



- 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**  $= (3^3)^{\frac{x}{4}} = 3^{\frac{3x}{4}}$
- 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  $(3^3)^{2x} = (3^2)^{3x-x}$   
 $3^{6x} = 3^{6-2x}$   
 $6x = 6 - 2x$   
 $x = \frac{3}{4}$
- 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  $= \frac{t^{\frac{1}{2}} \times 2t(t^2 - 2)}{t^2 - 2}$   
 $= 2t^{\frac{3}{2}}$