Chapter 5 Modelling With Graphs

Chapter 5 Get Ready

Chapter 5 Get Ready Question 1 Page 236

a) $\frac{-3}{4}$ is not equivalent to the others, since it is negative. All of the rest are positive.

b) $\frac{5}{2}$ is not equivalent to the others, since it is positive. All of the rest are negative.

c) $\frac{-1}{-2}$ is not equivalent to the others, since it is positive. All of the rest are negative.

Chapter 5 Get Ready Question 2 Page 236

a) $\frac{2}{5} = 0.4$

b) $-\frac{7}{10} = -0.7$

c) $\frac{-35}{40} = -0.875$

d) $\frac{-12}{5} = -2.4$

Chapter 5 Get Ready Question 3 Page 236

a) $-\frac{3}{9} = -\frac{1}{3}$

b) $\frac{-15}{10} = \frac{-3}{2}$

c) $\frac{-12}{-48} = \frac{1}{4}$

d) $\frac{30}{-12} = \frac{5}{-2}$

Chapter 5 Get Ready Question 4 Page 237

a) 5:20 = 1:4

b) 12:96 = 1:8

c) 12:14 = 6:7

d) 40:850 = 4:85

Chapter 5 Get Ready Question 5 Page 237

$$\frac{7}{10} \times 120 = 84$$

In a group of 120 people, 84 would prefer Fresh toothpaste.

Chapter 5 Get Ready Question 6 Page 237

$$\frac{12}{30} \times 160 = 64$$

A person who is 160 cm tall is about 64 inches tall.

Chapter 5 Get Ready Question 7 Page 237

Location	Number of Days With Rain	Percent of 31 Days in July
Toronto, ON	10	32.3
Vancouver, BC	7	22.6
Charlottetown, PE	12	38.7
St. John's, NL	14	45.2

Chapter 5 Get Ready Question 8 Page 237

	Bag	Nitrogen (kg)	Phosphorus (kg)	Potassium (kg)
a)	10-kg 20:4:8	2	0.4	0.8
b)	25-kg 21:7:7	5.25	1.75	1.75
c)	50-kg 15:5:3	7.5	2.5	1.5
d)	20-kg 10:6:4	2	1.2	0.8

Chapter 5 Section 1: Direct Variation

Chapter 5 Section 1 Question 1 Page 242

a) $k = \dfrac{280}{3.5}$

$= 80$

b) $k = \dfrac{35}{5}$

$= 7$

c) $k = \dfrac{500}{5}$

$= 100$

Chapter 5 Section 1 Question 2 Page 243

a) $k = \dfrac{4500}{200}$

$= 22.5$

$C = 22.5s$

b) The constant of variation represents the cost for each meter of sidewalk.

c) $C = 22.5(700)$

$= 15\ 750$

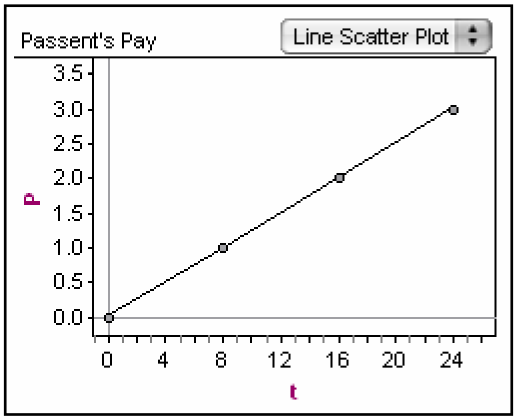
The cost of a 700-m sidewalk is $15 750.

Chapter 5 Section 1 Question 3 Page 243

a)

Time, t (h)	Pay, p ($)
0	0
1	8
2	16
3	24

b)



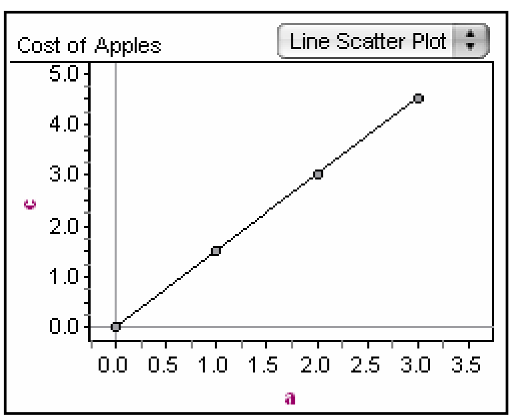
c) $p = 8t$

Chapter 5 Section 1 Question 4 Page 243

a)

Mass of Apples, a (kg)	Cost, c ($)
0	0.00
1	1.50
2	3.00
3	4.50

b)

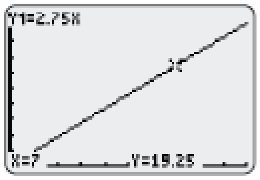


c) $c = 1.5a$

Chapter 5 Section 1 Question 5 Page 243

a) To calculate the cost of parking, multiply the time parked, in hours, by \$2.75. The cost *c*, in dollars, of parking, varies directly with the time, *t*, in hours, for which the car is parked.

b) $c = 2.75t$



c) Answers will vary. The cost is a little under \$3 per hour, so 7 h should cost about \$20.

d) $c = 2.75(7)$
$= 19.25$

It costs \$19.25 for 7 h of parking.

Chapter 5 Section 1 Question 6 Page 243

a) To calculate the cost *C*, of oranges, multiply the mass *r*, in kilograms, of oranges, by \$2.25.

b) $k = \frac{4.50}{2}$
$= 2.25$

$C = 2.25r$

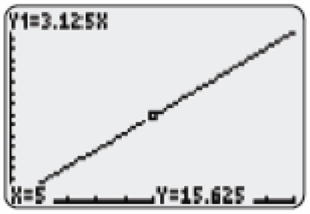
The constant of variation represents the constant average cost, \$2.25/kg.

c) $C = 2.25(30)$
$= 67.50$

It costs \$67.50 to buy 30 kg of oranges.

Chapter 5 Section 1 Question 7 Page 244

a)



b) $k = \frac{50}{16}$
$= 3.125$

$A = 3.125t$

c) $A = 3.125(24)$
$= 75$

Tania would have raised $75 by staying awake for 24 h.

Chapter 5 Section 1 Question 8 Page 244

a) $P = 9.5h$

b) $T = 1.5(9.5h)$
$= 14.25h$

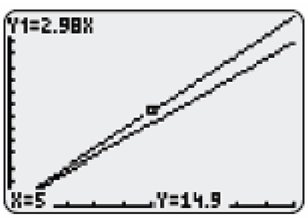
c) $P = 10h$

$T = 1.5(10h)$
$= 15h$

Chapter 5 Section 1 Question 9 Page 244

a) This relationship is a direct variation because the price of the sugar varies directly with the amount of sugar that is bought.

b)

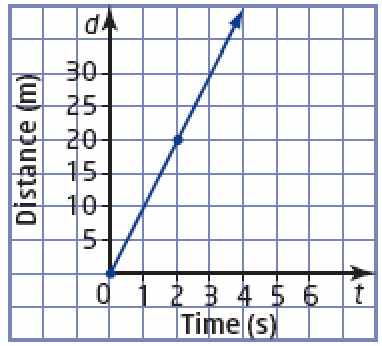


c) The graph shows that if the price increases to $1.49 for 0.5 kg (or $2.98/kg), the graph becomes steeper.

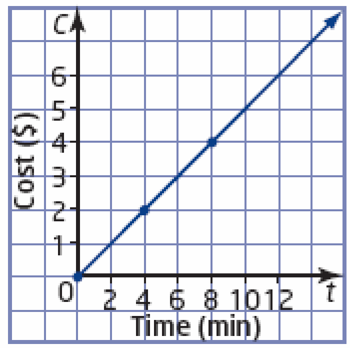
Chapter 5 Section 1 Question 10 Page 244

Answers will vary. Sample answers are shown.

a) A cyclist travels 20 m in 2 s.



b) A car is parked for 8 h. The cost of parking is $4.



Chapter 5 Section 1 Question 11 Page 244

The time given is for the round trip from the bat to the object and back to the bat. In order to find the distance to the object, the distance must be divided by 2.

$$d = \frac{1}{2} \times 342t$$
$$= 171t$$

Object	Time (s)	Distance (m)
Tree	0.1	17.1
House	0.25	42.75
Cliff wall	0.04	6.84

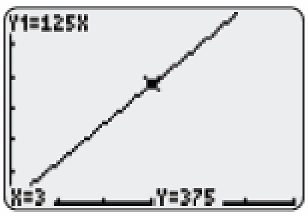
Chapter 5 Section 1 Question 12 Page 245

a) $k = \dfrac{500}{4}$
$= 125$

$V = 125t$

V is the volume of the water, in litres, and *t* is the time, in minutes. The constant of variation represents the rate of increase of the volume, 125 L/min.

b)



c) $V = 125(20)$
$= 2500 \text{ L}$

There are 2500 L of water in the pool after 20 min.

d) $115\,000 = 125t$

$$\frac{115\,000}{125} = \frac{125t}{125}$$
$$920 = t$$

It takes 920 min to fill a pool that holds 115 000 L of water.

e) $k = \dfrac{400}{4}$
$= 100$

$V = 100t$

The graph would still increase to the right, but less steeply. It would take longer to fill the pool.

Chapter 5 Section 1 Question 13 Page 245

a) The freezing point depends on the salt content. The salt content is the independent variable.

b) Let F represent the freezing point, in degrees Celsius, and s represent the salt content, as a percent.

$$k = \frac{3.5}{-2}$$
$$= -1.75$$

$$F = -1.75s$$

c)
$$F = -1.75(1)$$
$$= -1.75$$

Water with a salt content of 1% will freeze at –1.75ºC.

d)
$$-3 = -1.75s$$
$$\frac{-3}{-1.75} = \frac{-1.75s}{-1.75}$$
$$1.7 \doteq s$$

To freeze at –3ºC, water must have a salt content of about 1.7%.

Chapter 5 Section 1 Question 14 Page 245

Let k represent the number of kilometres, and m represent the number of miles.

$$m = 0.62k$$
$$\frac{m}{0.62} = \frac{0.62k}{0.62}$$
$$\frac{1}{0.62}m = k$$

An equation to convert miles to kilometres is $k = 1.61m$.

Chapter 5 Section 1 Question 15 Page 245

Coin	Diameter(cm)	Circumference(cm)
penny	1.9	6.0
nickel	2.1	6.6
dime	1.8	5.7
quarter	2.3	7.2

The circumference varies directly with the diameter. The constant of variation is π.

Chapter 5 Section 1 Question 16 Page 245

From 1 to 100, there are 19 disks that contain a 3: 3, 13, 23, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 43, 53, 63, 73, 83, and 93. So, the probability that a disk contains a 3 is

$$\begin{aligned}\frac{19}{100} &= 0.19 \\ &= 19\%\end{aligned}$$

Chapter 5 Section 1 Question 17 Page 245

The greatest possible number is 65 423. The least possible number is 23 465. The difference is 65 423 – 23 465 = 41 958.

Chapter 5 Section 2 Partial Variation

Chapter 5 Section 2 Question 1 Page 250

a) This is direct variation. The equation is of the form $y = kx$.

b) This is partial variation. The equation is of the form $y = mx + b$.

c) This is partial variation. The equation is of the form $y = mx + b$.

d) This is direct variation. The equation is of the form $y = kx$.

Chapter 5 Section 2 Question 2 Page 250

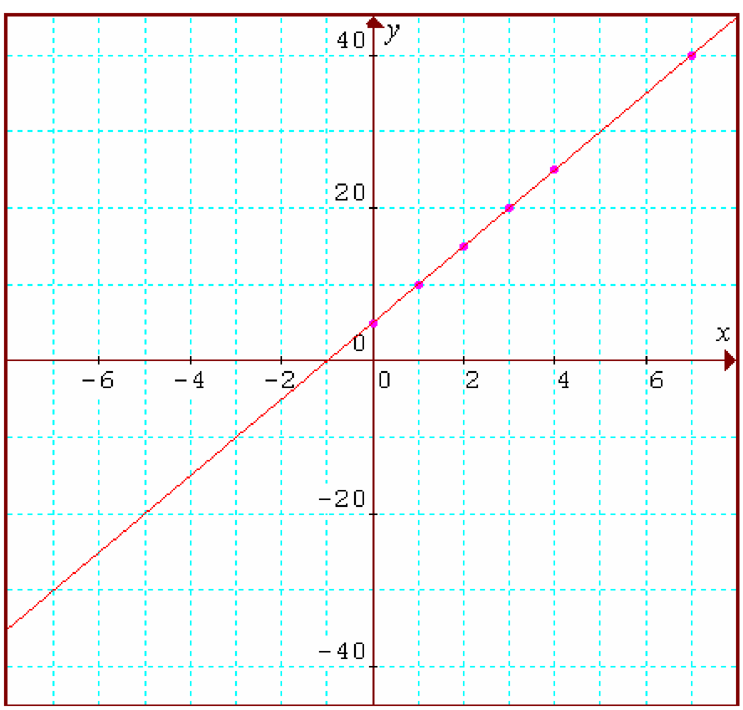
a)

x	y
0	5
1	10
2	15
3	20
4	25
7	40

b) The initial value of *y* is 5. The constant of variation is 5.

c) $y = 5x + 5$

d)



e) The graph is a straight line that intersects the *y*-axis at (0, 5). The *y*-values increase by 5 as the x-values increase by 1.

Chapter 5 Section 2 **Question 3** **Page 251**

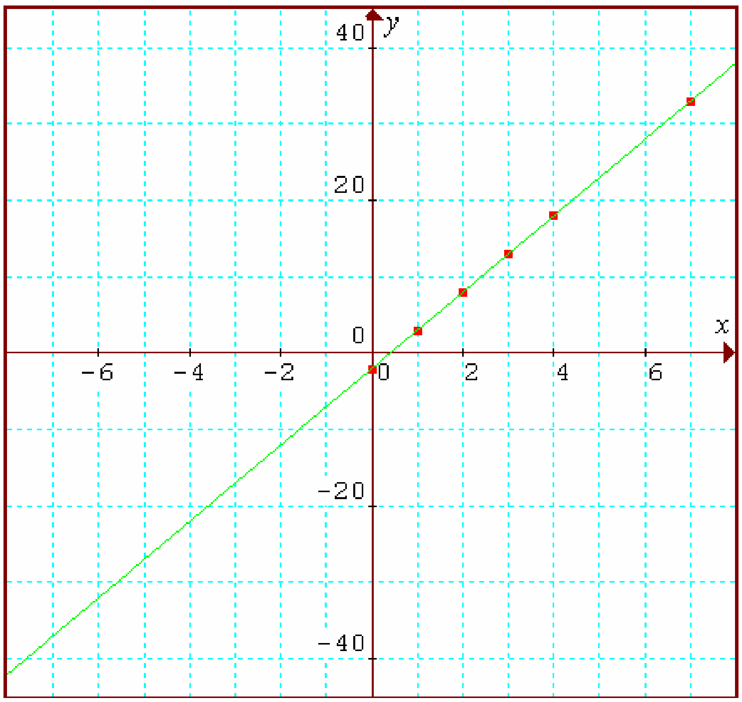
a)

x	y
0	−2
1	3
2	8
3	13
4	18
7	33

b) The initial value of *y* is –2. The constant of variation is 5.

c) $y = 5x - 2$

d)



e) The graph is a straight line that intersects the *y*-axis at (0, –2). The *y*-values increase by 5 as the x-values increase by 1.

Chapter 5 Section 2 Question 4 Page 251

a) The fixed cost is \$7.00. The variable cost is \$1.50 times the number of toppings.

b) $C = 1.50n + 7.00$

c) $C = 1.50(5) + 7.00$

$= 7.50 + 7.00$

$= 14.50$

The cost of a small pizza with five toppings is \$14.50.

Chapter 5 Section 2 Question 5 Page 251

a) The fixed cost is \$250. The variable cost is \$4 times the number of students.

b) $C = 4n + 250$

c) $C = 4(25) + 250$

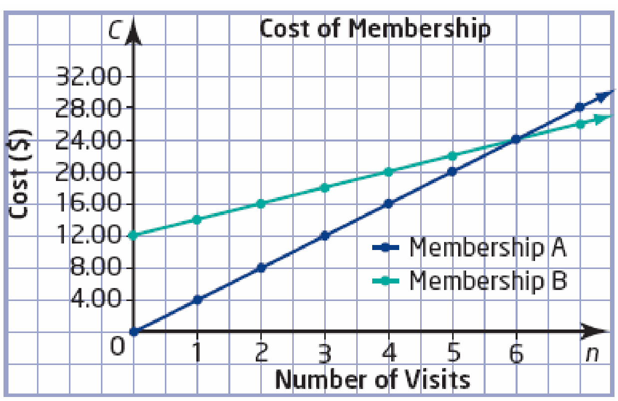
$= 100 + 250$

$= 350$

The total cost for 25 students is \$350.

Chapter 5 Section 2 Question 6 Page 251

a)



b) Membership A is a direct variation. Membership B is a partial variation.

c) Membership A: $C = 4n$ C represents the cost, and n represents the number of visits.

Membership B: $C = 2n + 12$

d) Membership A is cheaper when fewer than six visits are made. Membership B is cheaper when more than six visits are made. They cost the same when six visits are made.

Chapter 5 Section 2 Question 7 Page 252

Number of Flyers, n	Cost, C (\$)
0	100
100	120
200	140
300	160

a) The fixed cost is \$100 and could represent, for example, the cost of paper, ink, and overhead.

b) From the table, it costs \$20 over the fixed cost to print 100 flyers, so the variable cost to print one flyer is \$20 ÷ 100 or \$0.20.

c) $C = 0.20n + 100$

d)
$$\begin{aligned} C &= 0.20(1000) + 100 \\ &= 200 + 100 \\ &= 300 \end{aligned}$$

It costs \$300 to produce 1000 flyers.

e)
$$\begin{aligned} 280 &= 0.20n + 100 \\ 280 - 100 &= 0.20n + 100 - 100 \\ 180 &= 0.20n \\ \frac{180}{0.20} &= \frac{0.20n}{0.20} \\ 900 &= n \end{aligned}$$

900 flyers can be produced for \$280.

Chapter 5 Section 2 Question 8 Page 252

a) $T = 2n + 1$, where T is the number of toothpicks and n is the diagram number. This is a partial variation because it is of the form $y = mx + b$.

b)
$$\begin{aligned} T &= 2(20) + 1 \\ &= 41 \end{aligned}$$

Chapter 5 Section 2 Question 9 Page 252

a) $P = 10.13d + 102.4$**,** where P is the pressure, in kilopascals, and d is the depth below the lake's surface, in metres.

b)

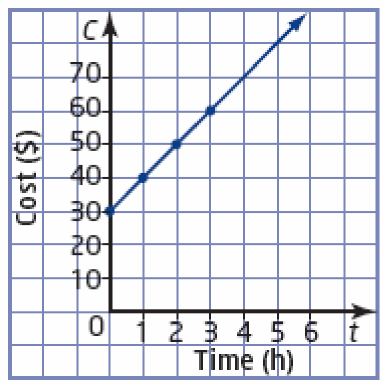
$$\begin{aligned} 400 &= 10.13d + 102.4 \\ 400 - 102.4 &= 10.13d + 102.4 - 102.4 \\ 297.6 &= 10.13d \\ \frac{297.6}{10.13} &= \frac{10.13d}{10.13} \\ 29.4 &\doteq d \end{aligned}$$

The danger from narcossis begins at about 29 m of depth.

Chapter 5 Section 2 Question 10 Page 252

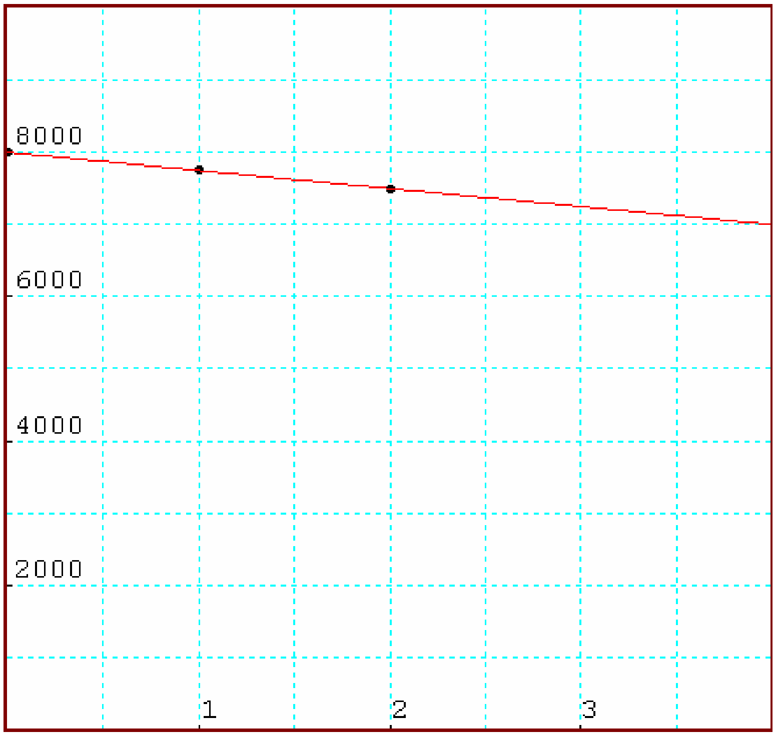
Answers will vary. A sample answer is shown.

A plumber comes to your house to repair a leak. It costs $30 for a service call, and $10 for each hour it takes to complete the job.



Chapter 5 Section 2 Question 11 Page 253

a)



b) The average rate of descent is $\frac{7500-8000}{2}$, or –250 m/min.

c) $H = -250t + 8000$, where *H* is the height above ground, in metres, and *t* is the time, in minutes.

Chapter 5 Section 2 Question 12 Page 253

Solutions for the Achievement Checks are shown in the Teacher's Resource.

Chapter 5 Section 2 Question 13 Page 253

a) i) The change is speed over 20ºC is 12 m/s. The constant of variation is $\frac{12}{20}=0.6$. Let v represent the speed, in metres per second, and T represent the temperature, in degrees Celsius.

$$\begin{aligned} v &= 0.6T + 331 \\ &= 0.6(30) + 331 \\ &= 349 \end{aligned}$$

The speed of sound at 30ºC is 349 m/s.

ii) $$\begin{aligned} v &= 0.6(-30) + 331 \\ &= 313 \end{aligned}$$

The speed of sound at –30ºC is 313 m/s.

b) $$\begin{aligned} v &= 0.6(-10) + 331 \\ &= 325 \end{aligned}$$

The speed of sound at –10ºC is 325 m/s.

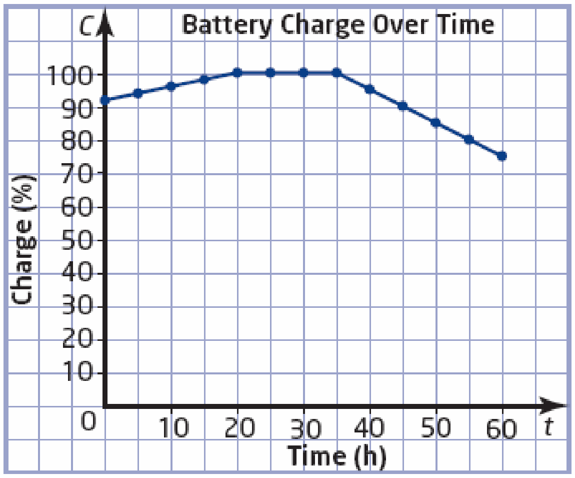
The time required for the sound to travel from Jenny to the wall of the canyon is $\frac{1.4}{2}$, or 0.7 s.

$$\begin{aligned} d &= vt \\ &= 325 \times 0.7 \\ &= 227.5 \end{aligned}$$

The wall of the canyon is 227.5 m from Jenny.

Chapter 5 Section 2 Question 14 Page 253

a)



b) In each case, *C* is the charge as a percent and *t* is the time, in hours.

From 0 to 20 h, the constant of variation is $\frac{94-92}{5-0}=0.4$. The equation is $C=0.4t+92$.
From 20 to 35 h, there is no change. The equation is $C=100$.
For 35 h and more, the constant of variation is $\frac{90-95}{40-35}=-1$. The equation is $C=-t+135$.

c) i) $C=0.4(12)+92$
$=96.8$

The charge remaining after 12 h was 96.8%.

ii) The charge remaining after 26 h was 100%.

iii) $C=-(71)+135$
$=64$

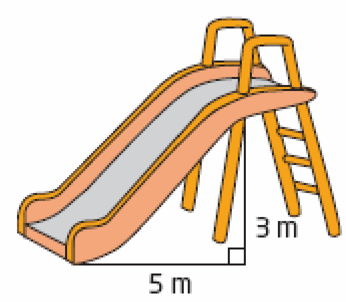
The charge remaining after 71 h was 64%.

Chapter 5 Section 3 Slope

Chapter 5 Section 3 Question 1 Page 259

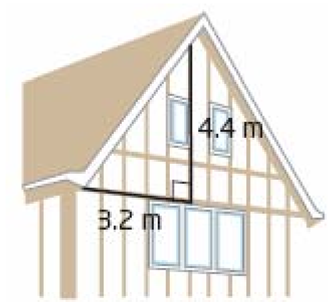
a)
$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{3}{5} \\ &= 0.6 \end{aligned}$$

The slope is 0.6.



b)
$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{4.4}{3.2} \\ &= 1.375 \end{aligned}$$

The slope is 1.375.



Chapter 5 Section 3 Question 2 Page 259

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{2.5}{152} \\ &\doteq 0.02 \end{aligned}$$

The slope, to the nearest hundredth, is 0.02.

Chapter 5 Section 3 Question 3 Page 259

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{1.4}{8} \\ &= 0.175 \end{aligned}$$

The slope of the ramp is 0.175, which does not satisfy the safety regulation of no more than 0.08.

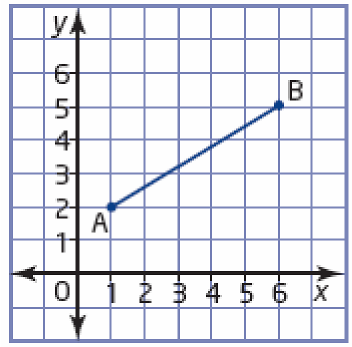
Chapter 5 Section 3 Question 4 Page 259

a) $m = \frac{\text{rise}}{\text{run}}$

$= \frac{3}{5}$

$= 0.6$

The slope is 0.6.

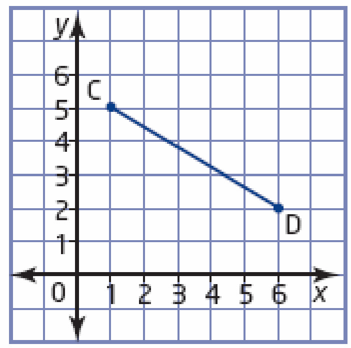


b) $m = \frac{\text{rise}}{\text{run}}$

$= \frac{-3}{5}$

$= -0.6$

The slope is –0.6.



Chapter 5 Section 3 Question 5 Page 259

a) $m_{AB} = \frac{\text{rise}}{\text{run}}$

$= \frac{1}{3}$

b) $m_{CD} = \frac{\text{rise}}{\text{run}}$

$= \frac{3}{6}$

$= \frac{1}{2}$ or 0.5

c) $m_{EF} = \frac{\text{rise}}{\text{run}}$

$= \frac{-5}{2}$

$= -2.5$

d) $m_{GH} = \frac{\text{rise}}{\text{run}}$

$= \frac{0}{5}$

$= 0$

e) $m_{IJ} = \frac{\text{rise}}{\text{run}}$

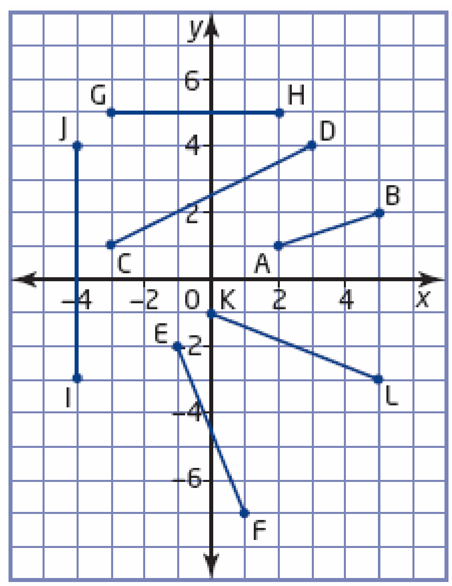
$= \frac{7}{0}$

Undefined

f) $m_{KL} = \frac{\text{rise}}{\text{run}}$

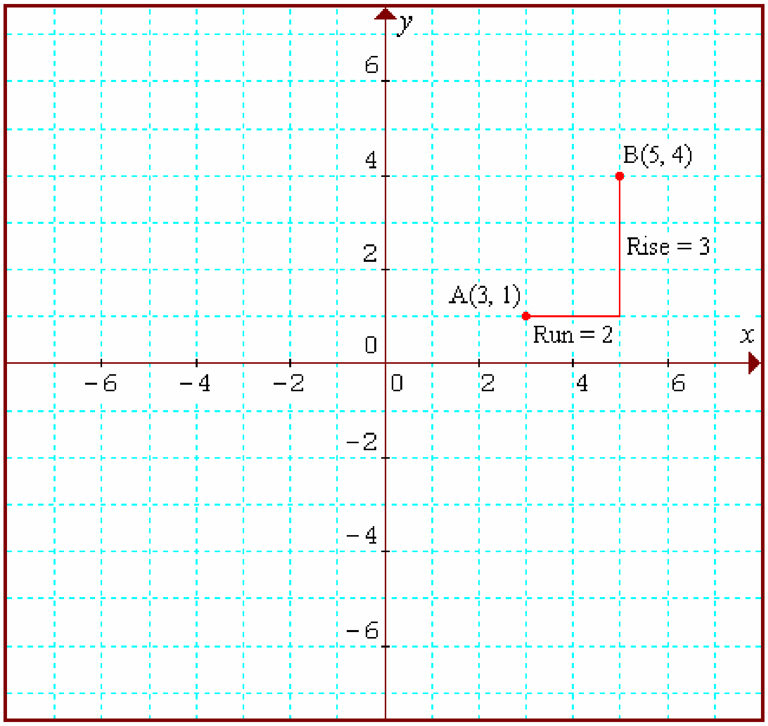
$= \frac{-2}{5}$

$= -0.4$



Chapter 5 Section 3 **Question 6** **Page 260**

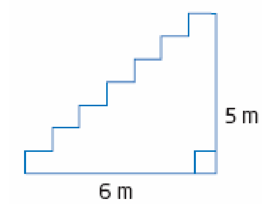
Answers for the coordinates of point B will vary. A sample answer is shown.



Chapter 5 Section 3 **Question 7** **Page 260**

If the slope is $-\frac{3}{4}$, the run is 4 and the rise is –3. Possible coordinates for B are (6 + 4, –2 + (–3)), or (10, –5). Answers will vary.

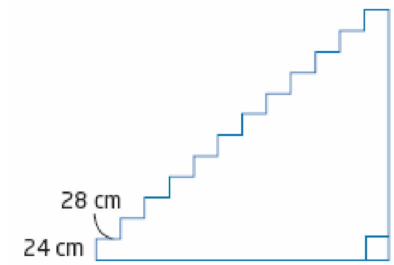
Chapter 5 Section 3 Question 8 Page 260



a)

$$m = \frac{\text{rise}}{\text{run}}$$
$$= \frac{5}{6}$$
$$= 0.8\dot{3}$$

The slope is $0.8\dot{3}$. This is outside the safety range of 0.58 to 0.70.



b)

$$m = \frac{\text{rise}}{\text{run}}$$
$$= \frac{24}{28}$$
$$\doteq 0.86$$

The slope is about 0.86. This is outside the safety range of 0.58 to 0.70.

Chapter 5 Section 3 Question 9 Page 260

Answers will vary. Sample answers are shown.

a) If the slope is $\frac{2}{3}$, the run is 3 and the rise is 2. Possible coordinates for B are $\left(-2+3,5+2\right)$ or $\left(1,7\right)$.

b) If the slope is $-\frac{2}{3}$, the run is 3 and the rise is –2. Possible coordinates for B are $\left(-2+3,5-2\right)$ or $\left(1,3\right)$.

c) If the slope is 4, the run is 1 and the rise is 4. Possible coordinates for B are $\left(-2+1,5+4\right)$ or $\left(-1,9\right)$.

d) If the slope is -3, the run is 1 and the rise is –3. Possible coordinates for B are $\left(-2+1,5-3\right)$ or $\left(-1,2\right)$.

e) If the slope is 0, the run is 1 and the rise is 0. Possible coordinates for B are $\left(-2+1,5+0\right)$ or $\left(-1,5\right)$.

f) If the slope is undefined, the line is vertical. Possible coordinates for B are $\left(-2+0,5+1\right)$ or $\left(-2,6\right)$.

Chapter 5 Section 3 Question 10 Page 260

Let *b* represent the length of the vertical brace.

First brace:	*b*:1 = 3:5	*b* = 0.6 m.
Second brace:	*b*:2 = 3:5	*b* = 1.2 m.
Third brace:	*b*:3 = 3:5	*b* = 1.8 m.
Fourth brace:	*b*:4 = 3:5	*b* = 2.4 m.

Chapter 5 Section 3 Question 11 Page 260

a) $m = \frac{\text{rise}}{\text{run}}$

$= \frac{21}{500}$

$= .042$

$= 4.2\%$

The grade of the road is 4.2%.

b) Let *y* represent the required rise.

$$0.03 = \frac{y}{600}$$

$$600 \times 0.03 = 600 \times \frac{y}{600}$$

$$18 = y$$

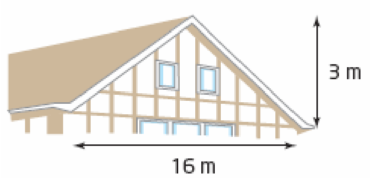
The road must rise 18 m over a run of 600 m to have a grade of 3%.

Chapter 5 Section 3 Question 12 Page 261

Classification	Pitch
Shallow	$m \le \frac{3}{12}$
Medium	$\frac{3}{12} < m \le \frac{6}{12}$
Steep	$m > \frac{6}{12}$

a) i)

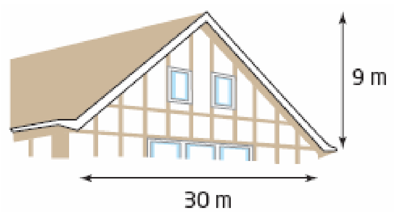
$$m = \frac{\text{rise}}{\text{run}} = \frac{3}{8} = 0.375$$



The slope of 0.375 is more than $\frac{3}{12} = 0.25$ but less than $\frac{6}{12} = 0.5$. The pitch is medium.

ii)

$$m = \frac{\text{rise}}{\text{run}} = \frac{9}{15} = 0.6$$



The slope of 0.6 is more than $\frac{6}{12} = 0.5$. The pitch is steep.

b) If the roof is 10 m wide, the run is 5 m. Let *y* represent the height.

$$\frac{5}{12} = \frac{y}{5}$$
$$60 \times \frac{5}{12} = 60 \times \frac{y}{5}$$
$$25 = 12y$$
$$\frac{25}{12} = \frac{12y}{12}$$
$$2.1 \doteq y$$

The height of the roof is about 2.1 m.

Chapter 5 Section 3 Question 13 Page 261

The two ramps have the same slope. If the rise is double, the run must be doubled as well. Otherwise, the slopes will be different.

Chapter 5 Section 3 Question 14 Page 261

The rise is 52 – 41 = 11 m. The run is 7 m.

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{11}{7} \\ &\doteq 1.6 \end{aligned}$$

The slope is about 1.6.

Chapter 5 Section 3 Question 15 Page 261

The rise is 8 m. Let x represent the run.

$$\begin{aligned} 6.3 &= \frac{8}{x} \\ x \times 6.3 &= x \times \frac{8}{x} \\ 6.3x &= 8 \\ \frac{6.3x}{6.3} &= \frac{8}{6.3} \\ x &\doteq 1.27 \end{aligned}$$

The maximum distance from the foot of the ladder to the wall is about 1.27 m.

$$\begin{aligned} 9.5 &= \frac{8}{x} \\ x \times 9.5 &= x \times \frac{8}{x} \\ 9.5x &= 8 \\ \frac{9.5x}{9.5} &= \frac{8}{9.5} \\ x &\doteq 0.84 \end{aligned}$$

The minimum distance from the foot of the ladder to the wall is about 0.84 m.

Chapter 5 Section 3 Question 16 Page 261

The run is 115 m for a rise of 147 m.

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{147}{115} \\ &\doteq 1.3 \end{aligned}$$

The slope is 1.3, which is almost twice as steep as a staircase with a slope of 0.7.

Chapter 5 Section 3 Question 17 Page 262

The run is 27.5 m for a rise of 18 m.

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{18}{27.5} \\ &\doteq 0.65 \end{aligned}$$

The slope is 0.65, which is about half as steep as the pyramid of Cheops with a slope of 1.3.

Chapter 5 Section 3 Question 18 Page 262

Let x represent the horizontal run.

$$
\begin{aligned}
0.09 &= \frac{10}{x} \\
x \times 0.09 &= x \times \frac{10}{x} \\
0.09x &= 10 \\
\frac{0.09x}{0.09} &= \frac{10}{0.09} \\
x &\doteq 111.1
\end{aligned}
$$

For a run of more than 111.1 m, the hill is easy.

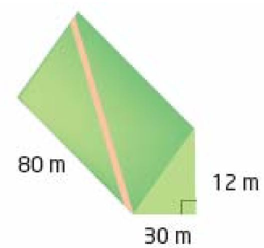
$$
\begin{aligned}
0.18 &= \frac{10}{x} \\
x \times 0.18 &= x \times \frac{10}{x} \\
0.18x &= 10 \\
\frac{0.18x}{0.18} &= \frac{10}{0.18} \\
x &\doteq 55.6
\end{aligned}
$$

For a run of 55.6 m to 111.1 m, the hill is intermediate.

For a run of less than 55.6 m, the hill is difficult.

Chapter 5 Section 3 Question 19 Page 262

Let x represent the run of the trail.



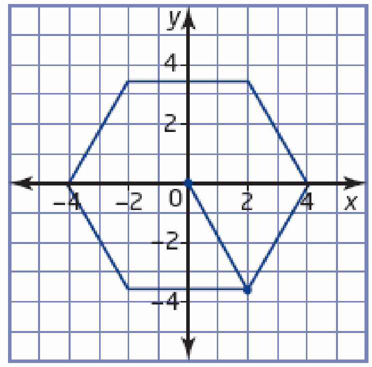
$$
\begin{aligned}
x^2 &= 30^2 + 80^2 \\
x^2 &= 900 + 6400 \\
x^2 &= 7300 \\
\sqrt{x^2} &= \sqrt{7300} \\
x &\doteq 85.4
\end{aligned}
$$

The hiking trail has a rise of 12 m and a run of about 85.4 m.

$$
\begin{aligned}
m &= \frac{\text{rise}}{\text{run}} \\
&\doteq \frac{12}{85.4} \\
&\doteq 0.14
\end{aligned}
$$

The slope of the trail is about 0.14.

Chapter 5 Section 3 Question 20 Page 262



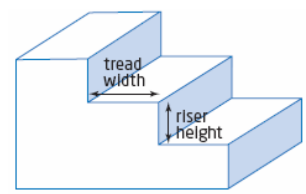
From the diagram, each side of the hexagon measures 4 units. Let *y* represent the rise. The run is 2 units.

$$
\begin{aligned}
4^2 &= 2^2 + y^2 \\
16 &= 4 + y^2 \\
16 - 4 &= 4 + y^2 - 4 \\
12 &= y^2 \\
\sqrt{12} &= \sqrt{y^2} \\
-3.46 &\doteq y
\end{aligned}
$$

$$
\begin{aligned}
m &= \frac{\text{rise}}{\text{run}} \\
&= \frac{-3.46}{2} \\
&= -1.73
\end{aligned}
$$

The slope is −1.73.

Chapter 5 Section 3 Question 21 Page 263

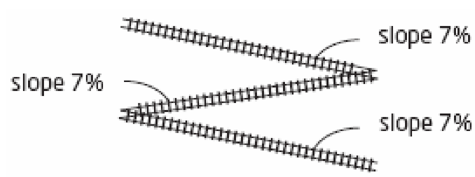


a) Answers will vary. A sample answer is shown.

Suppose that one set of stairs has a slope of 0.62 and another has a slope of 0.70. Both sets of stairs are safe, but the set of stairs with the more gradual slope is safer.

b) Answers will vary.

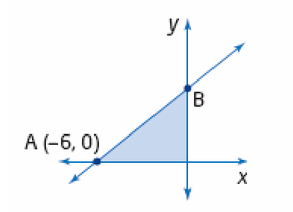
Chapter 5 Section 3 Question 22 Page 263



Answers will vary. A sample answer is shown.

Suppose that there are 5 switchbacks. There needs to be an odd number of switchbacks for the train to end up going in the correct direction. If the run is 1 km, then the slope of each switchback would be $50 \div 1000 = 0.05$ or 5%, which is less than 7%, as required.

Chapter 5 Section 3 Question 23 Page 263



The base of the triangle measures 6 units. Use the formula for the area of a triangle to find the height.

$$12 = \frac{1}{2}bh$$
$$12 = \frac{1}{2} \times 6 \times h$$
$$12 = 3h$$
$$\frac{12}{3} = \frac{3h}{3}$$
$$4 = h$$

$$m = \frac{\text{rise}}{\text{run}}$$
$$= \frac{4}{6}$$
$$= \frac{2}{3}$$

Answer D.

Chapter 5 Section 4 Slope as a Rate of Change

Chapter 5 Section 4 Question 1 Page 268

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{37}{5} \\ &= 7.4 \end{aligned}$$

The rate of change is 7.4 L/min.

Chapter 5 Section 4 Question 2 Page 268

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{7200}{24} \\ &= 300 \end{aligned}$$

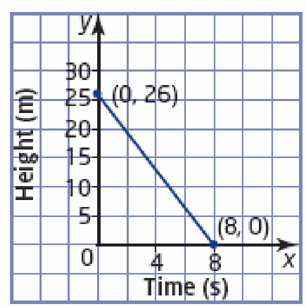
The rate of change is 300 L/h.

Chapter 5 Section 4 Question 3 Page 268

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{1800}{30} \\ &= 60 \end{aligned}$$

The rate of change is 60 flaps/s.

Chapter 5 Section 4 Question 4 Page 268

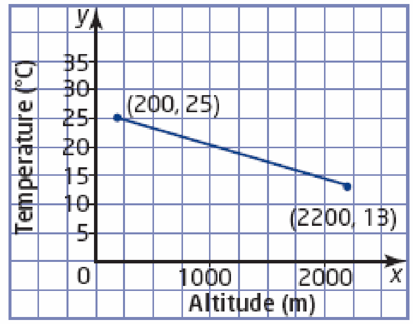


a)
$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{0-26}{8-0} \\ &= \frac{-26}{8} \\ &= -3.25 \end{aligned}$$

The slope is –3.25.

b) The height decreases at a rate of 3.25 m/s.

Chapter 5 Section 4 **Question 5** **Page 268**



a)
$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{13-25}{2200-200} \\ &= \frac{-12}{2000} \\ &= -0.006 \end{aligned}$$

The slope is –0.006.

b) The temperature decreases by 0.006°C/m.

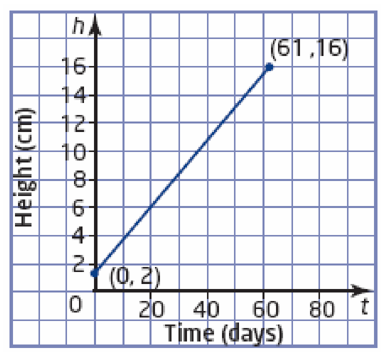
Chapter 5 Section 4 **Question 6** **Page 268**

The rise is 1.78 – 1.45 = 0.33, and the run is 2006 – 2003 = 3.

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{0.33}{3} \\ &= 0.11 \end{aligned}$$

The rate of change is 11¢/year.

Chapter 5 Section 4 **Question 7** **Page 268**



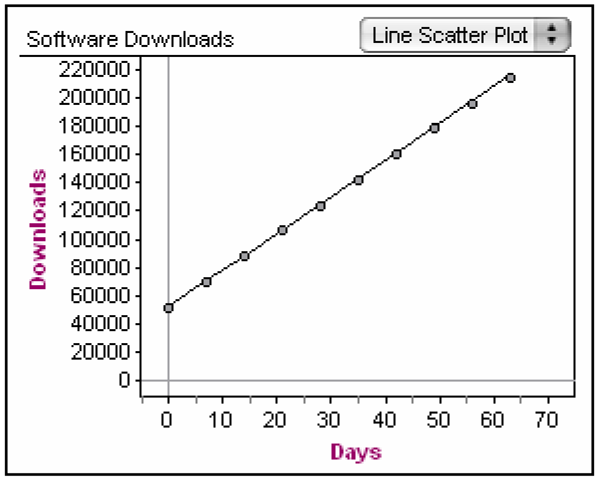
$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{16-2}{61-0} \\ &= \frac{14}{61} \\ &\doteq 0.23 \end{aligned}$$

The rate of change is 0.23 cm/day.

Chapter 5 Section 4 Question 8 Page 269

a)

Date	Downloads
Sept 3	52 000
Sept 10	70 000
Sept 17	88 000
Sept 24	106 000
Oct 1	124 000
Oct 8	142 000
Oct 15	160 000
Oct 22	178 000
Oct 29	196 000
Nov 5	214 000



b) Use the points (0, 52 000) and (63, 214 000).

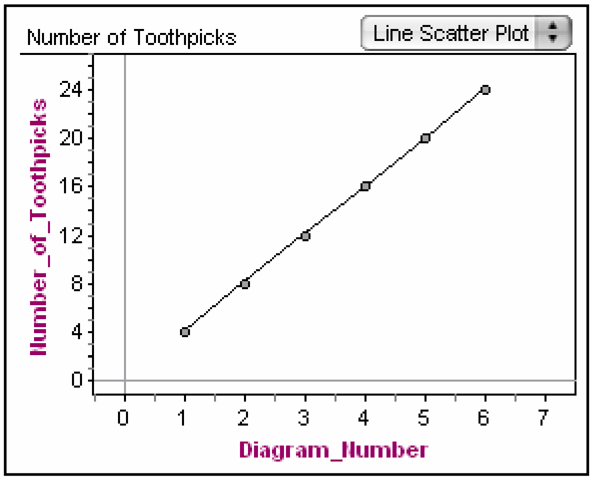
$$
\begin{aligned}
m &= \frac{\text{rise}}{\text{run}} \\
&= \frac{214\,000 - 52\,000}{63} \\
&= \frac{162\,000}{63} \\
&\doteq 2571
\end{aligned}
$$

The rate of change is about 2571 downloads/day.

c) The software is popular. The number of downloads continues to increase.

Chapter 5 Section 4 **Question 9** **Page 269**

a)



b) Use the points (1. 4) and (6, 24).

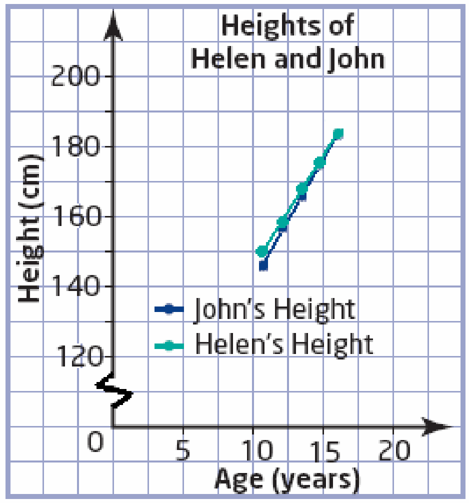
$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{24-4}{6-1} \\ &= \frac{20}{5} \\ &= 4 \end{aligned}$$

The slope is 4.

c) The rate of change is 4 toothpicks/diagram.

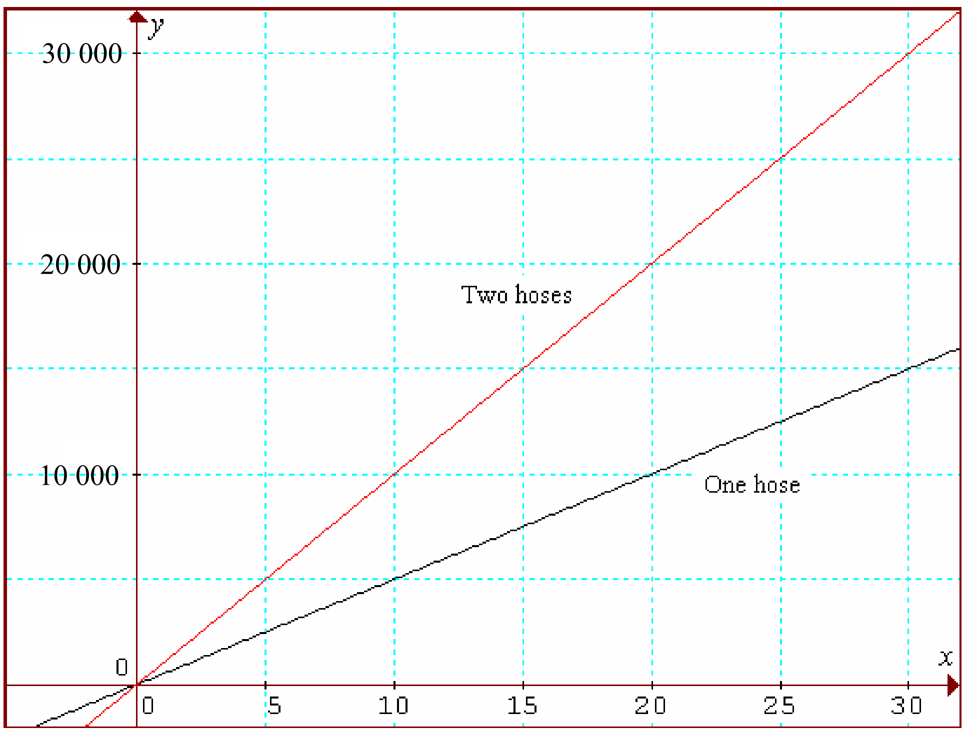
Chapter 5 Section 4 **Question 10** **Page 269**

Helen is 4 cm taller than John at age 12. John grows one more cm per year than Helen. Helen and John can expect their heights to be the same in 4 years, at age 16.



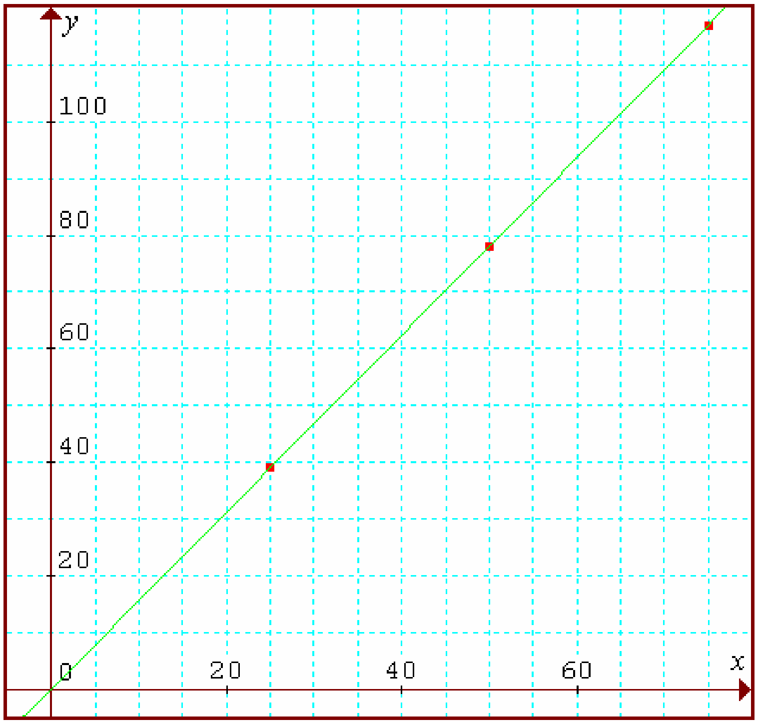
Chapter 5 Section 4 **Question 11** **Page 269**

a)



b) If two hoses are used, the graph will be steeper. It will have twice the slope.

a)



b) Use the points (25, 39) and (75, 117).

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{117-39}{75-25} \\ &= \frac{78}{50} \\ &= 1.56 \end{aligned}$$

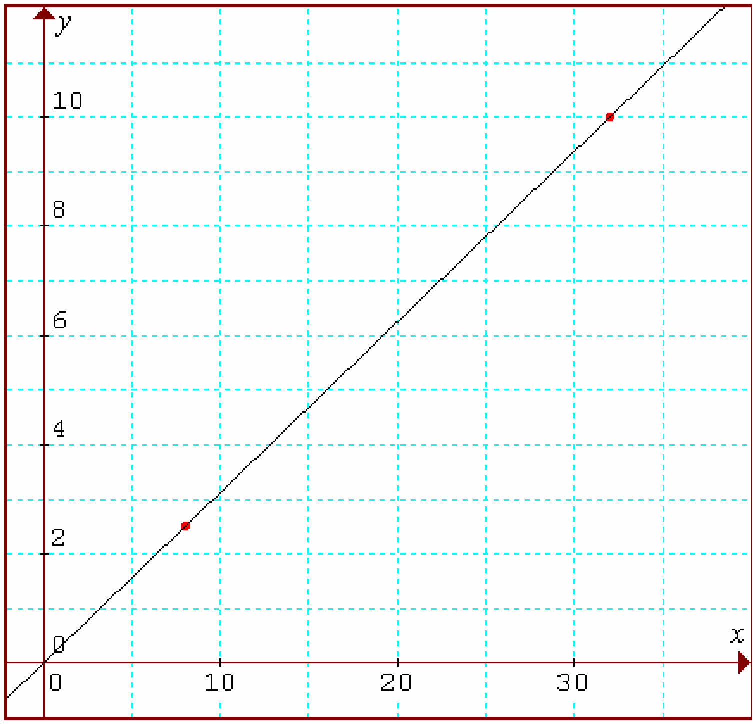
The rate of change is 1.56 L/m^2.

c) The amount of water need for a floor area of 140 m^2 is 1.56 × 140, or 218.4 L.

If the fire truck is pumping water at a rate of 200 L/min, the time required is $\frac{218.4}{200}$, or about 1.1 min.

Chapter 5 Section 4 Question 13 Page 270

a)



b) If it takes 8 s to fill the balloon to 2.5 L, it will take $\frac{10}{2.5} = 4$ times as long to fill to 10 L, or 32 s.

Chapter 5 Section 4 Question 14 Page 270

a) Car A:

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{360}{6} \\ &= 60 \end{aligned}$$

Car B:

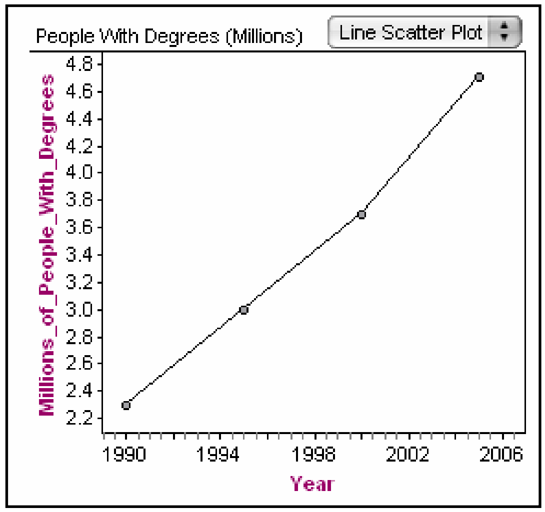
$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{480}{5} \\ &= 96 \end{aligned}$$

Car A has a speed of 60 km/h, while car B has a speed of 96 km/h. Car B is faster by 36 km/h.

b) The point of intersection of the two lines represents the time at which the two cars have travelled the same distance. If they are travelling in the same direction, it is the time at which Car B passes Car A.

Chapter 5 Section 4 Question 15 Page 270

a) The graph is shown.



b) The rate of change was relatively constant from 1990 to 2000.

c) The rate of change was different from 2000 to 2005. The rate of change increased.

Chapter 5 Section 4 Question 16 Page 270

a) In one minute, the diver will use 15×0.002, or 0.03 m^3 of air.

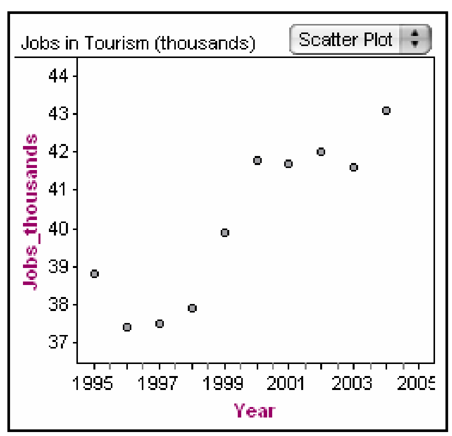
b) At this rate, the air will last $\frac{2.6}{0.03}$, or about 87 min.

c) The diver is using the air twice as fast. It will last $\frac{87}{2} = 43.5$ min.

d) The diver is using the air five times as fast. It will last $\frac{87}{5}$, or about 17 min.

Chapter 5 Section 4 Question 17 Page 271

a) The rate of change is not constant over the 10-year period.



b) Answers will vary. A sample answer is shown.

The rates of change are large because the number of jobs increased by about 4300, or 11%, which is a significant amount.

Chapter 5 Section 4 Question 18 Page 271

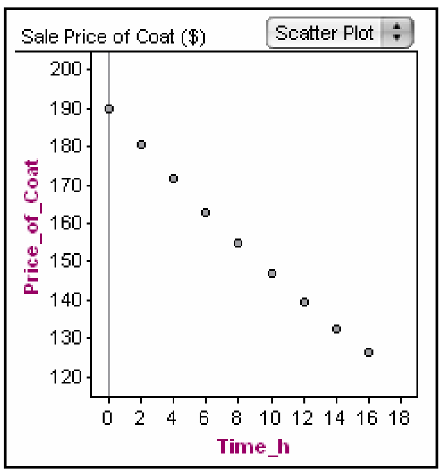
Solutions for the Achievement Checks are shown in the Teacher's Resource.

Chapter 5 Section 4 Question 19 Page 271

a)

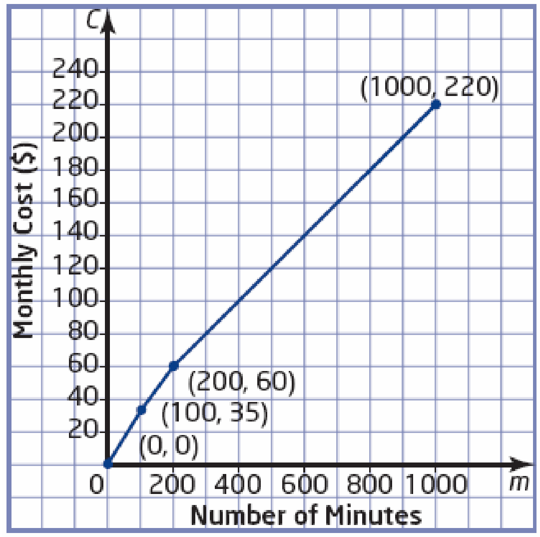
Time (h)	Price of Coat ($)
0	190.00
2	180.50
4	171.48
6	162.90
8	154.76
10	147.02
12	139.67
14	132.68
16	126.05

b)



c) The graph is decreasing. It is curved because the rate of change changes at each interval.

Chapter 5 Section 4 Question 20 Page 271



From 0 min to 100 min:

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{35-0}{100-0} \\ &= \frac{35}{100} \\ &= 0.35 \end{aligned}$$

From 0 to 100 min, the charge is 35¢/min.

From 100 min to 200 min:

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{60-35}{200-100} \\ &= \frac{25}{100} \\ &= 0.25 \end{aligned}$$

From 100 min to 200 min, the charge is 25¢/min.

For 200 min to 1000 min:

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{220-60}{1000-200} \\ &= \frac{160}{800} \\ &= 0.20 \end{aligned}$$

For 200 min to 1000 min the charge is 20¢/min.

Chapter 5 Section 5 First Differences

Chapter 5 Section 5 Question 1 Page 275

a) The relation is linear. The highest power of *x* is 1.

b) The relation is linear. The highest power of *x* is 1.

c) The relation is non-linear. The highest power of *x* is 2.

d) The relation is non-linear. *x* is used as an exponent.

e) The relation is linear. The highest power of *x* is 1.

f) The relation is non-linear. *x* appears in the denominator.

Chapter 5 Section 5 Question 2 Page 276

a)

x	*y*	First Differences
0	5	
1	6	1
2	8	2
3	12	4

The first differences are not constant.
The relation is non-linear.

b)

x	*y*	First Differences
3	-4	
4	-1	3
5	2	3
6	5	3

The first differences are constant.
The relation is linear.

c)

x	*y*	First Differences
-1	1	
0	0	-1
1	1	1
2	4	3

The first differences are not constant.
The relation is non-linear.

d)

x	*y*	First Differences
-5	8	
-3	4	-4
-1	0	-4
3	-4	-4

The first differences are constant.
The relation is linear.

Chapter 5 Section 5 Question 3 Page 276

a)

Time (s)	Speed (m/s)	First Differences
0	0.0	
1	9.8	9.8
2	19.6	9.8
3	29.4	9.8
4	39.2	9.8
5	49.0	9.8

The first differences are constant. The relation is linear.

b)

Time (s)	Speed (m/s)	First Differences
0	0.0	
1	9.6	9.6
2	16.6	7.0
3	23.1	6.5
4	30.8	7.7
5	34.2	3.4

The first differences are not constant. The relation is non-linear.

Chapter 5 Section 5 Question 4 Page 276

a)

Number of Houses	Number of Segments	First Differences
1	6	
2	11	5
3	16	5
4	21	5
5	26	5
6	31	5
7	36	5

The first differences are constant. The relation is linear.

Let *h* represent the number of houses, and let *S* represent the number of segments.

$S = 5h + 1$

The seventh step results in 36 segments.

b)

Base Side Length	Total Number of Tiles	First Differences
1	1	
2	4	3
3	9	5
4	16	7
5	25	9
6	36	11
7	49	13

The first differences are not constant. The relation is non-linear.

Chapter 5 Section 5 Question 5 Page 277

a)

Number of Circles	Number of Intersection Points	First Differences
1	0	
2	2	2
3	4	2
4	6	2
5	8	2
6	10	2
7	12	2

The first differences are constant. The relation is linear.

Let *c* represent the number of circles, and let *I* represent the number of intersection points.

$I = 2c - 2$

The seventh step results in 12 intersection points.

b)

Number of Sides	Number of Diagonals	First Differences
4	2	
5	5	3
6	9	4
7	14	5
8	20	6
9	27	7
10	35	8

The first differences are not constant. The relation is non-linear.

Chapter 5 Section 5 Question 6 Page 277

a)

Diagram Number	Number of Toothpicks	First Differences
1	4	
2	7	3
3	10	3
4	13	3
5	16	3
6	19	3
7	22	3
8	25	3
9	28	3
10	31	3

b) The first differences are constant. The relation is linear.

c) Let *d* represent the diagram number, and let *T* represent the number of toothpicks.

$T = 3d + 1$

d) The tenth step results in 31 toothpicks.

Chapter 5 Section 5 Question 7 Page 277

a)

Height (cm)	Wet Area (cm^2)	First Differences
0	0	
1	16	16
2	32	16
3	48	16
4	64	16
5	80	16
6	96	16
7	112	16
8	128	16
9	144	16
10	160	16

b) The first differences are constant. The relation is linear.

c) To obtain the wet area, multiply the height by 16. For a height of 50 cm, the wet area is 50×16, or 800 cm^2.

Chapter 5 Section 5 Question 8 Page 278

a)

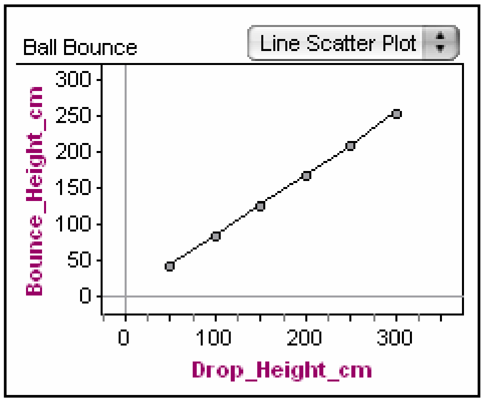
Height (cm)	Painted Area (cm^2)	First Differences
0	0	
1	1	1
2	4	3
3	9	5
4	16	7
5	25	9
6	36	11
7	49	13
8	64	15
9	81	17
10	100	19

b) The first differences are not constant. The relation is non-linear.

Chapter 5 Section 5 Question 9 Page 278

Drop Height (cm)	Bounce Height (cm)	First Differences
50	41	
100	82	41
150	125	43
200	166	41
250	208	42
300	254	46

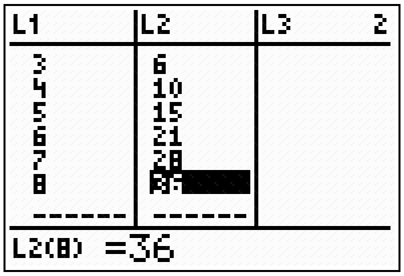
The first differences are not constant. The relation is non-linear.



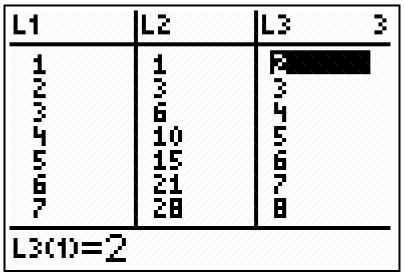
The points do not fall on a straight line. The relation is non-linear.

Chapter 5 Section 5 Question 10 Page 278

a)



b)



L3 contains the first differences. The first differences increase by adding 1.

Let C represent the number of circles, and let n represent the figure number.

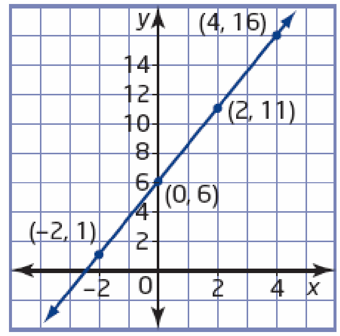
Try $C = n(n+1)$. This creates the sequence 2, 6, 12, 20,… . Note that each number is double the desired sequence.

Try $C = \frac{1}{2}n(n+1)$. This creates the desired sequence.

Chapter 5 Section 6 Connecting Variation, Slope, and First Differences

Chapter 5 Section 6 Question 1 Page 284

a) Use $(x_1, y_1) = (-2, 1)$ and $(x_2, y_2) = (4, 16)$.



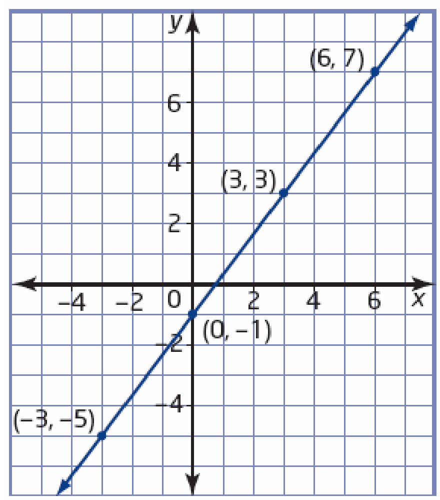
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{16 - 1}{4 - (-2)}$$
$$= \frac{15}{6}$$
$$= \frac{5}{2}$$

b) From the graph, the vertical intercept is 6.

c) The equation of the relation is $y = \frac{5}{2}x + 6$.

Chapter 5 Section 6 Question 2 Page 284

a) Use $(x_1, y_1) = (-3, -5)$ and $(x_2, y_2) = (6, 7)$.



$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{7 - (-5)}{6 - (-3)}$$
$$= \frac{12}{9}$$
$$= \frac{4}{3}$$

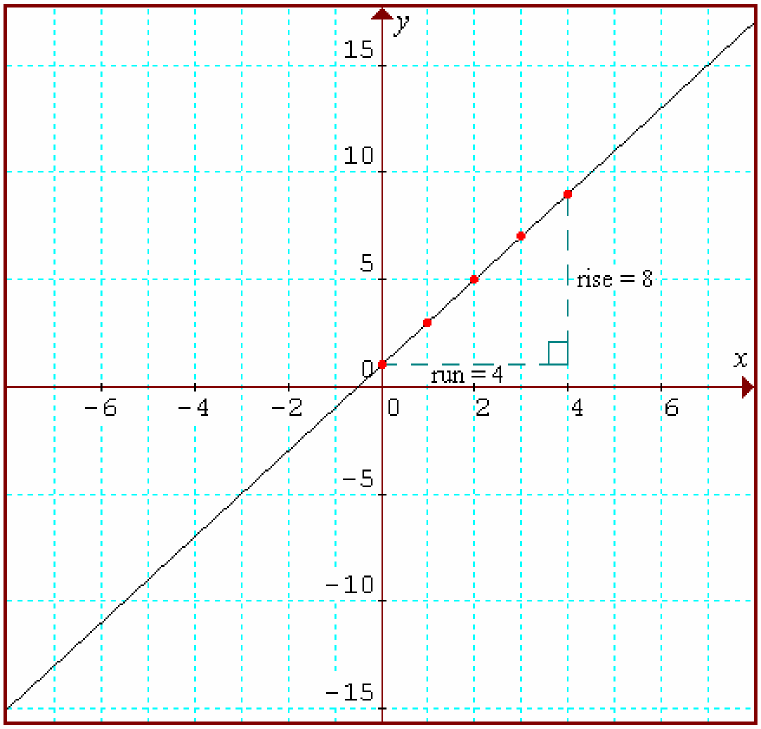
b) From the graph, the vertical intercept is –1.

c) The equation of the relation is $y = \frac{4}{3}x - 1$.

Chapter 5 Section 6 Question 3 Page 285

a)

x	y
0	1
1	3
2	5
3	7
4	9

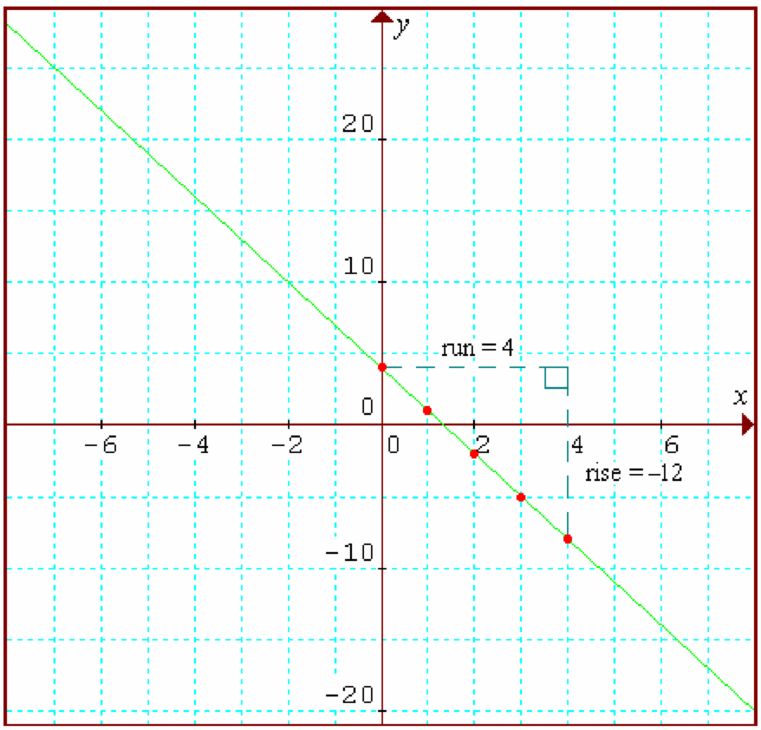


$$m = \frac{\text{rise}}{\text{run}}$$
$$= \frac{8}{4}$$
$$= 2$$

The slope is 2.

b)

x	y
0	4
1	1
2	−2
3	−5
4	−8

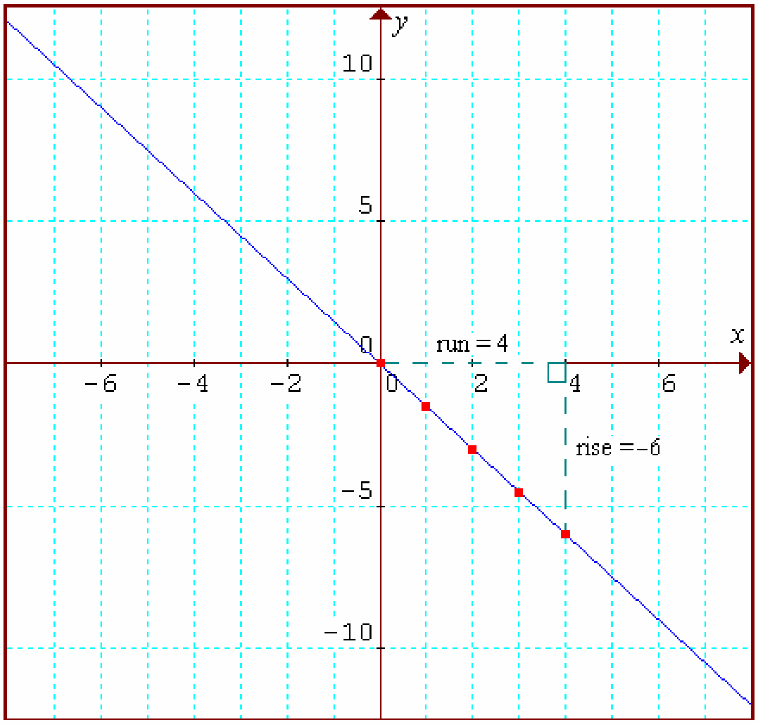


$$m = \frac{\text{rise}}{\text{run}}$$
$$= \frac{-12}{4}$$
$$= -3$$

The slope is –3.

c)

x	y
0	0.0
1	–1.5
2	–3.0
3	–4.5
4	–6.0

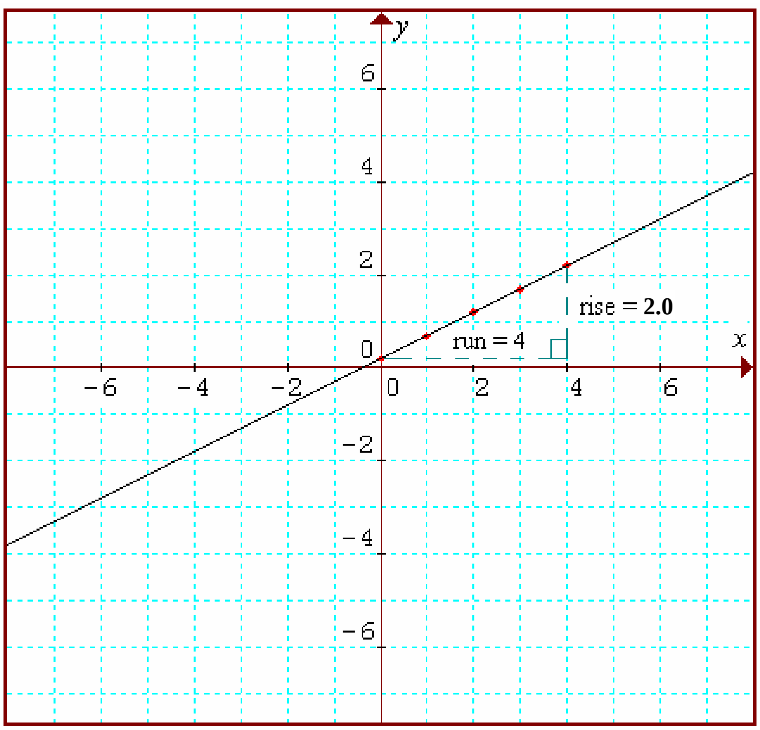


$$m = \frac{\text{rise}}{\text{run}}$$
$$= \frac{-6}{4}$$
$$= -\frac{3}{2}$$

The slope is $-\frac{3}{2}$.

d)

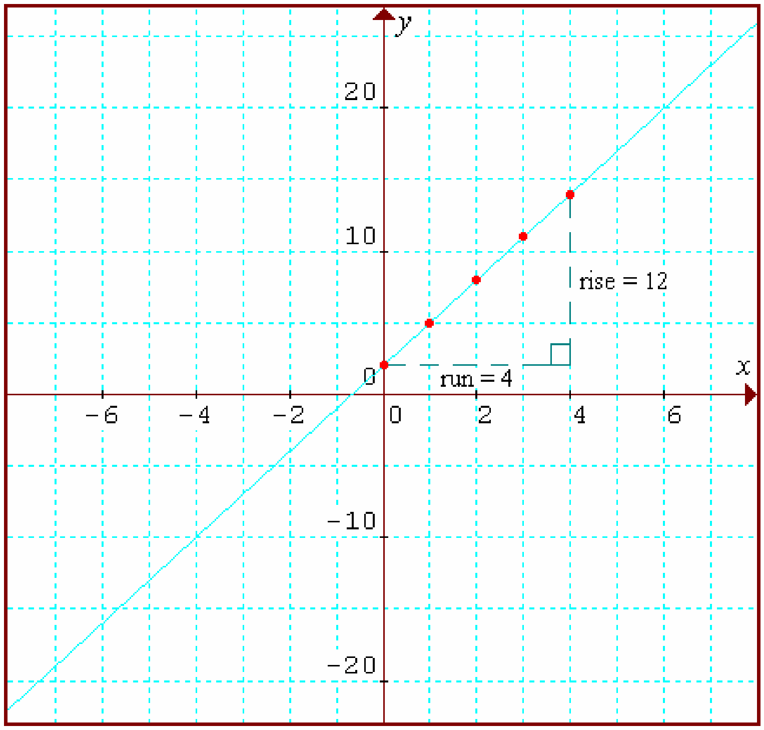
x	y
0	0.2
1	0.7
2	1.2
3	1.7
4	2.2



$$m = \frac{\text{rise}}{\text{run}}$$
$$= \frac{2.0}{4}$$
$$= 0.5$$

The slope is 0.5.

x	y
0	2
1	5
2	8
3	11
4	14



a) The graph is shown.

b) Each time the value of *x* increases by 1, the value of *y* increases by 3. The graph is a straight line that does not pass through (0, 0). This is a partial variation.

c)

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{12}{4} \\ &= 3 \end{aligned}$$

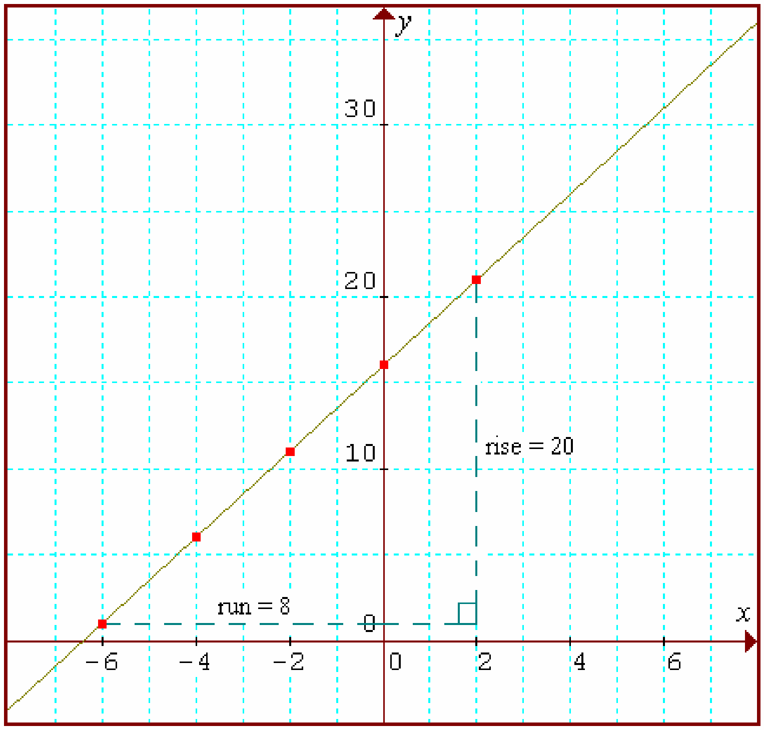
The slope is 3.

The vertical intercept is 2.

The equation is $y = 3x + 2$.

Chapter 5 Section 6 **Question 5** **Page 285**

x	y
−6	1
−4	6
−2	11
0	16
2	21



a) The graph is shown.

b) Each time the value of x increases by 2, the value of y increases by 5. The graph is a straight line that does not pass through (0, 0). This is a partial variation.

c)

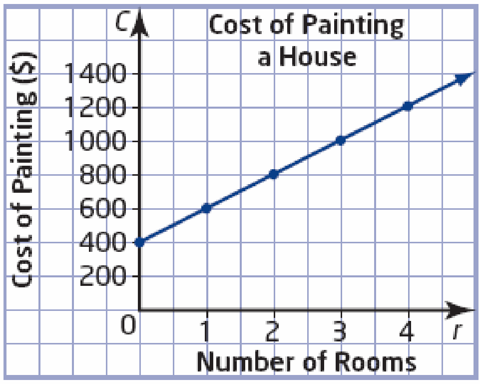
$$m = \frac{\text{rise}}{\text{run}}$$
$$= \frac{20}{8}$$
$$= \frac{5}{2}$$

The slope is $\frac{5}{2}$.

The vertical intercept is 16.

The equation is $y = \frac{5}{2}x + 16$.

Chapter 5 Section 6 Question 6 Page 285



Number of Rooms, r	Cost of Painting, C ($)
0	400
1	600
2	800
3	1000
4	1200

Let C represent the cost, and r represent the number of rooms.

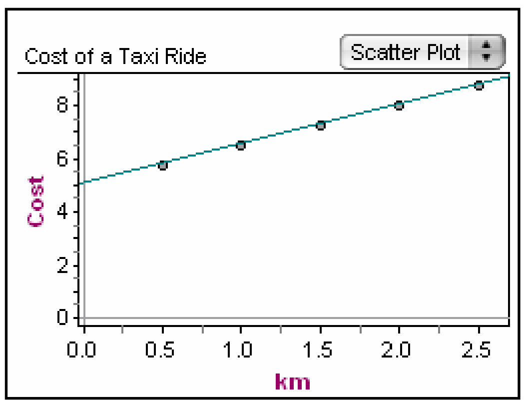
$C = 200r + 400$

Chapter 5 Section 6 Question 7 Page 285

a)

km	Cost
0.5	5.75
1.0	6.5
1.5	7.25
2.0	8
2.5	8.75

Click here to load the Fathom® file.



b) Use $(x_1, y_1) = (0.5, 5.75)$ and $(x_2, y_2) = (2.5, 8.75)$.

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{8.75 - 5.75}{2.5 - 0.5} \\ &= \frac{3.00}{2.0} \\ &= 1.5 \end{aligned}$$

The slope is 1.5. This represents the variable cost of $1.50 per km.

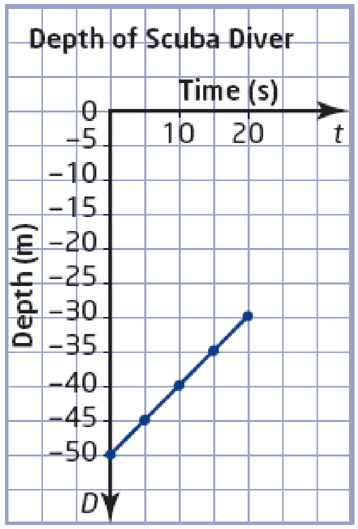
The vertical intercept is 5.00. This represents the fixed cost of $5.00.

c) This is a partial variation. The graph is a straight line that does not pass through (0, 0).

d) Let C represent the cost, and d represent the number of kilometres.

The equation is $C = 1.5d + 5.00$.

Time (s)	Depth (m)
0	−50
5	−45
10	−40
15	−35
20	−30



Each second, the scuba diver swims 1 m toward the surface of the water.

The rise is 20, and the run is 20.

$$m = \frac{\text{rise}}{\text{run}}$$
$$= \frac{20}{20}$$
$$= 1$$

The slope is 1, and the vertical intercept is –50. Let *D* represent the depth, in metres, and *t* represent the time, in seconds.

$$D = t - 50$$

Chapter 5 Section 6 Question 9 Page 286

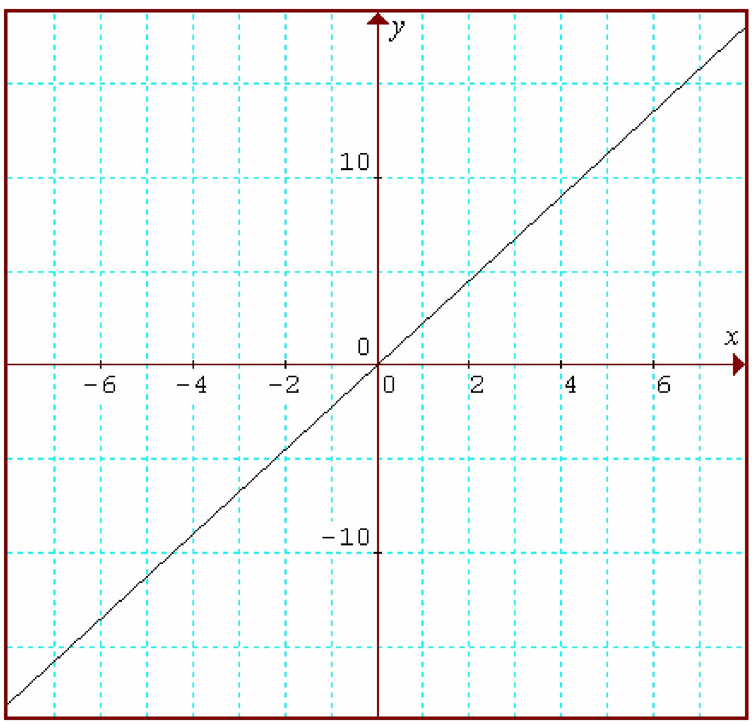
a) Since the variation is direct, the graph passes through (0, 0).
Use $(x_1, y_1) = (0, 0)$ and $(x_2, y_2) = (4, 9)$.

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{9-0}{4-0}$$
$$= \frac{9}{4}$$

The slope is $\frac{9}{4}$. The vertical intercept is 0.

b) The equation is $y = \frac{9}{4}x$.

c)



Chapter 5 Section 6 Question 10 Page 286

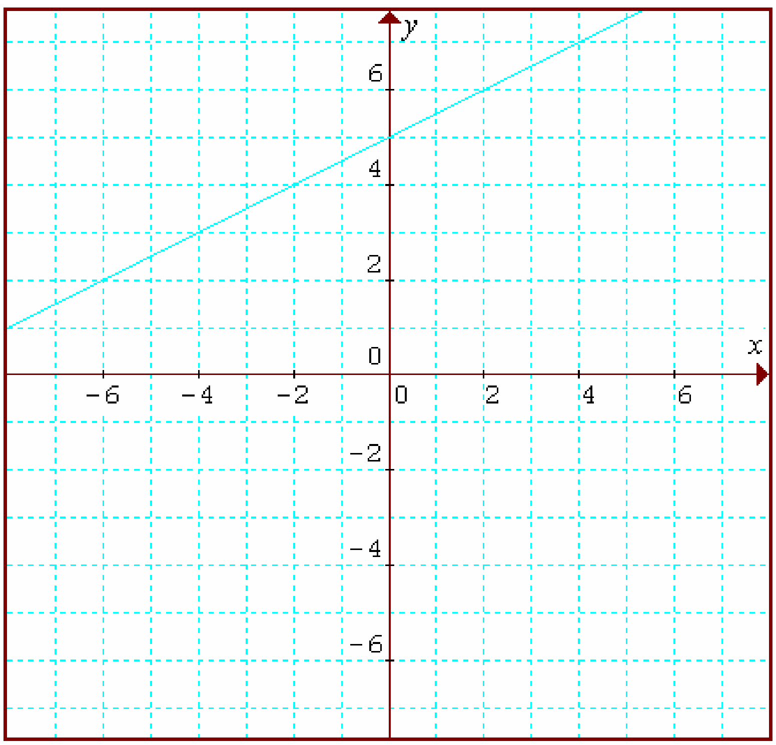
a) Use $(x_1, y_1) = (0, 5)$ and $(x_2, y_2) = (6, 8)$.

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{8 - 5}{6 - 0}$$
$$= \frac{3}{6}$$
$$= \frac{1}{2}$$

The slope is $\frac{1}{2}$. The vertical intercept is 5.

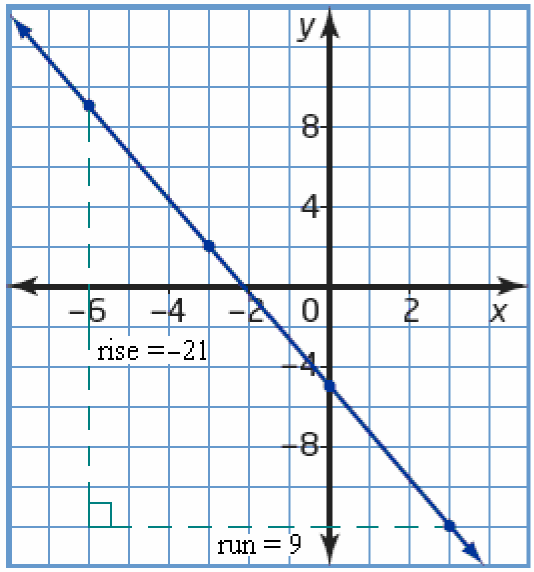
b) The equation is $y = \frac{1}{2}x + 5$.

c)



Chapter 5 Section 6 Question 11 Page 286

x	y
–6	9
–3	2
0	–5
3	–12



y varies partially with *x*. As the value of *x* increases by 3, the value of *y* decreases by 7.

$$m = \frac{\text{rise}}{\text{run}}$$
$$= \frac{-21}{9}$$
$$= -\frac{7}{3}$$

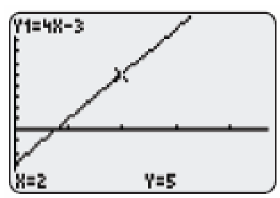
The slope is $-\frac{7}{3}$. The vertical intercept is –5.

The equation is $y = -\frac{7}{3}x - 5$.

Chapter 5 Section 6 Question 12 Page 286

$y = 4x - 3$

y varies partially with *x*. As the value of *x* increases by 1, the value of *y* increases by 4.



x	y
0	–3
1	1
2	5
3	9

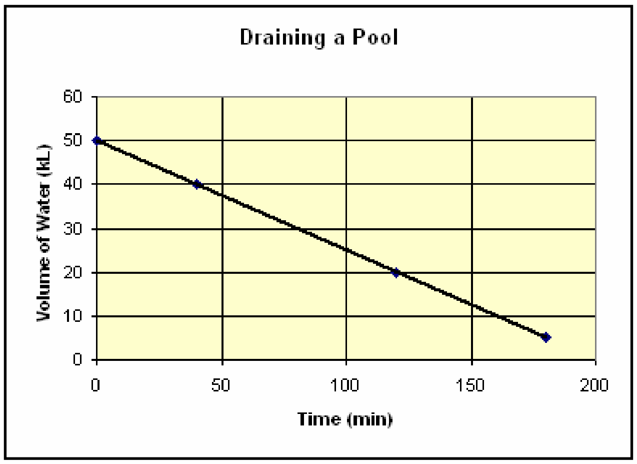
Chapter 5 Section 6 Question 13 Page 286

a)

Time (min)	Volume of Water (kL)	Rate of Change
0	50	
40	40	-0.25
120	20	-0.25
180	5	-0.25

The rate of change is the same for each succeeding pair of data points. The relation is linear.

b)



c) The rate of change from part a) is the slope of the graph. The slope is –0.25 or $-\frac{1}{4}$. The slope is constant. It represents the rate of change of the volume of water in the pool. Water is draining out at a rate of 0.25 kL/min.

d) Let *V* represent the volume of water in the pool, in kilolitres, and *t* represent the time, in minutes. The vertical intercept is 50.

$V = -0.25t + 50$

e)
$$\begin{aligned} V &= -0.25(60) + 50 \\ &= -15 + 50 \\ &= 35 \end{aligned}$$

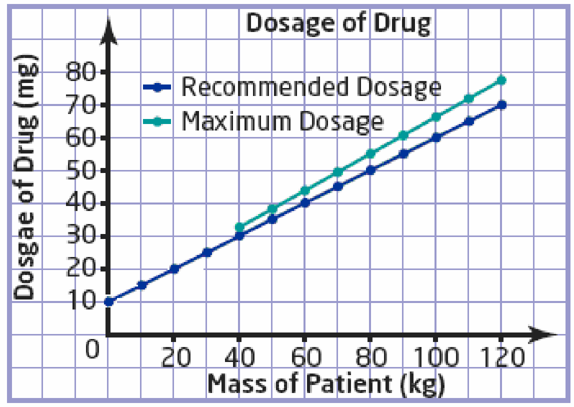
The volume of water after 60 min is 35 kL.

Chapter 5 Section 6 Question 14 Page 287

Solutions for Achievement Checks are shown in the Teacher's Resource.

Chapter 5 Section 6 Question 15 Page 287

a) Graph the mass versus dosage data. Extend the graph to determine the vertical intercept. The vertical intercept is 10.



Use $(x_1, y_1) = (40, 30)$ and $(x_2, y_2) = (120, 70)$.

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{70 - 30}{120 - 40}$$
$$= \frac{40}{80}$$
$$= \frac{1}{2}$$

Let D represent the dosage, in milligrams, and let m represent the mass of the patient, in kiolgrams. The equation is $D = \frac{1}{2}m + 10$

b) $D = 1.10\left(\frac{1}{2}m + 10\right)$

$$= 1.10 \times \frac{1}{2}m + 1.10 \times 10$$
$$= \frac{11}{20}m + 11$$

c) The graphs are shown. The graph of the maximum dosage has a vertical intercept of 11, which is 1 higher than the vertical intercept of the recommended dosage, 10. The maximum dosage graph rises more steeply.

Chapter 5 Section 6 Question 16 Page 287

Sales ($)	Salary ($)
15 000	1300
28 000	1560
34 000	1680
17 500	1350

Assume that the percent commission is constant.
Use $(x_1, y_1) = (15\ 000, 1300)$ and
$(x_2, y_2) = (34\ 000, 1680)$.

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{1680 - 1300}{34\ 000 - 15\ 000} \\ &= \frac{380}{19\ 000} \\ &= 0.02 \end{aligned}$$

The equation is $\text{Salary} = 0.02 \times \text{Sales} + \text{Base Salary}$. Use the first pair of numbers in the table to find the Base Salary.

$$\begin{aligned} 1300 &= 0.02 \times 15\ 000 + \text{Base Salary} \\ 1300 &= 300 + \text{Base Salary} \\ 1300 - 300 &= 300 + \text{Base Salary} - 300 \\ 1000 &= \text{Base Salary} \end{aligned}$$

The base salary is $1000 per month, and the rate of commission on sales is 0.02 or 2%.

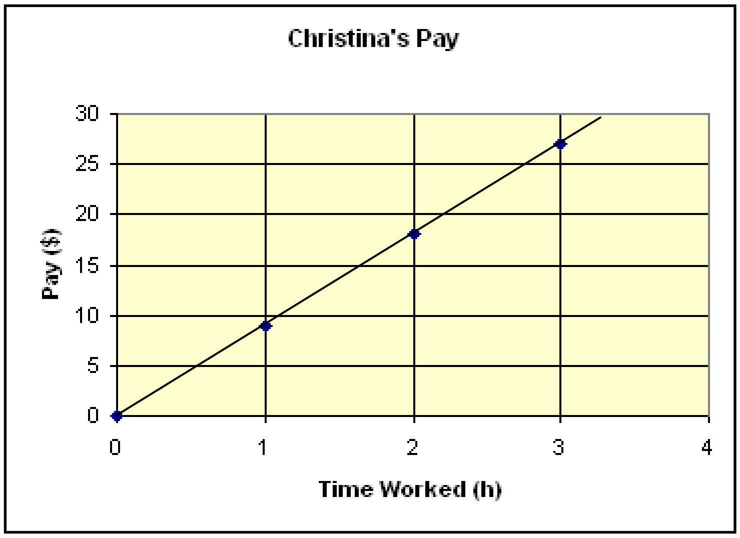
Chapter 5 Review

Chapter 5 Review Question 1 Page 288

a)

Time Worked, *t* (h)	Pay, *P* ($)
0	0
1	9
2	18
3	27

b)



c) Let P represent the pay, in dollars, and let t represent the time worked, in hours.

$P = 9t$

Chapter 5 Review Question 2 Page 288

a) The constant of variation is $\frac{144}{1.5} = 96$. This represent a speed of 96 km/h.

$d = 96t$

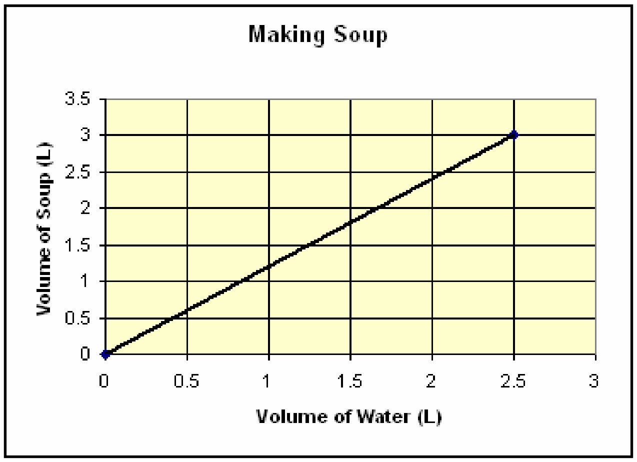
b)
$$300 = 96t$$
$$\frac{300}{96} = \frac{96t}{96}$$
$$3.125 = t$$

The time required to reach their destination is 3 h 7 min 30 s.

Chapter 5 Review   Question 3   Page 288

a) This is a direct variation. The volume of soup varies directly with the volume of water used to prepare it.

b)



c) If John uses 2.8 L of water to make 3.0 L of soup, the graph becomes less steep.

Chapter 5 Review   Question 4   Page 288

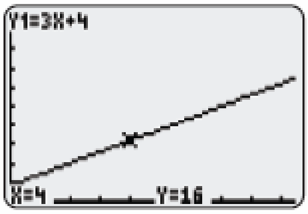
a)

x	y
0	4
1	7
2	10
3	13
4	16
7	25

b) The initial value of y is 4. When x changes by 1, y changes by 3. The constant of variation is 3.

c) $y = 3x + 4$

d)



This graph is a straight lien that starts at (0, 4) and rises upward to the right with a slope of 3.

Chapter 5 Review Question 5 Page 288

a) The variation is neither direct nor partial. It is not a straight line.

b) This is a partial variation. It is a straight line that does not pass through (0, 0).

c) This is a direct variation. It is a straight line that passes through (0, 0).

d) This is a partial variation. It is a straight line that does not pass through (0, 0).

Chapter 5 Review Question 6 Page 288

a) The fixed cost is $500. The variable cost is $0.15 times the number of flyers printed.

b) Let *C* represent the cost, and let *f* represent the number of flyers printed.

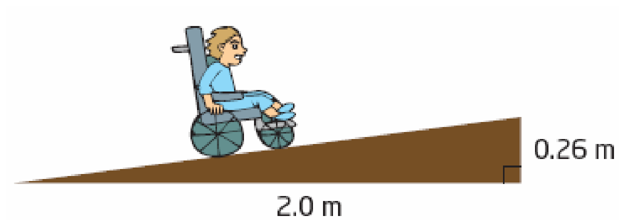
$C = 0.15f + 500$

c)
$$\begin{aligned} C &= 0.15(500) + 500 \\ &= 75 + 500 \\ &= 575 \end{aligned}$$

The cost of printing 500 flyers is $575.

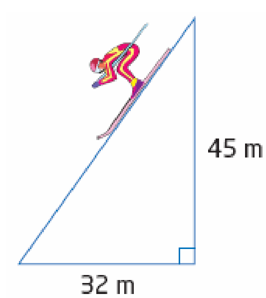
Chapter 5 Review Question 7 Page 288

a)
$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{0.26}{2.0} \\ &= 0.13 \end{aligned}$$



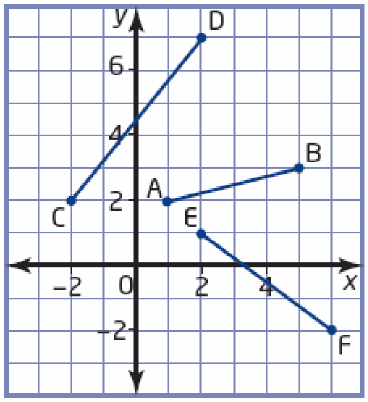
The slope is 0.13.

b)
$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{45}{32} \\ &\doteq 1.4 \end{aligned}$$



The slope is about 1.4.

Chapter 5 Review **Question 8** **Page 288**



a) $m_{AB} = \frac{\text{rise}}{\text{run}}$

$= \frac{1}{4}$

The slope of segment AB is $\frac{1}{4}$.

b) $m_{CD} = \frac{\text{rise}}{\text{run}}$

$= \frac{5}{4}$

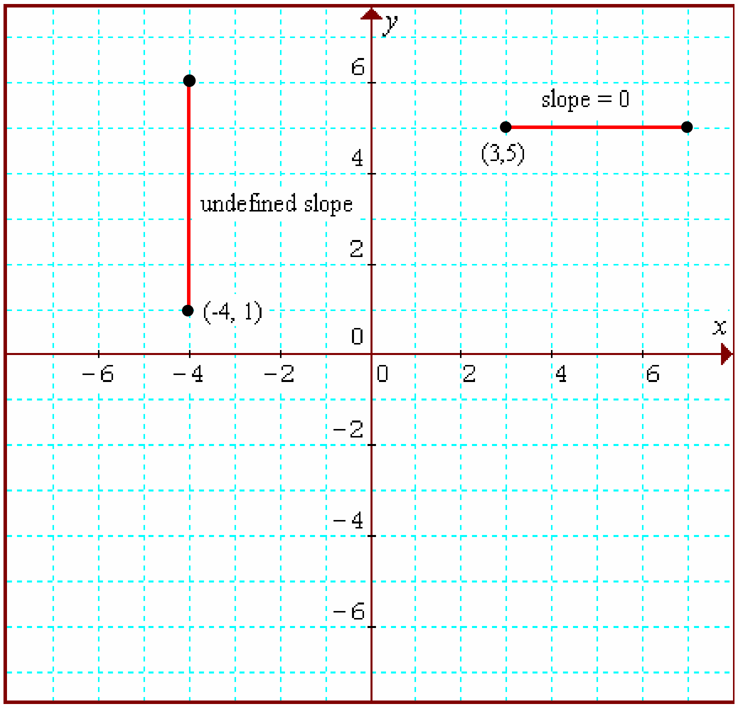
The slope of segment CD is $\frac{5}{4}$.

c) $m_{EF} = \frac{\text{rise}}{\text{run}}$

$= \frac{-3}{4}$

The slope of segment EF is $-\frac{3}{4}$.

Chapter 5 Review **Question 9** **Page 289**



Chapter 5 Review **Question 10** **Page 289**

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{2}{0.4} \\ &= 5 \end{aligned}$$

The slope of the ladder is 5. It is not within the safe range of 6.3 to 9.5.

$$m = \frac{\text{rise}}{\text{run}} = \frac{24}{30} = 0.8$$

Walking burns 0.8 kJ/min.

$$m = \frac{\text{rise}}{\text{run}} = \frac{36}{30} = 1.2$$

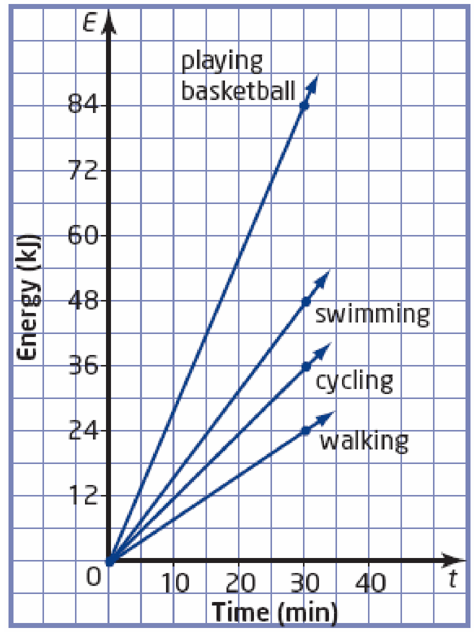
Cycling burns 1.2 kJ/min.

$$m = \frac{\text{rise}}{\text{run}} = \frac{48}{30} = 1.6$$

Swimming burns 1.6 kJ/min.

$$m = \frac{\text{rise}}{\text{run}} = \frac{84}{30} = 2.8$$

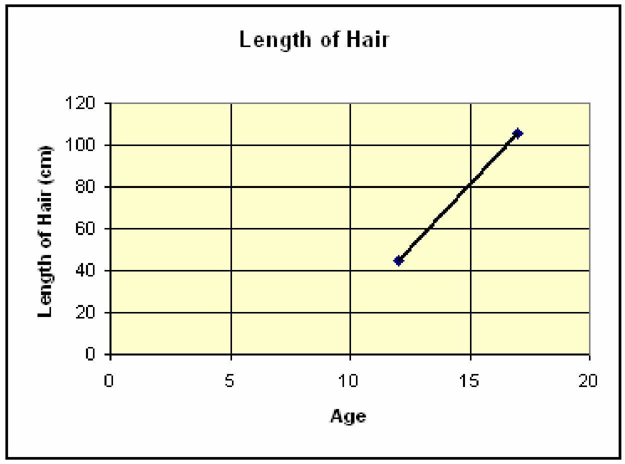
Playing basketball burns 2.8 kJ/min.



Chapter 5 Review **Question 12** **Page 289**

Use the points (12, 45) and (17, 106).

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{106-45}{17-12} \\ &= \frac{61}{5} \\ &= 12.2 \end{aligned}$$



The slope of the graph is 12.2.

Hair grows at a rate of 12.2 cm/year.

Chapter 5 Review **Question 13** **Page 289**

a)

x	*y*	First Differences
0	4	
1	11	7
2	18	7
3	25	7
4	32	7

The first differences are constant.
The relation is linear.

b)

t	*d*	First Differences
-1	21	
0	13	-8
1	9	-4
2	7	-2
3	6	-1

The first differences are not constant.
The relation is non-linear.

Chapter 5 Review **Question 14** **Page 289**

Length of Row	Area (cm^2)	First Differences
1	4	
2	8	4
3	12	4
4	16	4
5	20	4

The first differences are constant. The relation is linear.

Chapter 5 Review **Question 15** **Page 289**

a)

x	y	First Differences
0	2	
1	5	3
2	8	3
3	11	3
4	14	3

The first differences are constant. The relation is linear.

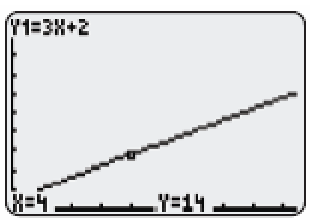
b) Use $(x_1, y_1) = (0, 2)$ and $(x_2, y_2) = (4, 14)$.

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{14 - 2}{4 - 0}$$
$$= \frac{12}{4}$$
$$= 3$$

The slope is 3.

c) The vertical intercept is 2. The equation is $y = 3x + 2$.

d)



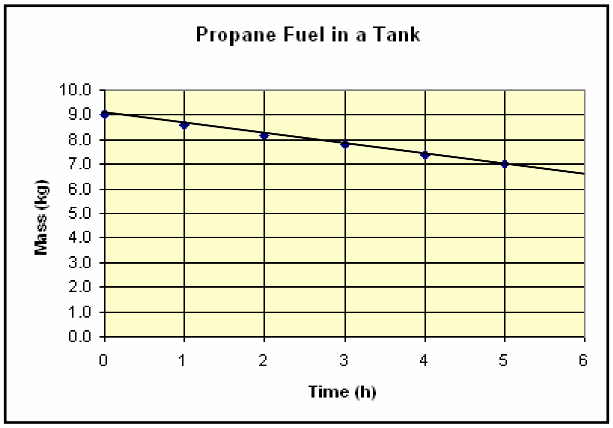
Chapter 5 Review **Question 16** **Page 289**

a)

Time (h)	Mass (kg)	First Differences
0	9.0	
1	8.6	-0.4
2	8.2	-0.4
3	7.8	-0.4
4	7.4	-0.4
5	7.0	-0.4

The first differences are constant. The relation is linear.

b)



c) Use $(x_1, y_1) = (0, 9.0)$ and $(x_2, y_2) = (5, 7.0)$.

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{7.0 - 9.0}{5 - 0} \\ &= \frac{-2.0}{5} \\ &= -0.4 \end{aligned}$$

The slope is –0.4. This means the propane is used up at a rate of 0.4 kg/h.
The vertical intercept is 9.0. This is the initial amount of propane, in kilograms.

d) Let *m* represent the mass, in kilograms, and let *t* represent the time, in hours. The equation is $m = -0.4t + 9.0$.

Chapter 5 Chapter Test

Chapter 5 Chapter Test Question 1 Page 290

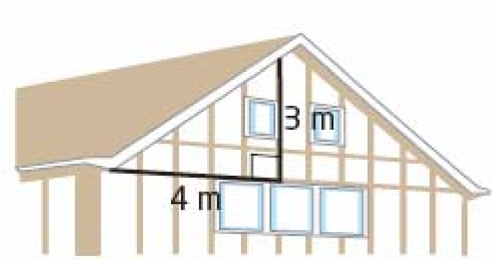
B and D are non-linear. A is a direct variation. The only partial variation is answer C.

Chapter 5 Chapter Test Question 2 Page 290

The constant of variation is $\frac{150}{1.5}=100$. Answer A.

Chapter 5 Chapter Test Question 3 Page 290

$$\begin{aligned} m &= \frac{\text{rise}}{\text{run}} \\ &= \frac{3}{4} \\ &= 0.75 \end{aligned}$$



The slope is 0.75. Answer C.

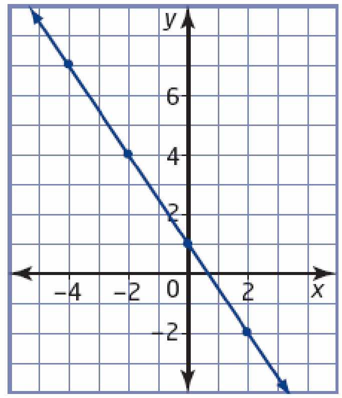
Chapter 5 Chapter Test Question 4 Page 290

Non-linear relations do not have constant first differences. Linear relations have constant first differences. Answer C is false.

Chapter 5 Chapter Test Question 5 Page 290

The constant of variation is $\frac{43.50}{50}=0.87$. Since the variation is direct, the correct answer is D.

Chapter 5 Chapter Test Question 6 Page 290



a) Use $(x_1, y_1) = (-4, 7)$ and $(x_2, y_2) = (2, -2)$.

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{-2 - 7}{2 - (-4)} \\ &= \frac{-9}{6} \\ &= -\frac{3}{2} \end{aligned}$$

The slope is $-\frac{3}{2}$.

b) The vertical intercept is 1.

c) The equation for the relation is $y = -\frac{3}{2}x + 1$.

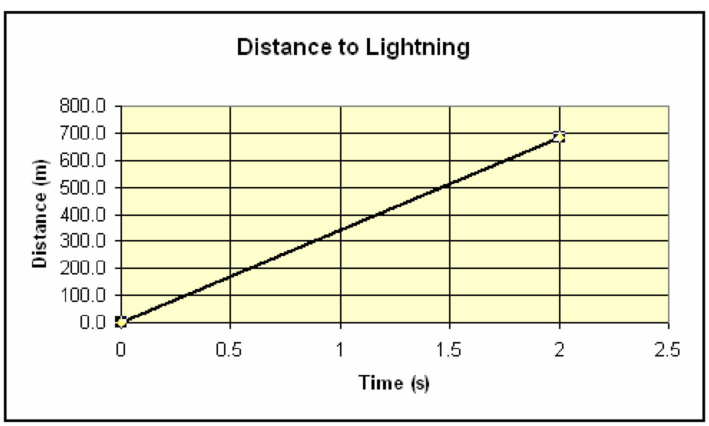
Chapter 5 Chapter Test Question 7 Page 290

a) $\frac{685}{2.0} = 342.5$

The rate of change is 342.5 m/s. So, the slope is 342.5.
Let d represent the distance, in metres, and let t represent the time, in seconds.

The equation for the relation is $d = 342.5t$.

b)



Chapter 5 Chapter Test Question 8 Page 290

Liquid Volume of Water (L)	Frozen Volume of Water (L)	First Differences
5	5.45	
10	10.90	5.45
15	16.35	5.45
20	21.80	5.45

The first differences are constant. The relation is linear.

Chapter 5 Chapter Test Question 9 Page 290

a) Let P represent the price charged, in dollars, and let t represent the time, in hours.

The equation is $P = 50t + 60$.

b)
$$\begin{aligned} P &= 50(3.5) + 60 \\ &= 175 + 60 \\ &= 235 \end{aligned}$$

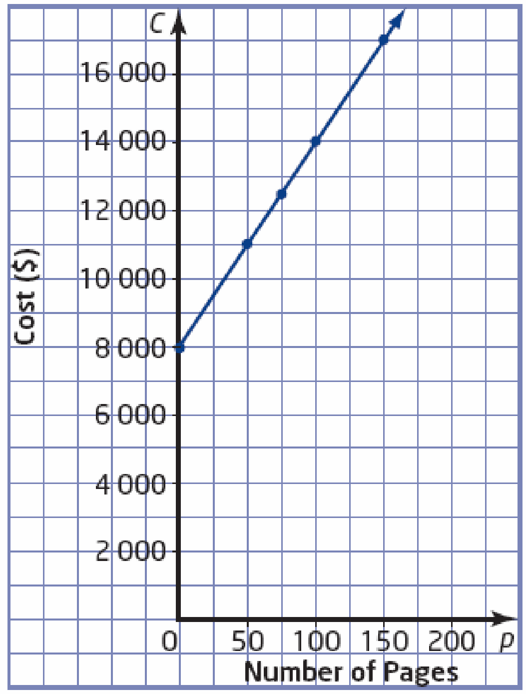
The total cost of a repair that takes 3.5 h is $235.

c) If the hourly cost changed to $45, the equation would become $P = 45t + 60$.

Chapter 5 Chapter Test Question 10 Page 291

a) Use $(x_1, y_1) = (0, 8000)$ and $(x_2, y_2) = (150, 17\,000)$.

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{17\,000 - 8000}{150 - 0} \\ &= \frac{9000}{150} \\ &= 60 \end{aligned}$$



The rate of change is \$60/page. This is the slope of the graph.

b) The equation is $C = 60p + 8000$.

c) If the base cost changed to \$9000, the vertical intercept would be 9000, and the equation would be $C = 60p + 9000$.

d) The new cost per page would be $1.08 \times 60 = 64.8$. The new equation would be $C = 64.8p + 8000$.