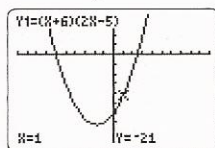


Answers

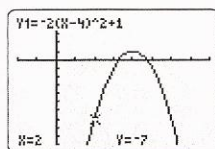
CHAPTER 1

Prerequisite Skills, pages 2–3

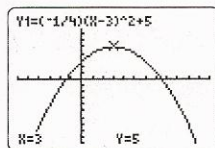
1. a) 7 b) -5 c) 11 d) 5 e) $8x + 7$ f) $-12x + 7$
 2. a) 1 b) 10 c) 6 d) 0 e) $24x^2 - 18x + 3$ f) $18x^2 - 9x + 1$
 3. a) $m = 3, b = 2$ b) $m = -\frac{1}{2}, b = \frac{3}{2}$ c) $m = 5, b = 7$
 d) $m = -5, b = -11$ e) $m = -\frac{1}{2}, b = 1$
 4. a) $y = 3x + 5$ b) $y = 4x + 4$ c) $y = -4x + 31$
 d) $y = -7x + 12$
 5. a) linear b) neither c) quadratic
 6. a) $\{x \in \mathbb{R}, \{y \in \mathbb{R}, y \geq 1\}\}$ b) $\{x \in \mathbb{R}, x \neq -5\}, \{y \in \mathbb{R}, y \neq 0\}$
 c) $\{x \in \mathbb{R}, x \leq \frac{1}{2}\}, \{y \in \mathbb{R}, y \geq 0\}$
 7. Answers may vary. Sample answers:
 a) $y = -3(x + 1)(x - 1)$ b) $y = -2x^2 - 3x + 3$
 c) $y = 4\left(x + \frac{1}{2}\right)(x - 2)$
 8. a) x -intercepts $-6, \frac{5}{2}$; vertex $\left(-\frac{7}{4}, -\frac{289}{8}\right)$; opens up;
 $\{x \in \mathbb{R}, \{y \in \mathbb{R}, y \geq -\frac{289}{8}\}\}$



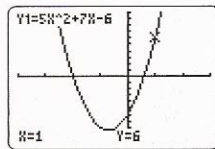
- b) x -intercepts approximately 3.29, 4.71; vertex (4, 1); opens down; $\{x \in \mathbb{R}, \{y \in \mathbb{R}, y \leq 1\}\}$



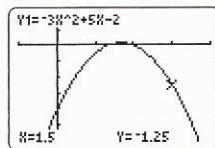
- c) x -intercepts approximately -1.47, 7.47; vertex (3, 5); opens down; $\{x \in \mathbb{R}, \{y \in \mathbb{R}, y \leq 5\}\}$



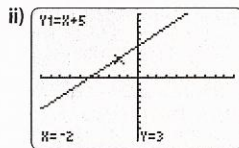
- d) x -intercepts $-2, \frac{3}{5}$; vertex $\left(-\frac{7}{10}, -\frac{169}{20}\right)$; opens up;
 $\{x \in \mathbb{R}, \{y \in \mathbb{R}, y \geq -\frac{169}{20}\}\}$



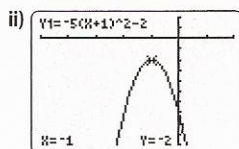
- e) x -intercepts $1, \frac{2}{3}$; vertex $\left(\frac{5}{6}, \frac{1}{12}\right)$; opens down; $\{x \in \mathbb{R}, \{y \in \mathbb{R}, y \leq \frac{1}{12}\}\}$



9. a) vertical stretch and a reflection in the x -axis b) vertical compression c) horizontal compression d) horizontal stretch and a reflection in the y -axis e) reflection in the y -axis
 10. a) i) $f(x) = x + 5$

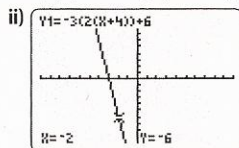


- iii) $\{x \in \mathbb{R}, \{y \in \mathbb{R}\}\}$
 b) i) $f(x) = -5(x + 1)^2 - 2$



- iii) $\{x \in \mathbb{R}, \{y \in \mathbb{R}, y \leq -2\}\}$

- c) i) $f(x) = -3[2(x + 4)] + 6$



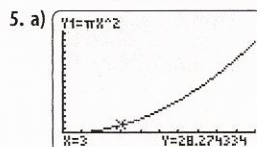
- iii) $\{x \in \mathbb{R}, \{y \in \mathbb{R}\}\}$

11. a) i) vertical stretch by a factor of 2, reflection in the x -axis, translation 3 units left, translation 1 unit up
 ii) $y = -2(x + 3) + 1$ b) i) vertical compression by a factor of $\frac{1}{3}$, translation 2 units down ii) $y = \frac{1}{3}x^2 - 2$
 12. vertical stretch by a factor of 3, horizontal stretch by a factor of 2, reflection in the y -axis, translation 1 unit right, translation 2 units up

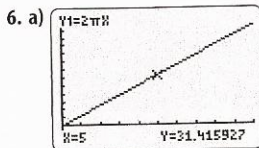
1.1 Power Functions, pages 11–14

1. a) No. b) Yes. c) Yes. d) Yes. e) No. f) No.
 2. a) 4, 5 b) 1, -1 c) 2, 8 d) 3, $-\frac{1}{4}$ e) 0, -5 f) 2, 1
 3. a) i) even ii) negative iii) $\{x \in \mathbb{R}, \{y \in \mathbb{R}, y \leq 0\}\}$ iv) line v) quadrant 3 to quadrant 4 b) i) odd ii) positive iii) $\{x \in \mathbb{R}, \{y \in \mathbb{R}\}\}$ iv) point v) quadrant 3 to quadrant 1 c) i) odd ii) negative iii) $\{x \in \mathbb{R}, \{y \in \mathbb{R}\}\}$ iv) point v) quadrant 2 to quadrant 4 d) i) even ii) negative iii) $\{x \in \mathbb{R}, \{y \in \mathbb{R}, y \leq 0\}\}$ iv) line v) quadrant 3 to quadrant 4 e) i) odd ii) negative iii) $\{x \in \mathbb{R}, \{y \in \mathbb{R}\}\}$ iv) point v) quadrant 2 to quadrant 4

End Behaviour	Function
Extends from quadrant 3 to quadrant 1	$y = 5x, y = 4x^2$
Extends from quadrant 2 to quadrant 4	$y = -x^3, y = -0.1x^{11}$
Extends from quadrant 2 to quadrant 1	$y = \frac{3}{7}x^2, y = 2x^4$
Extends from quadrant 3 to quadrant 4	$y = -x^6, y = -9x^{10}$



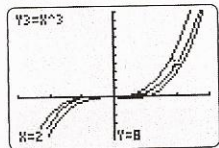
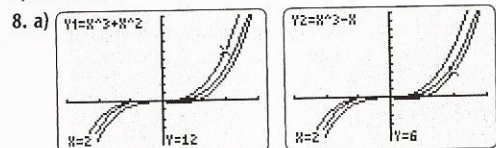
- b) $\{r \in \mathbb{R}, 0 \leq r \leq 10\}; \{A \in \mathbb{R}, 0 \leq A \leq 100\pi\}$
 c) Answers may vary. Sample answer: similarities—vertex (0, 0), x -intercept, y -intercept, end behaviour; differences—domain, range, shape



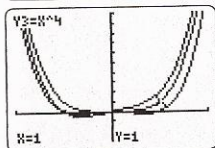
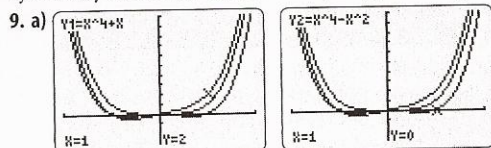
b) $\{r \in \mathbb{R}, 0 \leq r \leq 10\}$, $\{C \in \mathbb{R}, 0 \leq C \leq 20\pi\}$

c) Answers may vary. Sample answer: similarities—end behaviour; differences—domain, range, shape

7. a) power (cubic) b) exponential c) periodic d) power (constant)
e) none of these f) none of these g) power (quadratic)

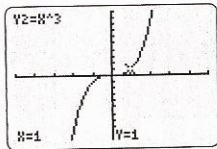
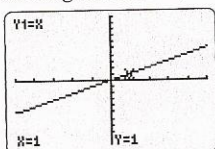


b) $\{x \in \mathbb{R}\}$, $\{y \in \mathbb{R}\}$, quadrant 3 to quadrant 1, point symmetry about $(0, 0)$; x-intercept 0, y-intercept 0

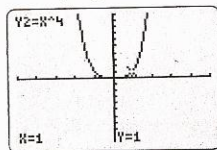
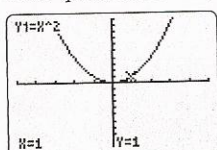


b) $\{x \in \mathbb{R}\}$, quadrant 2 to quadrant 1; x-intercept 0, y-intercept 0

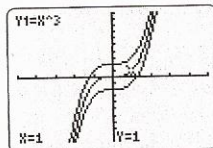
10. Answers may vary. Sample answer: similarities—extend from quadrant 1 to quadrant 3 (positive leading coefficient), $\{x \in \mathbb{R}\}$, $\{y \in \mathbb{R}\}$, point symmetry about $(0, 0)$; differences—shape, extend from quadrant 2 to quadrant 4 (negative leading coefficient)



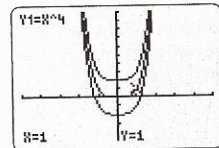
11. Answers may vary. Sample answer: similarities—extend from quadrant 2 to quadrant 1 (positive leading coefficient), domain, line symmetry; differences—shape, range, extend from quadrant 3 to quadrant 4 (negative leading coefficient)



12. a) Answers may vary. Sample answer: similarities—quadrant 3 to quadrant 1, domain, range, point symmetry, shape; difference—shifted vertically



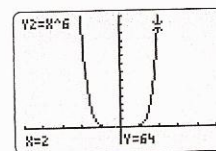
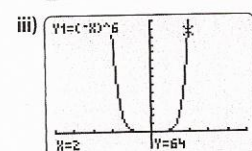
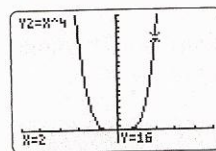
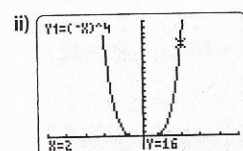
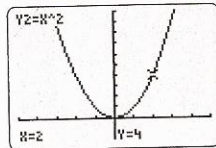
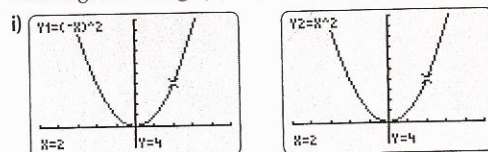
b) Answers may vary. Sample answer: similarities—quadrant 2 to quadrant 1, domain, line symmetry, shape; differences—range, shifted vertically



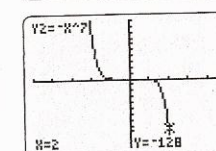
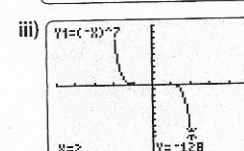
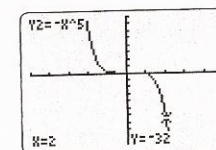
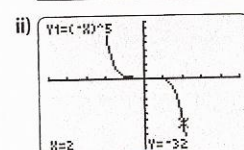
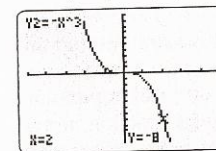
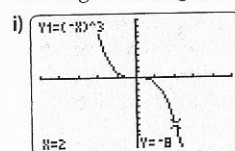
c) c is a vertical shift of x^n , $n \in \mathbb{N}$

13. Answers may vary. Sample answer: path of a river: $y = x^3$, $\{x \in \mathbb{R}\}$, $\{y \in \mathbb{R}\}$; cross-section of a valley: $y = x^2$, $\{x \in \mathbb{R}\}$, $\{y \in \mathbb{R}, y \geq 0\}$

14. a) $y = (-x)^{2n}$ is the same graph as $y = x^{2n}$, n is a non-negative integer, $(-x)^{2n} = (-1)^{2n}(x)^{2n} = x^{2n}$



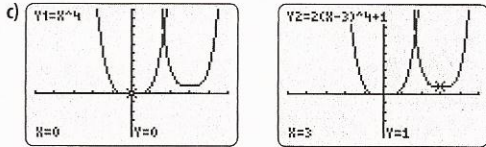
b) $y = (-x)^{2n+1}$ has the same graph as $y = -x^{2n+1}$, n is a non-negative integer, $(-x)^{2n+1} = (-1)^{2n+1}(x)^{2n+1} = -x^{2n+1}$



c) Answers may vary. Sample answer: $y = (-x)^{2n}$ has the same graph as $y = x^{2n}$, n is a non-negative integer, $(-x)^{2n} = (-1)^{2n}(x)^{2n} = x^{2n}$; $y = (-x)^{2n+1}$ has the same graph as $y = -x^{2n+1}$, n is a non-negative integer, $(-x)^{2n+1} = (-1)^{2n+1}(x)^{2n+1} = -x^{2n+1}$

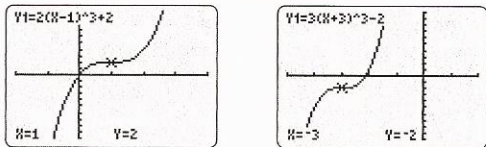
15. a) Answers may vary. Sample answer: For the graph of $y = ax^n$, if $a > 0$, vertical stretch by a factor of a if $0 < a < 1$ vertical compression by a factor of a ; if $1 < a < 0$, vertical compression by a factor of a and a reflection in the x -axis; if $a < -1$, vertical stretch by a factor of a and a reflection in the x -axis

16. a) vertical stretch by a factor of 2, translation 3 units right, translation 1 unit up b) vertical stretch by a factor of 2, translation 3 units right, translation 1 unit up



17. a) a is a vertical stretch or compression; b is a shift left or right; k is a shift up or down

b) Answers may vary. Sample answers:



18. 124

19. (4, 6), (6, 9)

1.2 Characteristics of Polynomial Functions, pages 26–29

1. a) 4 b) 5 c) 4 d) 5 e) 3 f) 6

2. a)–d)

Graph	Sign of Leading Coefficient	End Behaviour (quadrants)	Symmetry	Local Maximum Points (#)	Local Minimum Points (#)
1a)	+	2 to 1		2	1
1b)	+	3 to 1		2	2
1c)	–	3 to 4		1	2
1d)	–	2 to 4		2	2
1e)	–	2 to 4	point	1	1
1f)	–	3 to 4	line	2	3

d) number of maximums and minimums is less than or equal to the degree of the function plus one; number of local maximums and local minimums is less than or equal to the degree of the function minus one

3.	i) End Behaviour (quadrants)	ii) Constant Finite Differences	iii) Value of Constant Finite Differences
a)	2 to 1	2nd	2
b)	2 to 4	3rd	–24
c)	3 to 4	4th	–168
d)	3 to 1	5th	72
e)	2 to 4	1st	–1
f)	3 to 4	6th	–720

4. a) 2, –4 b) 4, –2 c) 3, –2 d) 4, 1 e) 3, 6 f) 5, $\frac{1}{2}$

5. a) odd b) even c) odd d) even

6.

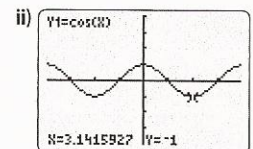
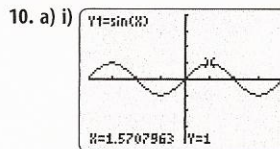
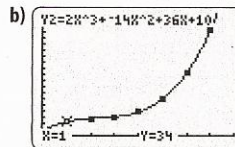
Graph	a) Least Degree	b) Sign of Leading Coefficient	c) End Behaviour (quadrants)	d) Symmetry
5a)	5	–	2 to 4	point
5b)	4	+	2 to 1	line
5c)	3	+	3 to 1	point
5d)	6	–	3 to 4	none

7. a) i) 3 ii) + iii) 1 b) i) 4 ii) – iii) –1

8. a) quartic b) fourth, 0.03 c) quadrant 2 to quadrant 1

d) $x \geq 0$ e) Answers may vary. Sample answer: They represent when the profit is equal to zero. f) \$1 039 500

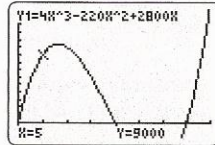
9. a) i) cubic (degree 3) ii) 2



10. a) i)

ii) Answers may vary.

11. a) $x \geq 0$, $V(x) \geq 0$



b) $V(x) = 4x(x - 35)(x - 20)$; x -intercepts 35, 20, 0 c) 24

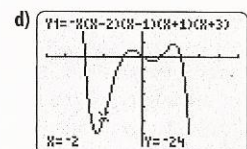
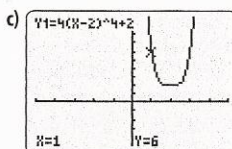
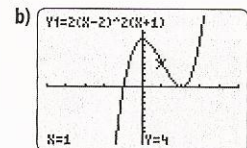
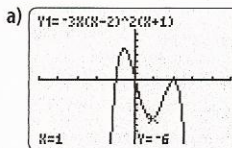
12. a) cubic b) third, –4.2 c) quadrant 2 to 4

d) $\{d \in \mathbb{R}, d \geq 0\}$, $\{r \in \mathbb{R}, r \geq 0\}$

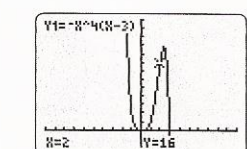
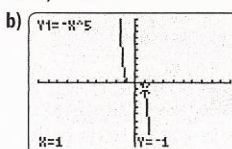
13. a) Answers may vary. Sample answer: quadrant 2 to quadrant 1, $\{x \in \mathbb{R}\}$, $\{P(t) \in \mathbb{R}, P(t) \geq 11\,732\}$, no x -intercepts

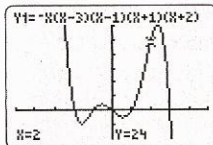
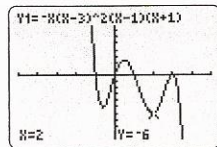
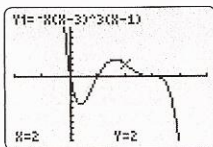
b) 144 c) 12 000 d) 69 000 e) 13 years

15. Answers may vary. Sample answers:

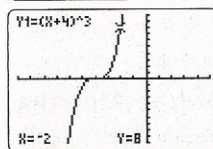
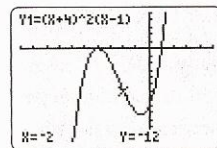
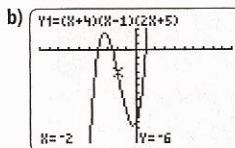


16. a) 1 to 5



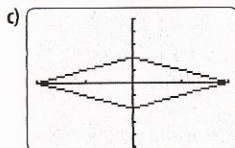
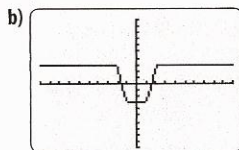
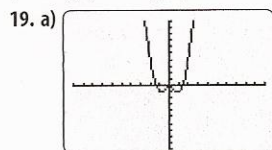


17. a) i) cubic ii) cubic iii) cubic



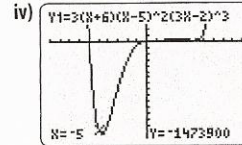
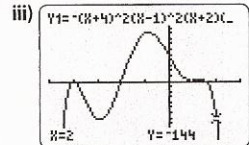
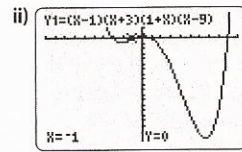
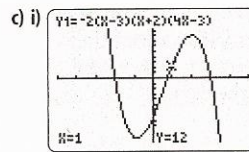
c) Answers may vary. Sample answer: The number of x -intercepts equals the number of roots of the equation.

18. a) i) $S(r) = 6\pi r^2(r+1)$ ii) $V(r) = 3\pi r^3$ b) Answers may vary. Sample answer: $S(r)$ cubic, two x -intercepts, $\{r \in \mathbb{R}\}$, $\{S \in \mathbb{R}\}$, quadrant 3 to quadrant 1; $V(r)$ cubic, one x -intercept, $\{r \in \mathbb{R}\}$, $\{V \in \mathbb{R}\}$, quadrant 3 to quadrant 1



1.3 Equations and Graphs of Polynomial Functions, pages 39–41

1. a) i) 3, + ii) quadrant 3 to quadrant 1 iii) 4, $-3, \frac{1}{2}$
 b) i) 4, - ii) quadrant 3 to quadrant 4 iii) $-2, 2, 1, -1$
 c) i) 5, + ii) quadrant 3 to quadrant 1 iii) $-\frac{2}{3}, 4, -1, \frac{3}{2}$
 d) i) 6, - ii) quadrant 3 to quadrant 4 iii) $-5, 5$
 2. a) i) $-4, -\frac{1}{2}, 1$ ii) positive, $-4 < x < -\frac{1}{2}, x > 1$; negative $x < -4, -\frac{1}{2} < x < 1$ iii) no zeros of order 2 or 3
 b) i) $-1, 4$ ii) negative for all intervals iii) could have zeros of order 2 c) i) $-3, 1$ ii) positive $x < -3, x > 1$; negative $-3 < x < 1$ iii) could have zeros of order 3 d) i) $-5, 3$
 ii) positive $x < -5, -5 < x < 3$; negative $x > 3$ iii) could have zeros of order 2 e) i) $-2, 3$ ii) positive $-2 < x < 3, x > 3$; negative $x < -2$ iii) could have zeros of order 2 and 3
 3. a) i) $-2, 3, \frac{3}{4}$, all order 1 ii) $-3, -1, 1, 2, 3$, all order 1 iii) order 2: $-4, 1$; order 1: $-2, \frac{3}{2}$ iv) order 3: $\frac{2}{3}$; order 2: 5; order 1: -6 b) graph in part ii) is even; others are neither

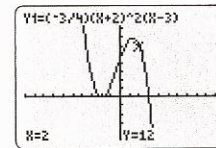


4. b) line, even; this function has line symmetry about the y -axis because it is an even function. a) c) d) neither, neither; there is no symmetry about the origin or about the y -axis because these functions are neither even nor odd.

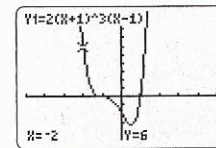
5. a) i) even ii) line b) i) odd ii) point c) i) neither ii) neither d) i) neither ii) neither e) i) even ii) line

6. a) $y = -2(x+3)(x+1)(x-2)$ b) $y = -3(x+2)^2(x-1)^2$ c) $y = 0.5(x+2)^3(x-1)^2$ d) $y = (x+5)^3$

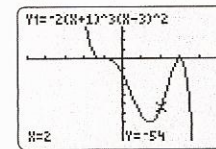
7. a) $y = -\frac{3}{4}(x+2)^2(x-3)$, neither



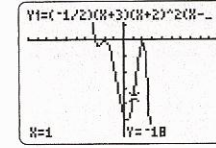
b) $y = 2(x+1)^3(x-1)$, neither



c) $y = -2(x+1)^3(x-3)^2$, neither



d) $y = -\frac{1}{2}(x+3)(x+2)^2(x-2)^2$, neither



8. a) point b) line c) point d) point

9. Answers may vary. Sample answers:

