

- 6 **a** $= \sqrt{4} \times \sqrt[3]{27}$
 $= 2 \times 3 = 6$
- b** $= \sqrt[4]{16} + \sqrt{25}$
 $= 2 + 5 = 7$
- c** $= \frac{1}{\sqrt[3]{8}} \div \sqrt{36}$
 $= \frac{1}{2} \div 6 = \frac{1}{12}$
- d** $= \sqrt[3]{-64} \times (\sqrt{9})^3$
 $= -4 \times 27 = -108$
- e** $= 3^2 - \sqrt[3]{-8}$
 $= 9 - (-2) = 11$
- f** $= \sqrt{\frac{1}{25}} \times 4^2$
 $= \frac{1}{5} \times 16 = \frac{16}{5}$ or $3\frac{1}{5}$
- g** $= (\sqrt[4]{81})^3 - \sqrt{49}$
 $= 27 - 7 = 20$
- h** $= \sqrt[3]{27} \times (\sqrt{\frac{9}{4}})^3$
 $= 3 \times \frac{27}{8} = \frac{81}{8}$ or $10\frac{1}{8}$
- i** $= \sqrt{9} \times (\sqrt[5]{-32})^3$
 $= 3 \times (-8) = -24$
- j** $= \sqrt{121} + \sqrt[5]{32}$
 $= 11 + 2 = 13$
- k** $= \sqrt{100} \div (\sqrt{\frac{1}{4}})^3$
 $= 10 \div \frac{1}{8} = 80$
- l** $= \frac{1}{\sqrt[4]{16}} \times (\sqrt[5]{243})^2$
 $= \frac{1}{2} \times 9 = \frac{9}{2}$ or $4\frac{1}{2}$
- 7 **a** $= x^2$
- b** $= y^{-6}$
- c** $= 3p^{-4}$
- d** $= 8x^{-12}$
- e** $= y^{\frac{5}{2}}$
- f** $= 8b^{\frac{2}{3} + \frac{1}{4}} = 8b^{\frac{11}{12}}$
- g** $= x^{\frac{3}{5} - \frac{1}{3}} = x^{\frac{4}{15}}$
- h** $= a^{\frac{1}{2} - \frac{4}{3}} = a^{-\frac{5}{6}}$
- i** $= p^{\frac{1}{4} - (-\frac{1}{5})} = p^{\frac{9}{20}}$
- j** $= 9x^{\frac{4}{5}}$
- k** $= y^{1 + \frac{5}{6} - \frac{3}{2}} = y^{\frac{1}{3}}$
- l** $= \frac{1}{3}t$
- m** $= b^{2 + \frac{1}{4} - \frac{1}{2}} = b^{\frac{7}{4}}$
- n** $= y^{\frac{1}{2} + \frac{1}{3} - 1} = y^{-\frac{1}{6}}$
- o** $= 2x^{\frac{2}{3} + (-\frac{1}{6}) - \frac{3}{4}} = 2x^{-\frac{1}{4}}$
- p** $= \frac{1}{4}a^{1 + \frac{3}{4} - (-\frac{1}{2})} = \frac{1}{4}a^{\frac{9}{4}}$
- 8 **a** $x = 6^2 = 36$
- b** $x = 5^3 = 125$
- c** $x^{\frac{1}{2}} = \frac{1}{2}$
 $x = (\frac{1}{2})^2 = \frac{1}{4}$
- d** $x^{\frac{1}{4}} = 3$
 $x = 3^4 = 81$
- e** $x^{\frac{1}{2}} = \sqrt[3]{8} = 2$
 $x = 2^2 = 4$
- f** $x^{\frac{1}{3}} = \pm \sqrt{16} = \pm 4$
 $x = (\pm 4)^3 = \pm 64$
- g** $x^{\frac{1}{3}} = \pm \sqrt[4]{81} = \pm 3$
 $x = (\pm 3)^3 = \pm 27$
- h** $x^{\frac{3}{2}} = \frac{1}{27}$
 $x^{\frac{1}{2}} = \sqrt[3]{\frac{1}{27}} = \frac{1}{3}$
 $x = (\frac{1}{3})^2 = \frac{1}{9}$
- 9 **a** $= x^{\frac{1}{2}}$
- b** $= x^{-\frac{1}{3}}$
- c** $= x^2 \times x^{\frac{1}{2}} = x^{\frac{5}{2}}$
- d** $= \frac{x^{\frac{1}{4}}}{x} = x^{-\frac{3}{4}}$
- e** $= (x^3)^{\frac{1}{2}} = x^{\frac{3}{2}}$
- f** $= x^{\frac{1}{2}} \times x^{\frac{1}{3}} = x^{\frac{5}{6}}$
- g** $= (x^{\frac{1}{2}})^5 = x^{\frac{5}{2}}$
- h** $= x^{\frac{2}{3}} \times x^{\frac{3}{2}} = x^{\frac{13}{6}}$
- 10 **a** $4x^{-\frac{1}{2}}$
- b** $\frac{1}{2}x^{-1}$
- c** $\frac{3}{4}x^{-3}$
- d** $\frac{1}{9}x^{-2}$
- e** $\frac{2}{5}x^{-\frac{1}{3}}$
- f** $\frac{1}{3}x^{-\frac{2}{3}}$
- 11 **a** $= (2^3)^2 = 2^6$
- b** $= (2^{-2})^{-2} = 2^4$
- c** $= (2^{-1})^{\frac{1}{3}} = 2^{-\frac{1}{3}}$
- d** $= (2^4)^{-\frac{1}{6}} = 2^{-\frac{2}{3}}$
- e** $= (2^3)^{\frac{2}{5}} = 2^{\frac{6}{5}}$
- f** $= (2^{-5})^{-3} = 2^{15}$
- 12 **a** $= (3^2)^x = 3^{2x}$
- b** $= (3^4)^{x+1} = 3^{4x+4}$
- c** $= (3^3)^{\frac{x}{4}} = 3^{\frac{3}{4}x}$
- d** $= (3^{-1})^x = 3^{-x}$
- e** $= (3^2)^{2x-1} = 3^{4x-2}$
- f** $= (3^{-3})^{x+2} = 3^{-3x-6}$
- 13 **a** $= 2 \times 2^x = 2y$
- b** $= 2^{-2} \times 2^x = \frac{1}{4}y$
- c** $= (2^x)^2 = y^2$
- d** $= (2^3)^x = 2^{3x} = (2^x)^3 = y^3$
- e** $= 2^3 \times 2^{4x} = 8y^4$
- f** $= (2^{-1})^{x-3} = 2^3 \times 2^{-x} = \frac{8}{y}$

- 14** **a** $2^x = 2^6$
 $x = 6$ **b** $5^{x-1} = 5^3$
 $x - 1 = 3$
 $x = 4$ **c** $3^{x+4} = 27 = 3^3$
 $x + 4 = 3$
 $x = -1$ **d** $(2^3)^x = 2^{3x} = 2$
 $3x = 1$
 $x = \frac{1}{3}$
- e** $3^{2x-1} = 3^2$
 $2x - 1 = 2$
 $x = \frac{3}{2}$ **f** $16 = 4^2 = 4^{3x-2}$
 $2 = 3x - 2$
 $x = \frac{4}{3}$ **g** $(3^2)^{x-2} = 3^{2x-4} = 3^3$
 $2x - 4 = 3$
 $x = \frac{7}{2}$ **h** $(2^3)^{2x+1} = 2^{6x+3} = 2^4$
 $6x + 3 = 4$
 $x = \frac{1}{6}$
- i** $(7^2)^{x+1} = 7^{2x+2} = 7^{\frac{1}{2}}$
 $2x + 2 = \frac{1}{2}$
 $x = -\frac{3}{4}$ **j** $3^{3x-2} = (3^2)^{\frac{1}{3}} = 3^{\frac{2}{3}}$
 $3x - 2 = \frac{2}{3}$
 $x = \frac{8}{9}$ **k** $(6^{-1})^{x+3} = 6^{-x-3} = 6^2$
 $-x - 3 = 2$
 $x = -5$ **l** $(2^{-1})^{3x-1} = 2^{1-3x} = 2^3$
 $1 - 3x = 3$
 $x = -\frac{2}{3}$
- 15** **a** $2^{x+3} = (2^2)^x = 2^{2x}$
 $x + 3 = 2x$
 $x = 3$ **b** $5^{3x} = (5^2)^{x+1} = 5^{2x+2}$
 $3x = 2x + 2$
 $x = 2$ **c** $(3^2)^{2x} = 3^{4x} = 3^{x-3}$
 $4x = x - 3$
 $x = -1$ **d** $(4^2)^x = 4^{2x} = 4^{1-x}$
 $2x = 1 - x$
 $x = \frac{1}{3}$
- e** $(2^2)^{x+2} = (2^3)^x$
 $2^{2x+4} = 2^{3x}$
 $2x + 4 = 3x$
 $x = 4$ **f** $(3^3)^{2x} = (3^2)^{3-x}$
 $3^{6x} = 3^{6-2x}$
 $6x = 6 - 2x$
 $x = \frac{3}{4}$ **g** $6^{3x-1} = (6^2)^{x+2}$
 $6^{3x-1} = 6^{2x+4}$
 $3x - 1 = 2x + 4$
 $x = 5$ **h** $(2^3)^x = (2^4)^{2x-1}$
 $2^{3x} = 2^{8x-4}$
 $3x = 8x - 4$
 $x = \frac{4}{5}$
- i** $(5^3)^x = 5^{x-3}$
 $5^{3x} = 5^{x-3}$
 $3x = x - 3$
 $x = -\frac{3}{2}$ **j** $(3^{-1})^x = 3^{x-4}$
 $3^{-x} = 3^{x-4}$
 $-x = x - 4$
 $x = 2$ **k** $(2^{-1})^{1-x} = (2^{-3})^{2x}$
 $2^{x-1} = 2^{-6x}$
 $x - 1 = -6x$
 $x = \frac{1}{7}$ **l** $(2^{-2})^{x+1} = (2^3)^x$
 $2^{-2x-2} = 2^{3x}$
 $-2x - 2 = 3x$
 $x = -\frac{2}{5}$
- 16** **a** $= x^3 - 1$ **b** $= 2x^2 + 6x^3$ **c** $= 3 - x^2$ **d** $= 12x^3 + 8x$
e $= 3x^3 + 2x$ **f** $= 3 - 3x^2$ **g** $= 5x^{\frac{1}{2}} + x^2$ **h** $= 3x^2 - x^{-1}$
i $= x^6 + x^4 - 3x^2 - 3$ **j** $= 2x^9 + 6x^5 + x^5 + 3x$
 $= 2x^9 + 7x^5 + 3x$ **k** $= x^3 - 1 - 2 + 2x^{-3}$
 $= x^3 - 3 + 2x^{-3}$ **l** $= x^3 - x^{\frac{5}{2}} - x^{\frac{5}{2}} + x^2$
 $= x^3 - 2x^{\frac{5}{2}} + x^2$
- 17** **a** $= x^2 + 2$ **b** $= 2t^3 - 3t$ **c** $= x - 3x^{\frac{1}{2}}$ **d** $= \frac{y^5 - 6y^2}{3y}$
 $= \frac{1}{3}y^4 - 2y$
e $= p^{\frac{1}{4}} + p^{\frac{3}{4}}$ **f** $= 2w^{\frac{3}{2}} - \frac{1}{2}w$ **g** $= \frac{x^{\frac{1}{2}}(x+1)}{x+1}$
 $= x^{\frac{1}{2}}$ **h** $= \frac{t^{\frac{1}{2}} \times 2t(t^2 - 2)}{t^2 - 2}$
 $= 2t^{\frac{3}{2}}$

- 1 **a** = 7 **b** = 11 **c** = $\frac{1}{3}$
d = $\frac{2}{5}$ **e** = 0.1 **f** = 0.3
g = 2 **h** = 10 **i** = 3
j = $\sqrt{\frac{25}{16}} = \frac{5}{4}$ or $1\frac{1}{4}$ **k** = $\sqrt[3]{\frac{1}{8}} = \frac{1}{2}$ or 0.5 **l** = $\sqrt[3]{\frac{125}{8}} = \frac{5}{2}$ or $2\frac{1}{2}$
- 2 **a** = 7 **b** = 20 **c** = 27 **d** = 36
e = $4\sqrt{2}$ **f** = $24\sqrt{3}$ **g** = $\sqrt{16} = 4$ **h** = $2\sqrt{81} = 18$
i = $\sqrt{16} = 4$ **j** = $\sqrt{\frac{1}{4}} = \frac{1}{2}$ **k** = 6 **l** = 54
- 3 **a** = $\sqrt{9} \times \sqrt{2} = 3\sqrt{2}$ **b** = $\sqrt{25} \times \sqrt{2} = 5\sqrt{2}$ **c** = $\sqrt{4} \times \sqrt{2} = 2\sqrt{2}$
d = $\sqrt{49} \times \sqrt{2} = 7\sqrt{2}$ **e** = $\sqrt{100} \times \sqrt{2} = 10\sqrt{2}$ **f** = $\sqrt{81} \times \sqrt{2} = 9\sqrt{2}$
- 4 **a** = $\sqrt{4} \times \sqrt{3} = 2\sqrt{3}$ **b** = $\sqrt{4} \times \sqrt{7} = 2\sqrt{7}$ **c** = $\sqrt{16} \times \sqrt{5} = 4\sqrt{5}$
d = $\sqrt{9} \times \sqrt{3} = 3\sqrt{3}$ **e** = $\sqrt{4} \times \sqrt{6} = 2\sqrt{6}$ **f** = $\sqrt{64} \times \sqrt{2} = 8\sqrt{2}$
g = $\sqrt{9} \times \sqrt{5} = 3\sqrt{5}$ **h** = $\sqrt{4} \times \sqrt{10} = 2\sqrt{10}$ **i** = $\sqrt{25} \times \sqrt{3} = 5\sqrt{3}$
j = $\sqrt{16} \times \sqrt{7} = 4\sqrt{7}$ **k** = $\sqrt{9} \times \sqrt{11} = 3\sqrt{11}$ **l** = $\sqrt{49} \times \sqrt{3} = 7\sqrt{3}$
m = $\sqrt{36} \times \sqrt{6} = 6\sqrt{6}$ **n** = $\sqrt{400} \times \sqrt{2} = 20\sqrt{2}$ **o** = $\sqrt{36} \times \sqrt{5} = 6\sqrt{5}$
p = $\sqrt{4} \times \sqrt{15} = 2\sqrt{15}$ **q** = $\sqrt{121} \times \sqrt{3} = 11\sqrt{3}$ **r** = $\sqrt{16} \times \sqrt{13} = 4\sqrt{13}$
- 5 **a** = $3\sqrt{2} + 5\sqrt{2} = 8\sqrt{2}$ **b** = $4\sqrt{3} - 3\sqrt{3} = \sqrt{3}$ **c** = $4\sqrt{2} + 6\sqrt{2} = 10\sqrt{2}$
d = $6\sqrt{10} - 4\sqrt{10} = 2\sqrt{10}$ **e** = $2\sqrt{5} - 3\sqrt{5} + 6\sqrt{5} = 5\sqrt{5}$ **f** = $2\sqrt{6} + 5\sqrt{6} - 8\sqrt{6} = -\sqrt{6}$
- 6 **a** = $3 + 2\sqrt{3}$ **b** = $4 - \sqrt{3} - 2 + 2\sqrt{3}$
= $2 + \sqrt{3}$ **c** = $2 + \sqrt{3} + 2\sqrt{3} + 3$
= $5 + 3\sqrt{3}$
d = $4 + 8\sqrt{3} + \sqrt{3} + 6$ **e** = $27 - 24\sqrt{3} + 16$ **f** = $6\sqrt{3} - 45 + 2 - 5\sqrt{3}$
= $10 + 9\sqrt{3}$ = $43 - 24\sqrt{3}$ = $-43 + \sqrt{3}$
- 7 **a** = $10 + 3\sqrt{5} + 2\sqrt{5} + 3$ **b** = $4\sqrt{2} - 3 - 8 + 3\sqrt{2}$ **c** = $28 + 12\sqrt{7} + 9$
= $13 + 5\sqrt{5}$ = $7\sqrt{2} - 11$ = $37 + 12\sqrt{7}$
d = $12 + 15\sqrt{2} - 2\sqrt{2} - 5$ **e** = $5 + 2\sqrt{10} - \sqrt{10} - 4$ **f** = $(3 - 2\sqrt{2})(4 + \sqrt{2})$
= $7 + 13\sqrt{2}$ = $1 + \sqrt{10}$ = $12 + 3\sqrt{2} - 8\sqrt{2} - 4$
= $8 - 5\sqrt{2}$

- 8
- a** $= \frac{1}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} = \frac{1}{5}\sqrt{5}$ **b** $= \frac{2}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{2}{3}\sqrt{3}$ **c** $= \frac{1}{2\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{1}{4}\sqrt{2}$
- d** $= \frac{14}{\sqrt{7}} \times \frac{\sqrt{7}}{\sqrt{7}} = 2\sqrt{7}$ **e** $= \frac{3\sqrt{2}}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \sqrt{6}$ **f** $= \frac{\sqrt{5}}{\sqrt{3}\sqrt{5}} = \frac{1}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{1}{3}\sqrt{3}$
- g** $= \frac{1}{3\sqrt{7}} \times \frac{\sqrt{7}}{\sqrt{7}} = \frac{1}{21}\sqrt{7}$ **h** $= \frac{12}{6\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \sqrt{2}$ **i** $= \frac{1}{4\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} = \frac{1}{20}\sqrt{5}$
- j** $= \frac{3}{6\sqrt{6}} \times \frac{\sqrt{6}}{\sqrt{6}} = \frac{1}{12}\sqrt{6}$ **k** $= \frac{8\sqrt{5}}{9\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{4}{9}\sqrt{10}$ **l** $= \frac{15\sqrt{7}}{6\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{5}{6}\sqrt{21}$
- 9
- a** $= 2\sqrt{2} + \frac{6}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$
 $= 2\sqrt{2} + 3\sqrt{2}$
 $= 5\sqrt{2}$
- b** $= 4\sqrt{3} - \frac{10}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$
 $= 4\sqrt{3} - \frac{10}{3}\sqrt{3}$
 $= \frac{2}{3}\sqrt{3}$
- c** $= \frac{6-2\sqrt{2}}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$
 $= \frac{6\sqrt{2}-4}{2}$
 $= 3\sqrt{2} - 2$
- d** $= \frac{3\sqrt{5}-5}{2\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$
 $= \frac{15-5\sqrt{5}}{10}$
 $= \frac{1}{2}(3 - \sqrt{5})$
- e** $= \frac{1}{3\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} + \frac{1}{4\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$
 $= \frac{1}{6}\sqrt{2} + \frac{1}{8}\sqrt{2}$
 $= \frac{7}{24}\sqrt{2}$
- f** $= \frac{2}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} - \frac{\sqrt{2}\sqrt{3}}{6\sqrt{2}}$
 $= \frac{2}{3}\sqrt{3} - \frac{1}{6}\sqrt{3}$
 $= \frac{1}{2}\sqrt{3}$
- 10
- a** $x^2 + 4x = 4x + 32$
 $x^2 = 32$
 $x = \pm\sqrt{32}$
 $x = \pm 4\sqrt{2}$
- b** $x - 4\sqrt{3} = 2\sqrt{3} - 2x$
 $3x = 6\sqrt{3}$
 $x = 2\sqrt{3}$
- c** $3\sqrt{2}x - 4 = 2\sqrt{2}$
 $6x - 4\sqrt{2} = 4$
 $6x = 4 + 4\sqrt{2}$
 $x = \frac{2}{3}(1 + \sqrt{2})$
- d** $\sqrt{5}x + 2 = 2\sqrt{5}(x - 1)$
 $5x + 2\sqrt{5} = 10(x - 1)$
 $5x = 10 + 2\sqrt{5}$
 $x = 2 + \frac{2}{5}\sqrt{5}$
- 11
- a** $= 4 - (\sqrt{3})^2 = 4 - 3 = 1$
- b** $= \frac{2}{2-\sqrt{3}} \times \frac{2+\sqrt{3}}{2+\sqrt{3}} = \frac{2(2+\sqrt{3})}{1} = 4 + 2\sqrt{3}$
- 12
- a** $= \frac{1}{\sqrt{2}+1} \times \frac{\sqrt{2}-1}{\sqrt{2}-1} = \frac{\sqrt{2}-1}{2-1} = \sqrt{2}-1$
- b** $= \frac{4}{\sqrt{3}-1} \times \frac{\sqrt{3}+1}{\sqrt{3}+1} = \frac{4(\sqrt{3}+1)}{3-1} = 2(\sqrt{3}+1)$
- c** $= \frac{1}{\sqrt{6}-2} \times \frac{\sqrt{6}+2}{\sqrt{6}+2} = \frac{\sqrt{6}+2}{6-4} = \frac{1}{2}(\sqrt{6}+2)$ or $\frac{1}{2}\sqrt{6}+1$
- d** $= \frac{3}{2+\sqrt{3}} \times \frac{2-\sqrt{3}}{2-\sqrt{3}} = \frac{3(2-\sqrt{3})}{4-3} = 3(2-\sqrt{3})$
- e** $= \frac{1}{2+\sqrt{5}} \times \frac{2-\sqrt{5}}{2-\sqrt{5}} = \frac{2-\sqrt{5}}{4-5} = \sqrt{5}-2$

$$f = \frac{\sqrt{2}}{\sqrt{2}-1} \times \frac{\sqrt{2}+1}{\sqrt{2}+1} = \frac{\sqrt{2}(\sqrt{2}+1)}{2-1} = 2 + \sqrt{2}$$

$$g = \frac{6}{\sqrt{7}+3} \times \frac{\sqrt{7}-3}{\sqrt{7}-3} = \frac{6(\sqrt{7}-3)}{7-9} = 3(3-\sqrt{7})$$

$$h = \frac{1}{3+2\sqrt{2}} \times \frac{3-2\sqrt{2}}{3-2\sqrt{2}} = \frac{3-2\sqrt{2}}{9-8} = 3-2\sqrt{2}$$

$$i = \frac{1}{4-2\sqrt{3}} \times \frac{4+2\sqrt{3}}{4+2\sqrt{3}} = \frac{4+2\sqrt{3}}{16-12} = \frac{1}{2}(2+\sqrt{3}) \text{ or } 1 + \frac{1}{2}\sqrt{3}$$

$$j = \frac{3}{3\sqrt{2}+4} \times \frac{3\sqrt{2}-4}{3\sqrt{2}-4} = \frac{3(3\sqrt{2}-4)}{18-16} = \frac{3}{2}(3\sqrt{2}-4) \text{ or } \frac{9}{2}\sqrt{2}-6$$

$$k = \frac{2\sqrt{3}}{7-4\sqrt{3}} \times \frac{7+4\sqrt{3}}{7+4\sqrt{3}} = \frac{2\sqrt{3}(7+4\sqrt{3})}{49-48} = 2(7\sqrt{3}+12)$$

$$l = \frac{6}{\sqrt{5}-\sqrt{3}} \times \frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}+\sqrt{3}} = \frac{6(\sqrt{5}+\sqrt{3})}{5-3} = 3(\sqrt{5}+\sqrt{3})$$

$$13 \quad 3x = \sqrt{5}x + 2\sqrt{5}$$

$$x(3 - \sqrt{5}) = 2\sqrt{5}$$

$$x = \frac{2\sqrt{5}}{3-\sqrt{5}} = \frac{2\sqrt{5}}{3-\sqrt{5}} \times \frac{3+\sqrt{5}}{3+\sqrt{5}} = \frac{2\sqrt{5}(3+\sqrt{5})}{9-5}$$

$$x = \frac{6\sqrt{5}+10}{4} = \frac{3}{2} + \frac{3}{2}\sqrt{5}$$

$$14 \quad l = \frac{6}{3\sqrt{2}-3} = \frac{6}{3\sqrt{2}-3} \times \frac{3\sqrt{2}+3}{3\sqrt{2}+3} = \frac{6(3\sqrt{2}+3)}{18-9}$$

$$l = \frac{18(\sqrt{2}+1)}{9} = 2\sqrt{2} + 2$$

$$15 \quad a = \frac{\sqrt{2}}{\sqrt{2}+\sqrt{6}} \times \frac{\sqrt{2}-\sqrt{6}}{\sqrt{2}-\sqrt{6}} = \frac{\sqrt{2}(\sqrt{2}-\sqrt{6})}{2-6} = -\frac{1}{4}(2-2\sqrt{3}) = \frac{1}{2}(\sqrt{3}-1)$$

$$b = \frac{1+\sqrt{3}}{2+\sqrt{3}} \times \frac{2-\sqrt{3}}{2-\sqrt{3}} = \frac{(1+\sqrt{3})(2-\sqrt{3})}{4-3} = 2 - \sqrt{3} + 2\sqrt{3} - 3 = \sqrt{3} - 1$$

$$c = \frac{1+\sqrt{10}}{\sqrt{10}-3} \times \frac{\sqrt{10}+3}{\sqrt{10}+3} = \frac{(1+\sqrt{10})(\sqrt{10}+3)}{10-9} = \sqrt{10} + 3 + 10 + 3\sqrt{10} = 13 + 4\sqrt{10}$$

$$d = \frac{3-\sqrt{2}}{4+3\sqrt{2}} \times \frac{4-3\sqrt{2}}{4-3\sqrt{2}} = \frac{(3-\sqrt{2})(4-3\sqrt{2})}{16-18} = \frac{12-9\sqrt{2}-4\sqrt{2}+6}{-2} = \frac{1}{2}(13\sqrt{2}-18) \text{ or } \frac{13}{2}\sqrt{2}-9$$

$$e = \frac{1-\sqrt{2}}{3-2\sqrt{2}} \times \frac{3+2\sqrt{2}}{3+2\sqrt{2}} = \frac{(1-\sqrt{2})(3+2\sqrt{2})}{9-8} = 3 + 2\sqrt{2} - 3\sqrt{2} - 4 = -1 - \sqrt{2}$$

$$f = \frac{\sqrt{3}-5}{2\sqrt{3}-4} \times \frac{2\sqrt{3}+4}{2\sqrt{3}+4} = \frac{(\sqrt{3}-5)(2\sqrt{3}+4)}{12-16} = \frac{6+4\sqrt{3}-10\sqrt{3}-20}{-4} = \frac{1}{2}(7+3\sqrt{3})$$

$$g = \frac{2\sqrt{3}+3}{3-\sqrt{3}} \times \frac{3+\sqrt{3}}{3+\sqrt{3}} = \frac{(2\sqrt{3}+3)(3+\sqrt{3})}{9-3} = \frac{6\sqrt{3}+6+9+3\sqrt{3}}{6} = \frac{1}{2}(3\sqrt{3}+5)$$

$$h = \frac{3\sqrt{7}-2}{2\sqrt{7}-5} \times \frac{2\sqrt{7}+5}{2\sqrt{7}+5} = \frac{(3\sqrt{7}-2)(2\sqrt{7}+5)}{28-25} = \frac{42+15\sqrt{7}-4\sqrt{7}-10}{3} = \frac{1}{3}(32+11\sqrt{7})$$