Chapter 1 Functions

1. Determine the domain and the range for each relation. Sketch a graph of each.

   a) $y = \frac{3}{x - 9}$ b) $y = \sqrt{2 - x} - 4$

2. Which of the following is NOT true?

   A All functions are also relations.

   B The vertical line test is used to determine if the graph of a relation is a function.

   C All relations are also functions.

   D Some relations are also functions.

3. The approximate time for an investment to double can be found using the function $n(r) = \frac{72}{r}$, where n represents the number of years and r represents the annual interest rate, as a percent.

   a) How long will it take an investment to double at each rate?

      i) 3% ii) 6% iii) 9%

   b) Graph the data to illustrate the function.

   c) Determine the domain and range in this context.

4. Determine the vertex of each quadratic function by completing the square. Verify your answer by using partial factoring. State if the vertex is a minimum or a maximum.

   a) $f(x) = 3x^2 + 9x + 1$

   b) $f(x) = -\frac{1}{2}x^2 + 3x - \frac{5}{2}$

5. A small company manufactures a total of x items per week. The production cost is modelled by the function $C(x) = 50 + 3x$. The revenue is given by the function $R(x) = 6x - \frac{x^2}{100}$. How many items per week should be manufactured to maximize the profit for the company?

   Hint: Profit = Revenue − Cost

6. Simplify.

   a) $2\sqrt{243} - 5\sqrt{48} + \sqrt{108} - \sqrt{192}$

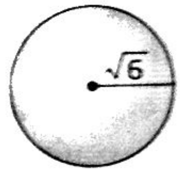
   b) $\frac{2}{3}\sqrt{125} - \frac{1}{3}\sqrt{27} + 2\sqrt{48} - 3\sqrt{80}$

7. Expand. Simplify where possible.

   a) $(\sqrt{5} + 2\sqrt{3})(3\sqrt{5} + 4\sqrt{3})$

   b) $(4 - \sqrt{6})(1 + \sqrt{6})$

8. Find a simplified expression for the area of the circle.



9. Solve $3x^2 + 9x - 30 = 0$ by

   a) completing the square

   b) using a graphing calculator

   c) factoring

   d) using the quadratic formula

10. The length of a rectangle is 5 m more than its width. If the area of the rectangle is 15 m², what are the dimensions of the rectangle, to the nearest tenth of a metre?

11. Find an equation for the quadratic function with the given zeros and containing the given point. Express each function in standard form. Graph each function to check.

    a) $2 \pm \sqrt{3}$, point $(4, -6)$

    b) 4 and −1, point $(1, -4)$

12. An arch of a highway overpass is in the shape of a parabola. The arch spans a distance of 16 m from one side of the road to the other. At a horizontal distance of 1 m from each side of the arch, its height above the road is 6 m.

    a) Sketch the quadratic function if the vertex of the parabola is on the y-axis and the road is along the x-axis.

    b) Use this information to determine the equation of the function that models the arch.

    c) Find the maximum height of the arch.

13. At a fireworks display, the path of the biggest firework can be modelled using the function $f(x) = -0.015x^2 + 2.24x + 1.75$, where x is the horizontal distance from the launching platform. The profile of a hill, some distance away from the platform, can be modelled with the equation $h(x) = 0.7x - 83$, with all distances in metres. Will the firework reach the hill? Justify your answer.

Chapter 2 Transformations of Functions

14. Test whether the functions in each pair are equivalent by
   i) testing three different values of x
   ii) simplifying the expressions on the right sides
   iii) graphing using graphing technology

   a) $f(x) = -2(x + 3)^2 + (5x + 1)$,
   $g(x) = -2x^2 - 7x - 17$

   b) $f(x) = \frac{x^2 - 2x - 15}{x^2 - 9x + 20}$,
   $g(x) = \frac{x + 3}{x - 4}$

15. Simplify and state the restrictions.

   a) $\frac{-x + 1}{8x} \div \frac{2x - 2}{14x^2}$

   b) $\frac{x^2 + 5x - 36}{x^2 - 2x} \div \frac{x^2 + 11x + 18}{8x^2 - 4x^3}$

   c) $\frac{x^2 - 25}{x - 4} \times \frac{x^2 - 6x + 8}{3x + 15}$

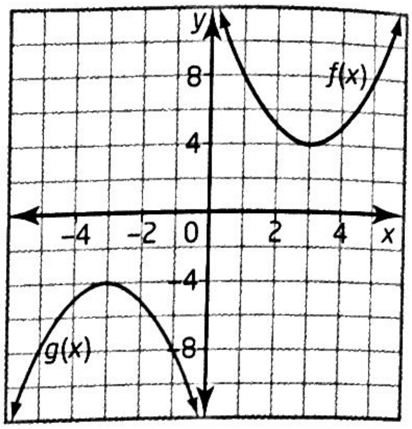
16. For each function $g(x)$, state the corresponding base function $f(x)$. Describe the transformations that must be applied to the base function using function notation and words. Then, transform the graph of $f(x)$ to sketch the graph of $g(x)$ and state the domain and range of each function.

   a) $g(x) = \frac{1}{x + 5} - 1$

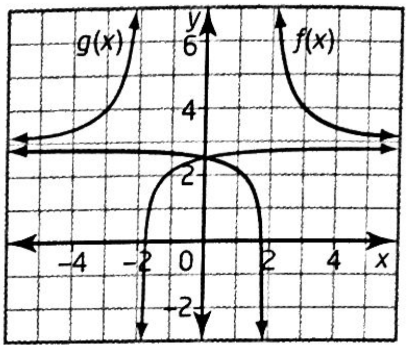
   b) $g(x) = \sqrt{x + 7} - 9$

17. For each graph, describe the reflection that transforms $f(x)$ into $g(x)$.

   a)



   b)



18. For each of the functions $f(x) = x^2$, $f(x) = \sqrt{x}$, and $f(x) = \frac{1}{x}$, write an equation to represent $g(x)$ and $h(x)$ and describe the transformations. Then, transform the graph of $f(x)$ to sketch graphs of $g(x)$ and $h(x)$ and state the domain and range of the functions.

   a) $g(x) = 4f(-x)$ and $h(x) = \frac{1}{4}f(x)$

   b) $g(x) = f(4x)$ and $h(x) = -f\left(\frac{1}{4}x\right)$

19. A ball is dropped from a height of 32 m. Acceleration due to gravity is -9.8 m/s^2. The height of the ball is given by $h(t) = -4.9t^2 + 32$.

   a) State the domain and range of the function.

   b) Write the equation for the height of the object if it is dropped on a planet with acceleration due to gravity of -11.2 m/s^2.

   c) Compare the domain and range of the function in part b) to those of the given function.

20. Describe the combination of transformations that must be applied to the base function $f(x)$ to obtain the transformed function $g(x)$. Then, write the corresponding equation and sketch its graph.

a) $f(x) = x$, $g(x) = -2f[3(x - 4)] - 1$

b) $f(x) = \frac{1}{x}$, $g(x) = \frac{1}{3}f\left[\frac{1}{4}(x - 2)\right] + 3$

21. For each function $f(x)$,

i) determine $f^{-1}(x)$

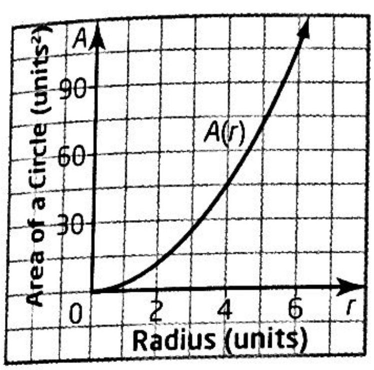
ii) graph $f(x)$ and its inverse

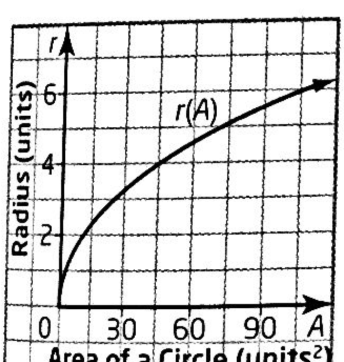
iii) determine whether the inverse of $f(x)$ is a function

a) $f(x) = 4x - 5$

b) $f(x) = 3x^2 - 12x + 3$

22. The relationship between the area of a circle and its radius can be modelled by the function $A(r) = \pi r^2$, where A is the area and r is the radius. The graphs of this function and its inverse are shown.





a) State the domain and range of the function $A(r)$.

b) Determine the equation of the inverse of the function. State its domain and range.

Chapter 3 Exponential Functions

23. A petri dish contains an initial sample of 20 bacteria. After 1 day, the number of bacteria has tripled.

a) Determine the population after each day for 1 week.

b) Write an equation to model this growth.

c) Graph the relation. Is it a function? Explain why or why not.

d) Assuming this trend continues, predict the population after

i) 2 weeks

ii) 3 weeks

e) Describe the pattern of finite differences for this relationship.

24. Tritium is a substance that is present in radioactive waste. It has a half-life of approximately 12 years. How long will it take for a 50-mg sample of tritium to decay to 10% of its original mass?

25. Apply the exponent rules first, if possible, and then evaluate.

a) $(-8)^{-2} + 2^{-6}$

b) $(3^{-3})^{-2} \div 3^{-5}$

c) $\left(\frac{2^3}{3^2}\right)^{-2}$

d) $\frac{(6^6)(6^{-3})}{6^2}$

26. Simplify.

a) $(4n^{-2})(-3n^5)$

b) $\frac{12c^{-3}}{15c^{-5}}$

c) $(3a^2b^{-2})^{-3}$

d) $\left(\frac{-2p^3}{3q^4}\right)^{-5}$

27. Evaluate.

a) $16^{-\frac{3}{4}}$

b) $\left(\frac{4}{9}\right)^{-\frac{1}{2}}$

c) $\left(-\frac{8}{125}\right)^{-\frac{2}{3}}$

28. Simplify. Express your answers using only positive exponents.

a) $\frac{a^{-2}b^3}{a^{\frac{1}{4}}b^{\frac{2}{3}}}$

b) $(u^{-\frac{2}{3}}v^{\frac{1}{4}})^{\frac{3}{5}}$

c) $w^{\frac{7}{8}} \div w^{-\frac{3}{4}}$

29. Graph each exponential function. Identify the

- domain
- range
- x- and y-intercepts, if they exist
- intervals of increase/decrease
- asymptote

a) $y = 5\left(\frac{1}{3}\right)^x$ b) $y = -4^{-x}$

30. A radioactive sample has a half-life of 1 month. The initial sample has a mass of 300 mg.

a) Write a function to relate the amount remaining, in milligrams, to the time, in months.

b) Restrict the domain of the function so the mathematical model fits the situation it is describing.

31. Sketch the graph of each function, using the graph of $y = 8^x$ as the base. Describe the effects, if any, on the

- asymptote
- domain
- range

a) $y = 8^{x-4}$ b) $y = 8^{x+2} + 1$

32. Write the equation for the function that results from each transformation applied to the base function $y = 11^x$.

a) reflect in the x-axis and stretch vertically by a factor of 4

b) reflect in the y-axis and stretch horizontally by a factor of $\frac{4}{3}$

33. At midnight, one hospital patient contracts an unknown virus. By 1 a.m., three other hospital patients are diagnosed with the same virus. One hour later, nine more patients are found to have the virus, and by 3 a.m., 27 more patients have the virus. The virus continues to spread this way through the hospital.

a) Make a table of values to relate the number of new patients who are diagnosed with the virus to time, in 1-h intervals.

b) Make a scatter plot. Describe the trend.

c) What type of function represents the spread of this virus? Justify your answer.

d) Determine an equation to model this relation. Explain the method you chose to determine the equation.

Chapter 4 Trigonometry

34. a) To find trigonometric ratios for 240° using a unit circle, a reference angle of 60° is used. What reference angle should you use to find the trigonometric ratios for 210°?

b) Use the unit circle to find exact values of the three primary trigonometric ratios for 210° and 240°.

35. A fishing boat is 15 km south of a lighthouse. A yacht is 15 km west of the same lighthouse.

a) Use trigonometry to find an exact expression for the distance between the two boats.

b) Check your answer using another method.

36. Without using a calculator, determine two angles between 0° and 360° that have a sine of $\frac{\sqrt{3}}{2}$.

37. The point P(−2, 7) is on the terminal arm of ∠A.

a) Determine the primary trigonometric ratios for ∠A and ∠B, such that ∠B has the same sine as ∠A.

b) Use a calculator and a diagram to determine the measures of ∠A and ∠B, to the nearest degree.

38. Consider right $\triangle PQR$ with side lengths $PQ = 5$ cm and $QR = 12$ cm, and $\angle Q = 90°$.

a) Determine the length of side PR.

b) Determine the six trigonometric ratios for $\angle P$.

c) Determine the six trigonometric ratios for $\angle R$.

39. Determine two possible measures between 0° and 360° for each angle, to the nearest degree.

a) $\csc A = \frac{7}{3}$

b) $\sec B = -6$

c) $\cot C = -\frac{9}{4}$

40. An oak tree, a chestnut tree, and a maple tree form the corners of a triangular play area in a neighbourhood park. The oak tree is 35 m from the chestnut tree. The angle between the maple tree and the chestnut tree from the oak tree is 58°. The angle between the oak tree and the chestnut tree from the maple tree is 49°.

a) Sketch a diagram of this situation. Why is the triangle formed by the trees an oblique triangle?

b) Is it necessary to consider the ambiguous case? Justify your answer.

c) Determine the unknown distances, to the nearest tenth of a metre. If there is more than one possible answer, determine both.

41. At noon, two cars travel away from the intersection of two country roads that meet at a 34° angle. Car A travels along one of the roads at 80 km/h and car B travels along the other road at 100 km/h. Two hours later, both cars spot a jet in the air between them. The angle of depression from the jet to car A is 20° and the distance between the jet and the car is 100 km. Determine the distance between the jet and car B.

42. Isra parks her motorcycle in a lot on the corner of Canal and Main streets. She walks 60 m west to Maple Avenue, turns 40° to the left, and follows Maple Avenue for 90 m to the office building where she works. From her office window on the 18th floor, she can see her motorcycle in the lot. Each floor in the building is 5 m in height.

a) Sketch a diagram to represent this problem, labelling all given measurements.

b) How far is Isra from her motorcycle, in a direct line?

43. Prove each identity.

a) $\frac{1}{\sin^2 \theta} + \frac{1}{\cos^2 \theta} = \left(\tan \theta + \frac{1}{\tan \theta}\right)^2$

b) $\csc \theta\left(\frac{1}{\cot \theta} + \frac{1}{\sec \theta}\right) = \sec \theta + \cot \theta$

Chapter 5 Trigonometric Functions

44. a) Sketch a periodic function, $f(x)$, with a maximum value of 5, a minimum value of −3, and a period of 4.

b) Select a value a for x, and determine $f(a)$.

c) Determine two other values, b and c, such that $f(a) = f(b) = f(c)$.

45. While visiting a town along the ocean, Bashira notices that the water level at the town dock changes during the day as the tides come in and go out. Markings on one of the piles supporting the dock show a high tide of 4.8 m at 6:30 a.m., a low tide of 0.9 m at 12:40 p.m., and a high tide again at 6:50 p.m.

a) Estimate the period of the fluctuation of the water level at the town dock.

b) Estimate the amplitude of the pattern.

c) Predict when the next low tide will occur.

46. Consider the following functions.

i) $y = 4 \sin \left[\frac{1}{3}(x + 30°)\right] - 1$

ii) $y = -\frac{1}{2} \cos [4(x + 135°)] + 2$

a) What is the amplitude of each function?

b) What is the period of each function?

c) Describe the phase shift of each function.

d) Describe the vertical shift of each function.

e) **Use Technology** Graph each function. Compare the graph to the characteristics expected.

47. A sinusoidal function has an amplitude of 6 units, a period of 150°, and a maximum at (0, 4).

a) Represent the function with an equation using a sine function.

b) Represent the function with an equation using a cosine function.

48. The height, h, in metres, above the ground of a rider on a Ferris wheel after t seconds can be modelled by the sine function $h(t) = 9 \sin [2(t - 30)] + 10$.

a) **Use Technology** Graph the function.

b) Determine

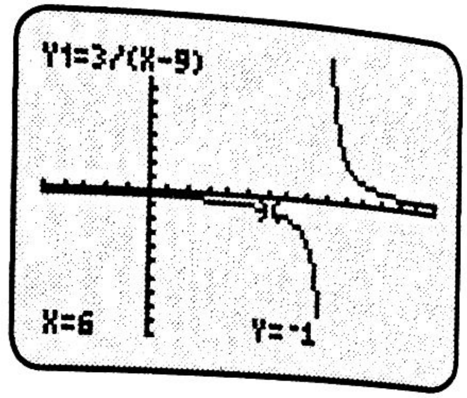
i) the maximum and minimum heights of the rider above the ground

ii) the height of the rider above the ground after 30 s

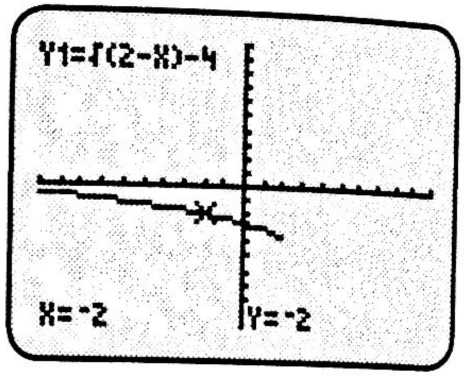
iii) the time required for the Ferris wheel to complete one revolution

Course Review, pages 471–477

1. a) domain $\{x \in \mathbb{R}, x \neq 9\}$, range $\{y \in \mathbb{R}, y \neq 0\}$



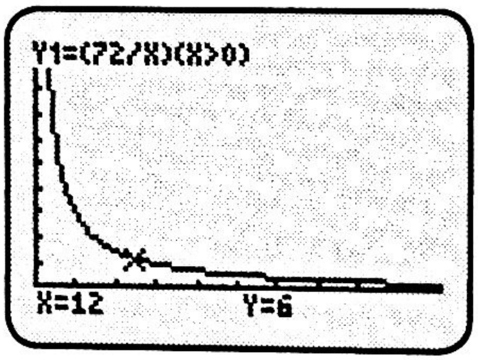
b) domain $\{x \in \mathbb{R}, x \leq 2\}$, range $\{y \in \mathbb{R}, y \geq -4\}$



2. C

3. a) i) 24 years **ii)** 12 years **iii)** 8 years

b)



c) domain $\{r \in \mathbb{R}, r > 0\}$, range $\{n \in \mathbb{R}, n > 0\}$

4. a) minimum $\left(-\frac{3}{2}, -\frac{23}{4}\right)$ **b)** maximum $(3, 2)$

5. 150 items

6. a) $-4\sqrt{3}$ **b)** $7\sqrt{3} - \frac{26}{3}\sqrt{5}$

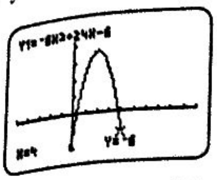
7. a) $39 + 10\sqrt{5}$ **b)** $3\sqrt{6} - 2$

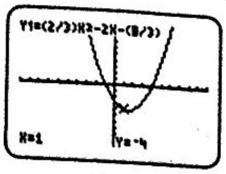
8. 6π

9. a)–d) all solutions are $x = 2$, $x = 25$

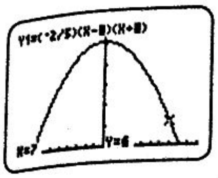
10. 2.1 m by 7.1 m

11. a) $y = -6x^2 + 24x - 6$ b) $y = \frac{2}{3}x^2 - 2x - \frac{8}{3}$





12. a)



b) $y = -\frac{2}{5}(x - 8)(x + 8)$

c) 25.6 m

13. Answers may vary. Sample answer: Yes, they intersect at a horizontal distance of approximately 142 m.

14. a) i) The functions appear to be equivalent.

ii) Algebraically the functions are equivalent.

iii) The functions seem to yield the same graph.

b) i) The functions appear to be equivalent.

ii) Algebraically the functions are not equivalent.

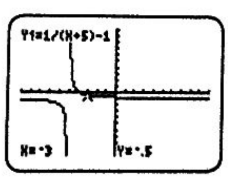
iii) The functions yield the same graph except at $x = 5$.

15. a) $-\frac{7x}{8}$, $x \neq 0$, $x \neq 1$

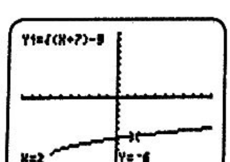
b) $\frac{-4x(x - 4)}{x + 2}$, $x \neq -9$, $x \neq -2$, $x \neq 0$, $x \neq 2$

c) $\frac{(x - 5)(x - 2)}{3}$, $x \neq -5$, $x \neq 4$

16. a) $f(x) = \frac{1}{x}$; $y = f(x + 5) - 1$; translate left 5 units and down 1 unit;
domain $\{x \in \mathbb{R}, x \neq -5\}$,
range $\{y \in \mathbb{R}, y \neq -1\}$



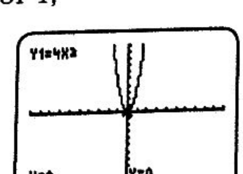
b) $f(x) = \sqrt{x}$, $y = f(x + 7) - 9$; translate left 7 units and down 9 units;
domain $\{x \in \mathbb{R}, x \geq -7\}$,
range $\{y \in \mathbb{R}, y \geq -9\}$



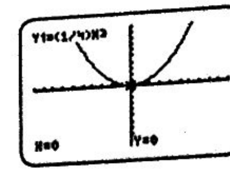
17. a) reflection in the x-axis and then the y-axis

b) reflection in the y-axis

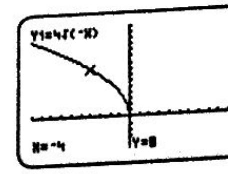
18. a) i) $g(x) = 4x^2$; reflection in the y-axis and a vertical stretch by a factor of 4;
domain $\{x \in \mathbb{R}\}$,
range $\{y \in \mathbb{R}, y \geq 0\}$



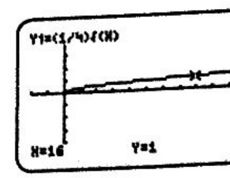
ii) $h(x) = \frac{1}{4}x^2$; vertical compression by a factor of $\frac{1}{4}$; domain $\{x \in \mathbb{R}\}$,
range $\{y \in \mathbb{R}, y \geq 0\}$



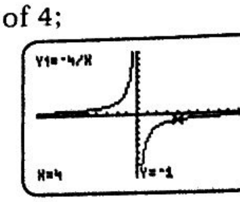
iii) $g(x) = 4\sqrt{-x}$; reflection in the y-axis and a vertical stretch by a factor of 4;
domain $\{x \in \mathbb{R}, x \leq 0\}$,
range $\{y \in \mathbb{R}, y \geq 0\}$



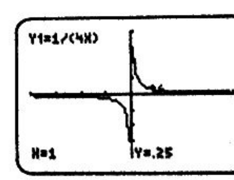
iv) $h(x) = \frac{1}{4}\sqrt{x}$; vertical compression by a factor of $\frac{1}{4}$;
domain $\{x \in \mathbb{R}, x \geq 0\}$,
range $\{y \in \mathbb{R}, y \geq 0\}$



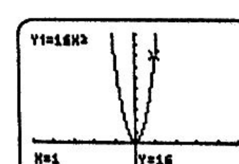
v) $g(x) = -\frac{4}{x}$; reflection in the y-axis and a vertical stretch by a factor of 4;
domain $\{x \in \mathbb{R}, x \neq 0\}$,
range $\{y \in \mathbb{R}, y \neq 0\}$



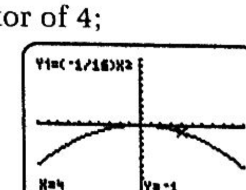
vi) $h(x) = \frac{1}{4x}$; vertical compression by a factor of $\frac{1}{4}$;
domain $\{x \in \mathbb{R}, x \neq 0\}$,
range $\{y \in \mathbb{R}, y \neq 0\}$



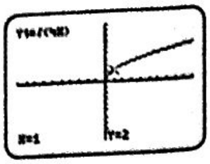
b) i) $g(x) = 16x^2$; horizontal compression by a factor of $\frac{1}{4}$;
domain $\{x \in \mathbb{R}\}$,
range $\{y \in \mathbb{R}, y \geq 0\}$



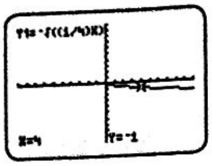
ii) $h(x) = -\frac{1}{16}x^2$; reflection in the x-axis and a horizontal stretch by a factor of 4;
domain $\{x \in \mathbb{R}\}$,
range $\{y \in \mathbb{R}, y \leq 0\}$



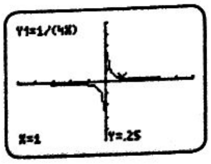
iii) $g(x) = \sqrt{4x}$; horizontal compression by a factor of $\frac{1}{4}$;
domain $\{x \in \mathbb{R}, x \geq 0\}$,
range$\{y \in \mathbb{R}, y \geq 0\}$



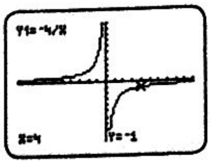
iv) $h(x) = -\sqrt{\frac{1}{4}x}$; reflection in the x-axis and a horizontal stretch by a factor of 4;
domain $\{x \in \mathbb{R}, x \geq 0\}$,
range $\{y \in \mathbb{R}, y \leq 0\}$



v) $g(x) = \frac{1}{4x}$; horizontal compression by a factor of $\frac{1}{4}$;
domain $\{x \in \mathbb{R}, x \neq 0\}$,
range $\{y \in \mathbb{R}, y \neq 0\}$



vi) $h(x) = -\frac{4}{x}$; reflection in the x-axis and a horizontal stretch by a factor of 4;
domain $\{x \in \mathbb{R}, x \neq 0\}$,
range $\{y \in \mathbb{R}, y \neq 0\}$

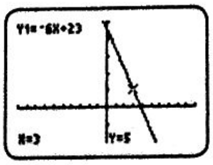


19. a) domain $\{t \in \mathbb{R}, 0 \leq t \leq 2.56\}$, range $\{h \in \mathbb{R}, 0 \leq h \leq 32\}$

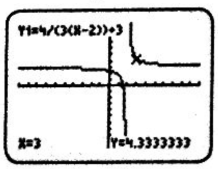
b) $h(t) = -5.6t^2 + 32$

c) Answers may vary. Sample answer: only the domain changes, domain $\{t \in \mathbb{R}, 0 \leq t \leq 2.39\}$

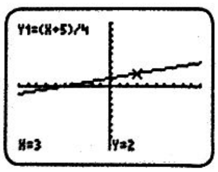
20. a) reflection in the x-axis, vertical stretch by a factor of 2, horizontal compression by a factor of $\frac{1}{3}$, and then translation of 4 units right and 1 unit down;
$g(x) = -6x + 23$



b) vertical compression by a factor of $\frac{1}{3}$, horizontal stretch by a factor of 4, and then translation of 2 units right and 3 units up; $g(x) = \frac{4}{3(x - 2)} + 3$



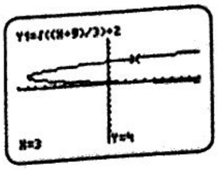
21. a) i) $f^{-1}(x) = \frac{x + 5}{4}$ **ii)**



iii) The inverse is a function.

b) i) $f^{-1}(x) = \pm\sqrt{\frac{x + 9}{3}} + 2$

ii)



iii) The inverse is not a function.

22. a) domain $\{r \in \mathbb{R}, r \geq 0\}$, range $\{A \in \mathbb{R}, A \geq 0\}$

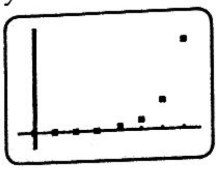
b) $r = \sqrt{\frac{A}{\pi}}$; domain $\{A \in \mathbb{R}, A \geq 0\}$, range $\{r \in \mathbb{R}, r \geq 0\}$

23. a)

Day	Number of Bacteria
0	20
1	60
2	180
3	540
4	1 620
5	4 860
6	14 580
7	43 740

b) $y = 20(3)^t$

c)



This is a function because each element in the domain corresponds to exactly one element in the range.

d) i) 95 659 380 **ii)** 209 207 064 100

e) Answers may vary. Sample answer: The consecutive values in each difference column increases by a factor of 3.

24. approx 40 years

25. a) $\frac{1}{2^5} = \frac{1}{32}$ **b)** $3^{11} = 177\ 147$

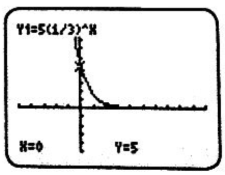
c) $\frac{3^4}{2^6} = \frac{81}{64}$ **d)** 6

26. a) $-12n^3$ **b)** $\frac{4}{5c^2}$ **c)** $\frac{b^6}{27a^6}$ **d)** $-\frac{243q^{20}}{32p^{15}}$

27. a) $\frac{1}{8}$ **b)** $\frac{3}{2}$ **c)** $\frac{25}{4}$

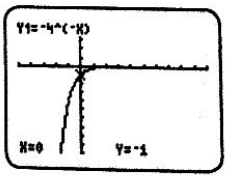
28. a) $\frac{b^{\frac{7}{3}}}{a^{\frac{9}{4}}}$ **b)** $\frac{v^{\frac{3}{20}}}{u^{\frac{2}{5}}}$ **c)** $w^{\frac{13}{8}}$

29. a)



domain $\{x \in \mathbb{R}\}$, range $\{y \in \mathbb{R}, y > 0\}$, no x-intercept, y-intercept is 5, always decreasing, and asymptote $y = 0$

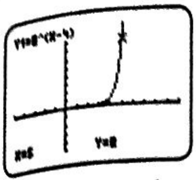
b)



domain $\{x \in \mathbb{R}\}$, range $\{y \in \mathbb{R}, y < 0\}$, no x-intercept, y-intercept is -1, always increasing, and asymptote $y = 0$

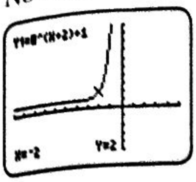
30. a) $A = 300\left(\frac{1}{2}\right)^t$ **b)** domain $\{t \in \mathbb{R}, t \geq 0\}$

31. a)



No effect on domain, range, or asymptote.

b)



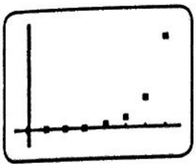
No effect on the domain, but the asymptote changes to $y = 1$ and the range changes to $\{y \in \mathbb{R}, y > 1\}$.

32. a) $y = -4(11)^x$ **b)** $y = 11^{-\frac{3}{4}x}$

33. a)

Time (1-h intervals)	Number of New Patients Diagnosed
0	1
1	3
2	9
3	27
4	81
5	243
6	729
7	2187

b)



c) exponential

d) $y = 3^t$

34. a) 30°

b) $\sin 240° = -\frac{\sqrt{3}}{2}$, $\cos 240° = -\frac{1}{2}$, $\tan 240° = \sqrt{3}$; $\sin 210° = -\frac{1}{2}$, $\cos 210° = -\frac{\sqrt{3}}{2}$, $\tan 210° = \frac{1}{\sqrt{3}}$

35. a) $15\sqrt{2}$ km **b)** Answers may vary.

36. 60°, 120°

37. a) $\sin A = \frac{7}{\sqrt{53}}$, $\cos A = -\frac{2}{\sqrt{53}}$, $\tan A = -\frac{7}{2}$

$\sin B = \frac{7}{\sqrt{53}}$, $\cos B = \frac{2}{\sqrt{53}}$, $\tan B = \frac{7}{2}$

b) $\angle A = 106°$, $\angle B = 74°$

38. a) 13 cm

b) $\sin P = \frac{12}{13}$, $\cos P = \frac{5}{13}$, $\tan P = \frac{12}{5}$

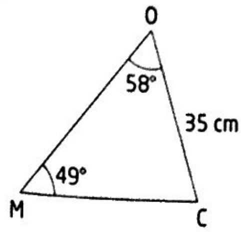
$\csc P = \frac{13}{12}$, $\sec P = \frac{13}{5}$, $\cot P = \frac{5}{12}$

c) $\sin R = \frac{5}{13}$, $\cos R = \frac{12}{13}$, $\tan R = \frac{5}{12}$

$\csc R = \frac{13}{5}$, $\sec R = \frac{13}{12}$, $\cot R = \frac{12}{5}$

39. a) 25°, 155° **b)** 99°. 261° **c)** 156°, 336°

40. a)



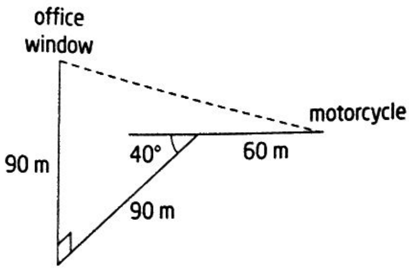
Since the triangle has no right angle, it is an oblique triangle.

b) It is not necessary to consider the ambiguous case because two angles and a side are given.

c) 39.3 m, 44.3 m

41. 38.7 km

42. a)



b) 167.6 m

43.–44. Answers may vary.

45. a) 12 h and 20 min

b) 1.95 m **c)** 1:00 a.m.

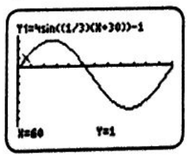
46. a) i) amplitude 4 **ii)** amplitude $\frac{1}{2}$

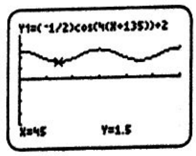
b) i) 1080° **ii)** 90°

c) i) 30° to the left **ii)** 135° to the left

d) i) 1 unit down **ii)** 2 units up

e)

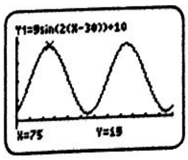




47. a) $y = 6 \sin\left[\frac{12}{5}(x + 37.5°)\right] - 2$

b) $y = 6 \cos\left(\frac{12}{5}x\right) - 2$

48. a)



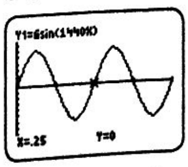
b) i) maximum 19 m, minimum 1 m

ii) 10 m **iii)** 3 min

49. a) 0.25 s **b)** 1440

c) 6 V **d)** $V = 6 \sin 1440t$

e)



Each tick mark on the x-axis represents 0.125 s. Each tick mark on the y-axis represents 1V.

50. a) $\frac{40}{9}$ **b)** −2187