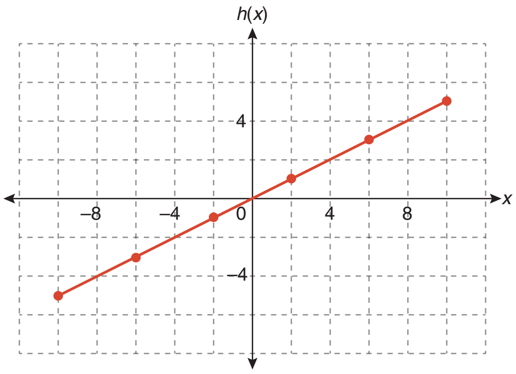
Plot the values from the table on a graph. Do not join the points because the domain is only defined for the given values.



b. Since the domain is all real numbers between –10 and 10, choose any values that are between –10 and 10.

x	$h(x)=\frac{x}{2}$	Ordered Pair
–10	$h(-10)=\frac{-10}{2}$ $=-5$	$(-10,-5)$
–6	$h(-6)=\frac{-6}{2}$ $=-3$	$(-6,-3)$
–2	$h(-2)=\frac{-2}{2}$ $=-1$	$(-2,-1)$
2	$h(2)=\frac{2}{2}$ $=1$	$(2,1)$
6	$h(6)=\frac{6}{2}$ $=3$	$(6,3)$
10	$h(10)=\frac{10}{2}$ $=5$	$(10,5)$

Plot the points and join them.



Question 8, page 312

a. The variable w represents the number of weeks.

b. $M(w)$ represents the amount of money Mike has saved after w weeks. $A(w)$ represents the amount of money Ali has remaining after w weeks.

c. $$\begin{aligned} M(w) &= 20w + 200 \\ M(4) &= 20(4) + 200 \\ &= 80 + 200 \\ &= 280 \end{aligned}$$

Mike has saved \$280 after 4 weeks.

$$\begin{aligned} A(w) &= 200 - 20w \\ A(4) &= 200 - 20(4) \\ &= 200 - 80 \\ &= 120 \end{aligned}$$

Ali has \$120 remaining after 4 weeks.

d. $$\begin{aligned} A(w) &= 200 - 20w \\ 0 &= 200 - 20w \\ 0 - 200 &= \cancel{200} - \cancel{200} - 20w \\ -200 &= -20w \\ \frac{-200}{-20} &= \frac{\cancel{-20}w}{\cancel{-20}} \\ 10 &= w \end{aligned}$$

After 10 weeks, Ali would have \$0 left.

Question 9, page 332

The function $C(d) = \pi d$ written as a formula is $C = \pi d$, where d represents the diameter of the circle and C represents the circumference.

Question 10, page 332

The formula $V = r^3$ written in function notation is $V(r) = r^3$.

Question 11, page 333

a. The relation is a function, because each value of x has only one value of y.

b. The relation is not a function. The graph fails the vertical line test.

c. The relation is not a function. The domain value of black has two different range values, male and female.

d. The relation is not a function. The domain value of 8.6 has two range values, 9.4 and 9.2.

Question 13, page 333

a. An appropriate domain would be 0 to 10 people.

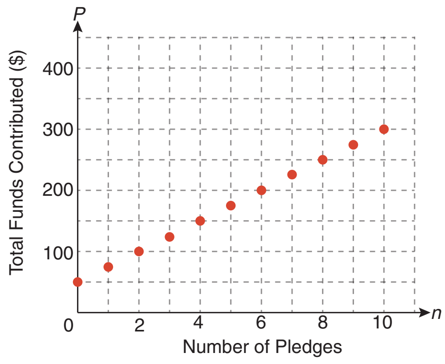
n	$P(n) = 25n + 50$
0	$P(0) = 25(0) + 50$ $= 0 + 50$ $= 50$
1	$P(1) = 25(1) + 50$ $= 25 + 50$ $= 75$
2	$P(2) = 25(2) + 50$ $= 50 + 50$ $= 100$
3	$P(3) = 25(3) + 50$ $= 75 + 50$ $= 125$
4	$P(4) = 25(4) + 50$ $= 100 + 50$ $= 150$

Continue this pattern to form the remaining ordered pairs.

Number of Pledges	Total Funds Contributed ($)
0	50
1	75
2	100
3	125
4	150
5	175
6	200
7	225
8	250
9	275
10	300

The corresponding range would be
$\{\$50, \$75, \$100, \$125, \$150, \$175, \$200, \$225, \$250, \$275, \$300\}$.

On the graph, let the horizontal axis represent the number of pledges and let the vertical axis represent the total funds contributed, in dollars. The data is discrete because the number of pledges must be whole numbers.



b. Substitute 8 for n in the function $P(n) = 25n + 50$.

$$\begin{aligned} P(8) &= 25(8) + 50 \\ &= 200 + 50 \\ &= 250 \end{aligned}$$

Amber would be able to contribute a total of \$250 if she had 8 pledges.

c. Substitute \$675 for $P(n)$.

$$\begin{aligned} 675 &= 25n + 50 \\ 675 - 50 &= 25n + 50 - 50 \\ 625 &= 25n \\ \frac{625}{25} &= \frac{\cancel{25}n}{\cancel{25}} \\ 25 &= n \end{aligned}$$

Amber would need more than 25 pledges to receive a prize.

d. This situation depicts a function because for each number of pledges, there is only one possible contribution amount.