AS and A LEVEL
MATHEMATICS

A Level Maths & Further Maths Summer Preparation

Take your time to complete the following tasks and enjoy getting your brain back in gear ready for your return to your studies in September. It is vital that you complete this preparation as we will not be covering this in lesson time.

1. **Read the Study Skills in A Level Maths booklet**
2. **Complete these preparation exercises (solutions are at the end of the booklet)**
3. **For support on any skills, there is a Summer Preparation power point covering all of these areas that you can work through. In addition to the power point, Key Skills videos on Dr Frost Maths are referenced at the start of each exercise.**
    - **If you do not already have an account to this website, it is free to set one up and you can do this at: https://www.drfrostmaths.com/register.php**
    - **To access the Key Skills, click on resources and select Key Skills or alternatively use the link: https://drfrostmaths.com/keyskills.php?n=1**
4. **Complete the practice paper under timed conditions (50 min) to prepare for the exam.**

There will be a 50 minute assessment based upon this preparation material early in the second week of term. The practice paper from the which is a good indication of the standard and style. The pass mark is 70%. If you find anything difficult, there will be an opportunity to address any issues that arise as you work through this material during the first week of term.

From the SGS and SHS Maths departments

AS and A LEVEL
MATHEMATICS

VIP GCSE Skills

Exercise 1 – Rearranging formulae (K359-364, K572-575)

Rearrange the following formulae to make x the subject.

1. $x + a = b$
2. $a - x = b$
3. $ax = b$
4. $ax + bx = c$
5. $ax + b = x$
6. $\frac{a}{x} = b$
7. $\frac{a}{x} + b = c$
8. $\frac{x}{a} + b = c$
9. $\frac{x}{a} + \frac{x}{b} = 1$
10. $\frac{a}{x} + \frac{b}{x}$
11. $a(x + b) = c$
12. $ax = b(c + x)$
13. $a(b - x) = cx$
14. $\frac{x}{2a} + \frac{x}{3a} = b$
15. $x(a - b) + b(c - x)$
16. $\frac{a}{b - x} = c$
17. $a + \frac{2b + 3x}{3b - 2x}$
18. $\sqrt{x} = a$
19. $\sqrt{(2x)} = a$
20. $2\sqrt{x} = a$
21. $\sqrt{\frac{x}{2}} = a$
22. $\frac{\sqrt{x}}{2} = a$
23. $a\sqrt{x} = b$
24. $\sqrt{(ax)} = b$
25. $\sqrt[3]{\frac{x}{a}} = b$
26. $x^2 = a^4$
27. $x^2 = a$
28. $\sqrt{x + a} = b$
29. $\sqrt{x + a} = b$
30. $\sqrt{x^2 + a^2} = b$
31. $\sqrt{x^2 + a^2} = 3a$
32. $\frac{a}{x} - 1 = \frac{b}{2x}$

Exercise 2 - Solving Equations with Algebraic Fractions (K371-373, K408-410, K605-606, K736)

Solve these equations

1. $\frac{x + 2}{3} = \frac{2x + 1}{5}$
2. $\frac{5x - 3}{4} = \frac{4x - 3}{3}$
3. $\frac{3x + 1}{4} = \frac{2 - x}{3}$
4. $\frac{2x + 3}{5} = \frac{4 + 3x}{3}$
5. $\frac{3}{x + 1} = \frac{4}{x}$
6. $\frac{2}{3x - 5} = \frac{5}{2x + 3}$
7. $\frac{6}{x + 8} = \frac{5}{3x + 4}$
8. $\frac{7}{x - 1} = \frac{3}{x + 2}$
9. $\frac{2}{x + 3} = \frac{4}{5}$

10. $\frac{5}{x-1}=\frac{2}{3}$ 11. $\frac{6}{2x-3}=\frac{1}{3}$ 12. $\frac{5}{2x-3}=\frac{3}{8}$

13. $3x+\frac{x+4}{3}=\frac{5x+6}{2}$ 14. $5x-\frac{3x+1}{2}=\frac{7x+9}{3}$ 15. $x+\frac{5x-1}{3}=\frac{11x-1}{4}$

16. $4x-\frac{2x+3}{2}=\frac{2x-1}{5}$

AS Pure Chapter 1:

Exercise 3 – Simplifying Expressions (K149-151, K409-410)

Simplify

1. $3\times 5x$ 2. $x\times 2x$ 3. $(2x)^2$

4. $5p\times 2q$ 5. $4x\times 2x$ 6. $2pq\times 5pr$

7. $(3a)^2$ 8. $7a\times 9b$ 9. $8t\times 3st$

10. $2a^2\times 4a$ 11. $25x^2\div 15x$ 12. $12m^2\div 6m$

13. $b^2\times 4ab$ 14. $25x^2y\div 5x$ 15. $(7pq)^2\times(2p)^2$

16. $\frac{22ab}{11b}$ 17. $\frac{18ax^2}{3x}$ 18. $\frac{36xy}{18y}$

19. $\frac{72ab^2}{40a^2b}$ 20. $\frac{2}{5}\div\frac{1}{x}$ 21. $\frac{x^2}{y}\div\frac{y}{x}$

Exercise 4 – Expand brackets (K351-358)

1. Expand and simplify.
   - **a** $3(y^2-8)-4(y^2-5)$
   - **b** $2x(x+5)+3x(x-7)$
   - **c** $4p(2p-1)-3p(5p-2)$
   - **d** $3b(4b-3)-b(6b-9)$

2. Expand and simplify.
   - **a** $(x+4)(x+5)$
   - **b** $(x+7)(x+3)$
   - **c** $(x+7)(x-2)$
   - **d** $(x+5)(x-5)$
   - **e** $(2x+1)(2x-1)$
   - **f** $(3x-2)(2x+1)$
   - **g** $(5x-3)(2x-5)$
   - **h** $(3x-2)(7+4x)$
   - **i** $(3x+4y)(5y+6x)$
   - **j** $(x+5)^2$
   - **k** $(2x-7)^2$
   - **l** $(4x-3y)^2$

3. Expand and simplify
   - **a** $(x+1)^3$
   - **b** $(p-5)^3$
   - **c** $(2a+3)^3$
   - **d** $(2x^2-1)(x+2)-(x^2+1)(x-1)$

Exercise 5 – Simplifying surds using $\sqrt{a \times b} = \sqrt{a} \times \sqrt{b}$ (K673)

Express in terms of the simplest possible surd.

1. $\sqrt{12}$
2. $\sqrt{32}$
3. $\sqrt{27}$
4. $\sqrt{50}$
5. $\sqrt{200}$
6. $\sqrt{72}$
7. $\sqrt{162}$
8. $\sqrt{288}$
9. $\sqrt{75}$
10. $\sqrt{48}$
11. $\sqrt{500}$
12. $\sqrt{20}$

Exercise 6 – Simplifying expressions involving surds (K680-684)

Expand and simplify where this is possible.

1. $\sqrt{3}(2-\sqrt{3})$
2. $\sqrt{2}(5+4\sqrt{2})$
3. $\sqrt{5}(2+\sqrt{75})$
4. $\sqrt{2}(\sqrt{32}-\sqrt{8})$
5. $(\sqrt{3}+1)(\sqrt{2}-1)$
6. $(\sqrt{3}+2)(\sqrt{3}+5)$
7. $(\sqrt{5}-1)(\sqrt{5}+1)$
8. $(2\sqrt{2}-1)(\sqrt{2}-1)$
9. $(\sqrt{5}-3)(2\sqrt{5}-4)$
10. $(4+\sqrt{7})(4-\sqrt{7})$
11. $(\sqrt{6}-2)^2$
12. $(2+3\sqrt{3})^2$

Exercise 7 – Rationalising denominators (K685-687)

Rationalise the denominator, simplify where possible.

1. $\frac{3}{\sqrt{2}}$
2. $\frac{1}{\sqrt{7}}$
3. $\frac{2}{\sqrt{11}}$
4. $\frac{3\sqrt{2}}{\sqrt{5}}$
5. $\frac{1}{\sqrt{27}}$
6. $\frac{\sqrt{5}}{\sqrt{10}}$
7. $\frac{1}{\sqrt{2}-1}$
8. $\frac{3\sqrt{2}}{5+\sqrt{2}}$
9. $\frac{2}{2\sqrt{3}-3}$
10. $\frac{5}{2-\sqrt{5}}$
11. $\frac{1}{\sqrt{7}-\sqrt{3}}$
12. $\frac{4\sqrt{3}}{2\sqrt{3}-3}$
13. $\frac{3-\sqrt{5}}{\sqrt{5}+1}$
14. $\frac{2\sqrt{3}-1}{4-\sqrt{3}}$
15. $\frac{\sqrt{5}-1}{\sqrt{5}-2}$
16. $\frac{3}{\sqrt{3}-\sqrt{2}}$
17. $\frac{3\sqrt{5}}{2\sqrt{5}+1}$
18. $\frac{\sqrt{2}+1}{\sqrt{2}-1}$

19. $\dfrac{2\sqrt{7}}{\sqrt{7}+2}$ 20. $\dfrac{\sqrt{5}-1}{3-\sqrt{5}}$ 21. $\dfrac{1}{\sqrt{11}-\sqrt{7}}$

22. $\dfrac{4-\sqrt{3}}{3-\sqrt{3}}$ 23. $\dfrac{1-3\sqrt{2}}{3\sqrt{2}+2}$ 24. $\dfrac{1}{3\sqrt{2-2\sqrt{3}}}$

Exercise 8 – Factorising with common factors (K348-350)

Factorise each of the following expressions.

1. $3x-6y$ 2. p^2+2p 3. $pq-rq$
4. $2a-ab$ 5. $2c+4c^2$ 6. $ap+bp$
7. $3m+m(u-v)$ 8. $2a-a(3x+y)$ 9. $x(3-a)+bx$
10. $(4m-3n)p-5p$ 11. $a(m+1)+b(m+1)$ 12. $a(n+2)-b(n+2)$
13. $ax-x(b-4c)$ 14. $5x(a-b)-2y(a-b)$ 15. $3h(5u-v)+2k(5u-v)$
16. $m(u-v)+m^2$ 17. $d(3h+k)-4d^2$ 18. $5a^2+a(b-c)$

Exercise 9 – Indices (K432-440, K689-694)

Simplify the following expressions.

1. $2a\times 3a^2$ 2. $2a\times(3a)^2$ 3. $(2a)^2\times 3a$
4. $4^{\frac{1}{2}}$ 5. $27^{\frac{1}{3}}$ 6. $125^{\frac{1}{3}}$
7. $\sqrt[3]{2^6}$ 8. $8^{\frac{2}{3}}$ 9. 2^{-2}
10. 3^{-3} 11. $9^{\frac{1}{2}}$ 12. $9^{-\frac{1}{2}}$
13. $(25a^2)^{\frac{1}{2}}$ 14. $2a^{-1}$ 15. $(2a)^{-1}$
16. $4^{\frac{1}{2}}$ 17. $2^{-2}\times 2^3$ 18. $(2^2)^2$
19. 10^{-2} 20. $\sqrt{1\dfrac{9}{16}}$ 21. $3a^{-2}$
22. $(3a)^{-2}$ 23. $\sqrt{3^4}$ 24. $(a^2)^{-\frac{1}{2}}$

25. $\left(\frac{1}{9}\right)^{-1}$
26. $\left(\frac{1}{4}\right)^{-\frac{1}{2}}$
27. $3^{\frac{1}{2}} \times 3^{\frac{3}{2}}$
28. $\left(\frac{1}{27}\right)^{-\frac{2}{3}}$
29. $3^{\frac{1}{2}} \times 3^{-\frac{3}{2}}$
30. $0.04\frac{1}{2}$
31. $2a^{-1} \times 3a^2$
32. $(2a)^{-1} \times 3a^2$
33. $2a^{-1} \times (3a)^2$
34. $16^{-\frac{3}{2}}$
35. $2^{\frac{1}{2}} \times 2^{\frac{5}{2}}$
36. $(2^6)^{-\frac{2}{3}}$
37. $125^{-\frac{2}{5}}$
38. $3^x \times 3^{-x}$
39. $16^{-\frac{3}{4}}$
40. $0.027^{\frac{2}{3}}$
41. $2a \times 3a^{-2}$
42. $2a \times (3a)^{-2}$
43. $4^{\frac{1}{2}}$
44. $\left(\frac{8}{27}\right)^{-\frac{2}{3}}$
45. $\frac{1}{3^{-2}}$
46. 2×2^{-3}
47. $\sqrt[3]{4^{1.5}}$
48. $3^{n-1} \times 3^{1-n}$
49. $64^{-\frac{5}{6}}$
50. $\sqrt[3]{8a^{-6}}$
51. $2x^{\frac{1}{2}} \times 3x^{-\frac{5}{2}}$
52. $0.125^{-\frac{1}{3}}$
53. $\left(\frac{16}{9}\right)^{-\frac{3}{2}}$
54. $\sqrt[4]{16a^{-12}}$
55. Solve $2^{x+3} = 32$
56. Solve $3^{2x-1} = \frac{1}{27}$
57. Solve $2^{x-1} = 2\sqrt{2}$

AS Pure Chapter 2:

Exercise 10 – Factorising Quadratics (K381-387)

Factorise

1. $x^2 + 8x + 15$
2. $x^2 + 11x + 28$
3. $x^2 + 7x + 6$
4. $x^2 + 7x + 12$
5. $x^2 - 10x + 9$
6. $x^2 - 6x + 9$
7. $x^2 + 8x + 12$
8. $x^2 - 9x + 8$
9. $x^2 + 5x - 14$
10. $x^2 + x - 12$
11. $x^2 - 4x - 5$
12. $x^2 - 10x - 24$
13. $x^2 + 9x + 14$
14. $x^2 - 2x + 1$
15. $x^2 - 9$
16. $x^2 + 5x - 24$
17. $x^2 + 4x + 4$
18. $x^2 - 1$
19. $x^2 - 3x - 18$
20. $x^2 + 10x + 25$
21. $x^2 - 16$
22. $4 + 5x + x^2$
23. $2x^2 - 3x + 1$
24. $3x^2 + 4x + 1$
25. $9x^2 - 6x + 1$
26. $6x^2 - x - 1$
27. $9 + 6x + x^2$

Exercise 11 – Solving Quadratics of the form $ax^2 + bx + c = 0$ by factorising (K615-618)

Solve the equations.

1. $x^2 + 10 - 7x = 0$
2. $15 - x^2 - 2x = 0$
3. $x^2 - 3x = 4$
4. $12 - 7x + x^2 = 0$
5. $2x - 1 + 3x^2 = 0$
6. $x(x + 7) + 6 = 0$
7. $2x^2 - 4x = 0$
8. $x(4x + 5) = -1$
9. $2 - x = 3x^2$
10. $6x^2 + 3x = 0$
11. $x^2 + 6x = 0$
12. $x^2 = 10x$
13. $x(4x + 1) = 3x$
14. $20 + x(1 - x) = 0$
15. $x(3x - 2) = 8$
16. $x^2 - x(2x - 1) + 2 = 0$
17. $x(x + 1) = 2x$
18. $4 + x^2 = 2(x + 2)$
19. $x(x - 2) = 3$
20. $1 - x^2 = x(1 + x)$

Exercise 12 – Using $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ to solve quadratics (K619-620)

Solve the equations by using the formula. Give the solutions in surd form.

1. $x^2 + 4x + 2 = 0$
2. $2x^2 + x - 2 = 0$
3. $x^2 + 5x + 1 = 0$
4. $2x^2 - x - 4 = 0$
5. $x^2 + 1 = 4x$
6. $2x^2 - x = 5$
7. $1 + x - 3x^2 = 0$
8. $3x^2 = 1 - x$

Exercise 13 - Completing the Square (K620)

Write these expressions in completed square form, $a(x + p)^2 + q$

1. $x^2 + 2x + 3$
2. $x^2 + 6x - 1$
3. $x^2 - 2x + 2$
4. $x^2 - 4x - 2$
5. $x^2 + x + 1$
6. $x^2 + 3x - 2$
7. $x^2 - 6x + 1$
8. $x^2 - 5x$
9. $2x^2 + 6x + 4$
10. $3x^2 + 6x - 9$
11. $3x^2 - 6x + 7$
12. $3x^2 - 6x - 15$

Solve by completing the square:

13. $2x^2 + 8x - 5 = 0$
14. $2x^2 - 4x - 6 = 0$
15. $6x^2 + 2x - 1 = 0$

Exercise 14 – Algebraic fractions leading to quadratic equations (K614)

1. $\frac{3}{x-1} - \frac{2}{x+1} = 1$

2 $\frac{5}{2x+1} + \frac{6}{x+1} = 3$

3 $\frac{x-4}{7} = \frac{2}{3x-1}$

4 $\frac{3}{2x-3} + \frac{3}{x+1} = 4$

AS Pure Chapter 3:

Exercise 15 – Solving linear simultaneous equations algebraically (K375-380)

Solve these simultaneous equations.

1 $4x + y = 8$
$x + y = 5$

2 $3x + y = 7$
$3x + 2y = 5$

3 $4x + y = 3$
$3x - y = 11$

4 $3x + 4y = 7$
$x - 4y = 5$

5 $2x + y = 11$
$x - 3y = 9$

6 $2x + 3y = 11$
$3x + 2y = 4$

Exercise 16 – Solving linear and quadratic equations simultaneously (K570-571)

Solve the following pairs of equations.

1. $x^2 + y^2 = 5$
$y - x = 1$

2. $y^2 - x^2 = 8$
$x + y = 2$

3. $3x^2 - y^2 = 3$
$2x - y = 1$

4. $y = 4x^2$
$y + 2x = 2$

5. $y^2 + xy = 3$
$2x + y = 1$

6. $x^2 - xy = 14$
$y = 3 - x$

Exercise 17 – Solving simultaneous equations graphically (K374)

1 Solve these pairs of simultaneous equations graphically.
a $y = 3x - 1$ and $y = x + 3$
b $y = x - 5$ and $y = 7 - 5x$
c $y = 3x + 4$ and $y = 2 - x$

2 Solve these pairs of simultaneous equations graphically.
a $x + y = 0$ and $y = 2x + 6$
b $4x + 2y = 3$ and $y = 3x - 1$
c $2x + y + 4 = 0$ and $2y = 3x - 1$

Hint

Rearrange the equation to make *y* the subject.

3 Solve these pairs of simultaneous equations graphically.

a $y = x - 1$ and $y = x^2 - 4x + 3$

b $y = 1 - 3x$ and $y = x^2 - 3x - 3$

c $y = 3 - x$ and $y = x^2 + 2x + 5$

4 Solve the simultaneous equations $x + y = 1$ and $x^2 + y^2 = 25$ graphically.

Solutions:

Solutions - Exercise 1

1. $x = b - a$
2. $x = a - b$
3. $x = \frac{b}{a}$
4. $x = \frac{c}{a+b}$
5. $x = \frac{b}{1-a}$
6. $x = \frac{a}{b}$
7. $x = \frac{a}{c-b}$
8. $x = a(c-b)$
9. $x = \frac{ab}{a+b}$
10. $x = a + b$
11. $x = \frac{c}{a} - b$
12. $x = \frac{bc}{a-b}$
13. $x = \frac{ab}{a+c}$
14. $x = \frac{6ab}{5}$
15. $x = \frac{bc}{a}$
16. $x = b - \frac{a}{c}$
17. $x = \frac{b(3a-2)}{2a+3}$
18. $x = a^2$
19. $x = \frac{a^2}{2}$
20. $x = \frac{a^2}{4}$
21. $x = 2a^2$
22. $x = 4a^2$
23. $x = \frac{b^2}{a^2}$
24. $x = \frac{b^2}{a}$
25. $x = ab^3$
26. $x = \pm a^2$
27. $x = \pm\sqrt{a}$
28. $x = b^2 - a$
29. $x = (b-a)^2$
30. $x = \pm\sqrt{b^2 - a^2}$
31. $x = \pm 2a\sqrt{2}$
32. $x = a - \frac{b}{2}$

Solutions - Exercise 2

1. $x = 7$
2. $x = 3$
3. $x = \frac{5}{13}$
4. $x = -\frac{11}{9}$
5. $x = -4$
6. $x = \frac{31}{11}$
7. $x = \frac{16}{13}$
8. $x = -\frac{17}{4}$
9. $x = -\frac{1}{2}$
10. $x = \frac{17}{2}$
11. $x = \frac{21}{2}$
12. $x = \frac{49}{6}$
13. $x = 2$
14. $x = 3$
15. $x = -1$
16. $x = \frac{1}{2}$

Solutions - Exercise 3

1. $15x$
2. $2x^2$
3. $4x^2$
4. $10pq$
5. $8x^2$
6. $10p^2qr$
7. $9a^2$
8. $63ab$
9. $24st^2$
10. $8a^3$
11. $\frac{5}{3}x$
12. $2m$
13. $4ab^3$
14. $5xy$
15. $196p^4q^2$
16. $2a$
17. $6ax$
18. $2x$
19. $\frac{9b}{5a}$
20. $\frac{2}{5}x$
21. $\frac{x^3}{y^2}$

Solutions – Exercise 4

1 **a** $-y^2 - 4$ **b** $5x^2 - 11x$
c $2p - 7p^2$ **d** $6b^2$

2 **a** $x^2 + 9x + 20$ **b** $x^2 + 10x + 21$
c $x^2 + 5x - 14$ **d** $x^2 - 25$
e $2x^2 + x - 3$ **f** $6x^2 - x - 2$
g $10x^2 - 31x + 15$ **h** $12x^2 + 13x - 14$
i $18x^2 + 39xy + 20y^2$ **j** $x^2 + 10x + 25$
k $4x^2 - 28x + 49$ **l** $16x^2 - 24xy + 9y^2$

3 **a** $x^3 + 3x^2 + 3x + 1$ **b** $p^3 - 15p^2 + 75p - 125$
c $8a^3 + 36a^2 + 54a + 27$ **d** $x^3 + 5x^2 - 2x + 1$

Solutions - Exercise 5

1. $2\sqrt{3}$ 2. $4\sqrt{2}$ 3. $3\sqrt{3}$
4. $5\sqrt{2}$ 5. $10\sqrt{2}$ 6. $6\sqrt{2}$
7. $9\sqrt{2}$ 8. $12\sqrt{2}$ 9. $5\sqrt{3}$
10. $4\sqrt{3}$ 11. $10\sqrt{5}$ 12. $2\sqrt{5}$

Solutions - Exercise 6

1. $2\sqrt{3} - 3$ 2. $5\sqrt{2} + 8$ 3. $2\sqrt{5} + 5\sqrt{15}$
4. 4 5. $\sqrt{6} + \sqrt{2} - \sqrt{3} - 1$ 6. $13 + 7\sqrt{3}$
7. 4 8. $5 - 3\sqrt{2}$ 9. $22 - 10\sqrt{5}$
10. 9 11. $10 - 4\sqrt{6}$ 12. $31 + 12\sqrt{3}$

Solutions - Exercise 7

1. $\frac{3}{2}\sqrt{2}$ 2. $\frac{1}{7}\sqrt{7}$ 3. $\frac{2}{11}\sqrt{11}$
4. $\frac{3}{5}\sqrt{10}$ 5. $\frac{1}{9}\sqrt{3}$ 6. $\frac{1}{2}\sqrt{2}$
7. $\sqrt{2} + 1$ 8. $\frac{1}{23}(15\sqrt{2} - 6)$ 9. $\frac{1}{3}(4\sqrt{3} + 6)$
10. $-5(2 + \sqrt{5})$ 11. $\frac{1}{4}(\sqrt{7} + \sqrt{3})$ 12. $4(2 + \sqrt{3})$
13. $\sqrt{5} - 2$ 14. $\frac{1}{13}(7\sqrt{3} + 2)$ 15. $3 + \sqrt{5}$
16. $3(\sqrt{3} + \sqrt{2})$ 17. $\frac{3}{19}(10 - \sqrt{5})$ 18. $3 + 2\sqrt{2}$
19. $\frac{2}{3}(7 - 2\sqrt{7})$ 20. $\frac{1}{2}(1 + \sqrt{5})$ 21. $\frac{1}{4}\sqrt{11} + \sqrt{7}$
22. $\frac{1}{6}(9 + \sqrt{3})$ 23. $\frac{1}{14}(9\sqrt{2} - 20)$ 24. $\frac{1}{6}(3\sqrt{2} + 2\sqrt{3})$

Solutions - Exercise 8

1.	$3(x-2y)$	2.	$p(p+2)$	3.	$q(p-r)$
4.	$a(2-b)$	5.	$2c(1+2c)$	6.	$p(a+b)$
7.	$m(3+u-v)$	8.	$a(2-3x-y)$	9.	$x(3-a+b)$
10.	$p(4m-3n-5)$	11.	$(a+b)(m+1)$	12.	$(a-b)(n+2)$
13.	$x(a-b+4c)$	14.	$(5x-2y)(a-b)$	15.	$(3h+2k)(5u-v)$
16.	$m(u-v+m)$	17.	$d(3h+k-4d)$	18.	$a(5a+b-c)$

Solutions - Exercise 9

1.	$6a^3$	2.	$18a^3$	3.	$12a^3$
4.	2	5.	3	6.	5
7.	4	8.	4	9.	$\frac{1}{4}$
10.	$\frac{1}{27}$	11.	3	12.	$\frac{1}{3}$
13.	$5a$	14.	$\frac{2}{a}$	15.	$\frac{1}{2a}$
16.	2	17.	2	18.	16
19.	$\frac{1}{100}$	20.	$1\frac{1}{4}$	21.	$\frac{3}{a^2}$
22.	$\frac{1}{9a^2}$	23.	9	24.	$\frac{1}{a}$
25.	9	26.	2	27.	9
28.	9	29.	$\frac{1}{3}$	30.	0.2
31.	$6a$	32.	$\frac{3a}{2}$	33.	$\frac{1}{64}$
34.	$\frac{1}{64}$	35.	8	36.	$\frac{1}{64}$
37.	$\frac{1}{25}$	38.	1	39.	$\frac{1}{8}$

40. $\frac{3}{10}$ 41. $\frac{6}{a}$ 42. $\frac{18}{a}$

43. 2 44. $\frac{9}{4}$ 45. 9

46. $\frac{1}{4}$ 47. 2 48. 1

49. $\frac{1}{32}$ 50. $\frac{2}{a^2}$ 51. $\frac{6}{x^2}$

52. 2 53. $\frac{27}{64}$ 54. $\frac{2}{a^3}$

55. $x = 2$ 56. $x = -1$ 57. $x = \frac{5}{2}$

Solutions – Exercise 10

1. $(x+5)(x+3)$ 2. $(x+7)(x+4)$ 3. $(x+6)(x+1)$

4. $(x+4)(x+3)$ 5. $(x-1)(x-9)$ 6. $(x-3)^2$

7. $(x+6)(x+2)$ 8. $(x-8)(x-1)$ 9. $(x+7)(x-2)$

10. $(x+4)(x-3)$ 11. $(x-5)(x+1)$ 12. $(x-12)(x+2)$

13. $(x+7)(x+2)$ 14. $(x-1)^2$ 15. $(x-3)(x+3)$

16. $(x+8)(x-3)$ 17. $(x+2)^2$ 18. $(x-1)(x+1)$

19. $(x-6)(x+3)$ 20. $(x+5)^2$ 21. $(x-4)(x+4)$

22. $(4+x)(1+x)$ 23. $(2x-1)(x-1)$ 24. $(3x+1)(x+1)$

25. $(3x-1)^2$ 26. $(3x+1)(2x-1)$ 27. $(3+x)^2$

28. $(2x-3)(2x+3)$ 29. $(x+a)^2$ 30. $(xy-1)^2$

Solutions - Exercise 11

1. $x = 2 \; or \; x = 5$ 2. $x = 3 \; or \; x = -5$ 3. $x = 4 \; or \; x = -1$

4. $x = 3 \; or \; x = 4$ 5. $x = \frac{1}{3} \; or \; x = -1$ 6. $x = -1 \; or \; x = -6$

7. $x = 0 \; or \; x = 2$ 8. $x = -1 \; or \; x = -\frac{1}{4}$ 9. $x = \frac{2}{3} \; or \; x = -1$

10. $x = 0 \; or \; x = -\frac{1}{2}$
11. $x = 0 \; or \; x = -6$
12. $x = 0 \; or \; x = 10$
13. $x = 0 \; or \; x = \frac{1}{2}$
14. $x = 5 \; or \; x = -4$
15. $x = 2 \; or \; x = -\frac{4}{3}$
16. $x = 2 \; or \; x = -1$
17. $x = 0 \; or \; x = 1$
18. $x = 0 \; or \; x = 2$
19. $x = 3 \; or \; x = -1$
20. $x = -1 \; or \; x = \frac{1}{2}$

Solutions - Exercise 12

1. $x = -2 \pm \sqrt{2}$
2. $x = \frac{1}{4}(-1 \pm \sqrt{17})$
3. $x = \frac{1}{2}(-5 \pm \sqrt{21})$
4. $x = \frac{1}{4}(1 \pm \sqrt{33})$
5. $x = 2 \pm \sqrt{3}$
6. $x = \frac{1}{4}(1 \pm \sqrt{41})$
7. $x = \frac{1}{6}(1 \pm \sqrt{13})$
8. $x = -\frac{1}{6}(1 \pm \sqrt{13})$

Solutions - Exercise 13

1. $(x+1)^2 + 2$
2. $(x+3)^2 - 10$
3. $(x-1)^2 + 1$
4. $(x-2)^2 - 6$
5. $(x+\frac{1}{2})^2 + \frac{3}{4}$
6. $(x+\frac{3}{2})^2 - \frac{17}{4}$
7. $(x-3)^2 - 8$
8. $(x-\frac{5}{2})^2 - \frac{25}{4}$
9. $2(x+\frac{3}{2})^2 - \frac{1}{2}$
10. $3(x+1)^2 - 12$
11. $3(x-1)^2 + 4$
12. $3(x-1)^2 - 18$
13. $2(x+2)^2 - 13 = 0$

    $x = -2 \pm \sqrt{\frac{13}{2}}$
14. $2(x-1)^2 - 8 = 0$

    $x = -1 \; or \; 3$
15. $6\left(x+\frac{1}{6}\right)^2 - \frac{7}{6}$

    $x = -\frac{1}{6} \pm \frac{\sqrt{7}}{6}$

Solutions – Exercise 14

1. $x = -2, x = 3$
2. $x = -\frac{2}{3}, \; x = 2$
3. $x = -\frac{2}{3}, x = 5$
4. $x = -\frac{3}{8}, x = 2$

Solutions – Exercise 15

1 $x = 1, y = 4$

2 $x = 3, y = -2$

3 $x = 2, y = -5$

4 $x = 3, y = -\frac{1}{2}$

5 $x = 6, y = -1$

6 $x = -2, y = 5$

Solutions - Exercise 16

1. $x = -2, y = -1$
   $x = 1, y = 2$

2. $x = -1, y = 3$

3. $x = 2, y = 3$

4. $x = -1, y = 4$
   $x = \frac{1}{2}, y = 1$

5. $x = 2, y = -3$
   $x = -\frac{1}{2}, y = 2$

6. $x = \frac{7}{2}, y = -\frac{1}{2}$
   $x = -2, y = -5$

Solutions – Exercise 17

1 **a** $x = 2, y = 5$
b $x = 2, y = -3$
c $x = -0.5, y = 2.5$

2 **a** $x = -2, y = 2$
b $x = 0.5, y = 0.5$
c $x = -1, y = -2$

3 **a** $x = 1, y = 0$ and $x = 4, y = 3$
b $x = -2, y = 7$ and $x = 2, y = -5$
c $x = -2, y = 5$ and $x = -1, y = 4$

4 $x = -3, y = 4$ and $x = 4, y = -3$