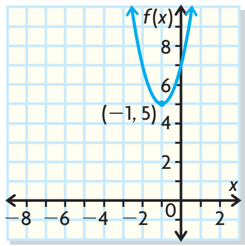
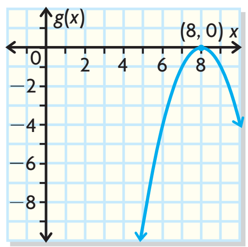
c) vertex: $(-1, 5)$; axis: $x = -1$; will have no zeros because the vertex is above the x-axis; parabola opens up



d) vertex: $(8, 0)$; axis: $x = 8$; $a < 0$, will have one zero because the vertex is on the x-axis; parabola opens down



5. **a)** $x = -\frac{1}{2}, x = 8$

b) no solution

c) $x = \frac{1}{3}$

d) $x = 1.16, x = -2.40$

6. **a)** 2.7 m **b)** 1.5 s

7. **a)** no solution

b) two distinct solutions

c) one solution

8. **a)** $\frac{16}{5} > k$ **b)** $\frac{16}{5} = k$ **c)** $\frac{16}{5} < k$

9. **a)** 25 cars **b)** $525

10. **a)** 41 472 m^2 **b)** 10 720 m^2 **c)** 36 m

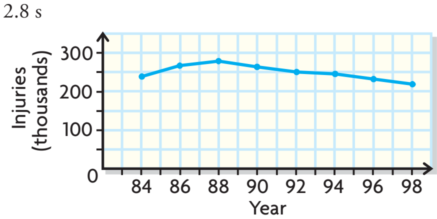
11. **a)** $y = -4.9(x - 1.5)^2 + 10.5$

b) domain: $\{x \in \mathbf{R} \mid 0 \leq x \leq 2.96\}$;

range: $\{y \in \mathbf{R} \mid 0 \leq y \leq 10.5\}$

c) 2.8 s

12. **a)**



b) $y = -673.86x^2 + 2\,680\,816x - 2\,665\,999\,342$

c) Use the quadratic regression function on a graphing calculator to determine the curve's equation. $y = -673.86x^2 + 2\,680\,816x - 2\,665\,999\,342$

d) 160 715, using the above equation

e) 1989

Chapter Self-Test, p. 256

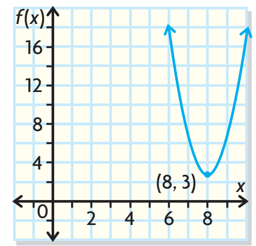
1. **a)** $f(x) = x^2 + 6x + 2$

b) $f(x) = -3x^2 - 30x - 73$

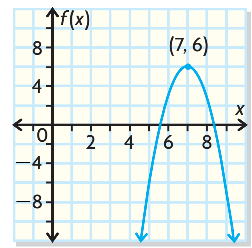
2. **a)** $f(x) = (x - 5)^2 + 8$

b) $f(x) = -5(x - 2)^2 + 8$

3. **a)** vertex: $(8, 3)$; axis: $x = 8$; min. 3



b) vertex: $(7, 6)$; axis: $x = 7$; max. 6



4. If you get a negative under the square root, you cannot solve. There are no solutions to these equations.

5. **a)** $x = -1.12, x = 7.12$

b) no solution

6. **a)** no solution **b)** one solution

7. **a)** 20.1m **b)** 15.2 m

8. **a)** $13 812 **b)** $24

9. **a)** $y = -1182(x - 2)^2 + 4180$

b) It fits the data pretty well.

c) domain: $\{x \in \mathbf{R} \mid x \geq 0\}$; range: $\{y \in \mathbf{R} \mid y \leq 4180\}$

d) $4106

10. It is easier to use this method to find the max/min and vertex.

Chapter 5

Getting Started, pp. 260–262

1. **a)** (v) **c)** (ii) **e)** (iv)

b) (vi) **d)** (i) **f)** (iii)

2. **a)** $\sin A = \frac{12}{13}, \cos A = \frac{5}{13}, \tan A = \frac{12}{5}$

b) $\sin A = \frac{8}{17}, \cos A = \frac{15}{17}, \tan A = \frac{8}{15}$

3. **a)** $\angle A \doteq 27°$ **b)** $b \doteq 3$ **c)** $\angle A \doteq 50°$ **d)** $d \doteq 16$

4. **a)** 12 cm **b)** 10 m

5. **a)** $\sin A = \frac{4}{13}, \cos A = \frac{12}{13}, \tan A = \frac{1}{3}; \angle A \doteq 18°$

b) $\sin D = \frac{5}{7}, \cos D = \frac{5}{7}, \tan D = 1; \angle D \doteq 44°$

c) $\sin C = \frac{12}{13}, \cos C = \frac{4}{13}, \tan C = 3; \angle C \doteq 72°$

Answers

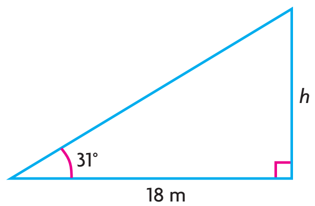
6. a) 0.7660 b) 0.9816 c) 3.0777

7. a) 47° b) 11° c) 80°

8. a) $\theta = 71°, \phi = 109°$ b) $\theta \doteq 72°, \phi \doteq 18°$

9. a) 27° b) 2.3 m

10. a) Answers may vary. E.g., Given the triangle below, calculate the length of h to the nearest metre.



$\tan 31° = \frac{h}{18}$ ← I knew one angle and the side adjacent to that angle. I needed to determine the length of the opposite side, so I used tangent.

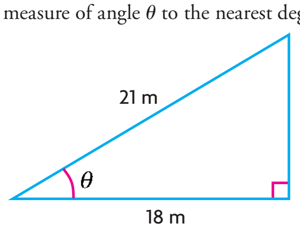
$18 \times \tan 31° = \overset{1}{\cancel{18}} \times \frac{h}{\underset{1}{\cancel{18}}}$ ← To solve for *h*, I multiplied both sides of the equation by 18.

$18 \times \tan 31° = h$

$11 \text{ m} \doteq h$ ← I rounded to the nearest metre.

The height of the triangle is about 11 m.

b) Answers may vary. E.g., Given the triangle below, calculate the measure of angle θ to the nearest degree.



$\cos \theta = \frac{18}{21}$ ← I knew the hypotenuse and the side adjacent to angle *θ*, so I used cosine.

$\theta = \cos^{-1}\left(\frac{18}{21}\right)$ ← To solve for *θ*, I used the inverse cosine key on my calculator.

$\theta \doteq 31°$ ← I rounded to the nearest degree.

Angle θ is about 31°.

Lesson 5.1, pp. 271–273

1. a) 0.2588 b) 0.5736

2. a) 22° b) 45°

3. a) $\sin A = \frac{3}{5}, \cos A = \frac{4}{5}, \tan A = \frac{3}{4}; \angle A \doteq 37°$

b) $\sin D = \frac{6.9}{13}, \cos D = \frac{11}{13}, \tan D = \frac{6.9}{11}; \angle D \doteq 32°$

4. a) 8 cm b) 11 cm

5. a) $x \doteq 62°, y \doteq 28°, z = 17$ b) $i = 8, j \doteq 7$ c) $x \doteq 64°, y \doteq 26°, q \doteq 4$ d) $x = 18°, l \doteq 3, j \doteq 10$

6. a) (Eiffel Tower) 254 m b) (Empire State Building) 381 m c) (Leaning Tower of Pisa) 56 m d) (Big Ben's clock tower) 97 m

Order of heights (tallest to shortest): (b), (a), (d), (c)

7. 7.4 m

8. 26°

9. a) 0.3 b) 18°

10. 120 m

11. a) 30.91 m b) 29.86 m

12. a) nothing b) scaffolding c) planks

13. Answers may vary. E.g., They could place the pole into the ground on the opposite bank of the river (side B). Then they measure the angle of elevation from the other bank (side A). The width of the river can be calculated using tangent.

$\tan \theta = \frac{h}{x}$

$x = \frac{h}{\tan \theta}$, where h is the height of the pole and θ is the angle of elevation

14. 105 m

15. a) 63° b) 4.22 m c) 2.6 m

16. No, the height of the array will be 3.3 m.

17. 29 m

18. a) 18.4 m

b) (Jodi) 85.7 m, (Nalini) 135.0 m

c) (pole) 5.5 m, (Jodi) 19.4 m, (Nalini) 30.6 m

Lesson 5.2, pp. 280–282

1. a) 8.3 cm^2 b) 43.1 cm^2

2. In $\triangle ATB$, calculate AB using tangent. In $\triangle CTB$, calculate BC using tangent. Then add AB and BC. The length is about 897.8 m.

3. Karen; Karen's eyes are lower than Anna's. Thus, the angle of elevation is greater.

4. a) tangent; Tangent relates a known side and the length we must find.

b) 26 m

5. No. The height of a pyramid is measured from the very top of the pyramid to the centre of the base. I don't know how far that point on its base is from the person measuring the angle of elevation.

6. Darren can only store the 1.5 m plank in the garage.

7. a) 58.5 m b) 146 m c) 87.7 m

8. 12 m

9. 31 m

10. 22.2 m

11. a) 35° b) 0.8 m

12. a) 180 cm^2 b) (volume) 18 042 cm^3, (surface area) 5361 cm^2

13. a) 54° b) 24 703 m

14. Draw a perpendicular from the base to divide x into two parts, x_1 and x_2. Use cosine to solve for x_1 and x_2. Then, add x_1 and x_2 to determine x.

$\cos 24° = \frac{x_1}{148}$ and $\cos 19° = \frac{x_2}{181}$

$x = x_1 + x_2$

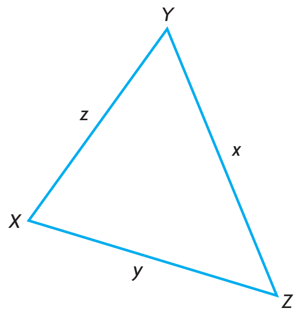
$x \doteq 306$

15. 12 cm

16. 0.7 m^2

Lesson 5.3, pp. 288–290

1. a)



b) $\frac{\sin X}{x} = \frac{\sin Y}{y} = \frac{\sin Z}{z}$ or $\frac{x}{\sin X} = \frac{y}{\sin Y} = \frac{z}{\sin Z}$

2. a) $x \doteq 4.6$ b) $\theta \doteq 24°$

3. a) $b \doteq 12$ cm b) $\angle D \doteq 49°$

4. $q \doteq 9$ cm

5. a) 75° b) 82 m

6. a) $\angle C \doteq 39°$, $b \doteq 4.7$ cm c) $\angle C \doteq 53°$, $b \doteq 11.6$ cm
b) $\angle C \doteq 74°$, $b \doteq 8.7$ cm d) $\angle C \doteq 71°$, $b \doteq 10.8$ cm

7. a) 20.3 cm b) 13.6 cm^2

8. a) $\angle A = 75°$, $a \doteq 13$ cm, $b \doteq 13$ cm
b) $\angle M \doteq 58°$, $\angle N \doteq 94°$, $n \doteq 11$ cm
c) $\angle Q = 55°$, $q \doteq 8$ cm, $s \doteq 10$ cm
d) $\angle D \doteq 57°$, $\angle F \doteq 75°$, $f \doteq 10$ cm

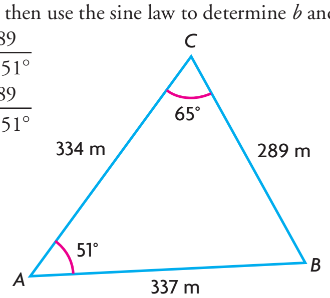
9. a) $\angle A \doteq 42°$, $\angle B \doteq 68°$, $b \doteq 14.6$
b) $\angle D = 94°$, $d \doteq 21.2$, $e \doteq 13.1$
c) $\angle J \doteq 31°$, $\angle H \doteq 88°$, $h \doteq 6.1$
d) $\angle K \doteq 61°$, $\angle M \doteq 77°$, $m \doteq 14.0$
e) $\angle P \doteq 36°$, $\angle Q \doteq 92°$, $q \doteq 2.0$
f) $\angle Z = 61°$, $x \doteq 5.2$, $y \doteq 7.6$

10. (1.9 m chain) 52°, (2.2 m chain) 42°

11. Calculate $\angle B$, then use the sine law to determine b and c.

$\frac{b}{\sin 64°} = \frac{289}{\sin 51°}$

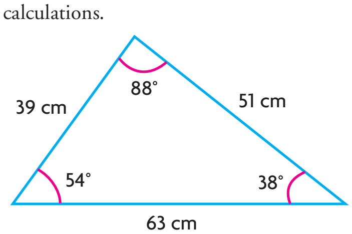
$\frac{c}{\sin 65°} = \frac{289}{\sin 51°}$



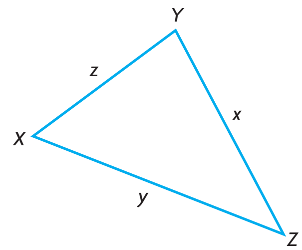
Phones A and B are farthest apart.

12. Answers may vary. E.g., The primary trigonometric ratios only apply when you have a right triangle. If you have a triangle that doesn't have a right angle, you would have to use the height of the triangle in order to use primary trigonometric ratios. This would mean you use two smaller triangles, instead of the original one. If you use the sine law, you can calculate either an angle or side directly without unnecessary calculations.

13.



14. Answers may vary. E.g., Given any acute angle θ, the value of $\sin \theta$ ranges from 0 to 1. If θ gets very small, $\sin \theta$ approaches zero. But if θ gets close to 90°, $\sin \theta$ approaches 1. Suppose in $\triangle XYZ$, $\angle X$ is 90°.



Suppose that $\angle X$ is the largest angle. Let's look at $\angle Y$. Since Y is a smaller angle than X in $\triangle XYZ$, we have $\sin Y < \sin X$. Thus, $\frac{1}{\sin X} < \frac{1}{\sin Y}$. Multiplying through by x yields $\frac{x}{\sin X} < \frac{x}{\sin Y}$. But by the sine law, $\frac{x}{\sin X} = \frac{y}{\sin Y}$. Thus, the previous inequality becomes $\frac{y}{\sin Y} < \frac{x}{\sin Y}$. Cancelling $\sin Y$, we obtain $y < x$. The same argument applies to side z.

15. 15.1 m

16. a) 4.0 m, 3.4 m b) 85%

Mid-Chapter Review, pp. 292–293

1. 100 m

2. a) 23° b) 1.9 m

3. a) $x \doteq 4.4$ cm, $y \doteq 8.6$ cm, $\angle X = 27°$
b) $\angle K \doteq 44°$, $\angle L \doteq 46°$, $j \doteq 99.8$ cm
c) $m \doteq 13.2$ m, $n \doteq 24.2$ m, $\angle M = 33°$
d) $i \doteq 20.9$ m, $\angle I \doteq 59°$, $\angle G \doteq 31°$

4. 84°

5. 5.1 m^2

6. 3.9 km

7. 44°

8. a) 56° b) 126 m

9. a) $\angle E = 71°$, $d \doteq 24$, $f \doteq 18$
b) $\angle P = 51°$, $p \doteq 6$, $q \doteq 6$
c) $\angle C = 58°$, $b \doteq 24$, $c \doteq 22$
d) $\angle X = 103°$, $y \doteq 13$, $z \doteq 6$

10. a) 123 m b) 6 m

11. a) 68° b) 69 cm

Lesson 5.4, pp. 299–301

1. i) (a); In order to apply the sine law, we would need to know $\angle A$ or $\angle C$.
ii) $b^2 = a^2 + c^2 - 2ac \cos B$

2. a) $b \doteq 6.4$ cm b) $b \doteq 14.5$ cm

3. a) $\angle B \doteq 83°$ b) $\angle D \doteq 55°$

4. a) 12.9 cm b) 10.1 cm c) 8.1 cm

5. a) $a \doteq 11.9$ cm, $\angle B \doteq 52°$, $\angle C \doteq 60°$
b) $d \doteq 7.7$ cm, $\angle E \doteq 48°$, $\angle F \doteq 80°$
c) $h \doteq 7.2$ cm, $\angle I \doteq 48°$, $\angle F \doteq 97°$
d) $\angle P \doteq 37°$, $\angle Q \doteq 40°$, $\angle R \doteq 103°$

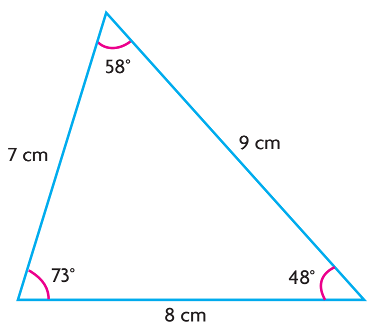
6. No, the interior angles are about 22°, 27°, and 130°.

7. 18 km

8. No; E.g., Calculate $\angle G$ using the fact that the sum of the interior angles equals 180°. Use the sine law to calculate f and h. $\angle G \doteq 85°$, $f \doteq 45.3$ m, $h \doteq 59.7$ m
9. 7.1 km
10. Answers may vary. E.g., Use the cosine law to calculate r. Then use the sine law to calculate angle θ. $\theta \doteq 29°$
11. a) 13 cm b) 6 cm
12. a) Answers may vary. E.g., Two sailboats headed on two different courses left a harbour at the same time. One boat travelled 25 m and the other 35 m. The sailboats travelled on paths that formed an angle of 78° with the harbour. Calculate the separation distance of the sailboats.
$d^2 = 25^2 + 35^2 - 2(25)(35)\cos 78°$
$d \doteq 39$ m
13. a) (AX) 0.9 km, (AY) 2.0 km
b) (BX) 1.6 km, (BY) 0.6 km
c) 1.7 km

Lesson 5.5, pp. 309–311

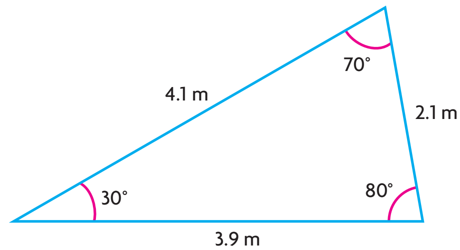
1. a) primary trigonometric ratios, $\sin 39° = \frac{x}{43.0}$
b) the sine law, $\frac{\sin\theta}{3.1} = \frac{\sin 42°}{2.2}$
c) the cosine law, $\cos\theta = \frac{3.6^2 + 5.2^2 - 4.1^2}{2(3.6)(5.2)}$
2. a) $x \doteq 27.1$ b) $\theta \doteq 71°$ c) $\theta \doteq 52°$
3. 486 cm^2
4. 1.4 m
5. 260.7 m
6. 50°
7. 27°
8. 0.004 s
9.



10. (perimeter) 32.7 cm, (area) 73.6 cm^2
11. 6.3 m
12. 107.7 m
13. (if $\angle ABC = 61°$) 78°, (if $\angle ABC = 65°$) 72°
14.

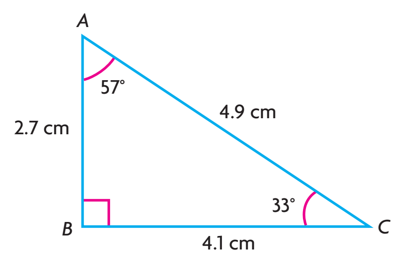
the cosine law	3rd problem	$x^2 = 1.7^2 + 3.8^2 - 2(1.7)(3.8)\cos 70°$ $x \doteq 3.6$ km
the sine law	1st problem	$\frac{b}{\sin 58°} = \frac{54}{\sin 51°}$ $b \doteq 59$ m $\frac{j}{\sin 71°} = \frac{54}{\sin 51°}$ $j \doteq 66$ m
primary trigonometric ratios	2nd problem	$\tan 41° = \frac{h}{11.4}$ $h \doteq 9.9$ m

15. 30.3 cm^2
16. 61 m
17.

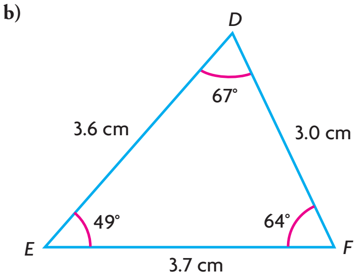


Chapter Review, pp. 314–315

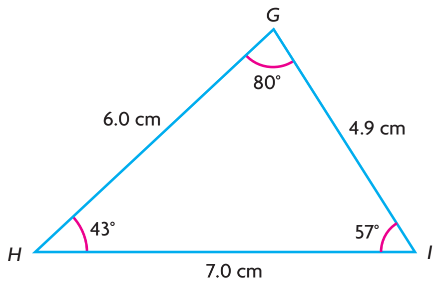
1. a) 4 cm b) 40°
2. 27°
3. a) 12 m b) 6.4 m^2
4. 84 m
5. a) $\angle A = 80°$, $a \doteq 19$ cm, $b \doteq 18$ cm
b) $\angle M \doteq 64°$, $\angle N \doteq 86°$, $n \doteq 20$ cm
c) $\angle Q = 45°$, $q \doteq 6$ cm, $s \doteq 9$ cm
d) $\angle D \doteq 40°$, $\angle F \doteq 88°$, $f \doteq 14$ cm
6. 59 m
7. a) $b \doteq 5$ cm, $\angle A \doteq 78°$, $\angle C \doteq 54°$
b) $\angle T = 90°$, $\angle U \doteq 53°$, $\angle V \doteq 37°$
c) $m \doteq 9$ cm, $\angle N \doteq 37°$, $\angle L \doteq 83°$
d) $y \doteq 6$ m, $\angle X = \angle C = 70°$
8. 47°
9. a)



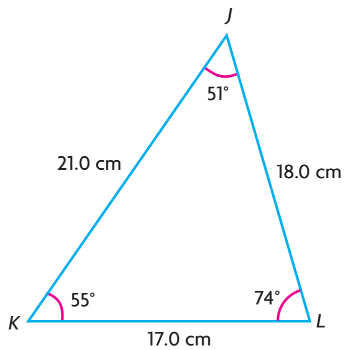
b)



c)



d)



10. **a)** 96°, 84°
b) 10.8 cm

Chapter Self-Test, p. 316

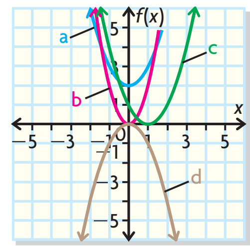
1. 3 m
2. Yes, the angle of elevation is 6.4°, which is greater than 4.5°.
3. $x \doteq 111$ m, $y \doteq 108$ m
4. **a)** $\angle A \doteq 120°$, $\angle C \doteq 33°$, $a \doteq 29$ cm
b) $\angle F = 47°$, $d \doteq 31$ cm, $e \doteq 37$ cm
5. 2 m
6. 8 m
7. 795 m
8. 197 m

CHAPTER 6

Getting Started, pp. 320–322

1. **a)** (i) **c)** (vi) **e)** (iv)
b) (iii) **d)** (v) **f)** (ii)
2. **a)** about 175 m
b) about 30 s; Started fast for 8s; then slower; then top speed
c) for first 8 s started off slower; then sped up; at 20 s full speed
3. **a)** Moved to the right 5 units, stretched by a factor of 3, and moved up 4 units
b) Moved to the right 2 units, stretched by a factor of 2, and moved up 1 unit
c) Moved to the left 1 unit, compressed by a factor of 0.5, and moved down 3 units
d) Moved to the left 2 units, reflection in the x-axis and compressed by a factor of $\frac{1}{4}$, and moved down 4 units

4. **a)** **i)** 0.5; Truck is moving at a steady pace away from the detector.
ii) (0, 1.5); Spot where the truck starts away from the detector.
iii) 0; Truck is not moving for 2 s.
iv) (8, 0); Truck stops and this is how long it took for the truck to go the entire distance (to and from the detector).
b) domain: $\{t \in \mathbf{R} \mid 0 \le t \le 8\}$; range $\{t \in \mathbf{R} \mid 0 \le d \le 3\}$
5. **a)** $\sin A = \frac{3}{5}$; $\cos A = \frac{4}{5}$; $\tan A = \frac{3}{4}$
6.

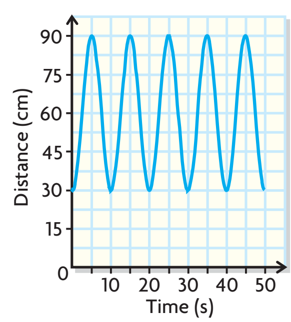


7. **a)** max: 4; zeros: (0, 0), (6, 0); domain: $\{x \in \mathbf{R}\}$; range: $\{y \in \mathbf{R} \mid y \le 4\}$
b) min: −2.5; zeros: (−3, 0), (1, 0); domain: $\{x \in \mathbf{R}\}$; range: $\{y \in \mathbf{R} \mid y \ge -2.5\}$
8.

Definition:	Ways to Test:
A function is an equation that has only one corresponding value of y for each value of x.	Graph the equation on a co-ordinate grid. You should be able to draw a vertical line through the graph at any point and not have it intersect the graph at more than one point. If a vertical line does intersect the graph at more than one point, then the graph is not a function.
Function	
Example: $y = 6x^2 - 13$	Non-examples: $x = 6y^2 - 13$

Lesson 6.1, p. 325

1. **a)**



b)