Answer Keys

Chapter 1: Quadratic Functions

Tutorial 1.1

1. (a) $(x-2)^2-4$
   (b) $2(x+3)^2-15$
   (c) $-(x-4)^2+9$
   (d) $-\frac{1}{2}(x+5)^2+\frac{37}{2}$
2. (a) Min value = 5, when $x=3$
   (b) Max value = 9, when $x=0$
   (c) Min value $=-\frac{7}{10}$, when $x=-4$
   (d) Max value = −8, when $x=1$
3. (a) Min value = 1, when $x=2$
   (b) Max value $=\frac{5}{4}$, when $x=-\frac{1}{2}$
   (c) Min value = −32, when $x=\frac{9}{2}$
   (d) Max value = 52, when $x=-15$

Tutorial 1.2

1. (i) (1, −2)
   (ii) Min value = −2
2. (i) $-\left(x+\frac{3}{4}\right)^2+\frac{49}{16}$
   (ii) $\left(-\frac{3}{4}, 3\frac{1}{16}\right)$
3. (a) $\left(2\frac{1}{2}, -12\frac{1}{2}\right)$, minimum point
   (b) (−3, 1.6), maximum point
4. Min value $=\frac{59}{12}$, when $x=\frac{1}{6}$
5. (i) Maximum point
   (ii) $p=1, q=2.5$
6. (a) Lies entirely above the x-axis
   (b) Lies entirely below the x-axis
7. (i) $p>0$ and $q+\frac{49}{4p}<0$
   (ii) $p=2$ and $q=-10$
8. No
9. (a) $y=2(x-3)^2+8$
   (b) $y=-(x-3)^2-3$
10. (a) False (b) True
    (c) False (d) False

Tutorial 1.3

1. (i) Greatest height = 21 m, when horizontal distance = 5 m
   (ii) 13.8 m, upward
2. (i) 0 (iii) 6 s
3. (i) $-x^2+50x$
   (iii) 625 cm²
4. Option A: $y=-0.5(x-2)^2+5$
   Option B: $y=-0.1(x-3)^2+3.9$

Quick Test 1

1. (i) $2(x-3)^2-15$
   (ii) (3, −15) (iii) −15
3. (ii) (1, 0.75) (iv) 2

Chapter 2: Equations and Inequalities

Tutorial 2.1

1. (a) 1 or $\frac{2}{3}$ (b) 1 or $\frac{2}{3}$
2. (i) $-3(x-3)^2+22$
   (ii) $3\pm\sqrt{\frac{22}{3}}$
3. (i) Greatest height = 14 m, when $t=2$
   (ii) 2.16 s
4. (ii) 0

Tutorial 2.2

1. $k\leq\frac{16}{3}$
2. $p=-2, q=2$
3. $-\frac{9}{8}$
4. $\pm\frac{7}{2}$
5. (a) No (b) $p<\frac{143}{16}$
7. (a) 1 (b) 0
8. Yes
9. (a) $k>\frac{1}{36}$ (b) $k<-\frac{2}{3}$
10. (i) $4ac<-9$ and $a>0$
    (ii) $a=2, c=-5$
11. (ii) No real roots
12. (i) $-7k^2-1$

Tutorial 2.3

1. $x=\frac{5}{9}, y=\frac{23}{27}$ or $x=-\frac{1}{2}, y=\frac{1}{2}$
2. $x=-\frac{48}{5}, y=\frac{72}{5}$ or $x=6, y=4$
3. $x=-\frac{4}{5}, y=-\frac{5}{16}$ or $x=\frac{3}{4}, y=\frac{1}{3}$
4. (i) $a=1, b=-2$
   (ii) $x=4, y=-\frac{3}{2}$
5. (1, 7), (−7, −1)
6. $\frac{25}{3}$ units
7. (a) No (b) Yes
8. 2
10. (ii) $b=1, c=-2$
11. (i) $p>-\frac{9}{2}$ (ii) $p=-\frac{9}{2}$
12. 15 or −17
13. (i) (5, −16), (−2, 26)
14. (i) (1, 14) (ii) 4

Tutorial 2.4

1. (a) $-\frac{5}{2}<x<\frac{1}{4}$
   (b) $x<-\frac{3}{5}$ or $x>1$
   (c) $-1\leq x\leq\frac{7}{6}$
   (d) $x\leq-\frac{7}{5}$ or $x\geq\frac{7}{5}$
   (e) $-5\leq x\leq 5$
   (f) $x\leq-\frac{22}{9}$ or $x\geq-\frac{16}{9}$
2. $-4<x<\frac{2}{3}$
3. $x^2-2x\leq 15$
4. $-10\leq x\leq 10$
5. (i) $x\leq\frac{15}{8}$
   (ii) $-\frac{5}{4}<x<6$; $-\frac{5}{4}<x\leq\frac{15}{8}$
6. $p>\frac{3}{5}$
7. No real solutions
8. $p<-\frac{1}{2\sqrt{2}}$ or $p>\frac{1}{2\sqrt{2}}$
9. (a) $2x^2-12x+25$
   (b) $-x^2+8x-21$
10. $c=-12, k=6$
11. (a) $k\leq 0$ or $k\geq 8$
    (b) $-\frac{6}{5}<k<\frac{6}{5}$

12. (a) $p < \frac{1}{9}$ or $p > 1$
    (b) $p = \frac{1}{9}$ or $p = 1$
    (c) $\frac{1}{9} < p < 1$
13. (i) $-\frac{5}{2} < x < 1$
    (iii) -5

Quick Test 2

1. $\frac{8}{5} \leqslant x \leqslant \frac{9}{5}$
2. (i) $p = -\frac{13}{6}$, $q = 1$
   (ii) Min value $= -\frac{25}{144}$, when $x = \frac{13}{12}$
   (iii) 1
3. $-2 < k < 2$
4. (i) $\left(-\frac{5}{2}, -\frac{29}{4}\right)$, $(1, -2)$
5. (i) 21 (ii) $P\left(-\frac{2}{5}, -\frac{57}{5}\right)$

Chapter 3: Surds

Tutorial 3.1

1. (a) 7 (b) $8\sqrt{3}$
   (c) 9 (d) $2\sqrt{5}$
2. (a) $20\sqrt{2}$ (b) $5\sqrt{5}$
3. (a) $29 - 3\sqrt{3}$
   (b) $177 + 72\sqrt{6}$
   (c) 46 (d) $507 - 20\sqrt{35}$
4. $75 + 6\sqrt{5}$; $a = 75$, $b = 6$
5. (i) $8 - 2\sqrt{15}$
   (ii) $309 - 80\sqrt{15}$
6. (a) $5\sqrt{11}$ (b) $3\sqrt{10} + 3$
   (c) $\frac{9\sqrt{2} - 8}{49}$ (d) $-\frac{11 + 7\sqrt{3}}{13}$
7. $20 - 7\sqrt{7}$
8. $\frac{35 - 26\sqrt{3}}{37}$
9. $5 - 16\sqrt{5}$; $a = 5$, $b = -16$
11. $a = \frac{5}{11}$, $b = \frac{8}{11}$
12. (i) $32\sqrt{2} - 11$
    (ii) $\frac{107}{7}\sqrt{2} - \frac{97}{7}$

Tutorial 3.2

1. (a) 31 (b) 1
   (c) 2 (d) $\frac{99}{16}$
   (e) 16 (f) 40
2. ± 5
4. 6
5. $10(\sqrt{2} + 1)$
6. $-\frac{73}{11} - \frac{43}{11}\sqrt{5}$
7. $a = 11$, $b = -9$
8. $a = -8$, $b = 4$
9. $a = 331$, $b = -234$
10. (i) $a + 2\sqrt{ab} + b$
    (ii) $8 + \sqrt{5}$
11. (i) 5 (ii) $a = \frac{1}{5}$, $b = -\frac{2}{5}$
13. (i) $\left(\frac{27}{2} - \frac{5}{2}\sqrt{2}\right)$ cm^2
    (ii) $\left(\frac{135}{2} - \sqrt{2}\right)$ cm^2

Quick Test 3

1. $\frac{19}{16}\sqrt{2} - 4$
2. $5\sqrt{7} - 14$
3. -1
4. $a = 86$, $b = -48$
5. (a) $(6 - \sqrt{3})$ cm
   (b) $(294 + 303\sqrt{3})$ cm^3

Chapter 4: Polynomials, Cubic Equations and Partial Fractions

Tutorial 4.1

1. (a) Yes (b) Yes
   (c) No (d) Yes
2. (i) (a) $3x^3 + 2x^2 + 4x + 7$; 3
   (b) $6x^3 - 10x^2 + 50x - 49$; 3
3. $P(x) = 4x^3 + x^2 - 9$, $Q(x) = -4x^3 + 7x + 10$
4. (a) $3x^3 - 19x^2 - 61x - 35$
   (b) $20 + 10x + 58x^2 - x^3 - 6x^4$
5. 13
6. -2
7. $x^2 + 3x - 8$
8. (a) $A = 4$, $B = -4$
   (b) $A = 5$, $B = 5$
   (c) $A = -10$, $B = 3$, $C = 8$
   (d) $A = 21$, $B = -6$, $C = -1$
9. $a = 1$, $b = -8$
10. (a) 28 (b) -5
11. $x^2 - 4x + 5$
12. (i) -6
    (ii) $12x^3 + 5x^2 + 6x - 8 = (3x^2 + 2x + 2)(4x - 1) - 6$
13. $Q(x) = 3x - 5$, $R(x) = 4x + 1$
14. (i) 2 (ii) $A = 27, B = -31$
15. Quotient $= 5x^3 - 6y^2$, Remainder $= 10y^3$
16. (a) True
    (b) Insufficient information to conclude
    (c) Insufficient information to conclude
    (d) Insufficient information to conclude

Tutorial 4.2

1. (a) -251 (b) $\frac{31}{9}$
2. (a) -15 (b) -3
3. 3
4. -2
5. 6 or 4
6. $\frac{4}{7}$
7. (ii) $a = 1$, $b = 33$
8. $\frac{8}{21}$
9. No
11. (i) $\frac{7}{3}$
12. 8
13. (i) $\frac{23}{18}$ (ii) 4
14. $a = 1$, $b = 13$
15. $p = 37$, $q = -40$
16. $4x^3 - 23x^2 + 14x + 5$

Tutorial 4.3

1. (a) $(x + 3)(x^2 - 3x + 9)$
   (b) $(x - 10)(x^2 + 10x + 100)$
   (c) $(4x + y^2)(16x^2 - 4xy^2 + y^4)$
   (d) $(x^2 - 5y^3)(x^4 + 5x^2y^3 + 25y^6)$
   (e) $4x(4x^2 + 3y^2)$
   (f) $2(x - 3y)(x^2 + 3y^2)$
2. (ii) $(a - b)(a^2 + ab + b^2)$
   (iii) $(2x^2 - 7y^4)(4x^4 + 14x^2y^4 + 49y^8)$
3. (i) $(27x^3 + 8)(27x^3 - 8)$
   (ii) $(3x + 2)(3x - 2)(9x^2 + 6x + 4)(9x^2 - 6x + 4)$
4. (a) $(x - 1)(x - 2)(x - 3)$
   (b) $(x - 5)(x + 4)^2$
   (c) $(5x - 4)(x + 1)(x + 3)$
   (d) $-(7x - 6)(2x - 1)(x + 2)$
5. (ii) $(5x - 1)(x - 1)(x + 4)$
6. (ii) $(x + 3)(x - 2)(x - 4)$
7. (i) -8
   (iii) $(6x + 1)(x + 2)(x - 4)$
8. (a) -2, 1 or 8
   (b) 4 or $-\frac{1}{3}$ (c) $\frac{1}{2}$
   (d) 3, $\frac{-11 + \sqrt{41}}{8}$ or $\frac{-11 - \sqrt{41}}{8}$

9. (i) $a = 14, b = 3$
   (ii) $\frac{1}{3}$ or $\frac{1}{2}$
10. (i) -104 (iv) -2
11. $(5x-3)(25x^2+15x+9)$
12. (i) $a = 4, b = 30$
    (ii) 1
13. (i) 2, -1 or -4
    (iii) $a = -1, b = 15$
14. (i) $3x^4 - 18x^3 + 33x^2 - 18x - 72$
    (ii) 2

Tutorial 4.4

1. (a) $\frac{5}{3x-1} + \frac{6}{x+2}$
   (b) $\frac{2}{8x-3} - \frac{1}{4x+7}$
   (c) $\frac{9}{x+2} - \frac{4}{x-2}$
   (d) $\frac{1}{6x} - \frac{5}{6(5x+1)}$
2. (a) $\frac{3}{4x+7} - \frac{7}{(4x+7)^2}$
   (b) $\frac{8}{5x-3} + \frac{1}{(5x-3)^2}$
3. (a) $\frac{3}{x} + \frac{3}{x^2} - \frac{2}{x-9}$
   (b) $\frac{6}{x+3} - \frac{5}{x-4} + \frac{1}{(x-4)^2}$
4. (a) $\frac{2}{x} + \frac{1}{x^2+1}$
   (b) $\frac{x}{x^2+4} - \frac{1}{x+2}$
   (c) $\frac{2}{3x-1} + \frac{4x-1}{x^2+9}$
   (d) $\frac{7}{5x} - \frac{3x}{x^2+5}$
5. $\frac{4}{x-4} - \frac{3}{x} - \frac{4}{x^2}$
6. (a) $4 + \frac{6x-1}{(2x+7)(x-2)}$
   (b) $x+1 + \frac{5x-1}{(3x-1)^2}$
7. $2 - \frac{1}{x-5} + \frac{3}{x+4}$
8. (i) $-x+2 - \frac{3x+33}{9-x^2}$
   (ii) $-x+2 - \frac{4}{x+3} + \frac{7}{x-3}$
9. (ii) $3 - \frac{5}{x-4} + \frac{4x}{x^2+16}$
10. (ii) $\frac{7}{3(x+1)} - \frac{4x-1}{3(x^2+5)}$

Quick Test 4

1. $3x - 2$
2. (i) $a = 8, b = 20$
   (ii) $(x+4)(x+2)^2$
   (iii) 0
3. (i) -1360 (ii) $-\frac{1}{3}$, 2 or 4
4. (i) $x^2 + 4$ (ii) $\frac{2}{2x-1} + \frac{4-x}{x^2+4}$

Chapter 5: Binomial Theorem and its Applications

Tutorial 5.1

1. (a) 720 (b) 36
   (c) 4320 (d) 120
2. (a) 8 (b) 1
   (c) 21 (d) 126
3. 26
4. (ii) $k = 3, n = 19$
5. (i) $1 + 5b + 10b^2 + 10b^3 + \ldots$
   (ii) (a) $1 - 5b + 10b^2 - 10b^3 + \ldots$
   (b) $1 + 20b^2 + 160b^4 + 640b^6 + \ldots$
6. (i) $1 + 8x + 28x^2 + 56x^3 + \ldots$
   (ii) 168
7. (i) (a) $1 - 12x + 60x^2 + \ldots$
   (b) $1 + 21x + 189x^2 + \ldots$
   (ii) $1 + 9x - 3x^2 + \ldots$
8. (i) (a) $1 + 20x + 160x^2 + \ldots$
   (b) $1 - 15x + 90x^2 + \ldots$
   (ii) $1 + 5x - 50x^2 + \ldots$
9. $\frac{55}{4}, -\frac{231}{16}$
10. $-\frac{3}{2}$
11. $a = -\frac{5}{4}, n = 12$
12. (i) $n = 2k + 3$

Tutorial 5.2

1. (a) $7776 - 6480x + 2160x^2 - 360x^3 + \ldots$
   (b) $\frac{1}{x^7} + \frac{7}{x^4} + \frac{21}{x} + 35x^2 + \ldots$
2. (a) $256a^4 + \frac{256}{3}a^3y + \frac{32}{3}a^2y^2 + \frac{16}{27}ay^3 + \ldots$
   (b) $\frac{1}{256y^8} - \frac{bx}{16y^7} + \frac{7b^2x^2}{16y^6} - \frac{7b^3x^3}{4y^5} + \ldots$
4. $59\,049x^{10} - 393\,660x^7 + 1\,180\,980x^4 + \ldots$
5. $a = 2, b = 1024, c = 1125$
6. (i) $\binom{12}{r}(3)^{12-2r}(-1)^r x^{36-4r}$
   (ii) $36 - 4r$
   (iii) (a) $-160\,380x^{24}$
   (b) $\frac{22}{2187}$
7. (ii) $\frac{1}{2}$
8. (i) 5
9. $-5\,406\,720x^2$
10. 2 449 440
11. (a) $2500x^3$
    (b) $\frac{9375}{4}$
13. $p = 3, q = 2, n = 9$
14. $a = \frac{1}{3}, b = -1050$
15. $\frac{1}{3}$
16. (i) $6561 + 8748x + 5103x^2 + 1701x^3 + \ldots$
    (ii) -4860
17. (i) 3
18. $a = -\frac{1}{2}, b = 1$

Tutorial 5.3

1. (i) $2187 - \frac{5103}{2}x + \frac{5103}{4}x^2 - \frac{2835}{8}x^3 + \ldots$
   (ii) 2161.6
2. (i) $1 + 8x + 28x^2 + 56x^3 + \ldots$
   (ii) $1 + 8z + 36z^2 + 112z^3 + \ldots$
   (iii) 1.0837
3. (i) $1 - 99x + 4851x^2 + \ldots$
   (ii) 0.495 (iii) No
4. (i) $81 + 108p + 54p^2 + 12p^3 + p^4$
   (ii) $81 + 216x + 108x^2 - 120x^3 + \ldots$
   (iii) 1.9 or 0.1; 0.1

Quick Test 5

1. $n = 9, b = -3$
2. (i) -84
3. (i) $729 - 18x + \frac{5}{27}x^2 + \ldots$
   (ii) $-\frac{1}{3}$
4. (i) $10a^4b + 20a^2b^3 + 2b^5$
   (ii) 218

Chapter 6: Exponential and Logarithmic Functions

Tutorial 6.1

1. (a) $\frac{1}{45}$ (b) $\frac{1}{24}$
   (c) 64 (d) 0
   (e) $7^{\frac{2}{x}-3x}$ (f) 11^{6-10x}
2. $126(5^{-2x})$
3. 102 400
4. 0.311
5. (a) $-\frac{2}{3}$ (b) $\frac{1}{2}$
   (c) ± 3 (d) $\frac{3}{2}$ or -1
   (e) $-\frac{1}{4}$ (f) $\frac{20}{9}$
6. -1 or 0
7. (a) 1 (b) 6
8. (i) $u^2 - 12u + 27 = 0$
   (ii) 1 or 2
9. $x = -\frac{3}{11}, y = \frac{4}{11}$
10. $x = \frac{9}{13}, y = -\frac{3}{13}$ or $x = 3, y = -1$
11. $x = 2, y = \frac{1}{2}$

Tutorial 6.2

1. $x > 4$
2. 5.5
3. (a) $3 = \log_5 125$
   (b) $-2 = \log_7 \frac{1}{49}$
   (c) $p = \log_8 0.9$
   (d) $q = \log_a 6$
4. (a) $3^5 = 243$ (b) $11^{-3} = \frac{1}{1331}$
   (c) $6^x = 7$ (d) $y^z = 9.08$
5. $y = \frac{1}{2}\lg(x+3)$
6. $y = \frac{1}{2}(5x - e^{k+6})$
7. (a) 2^{4m+3n} (b) 2^{2m-n}
8. $k = 2m - \frac{3}{2}n$
9. (a) 1.48 (b) -0.243
   (c) -0.560 (d) 0.0445
10. (a) 4 (b) $\frac{2}{3}$
    (c) 128 (d) 0
    (e) 0 (f) 5
11. (a) 64 (b) 0.607
    (c) 0 (d) 5
    (e) 4 (f) 1 or 2
    (g) e (h) 168

Tutorial 6.3

1. (a) $\lg 60$ (b) $\log_3 56$
2. (a) 3 (b) 1
3. (a) $\ln 7$ (b) $\log_5 15$
4. (a) 1 (b) 0
5. (a) $\frac{1}{4}(p+q)$
   (b) $1+\frac{1}{2}(p-q)$
6. (a) -2 (b) $\frac{2}{3}$
   (c) 48 (d) 2
7. (a) $\lg 70$ (b) $\log_2 \frac{5}{4}$
   (c) $\lg 100\,000a^3$
   (d) $\ln\frac{\sqrt{b^5}}{e^8}$
8. (a) 1.37 (b) 4.87
11. (a) $1 + 2p$ (b) $2 - p$
    (c) $(1 + 2p)^2$ (d) $5(2^p)$
12. (a) 2.58 (b) -3.06
    (c) 3.9 (d) -0.05
13. (a) $m + n$ (b) $2m - n$
    (c) $1 + n - m$
    (d) $\frac{2}{m+2n}$

Tutorial 6.4

1. (a) 512 (b) 6.31
   (c) 134 (d) 6.09
   (e) 8 (f) $-\frac{8}{9}$
   (g) 3.63 (h) -1370
2. (a) 7 (b) No solutions
   (c) $\frac{1}{4}$ (d) 6
   (e) 2 (f) $\frac{5}{2}$ or $\frac{9}{2}$
3. 77
4. (i) 8 (ii) 2
5. 10 or $\frac{1}{10}$
6. (a) 9 or $\frac{1}{9}$ (b) e^2
   (c) 10 (d) $\frac{1}{2}$
   (e) $\frac{7}{3}$ or $\frac{7}{2}$ (f) $\frac{9}{2}$
7. $\frac{1}{9}$
8. 30
9. $x = \frac{5}{2a}$
11. (ii) 656
12. $\frac{1}{162}$
13. (a) 0.774 (b) 0.312
    (c) 0.0458 (d) -4.32
    (e) 2.99 (f) -2.94
14. (a) 0.426 (b) 2.87
    (c) 3.03 (d) 56.4
    (e) 2.27 (f) 0.185
15. 0
16. 0.916 or 1.10
17. $x = 3, y = \frac{1}{2}$
18. $x = \frac{3}{2}, y = \frac{3}{4}$

Tutorial 6.5

3. (ii) $x \geqslant 0$
4. (ii) $0 < x < 1$
5. (ii) $y = 2 - 3x$; 2 solutions
6. (i) $a = 2, b = 0, c = 16$

Tutorial 6.6

1. (i) 0.000 121
   (ii) 56.2 g
2. (i) 72 g (iii) 49.5 g
3. 9.2
4. (i) 4.10 (ii) No

Quick Test 6

1. ± 2
2. (i) 10 (ii) 1.53
4. (i) $p = \frac{9q^2}{1-3q}$
   (ii) $p > 0$
5. (i) $u = x^3$
   (ii) $\sqrt{5}$
6. (ii) $y = \frac{1}{3}x - 2$; 2 solutions
7. $x = \frac{1}{3}, y = -\frac{2}{3}$

Chapter 7: Coordinate Geometry

Tutorial 7.1

1. (a) (7, 1) (b) $\left(-1\frac{1}{2}, -\frac{3}{4}\right)$
   (c) (8, −3.5) (d) (4.4, −6)
2. (a) (−6, −2) (b) (4, 1)
3. $\left(-\frac{1}{2}, 1\frac{3}{4}\right)$
5. (i) $D(-4, 0)$ (ii) No
6. $C(9, 0), D(1, 4)$

Tutorial 7.2

1. (a) 63.4° (b) 59.0°
2. $a = -\sqrt{3}, b = 1$
3. (a) $\frac{47}{7}$ (b) 2

4. (a) (i) $10h - 3k = 36$
(ii) $h = 6, k = 8$
(b) $5h + 6k = 0$
5. (a) $\frac{103}{15}$ (b) $\frac{13}{15}$
7. 1
8. (a) Neither (b) Perpendicular
9. (a) No (b) Yes
(c) No (d) No

Tutorial 7.3

1. $y = -\frac{3}{5}x + 8$
2. $y = 4x + 15$
3. $y = -\frac{7}{5}x + \frac{58}{5}$
4. $y = -\frac{1}{4}x - \frac{15}{8}$
5. (a) $y = \frac{3}{4}x - 2$
(b) $y = -\frac{5}{2}x - \frac{23}{4}$
(c) $x = -\frac{5}{2}$
(d) $y = -\frac{3}{2}$
6. $2x + 10y = 13a + 21$
7. (i) $B(5, 7)$
(ii) $M\left(\frac{9}{2}, \frac{7}{4}\right)$, $D\left(4, -\frac{7}{2}\right)$
8. (ii) $Q(6, 3)$ (iii) $R(9, -6)$
9. (i) $A(1, 1), D(0, -6)$
(ii) $l_{CD}: y = \frac{3}{5}x - 6$;
$l_{BC}: y = 7x - 70$
(iii) $B(11, 7)$
10. (i) $y = 4x - 11$
(ii) $A(4, 5)$

Tutorial 7.4

1. 37 units^2
2. 18.5 units^2
3. $\frac{1}{2}$ or $\frac{17}{2}$
4. 33.5 units^2
5. (i) No (ii) 20 : 29
6. (i) $A(-5, 3), B(1, 6), C(4, 2)$
(ii) 16.5 units^2
(iii) 3.64 units
(iv) $D\left(-2, \frac{8}{3}\right)$
7. (i) $B(-2, 5), D(0, 1)$
(ii) 10 units^2
(iv) 5
8. (ii) $D(-1.4, 10.8)$
(iii) 10.8 units^2

Tutorial 7.5

1. (a) 5 units, $(-4, 0)$
(b) 1 unit, $\left(\frac{1}{2}, -\frac{2}{3}\right)$
2. (a) $x^2 + (y - 5)^2 = 36$
(b) $(x + 8)^2 + (y - 1)^2 = 32$
(c) $(x - 3)^2 + (y + 7)^2 = 9$
(d) $(x + 9)^2 + (y - 2)^2 = 169$
3. (a) 12 units, $(3, -7)$
(b) $\sqrt{\frac{53}{2}}$ units, $\left(-\frac{5}{2}, \frac{7}{2}\right)$
4. (i) $(x - 2)^2 + (y + 3)^2 = 40$
(ii) Inside (iii) 36 units^2
5. (i) $x^2 + y^2 - 12x - 16y + 50 = 0$
(ii) Outside
6. (i) $(x + 4)^2 + (y - 1)^2 = 25$
(ii) 6 units (iii) 1
(iv) -7
(v) $g = 7, f = -1, c = -8$
7. $(x - 15)^2 + (y - 10)^2 = 100$ or
$(x + 1)^2 + (y - 10)^2 = 100$
8. (i) $g = -7, f = 6, c = 60$
(ii) $y = \frac{4}{3}x - \frac{71}{3}$
(iii) $x = 2, x = 12$
9. (i) 36 (ii) 5 units
10. (iii) $(x + 4)^2 + (y - 6)^2 = 25$
(v) $y = \frac{3}{4}x + \frac{11}{4}$
11. (i) $(x - 1)^2 + (y - 3)^2 = 5$
(ii) $(x + 1)^2 + (y - 3)^2 = 5$
(iii) $A(2, 1), B(3, 4)$
(iv) $y = -\frac{1}{3}x + \frac{10}{3}$
(v) $P\left(0, \frac{10}{3}\right)$, $Q(-2, 4)$

Quick Test 7

1. (i) 144.5° (ii) $P(2.25, 4.25)$
2. (i) $D(5, -3)$ (ii) 7
(iii) 58 units^2
3. (i) $y = \frac{1}{2}x$ (ii) $B\left(\frac{48}{5}, \frac{24}{5}\right)$
(iii) 72 units^2
4. (i) $y = -2x - 1$
(ii) $(x + 2)^2 + (y - 3)^2 = 25$

Chapter 8: Applications of Straight Line Graphs

Tutorial 8.1

1. (a) $y = 6x^2 + 1; m = 6, c = 1$
(b) $y^3 = -4x + 28; m = -4, c = 28$
(c) $xy = \frac{5}{8}x^2 + \frac{1}{8}; m = \frac{5}{8}, c = \frac{1}{8}$
(d) $x\sqrt{y} = \frac{9}{2}\sqrt{y} + \frac{1}{2}; m = \frac{9}{2}, c = \frac{1}{2}$
(e) $\lg y = x + \lg 3; m = 1, c = \lg 3$
(f) $y = \frac{1}{6}\ln x - \frac{1}{2}\ln 6; m = \frac{1}{6}, c = -\frac{1}{2}\ln 6$
2. (a) $y = (\ln b)x + \ln a$
(b) $\frac{x}{\sqrt{y}} = \frac{1}{a}x^2 - \frac{b}{a}$;
3. $p = 4, q = 28$
4. $a = \sqrt{e}, b = -3$
6. (i) $y = 10^{\frac{15-x}{2}}$
(ii) 7
7. (i) $y = \ln\left(\frac{3}{4}x^3 + \frac{15}{4}\right)$
(ii) 6.63
(iii) $h = 7, k = 9$
8. (a) $y = \frac{3x^2 + 20}{5x}$
(b) $y = \pm\sqrt{10 - \frac{5}{4}\sqrt{x}}$
(c) $y = e^{\frac{50-7x}{4}}$
(d) $y = 4\sqrt{3} + 3 - x + \frac{\sqrt{3}}{x}$
9. (i) $y = x^2 + \ln x + 2$
(ii) $18 + \ln 4$
10. $\frac{36}{49}$

Tutorial 8.2

1. (ii) $a = 0.5, b = -0.2$
2. (i) $\ln y = b \ln x + \ln a$
(ii) $a = e, b = 1.5$
(iii) e^2
3. (ii) 75.2 g (iii) 0.02
(iv) 34.5 h
4. (i) 21 (ii) 21.5
(iii) 15.0

Quick Test 8

1. $a = 19, b = 1$
2. (ii) $p = 44.7, q = -12.1$
   (iii) 36.7 cm/s
   (v) 20.8

Chapter 9: Trigonometric Functions and Graphs

Tutorial 9.1

1. (a) $4\sqrt{3} - \frac{3}{4}$
   (b) $\frac{1}{3}$
2. 20°, 160°, 200°, 340°
3. $\frac{\pi}{8}, \frac{7\pi}{8}, \frac{9\pi}{8}, \frac{15\pi}{8}$
4. (a) $\frac{1}{2}$ (b) $-\frac{\sqrt{3}}{2}$
   (c) $-\frac{\sqrt{2}}{2}$ (d) $\frac{\sqrt{3}}{2}$
   (e) $-\sqrt{3}$ (f) -1
5. $\frac{1}{4}$
6. (a) $-\frac{\sqrt{2}}{2}$ (b) $-\frac{1}{2}$
   (c) $-\frac{1}{2}$ (d) $-\frac{\sqrt{3}}{2}$
   (e) $-\frac{\sqrt{3}}{3}$ (f) $\sqrt{3}$
7. (a) $-\frac{12}{13}$ (b) $-\frac{5}{12}$
8. (a) $\frac{p}{\sqrt{p^2+1}}$ (b) $\sqrt{p^2+1}$
9. (a) $\pm\frac{3}{5}$ (b) $\pm\frac{3}{4}$
10. (a) $\frac{k}{\sqrt{1-k^2}}$ (b) $\sqrt{1-k^2}$
    (c) k (d) $-\frac{\sqrt{1-k^2}}{k}$
11. (a) $-\frac{2}{\sqrt{5}}$ (b) $\sqrt{15}$
    (c) 2 (d) $\frac{\sqrt{15}}{4}$
12. (a) $-\frac{2}{9}$ (b) $-\frac{1}{\sqrt{10}}$
13. (a) $\frac{1}{7}$ (b) $-\frac{25}{6}$
    (c) $\frac{25}{7}$ (d) $\frac{24}{7}$
14. (a) $-\sqrt{k^2+1}$
    (b) $-\frac{\sqrt{k^2+1}}{2k}$
    (c) $-k - \frac{6}{k}$ (d) $-\frac{k^2+1}{k}$

Tutorial 9.2

1. (a) Amplitude = 1, period = 360°, range is $-1 \leq y \leq 1$
   (b) Amplitude = 3, period = 360°, range is $-3 \leq y \leq 3$
   (c) Amplitude = 1, period = 120°, range is $-1 \leq y \leq 1$
   (d) Amplitude = 3, period = 120°, range is $-3 \leq y \leq 3$
2. (i) $\frac{3}{2}, \frac{1}{2}$ (ii) $\frac{1}{2}, \pi$
3. (ii) 0
4. (a) Amplitude = 1, period = 360°, range is $-1 \leq y \leq 1$
   (b) Amplitude = 2, period = 360°, range is $-2 \leq y \leq 2$
   (c) Amplitude = 1, period = 180°, range is $-1 \leq y \leq 1$
   (d) Amplitude = 2, period = 180°, range is $-2 \leq y \leq 2$
5. (i) 3, 1 (ii) 1, 4π
6. (ii) (a) $y = 1$
   (b) $x = \frac{\pi}{2}$
7. (a) 180° (b) 180°
   (c) 360° (d) 360°
8. (i) $\frac{\pi}{3}$
   (iii) $x = \frac{\pi}{6}, x = \frac{\pi}{2}, x = \frac{5\pi}{6}$
9. (i) π
10. (i) $p = 5, q = -2$
    (ii) (0°, 3)
11. $\tan 4x$
12. $a = -3, b = 2, c = 1$
13. $a = 2, b = 4, c = -1$
14. (ii) 3
15. (ii) 1
    (iii) $a = \frac{1}{8\pi}, b = -0.5$
16. (i) 24 amperes
    (iii) $\frac{\pi}{2}$ ms

Quick Test 9

1. (a) $-\frac{1}{2}$ (b) $-\frac{\sqrt{5}}{2}$
2. (a) $a + \pi = c$
   (b) $a + b = \frac{\pi}{2}$
3. (i) $p = -3, q = -1$
   (ii) (180°, −2)
4. (i) 2, −6 (ii) 3, −3
   (iii) 720° (iv) 180°
   (vi) 3

Chapter 10: Trigonometric Equations and Identities

Tutorial 10.1

1. (i) $-90° \leq \sin^{-1} x \leq 90°$
   (ii) $0° \leq \cos^{-1} x \leq 180°$
2. (a) 60° (b) 120°
   (c) 30° (d) −60°
3. (a) $\frac{\pi}{6}$ (b) $\frac{3\pi}{4}$
   (c) $\frac{\pi}{3}$ (d) $-\frac{\pi}{4}$
4. (a) $\frac{\pi}{4}$ (b) π
5. (i) $x = \frac{\pi}{6}$ (ii) $\frac{1}{2} + \frac{1}{\sqrt{3}}$
6. (a) 60°, 120°
   (b) 60°, 300°
   (c) 45°, 225°
   (d) 203.6°, 336.4°
   (e) 135°, 225°
   (f) 99.5°, 279.5°
   (g) 18°, 162°
   (h) 101°, 259°
7. (a) 135°, 315°
   (b) 60°
   (c) 0°, 60°, 120°, 180°, 240°, 300°, 360°
   (d) 18.2°, 81.8°
   (e) 61.6°, 330.4°
   (f) 52.2°, 142.2°, 232.2°, 322.2°
   (g) 39.0°, 341.0°
   (h) 13.3°, 53.3°, 133.3°, 173.3°, 253.3°, 293.3°
8. (a) −153.4°, −333.4°
   (b) −21.0°, −111.0°, −201.0°
   (c) 587.0°
   (d) 103.3°, −166.7°
9. (a) $\frac{5\pi}{12}, \frac{7\pi}{12}, \frac{17\pi}{12}, \frac{19\pi}{12}$
   (b) 1.30, 2.87
   (c) 2.13, 5.27
   (d) 0.307

10. (ii) 99.7°, 170.3°
11. (i) −2 (ii) π
12. (i) 720° (ii) 4
    (iii) $a = -1, b = 4$
    (iv) 151.0°
13. (a) 60°, 120°, 240°, 300°
    (b) 45°, 135°, 225°, 315°
    (c) 1.23, 1.91, 4.37, 5.05
    (d) 0.554, 2.12
14. (a) 60°, 90°, 120°, 270°
    (b) 281.5°, 438.5°
    (c) 0.124, 1.33, 3.27, 4.47
    (d) $\pm\frac{\pi}{3}$

Tutorial 10.2

1. (a) −1 (b) −cosec x
2. (a) No (b) Yes
3. (a) 41.8°, 138.2°
   (b) 60°, 300°
   (c) 3.34, 6.08
   (d) $\frac{13\pi}{4}$
4. (a) −41.8°, −138.2°, −221.8°, −318.2°
   (b) −5.36, −4.18, 0.927, 2.10
5. 7.51, 8.11
6. (ii) 30°, 150°, 210°, 330°
7. 3

Tutorial 10.3

1. (a) $\frac{1}{\sqrt{2}}$ (b) $-\frac{\sqrt{3}}{2}$
   (c) 1 (d) $-\frac{1}{\sqrt{3}}$
6. (a) $\frac{7}{8}$ (b) $-\frac{7+48\sqrt{2}}{75}$
   (c) $\frac{24+14\sqrt{2}}{75}$
   (d) $\frac{625\sqrt{2}-756}{92}$
7. (ii) −7
8. (i) A: 2nd quadrant; B: 1st quadrant
   (ii) $-\frac{32}{13\sqrt{17}}$
9. (i) $\frac{1}{5}$ (ii) $\frac{9}{10}$
   (iii) $\frac{7}{2}$
10. (ii) $\frac{15\sqrt{3}+8}{13}$
11. (i) $\frac{2}{3}, \frac{5}{6}$
    (ii) $x = 40.9°, y = 7.3°$
12. (a) 73.9°, 253.9°
    (b) −2.71, −1.14, 0.429, 2.00
13. 132.8°
14. (i) Yes (ii) −0.322, 2.42
15. (ii) 90°, 109.5°, 250.5°, 270°

Tutorial 10.4

1. (a) $\frac{1}{\sqrt{2}}$ (b) $\frac{3\sqrt{3}}{2}$
   (c) $-\frac{2}{\sqrt{3}}$ (d) $1+\frac{1}{\sqrt{2}}$
2. (a) $\frac{24}{25}$ (b) $\frac{7}{25}$
   (c) $\frac{24}{7}$ (d) $-\frac{527}{625}$
3. (a) $\frac{\sqrt{k^2-9}}{3}$ (b) $\frac{k^2}{k^2-18}$
4. (a) $\frac{7}{25}$ (b) $\frac{44}{117}$
   (c) $-\frac{527}{625}$ (d) $\frac{\sqrt{10}}{10}$
6. (ii) π, 1
7. (a) 45°, 225°
   (b) 0.903, 2.24
   (c) −150°, −30°, 23.6°, 156.4°, 210°
   (d) $-\pi, -\frac{5\pi}{6}, -\frac{2\pi}{3}, -\frac{\pi}{2}, -\frac{\pi}{3}, -\frac{\pi}{6}, 0$
9. (i) $\cos\theta - \cos^2\theta$
   (ii) $\frac{2\pi}{3}, \frac{4\pi}{3}$
10. (i) $a = -2, b = \frac{1}{2}, c = 2$
    (iv) $-\frac{5\pi}{3}, -\frac{\pi}{3}, \pi$

Tutorial 10.5

5. (ii) 0.245, 3.39
6. (ii) 7.39
7. (ii) 1
8. (ii) 15°, 75°, 195°, 255°

Tutorial 10.6

1. (a) $5\sin(\theta + 36.870°)$
   (b) $\sqrt{26}\sin(\theta - 78.690°)$
   (c) $\frac{\sqrt{2}}{2}\cos(\theta - 45°)$
   (d) $3\cos(\theta + 19.471°)$
2. (a) Max value = 13, when $\theta = 22.6°$; Min value = −13, when $\theta = 202.6°$
   (b) Max value = 25, when $\theta = 343.7°$; Min value = −25, when $\theta = 163.7°$
   (c) Max value = 4, when $\theta = 120°, 300°$ Min value = 0, when $\theta = 30°, 210°$
   (d) Max value = 1, when $\theta = 233.1°$; Min value = $\frac{1}{21}$, when $\theta = 53.1°$
3. (a) 90°, 180° (b) 0.109, 3.87
5. 103.3°
6. (i) $\sqrt{2}\cos(2x - 45°)$
   (iii) 90°
7. (ii) $30 + \sqrt{1800}\cos\left(\theta - \frac{\pi}{4}\right)$
   (iii) 0.446, 1.13
8. (ii) $\sqrt{37}\cos(\theta - 0.165\,15)$
   (iii) 6.08 units, $\theta = 0.165$
9. (ii) 10.8 cm, $\theta = 0.381$

Quick Test 10

1. (i) −1.37, 0.197
2. (i) $\sin\theta, \frac{\sqrt{3}}{2}\sin\theta + \frac{1}{2}\cos\theta$
3. (ii) $\frac{\pi}{6}$
4. (ii) 0, 0.253, 2.89, π, 2π
5. (i) $CD = \frac{40}{\tan\theta}$, $DE = 120 - \frac{40}{\tan\theta}$
   (iii) 67.1

Secondary 3 Express End-of-year Specimen Paper A

1. $x \leq -\frac{4}{3}$ or $x \geq \frac{4}{3}$
2. (i) $45q - 32p < 2$
   (ii) $p = 2, q = 1$
3. $(5x + 4)(25x^2 - 20x + 16)$
4. (i) $(4\sqrt{3} - 3)$ cm
   (ii) $(3\sqrt{3} + 82)$ cm²
5. (i) $\frac{1}{2}$ (ii) $\frac{5}{2}$
6. 8
7. (a) $x = 1, y = -1$
   (b) 6561
8. (ii) $P_0 = 2.00, k = -0.08$
   (iii) $0.90
9. (ii) $\frac{\pi}{3}, \frac{2\pi}{3}$

10. (i) -8 (ii) $y = x + 2$

11. (a) (i) $\dfrac{p+q}{1-pq}$

(ii) $p = \dfrac{1}{2}, q = \dfrac{1}{4}$

(b) $\dfrac{\sqrt{5}}{5}$

12. (i) $-\dfrac{21}{16}$

(ii) $(x + 1)(2x + 1)(2x - 3)$

(iii) $\dfrac{4}{2x-3} - \dfrac{1}{2x+1} - \dfrac{2}{x+1}$

13. (ii) $\left(x - \dfrac{3}{2}\right)^2 + \left(y - \dfrac{1}{2}\right)^2 = \dfrac{25}{2}$

(iii) $D(1, -3)$

(iv) $\left(\dfrac{3}{2}, \dfrac{1+5\sqrt{2}}{2}\right)$

Secondary 3 Express End-of-year Specimen Paper B

2. 343

3. $\dfrac{1}{100}$ or 10

4. $\dfrac{4}{9}$

5. (i) ± 2

6. (ii) $\dfrac{1}{x-2} - \dfrac{1}{x+2} - \dfrac{4}{(x+2)^2}$

7. (i) $32\sqrt{11} - 40\sqrt{7}$

(ii) $(p - q)(p^2 + pq + q^2), 18 + \sqrt{77}$

8. (i) $6 \sin \theta - 4 \cos \theta$

(ii) $\sqrt{52} \sin (\theta - 33.690°)$

(iii) $54.0°$ (iv) $h > 7.21$

9. (i) $2^n - n(2^{n-3})x + n(n - 1)(2^{n-7})x^2 + \ldots$

(ii) 16

(iii) $a = 65\,536, b = -139\,264$

10. (ii) $(x + 10)^2 + (y - 10)^2 = 100$

(iii) $y = \dfrac{3}{4}x + 30$

(iv) $y = -\dfrac{4}{3}x + 80$

11. (ii) $B(1.6, 10.2)$

(iii) 108.8 units^2

12. (i) (a) 3, 180°

(b) 2, 360°

(ii) 90°, 221.8°, 318.2°

(iv) $x = 90°$ or $221.8° \leqslant x \leqslant 318.2°$