Chapter 3
EXPONENTIALS

EXERCISE 3A

1 **a** $2^1 = 2,\ 2^2 = 4,\ 2^3 = 8,\ 2^4 = 16,\ 2^5 = 32,\ 2^6 = 64$

b $3^1 = 3,\ 3^2 = 9,\ 3^3 = 27,\ 3^4 = 81,\ 3^5 = 243,\ 3^6 = 729$

c $4^1 = 4,\ 4^2 = 16,\ 4^3 = 64,\ 4^4 = 256,\ 4^5 = 1024,\ 4^6 = 4096$

2 **a** $5^1 = 5,\ 5^2 = 25,\ 5^3 = 125,\ 5^4 = 625$ **b** $6^1 = 6,\ 6^2 = 36,\ 6^3 = 216,\ 6^4 = 1296$

c $7^1 = 7,\ 7^2 = 49,\ 7^3 = 343,\ 7^4 = 2401$

3 **a**
$$\begin{aligned}&(-1)^5\\ &= (-1)\times(-1)\times(-1)\times(-1)\times(-1)\\ &= 1\times 1\times(-1)\\ &= -1\end{aligned}$$

b
$$\begin{aligned}&(-1)^6\\ &= (-1)^5\times(-1)\\ &= (-1)\times(-1)\\ &= 1\end{aligned}$$

c
$$\begin{aligned}&(-1)^{14}\\ &= 1\end{aligned}$$

d
$$\begin{aligned}&(-1)^{19}\\ &= -1\end{aligned}$$

e
$$\begin{aligned}&(-1)^8\\ &= 1\end{aligned}$$

f
$$\begin{aligned}&-1^8\\ &= -(1^8)\\ &= -1\end{aligned}$$

g
$$\begin{aligned}&-(-1)^8\\ &= -(1)\\ &= -1\end{aligned}$$

h
$$\begin{aligned}&(-2)^5\\ &= (-2)\times(-2)\times(-2)\times(-2)\times(-2)\\ &= 4\times 4\times(-2)\\ &= -32\end{aligned}$$

i
$$\begin{aligned}&-2^5\\ &= -(2^5)\\ &= -32\end{aligned}$$

j
$$\begin{aligned}&-(-2)^6\\ &= -(-2)^5\times(-2)\\ &= 32\times(-2)\\ &= -64\end{aligned}$$

k
$$\begin{aligned}&(-5)^4\\ &= (-5)\times(-5)\times(-5)\times(-5)\\ &= 25\times 25\\ &= 625\end{aligned}$$

l
$$\begin{aligned}&-(-5)^4\\ &= -(-5)\times(-5)\times(-5)\times(-5)\\ &= -25\times 25\\ &= -625\end{aligned}$$

4 **a** $4^7 = 16\,384$ **b** $7^4 = 2401$ **c** $-5^5 = -3125$ **d** $(-5)^5 = -3125$

e $8^6 = 262\,144$ **f** $(-8)^6 = 262\,144$ **g** $-8^6 = -262\,144$

h $2.13^9 \approx 902.436\,039\,6$ **i** $-2.13^9 \approx -902.436\,039\,6$ **j** $(-2.13)^9 \approx -902.436\,039\,6$

5 **a** $9^{-1} = 0.\overline{1}$ **b** $\dfrac{1}{9^1} = 0.\overline{1}$ **c** $6^{-2} = 0.02\overline{7}$ **d** $\dfrac{1}{6^2} = 0.02\overline{7}$

e $3^{-4} \approx 0.012\,345\,679$ **f** $\dfrac{1}{3^4} \approx 0.012\,345\,679$ **g** $17^0 = 1$ **h** $(0.366)^0 = 1$

We notice that $a^{-n} = \dfrac{1}{a^n}$ and $a^0 = 1$ for $a \neq 0$.

6 $3^{101} = \underbrace{3^4 \times 3^4 \times 3^4 \times .... \times 3^4}_{25 \text{ of these}} \times 3^1$

But $3^4 = 81$ which ends in a 1

$\therefore$ $\underbrace{3^4 \times 3^4 \times 3^4 \times .... \times 3^4}_{25 \text{ of these}}$ ends in a 1

$\therefore$ 3^{101} ends in a 3

7 $7^1 = 7,\quad 7^2 = 49,\quad 7^3 = 343,\quad 7^4 = 2401,\quad 7^5 = 16\,807$

Now $7^{217} = \underbrace{7^4 \times 7^4 \times 7^4 \times .... \times 7^4}_{54 \text{ of these so this part ends in a 1}} \times 7^1$

$\therefore$ 7^{217} ends in $1 \times 7 = 7$.

EXERCISE 3B

1 **a** $5^4 \times 5^7 = 5^{4+7}$
$= 5^{11}$

b $d^2 \times d^6 = d^{2+6}$
$= d^8$

c $\dfrac{k^8}{k^3} = k^{8-3}$
$= k^5$

d $\dfrac{7^5}{7^6} = 7^{5-6}$
$= 7^{-1}$
$= \frac{1}{7}$

e $(x^2)^5 = x^{2\times5}$
$= x^{10}$

f $(3^4)^4 = 3^{4\times4}$
$= 3^{16}$

g $\dfrac{p^3}{p^7} = p^{3-7}$
$= p^{-4}$ or $\dfrac{1}{p^4}$

h $n^3 \times n^9 = n^{3+9}$
$= n^{12}$

i $(5^t)^3 = 5^{t\times3}$
$= 5^{3t}$

j $7^x \times 7^2 = 7^{x+2}$

k $\dfrac{10^3}{10^q} = 10^{3-q}$

l $(c^4)^m = c^{4\times m}$
$= c^{4m}$

2 **a** $4 = 2 \times 2$
$= 2^2$

b $\dfrac{1}{4} = \dfrac{1}{2^2}$
$= 2^{-2}$

c $8 = 2 \times 2 \times 2$
$= 2^3$

d $\dfrac{1}{8} = \dfrac{1}{2^3}$
$= 2^{-3}$

e 32
$= 2 \times 2 \times 2 \times 2 \times 2$
$= 2^5$

f $\dfrac{1}{32} = \dfrac{1}{2^5}$
$= 2^{-5}$

g $2 = 2^1$

h $\dfrac{1}{2} = \dfrac{1}{2^1}$
$= 2^{-1}$

i $64 = 32 \times 2$
$= 2^5 \times 2^1$
$= 2^6$

j $\dfrac{1}{64} = \dfrac{1}{2^6}$
$= 2^{-6}$

k $128 = 64 \times 2$
$= 2^6 \times 2^1$
$= 2^7$

l $\dfrac{1}{128} = \dfrac{1}{2^7}$
$= 2^{-7}$

3 **a** $9 = 3 \times 3$
$= 3^2$

b $\dfrac{1}{9} = \dfrac{1}{3^2}$
$= 3^{-2}$

c $27 = 3 \times 3 \times 3$
$= 3^3$

d $\dfrac{1}{27} = \dfrac{1}{3^3}$
$= 3^{-3}$

e $3 = 3^1$

f $\dfrac{1}{3} = \dfrac{1}{3^1}$
$= 3^{-1}$

g $81 = 3 \times 3 \times 3 \times 3$
$= 3^4$

h $\dfrac{1}{81} = \dfrac{1}{3^4}$
$= 3^{-4}$

i $1 = 3^0$

j $243 = 81 \times 3$
$= 3^4 \times 3^1$
$= 3^5$

k $\dfrac{1}{243} = \dfrac{1}{3^5}$
$= 3^{-5}$

4 **a** $2 \times 2^a = 2^1 \times 2^a$
$= 2^{a+1}$

b $4 \times 2^b = 2^2 \times 2^b$
$= 2^{b+2}$

c $8 \times 2^t = 2^3 \times 2^t$
$= 2^{t+3}$

d $(2^{x+1})^2 = 2^{2(x+1)}$
$= 2^{2x+2}$

e $(2^{1-n})^{-1} = 2^{-(1-n)}$
$= 2^{n-1}$

f $\dfrac{2^c}{4} = \dfrac{2^c}{2^2} = 2^{c-2}$

g $\dfrac{2^m}{2^{-m}} = 2^{m-(-m)}$
$= 2^{2m}$

h $\dfrac{4}{2^{1-n}} = \dfrac{2^2}{2^{1-n}}$
$= 2^{2-(1-n)}$
$= 2^{n+1}$

i $\dfrac{2^{x+1}}{2^x} = 2^{x+1-x}$
$= 2^1$

j $\dfrac{4^x}{2^{1-x}} = \dfrac{(2^2)^x}{2^{1-x}}$
$= 2^{2x-(1-x)}$
$= 2^{3x-1}$

5 **a** $9 \times 3^p = 3^2 \times 3^p$
$= 3^{p+2}$

b $27^a = (3^3)^a$
$= 3^{3a}$

c $3 \times 9^n = 3^1 \times (3^2)^n$
$= 3^{2n+1}$

d $27 \times 3^d = 3^3 \times 3^d$
$= 3^{d+3}$

e $9 \times 27^t = 3^2 \times (3^3)^t$
$= 3^{3t+2}$

f $\dfrac{3^y}{3} = \dfrac{3^y}{3^1} = 3^{y-1}$

g $\dfrac{3}{3^y} = \dfrac{3^1}{3^y}$
$= 3^{1-y}$

h $\dfrac{9}{27^t} = \dfrac{3^2}{(3^3)^t}$
$= 3^{2-3t}$

i $\dfrac{9^a}{3^{1-a}} = \dfrac{(3^2)^a}{3^{1-a}}$
$= 3^{2a-(1-a)}$
$= 3^{3a-1}$

j $\dfrac{9^{n+1}}{3^{2n-1}} = \dfrac{(3^2)^{n+1}}{3^{2n-1}}$
$= 3^{2n+2-(2n-1)}$
$= 3^3$

6 **a** $(2a)^2 = 2^2 \times a^2$
$= 4a^2$

b $(3b)^3 = 3^3 \times b^3$
$= 27b^3$

c $(ab)^4 = a^4 \times b^4$
$= a^4b^4$

d $(pq)^3 = p^3 \times q^3$
$= p^3q^3$

e $\left(\dfrac{m}{n}\right)^2 = \dfrac{m^2}{n^2}$

f $\left(\dfrac{a}{3}\right)^3 = \dfrac{a^3}{3^3} = \dfrac{a^3}{27}$

g $\left(\dfrac{b}{c}\right)^4 = \dfrac{b^4}{c^4}$

h $\left(\dfrac{2a}{b}\right)^0 = 1, \ b \neq 0$

i $\left(\dfrac{m}{3n}\right)^4 = \dfrac{m^4}{3^4 \times n^4} = \dfrac{m^4}{81n^4}$

j $\left(\dfrac{xy}{2}\right)^3 = \dfrac{x^3y^3}{2^3} = \dfrac{x^3y^3}{8}$

7 **a** $(-2a)^2$
$= (-2)^2a^2$
$= 4a^2$

b $(-6b^2)^2$
$= (-6)^2b^4$
$= 36b^4$

c $(-2a)^3$
$= (-2)^3a^3$
$= -8a^3$

d $(-3m^2n^2)^3$
$= (-3)^3m^6n^6$
$= -27m^6n^6$

e $(-2ab^4)^4$
$= (-2)^4a^4b^{16}$
$= 16a^4b^{16}$

f $\left(\dfrac{-2a^2}{b^2}\right)^3$
$= \dfrac{(-2)^3a^6}{b^6}$
$= -\dfrac{8a^6}{b^6}$

g $\left(\dfrac{-4a^3}{b}\right)^2$
$= \dfrac{(-4)^2a^6}{b^2}$
$= \dfrac{16a^6}{b^2}$

h $\left(\dfrac{-3p^2}{q^3}\right)^2$
$= \dfrac{(-3)^2p^4}{q^6}$
$= \dfrac{9p^4}{q^6}$

8 **a** $ab^{-2} = \dfrac{a}{b^2}$

b $(ab)^{-2} = \dfrac{1}{(ab)^2}$
$= \dfrac{1}{a^2b^2}$

c $(2ab^{-1})^2 = 2^2a^2b^{-2}$
$= \dfrac{4a^2}{b^2}$

d $(3a^{-2}b)^2 = 3^2a^{-4}b^2$
$= \dfrac{9b^2}{a^4}$

e $\dfrac{a^2b^{-1}}{c^2} = \dfrac{a^2}{bc^2}$

f $\dfrac{a^2b^{-1}}{c^{-2}} = \dfrac{a^2c^2}{b}$

g $\dfrac{1}{a^{-3}} = a^3$

h $\dfrac{a^{-2}}{b^{-3}} = \dfrac{b^3}{a^2}$

i $\dfrac{2a^{-1}}{d^2} = \dfrac{2}{ad^2}$

j $\dfrac{12a}{m^{-3}} = 12am^3$

9 **a** $\dfrac{1}{a^n} = a^{-n}$

b $\dfrac{1}{b^{-n}} = b^n$

c $\dfrac{1}{3^{2-n}} = 3^{n-2}$

d $\dfrac{a^n}{b^{-m}} = a^nb^m$

e $\dfrac{a^{-n}}{a^{2+n}} = a^{-n-(2+n)}$
$= a^{-2n-2}$

10 **a** $(\frac{5}{3})^0 = 1$ **b** $(\frac{7}{4})^{-1} = \frac{4}{7}$ **c** $(\frac{1}{6})^{-1} = \frac{6}{1} = 6$ **d** $\frac{3^3}{3^0} = \frac{27}{1} = 27$

e $(\frac{4}{3})^{-2} = \frac{3^2}{4^2} = \frac{9}{16}$ **f** $2^1 + 2^{-1} = 2 + \frac{1}{2} = \frac{5}{2}$ **g** $(1\frac{2}{3})^{-3} = (\frac{5}{3})^{-3} = \frac{3^3}{5^3} = \frac{27}{125}$ **h** $5^2 + 5^1 + 5^{-1} = 25 + 5 + \frac{1}{5} = \frac{151}{5}$

11 **a** $\frac{1}{9} = \frac{1}{3^2} = 3^{-2}$ **b** $\frac{1}{16} = \frac{1}{2^4} = 2^{-4}$ **c** $\frac{1}{125} = \frac{1}{5^3} = 5^{-3}$ **d** $\frac{3}{5} = 3 \times \frac{1}{5} = 3^1 \times 5^{-1}$ **e** $\frac{4}{27} = \frac{2^2}{3^3} = 2^2 \times 3^{-3}$

f $\frac{2^c}{8 \times 9} = \frac{2^c}{2^3 \times 3^2} = 2^{c-3} \times 3^{-2}$ **g** $\frac{9^k}{10} = \frac{(3^2)^k}{2 \times 5} = 3^{2k} \times 2^{-1} \times 5^{-1}$ **h** $\frac{6^p}{75} = \frac{(2 \times 3)^p}{3 \times 5^2} = \frac{2^p \times 3^p}{3 \times 5^2} = 2^p \times 3^{p-1} \times 5^{-2}$

12 **a** $5^3 = 21 + 23 + 25 + 27 + 29$ **b** $7^3 = 43 + 45 + 47 + 49 + 51 + 53 + 55$

c $12^3 = 133 + 135 + 137 + 139 + 141 + 143 + 145 + 147 + 149 + 151 + 153 + 155$

EXERCISE 3C

1 **a** $\sqrt[5]{2} = 2^{\frac{1}{5}}$ **b** $\frac{1}{\sqrt[5]{2}} = \frac{1}{2^{\frac{1}{5}}} = 2^{-\frac{1}{5}}$ **c** $2\sqrt{2} = 2^1 \times 2^{\frac{1}{2}} = 2^{\frac{3}{2}}$ **d** $4\sqrt{2} = 2^2 \times 2^{\frac{1}{2}} = 2^{\frac{5}{2}}$

e $\frac{1}{\sqrt[3]{2}} = \frac{1}{2^{\frac{1}{3}}} = 2^{-\frac{1}{3}}$ **f** $2 \times \sqrt[3]{2} = 2^1 \times 2^{\frac{1}{3}} = 2^{\frac{4}{3}}$ **g** $\frac{4}{\sqrt{2}} = \frac{2^2}{2^{\frac{1}{2}}} = 2^{\frac{3}{2}}$

h $(\sqrt{2})^3 = (2^{\frac{1}{2}})^3 = 2^{\frac{3}{2}}$ **i** $\frac{1}{\sqrt[3]{16}} = \frac{1}{\sqrt[3]{2^4}} = \frac{1}{2^{\frac{4}{3}}} = 2^{-\frac{4}{3}}$ **j** $\frac{1}{\sqrt{8}} = \frac{1}{\sqrt{2^3}} = \frac{1}{2^{\frac{3}{2}}} = 2^{-\frac{3}{2}}$

2 **a** $\sqrt[3]{3} = 3^{\frac{1}{3}}$ **b** $\frac{1}{\sqrt[3]{3}} = \frac{1}{3^{\frac{1}{3}}} = 3^{-\frac{1}{3}}$ **c** $\sqrt[4]{3} = 3^{\frac{1}{4}}$ **d** $3\sqrt{3} = 3^1 \times 3^{\frac{1}{2}} = 3^{\frac{3}{2}}$

e $\frac{1}{9\sqrt{3}} = \frac{1}{3^2 \times 3^{\frac{1}{2}}} = \frac{1}{3^{\frac{5}{2}}} = 3^{-\frac{5}{2}}$

3 **a** $\sqrt[3]{7} = 7^{\frac{1}{3}}$ **b** $\sqrt[4]{27} = \sqrt[4]{3^3} = 3^{\frac{3}{4}}$ **c** $\sqrt[5]{16} = \sqrt[5]{2^4} = 2^{\frac{4}{5}}$ **d** $\sqrt[3]{32} = \sqrt[3]{2^5} = 2^{\frac{5}{3}}$

e $\sqrt[7]{49} = \sqrt[7]{7^2} = 7^{\frac{2}{7}}$ **f** $\frac{1}{\sqrt[3]{7}} = \frac{1}{7^{\frac{1}{3}}} = 7^{-\frac{1}{3}}$ **g** $\frac{1}{\sqrt[4]{27}} = \frac{1}{3^{\frac{3}{4}}} = 3^{-\frac{3}{4}}$ **h** $\frac{1}{\sqrt[5]{16}} = \frac{1}{2^{\frac{4}{5}}} = 2^{-\frac{4}{5}}$

i $\frac{1}{\sqrt[3]{32}} = \frac{1}{2^{\frac{5}{3}}} = 2^{-\frac{5}{3}}$ **j** $\frac{1}{\sqrt[7]{49}} = \frac{1}{7^{\frac{2}{7}}} = 7^{-\frac{2}{7}}$

4 **a** $3^{\frac{3}{4}} \approx 2.28$ **b** $2^{\frac{7}{8}} \approx 1.83$ **c** $2^{-\frac{1}{3}} \approx 0.794$ **d** $4^{-\frac{3}{5}} \approx 0.435$

e $\sqrt[4]{8} \approx 1.68$ **f** $\sqrt[5]{27} \approx 1.93$ **g** $\dfrac{1}{\sqrt[3]{7}} \approx 0.523$

5 **a** $4^{\frac{3}{2}} = (2^2)^{\frac{3}{2}} = 2^3 = 8$

b $8^{\frac{5}{3}} = (2^3)^{\frac{5}{3}} = 2^5 = 32$

c $16^{\frac{3}{4}} = (2^4)^{\frac{3}{4}} = 2^3 = 8$

d $25^{\frac{3}{2}} = (5^2)^{\frac{3}{2}} = 5^3 = 125$

e $32^{\frac{2}{5}} = (2^5)^{\frac{2}{5}} = 2^2 = 4$

f $4^{-\frac{1}{2}} = (2^2)^{-\frac{1}{2}} = 2^{-1} = \frac{1}{2}$

g $9^{-\frac{3}{2}} = (3^2)^{-\frac{3}{2}} = 3^{-3} = \frac{1}{27}$

h $8^{-\frac{4}{3}} = (2^3)^{-\frac{4}{3}} = 2^{-4} = \frac{1}{16}$

i $27^{-\frac{4}{3}} = (3^3)^{-\frac{4}{3}} = 3^{-4} = \frac{1}{81}$

j $125^{-\frac{2}{3}} = (5^3)^{-\frac{2}{3}} = 5^{-2} = \frac{1}{25}$

EXERCISE 3D.1

1 **a** $x^2(x^3 + 2x^2 + 1)$
$= x^2 \times x^3 + x^2 \times 2x^2 + x^2 \times 1$
$= x^5 + 2x^4 + x^2$

b $2^x(2^x + 1)$
$= 2^x \times 2^x + 2^x \times 1$
$= 2^{2x} + 2^x$

c $x^{\frac{1}{2}}(x^{\frac{1}{2}} + x^{-\frac{1}{2}})$
$= x^{\frac{1}{2}} \times x^{\frac{1}{2}} + x^{\frac{1}{2}} \times x^{-\frac{1}{2}}$
$= x^1 + x^0$
$= x + 1$

d $7^x(7^x + 2)$
$= 7^x \times 7^x + 7^x \times 2$
$= 7^{2x} + 2(7^x)$
or $49^x + 2(7^x)$

e $3^x(2 - 3^{-x})$
$= 3^x \times 2 - 3^x \times 3^{-x}$
$= 2(3^x) - 3^0$
$= 2(3^x) - 1$

f $x^{\frac{1}{2}}(x^{\frac{3}{2}} + 2x^{\frac{1}{2}} + 3x^{-\frac{1}{2}})$
$= x^{\frac{1}{2}} \times x^{\frac{3}{2}} + x^{\frac{1}{2}} \times 2x^{\frac{1}{2}} + x^{\frac{1}{2}} \times 3x^{-\frac{1}{2}}$
$= x^2 + 2x^1 + 3x^0$
$= x^2 + 2x + 3$

g $2^{-x}(2^x + 5)$
$= 2^{-x} \times 2^x + 2^{-x} \times 5$
$= 2^0 + 5(2^{-x})$
$= 1 + 5(2^{-x})$

h $5^{-x}(5^{2x} + 5^x)$
$= 5^{-x} \times 5^{2x} + 5^{-x} \times 5^x$
$= 5^x + 5^0$
$= 5^x + 1$

i $x^{-\frac{1}{2}}(x^2 + x + x^{\frac{1}{2}})$
$= x^{-\frac{1}{2}} \times x^2 + x^{-\frac{1}{2}} \times x^1 + x^{-\frac{1}{2}} \times x^{\frac{1}{2}}$
$= x^{\frac{3}{2}} + x^{\frac{1}{2}} + x^0$
$= x^{\frac{3}{2}} + x^{\frac{1}{2}} + 1$

2 **a** $(2^x - 1)(2^x + 3)$
$= 2^x \times 2^x + 2^x \times 3 - 1 \times 2^x - 3$
$= 2^{2x} + 2(2^x) - 3$
$= 4^x + 2^{x+1} - 3$

b $(3^x + 2)(3^x + 5)$
$= 3^x \times 3^x + 3^x \times 5 + 2 \times 3^x + 10$
$= 3^{2x} + 7(3^x) + 10$
$= 9^x + 7(3^x) + 10$

c $(5^x - 2)(5^x - 4)$
$= 5^x \times 5^x - 5^x \times 4 - 2 \times 5^x + 8$
$= 5^{2x} - 6(5^x) + 8$
$= 25^x - 6(5^x) + 8$

d $(2^x + 3)^2$
$= (2^x)^2 + 2 \times 2^x \times 3 + 3^2$
$= 2^{2x} + 6(2^x) + 9$
$= 4^x + 6(2^x) + 9$

e $(3^x - 1)^2$
$= (3^x)^2 - 2 \times 3^x \times 1 + 1^2$
$= 3^{2x} - 2(3^x) + 1$
$= 9^x - 2(3^x) + 1$

f $(4^x + 7)^2$
$= (4^x)^2 + 2 \times 4^x \times 7 + 7^2$
$= 4^{2x} + 14(4^x) + 49$
$= 16^x + 14(4^x) + 49$

g $(x^{\frac{1}{2}}+2)(x^{\frac{1}{2}}-2)$
$=(x^{\frac{1}{2}})^2-2^2$
$=x-4$

h $(2^x+3)(2^x-3)$
$=(2^x)^2-3^2$
$=2^{2x}-9$
$=4^x-9$

i $(x^{\frac{1}{2}}+x^{-\frac{1}{2}})(x^{\frac{1}{2}}-x^{-\frac{1}{2}})$
$=(x^{\frac{1}{2}})^2-(x^{-\frac{1}{2}})^2$
$=x^1-x^{-1}$
$=x-x^{-1}$

j $\left(x+\frac{2}{x}\right)^2$
$=x^2+2\times x\times\left(\frac{2}{x}\right)+\left(\frac{2}{x}\right)^2$
$=x^2+4+\frac{4}{x^2}$

k $(7^x-7^{-x})^2$
$=(7^x)^2-2\times 7^x\times 7^{-x}+(7^{-x})^2$
$=7^{2x}-2\times 7^0+7^{-2x}$
$=7^{2x}-2+7^{-2x}$

l $(5-2^{-x})^2$
$=5^2-2\times 5\times 2^{-x}+(2^{-x})^2$
$=25-10(2^{-x})+2^{-2x}$
$=25-10(2^{-x})+4^{-x}$

EXERCISE 3D.2

1 **a** $5^{2x}+5^x$
$=5^x\times 5^x+5^x$
$=5^x(5^x+1)$

b $3^{n+2}+3^n$
$=3^n\times 3^2+3^n$
$=3^n(3^2+1)$
$=10(3^n)$

c 7^n+7^{3n}
$=7^n+7^n\times 7^{2n}$
$=7^n(1+7^{2n})$

d $5^{n+1}-5$
$=5\times 5^n-5$
$=5(5^n-1)$

e $6^{n+2}-6$
$=6\times 6^{n+1}-6$
$=6(6^{n+1}-1)$

f $4^{n+2}-16$
$=4^2\times 4^n-16$
$=16\times 4^n-16$
$=16(4^n-1)$

2 **a** 9^x-4
$=(3^x)^2-2^2$
$=(3^x+2)(3^x-2)$

b 4^x-25
$=(2^x)^2-5^2$
$=(2^x+5)(2^x-5)$

c $16-9^x$
$=4^2-(3^x)^2$
$=(4+3^x)(4-3^x)$

d $25-4^x$
$=5^2-(2^x)^2$
$=(5+2^x)(5-2^x)$

e 9^x-4^x
$=(3^x)^2-(2^x)^2$
$=(3^x+2^x)(3^x-2^x)$

f $4^x+6(2^x)+9$
$=(2^x)^2+6(2^x)+9$
$=(2^x+3)^2$
$\{a^2+6a+9=(a+3)^2\}$

g $9^x+10(3^x)+25$
$=(3^x)^2+10(3^x)+25$
$=(3^x+5)^2$
$\{a^2+10a+25=(a+5)^2\}$

h $4^x-14(2^x)+49$
$=(2^x)^2-14(2^x)+49$
$=(2^x-7)^2$
$\{a^2-14a+49=(a-7)^2\}$

i $25^x-4(5^x)+4$
$=(5^x)^2-4(5^x)+4$
$=(5^x-2)^2$
$\{a^2-4a+4=(a-2)^2\}$

3 **a** $4^x+9(2^x)+18$
$=(2^x)^2+9(2^x)+18$
$=(2^x+3)(2^x+6)$
$\{a^2+9a+18=(a+3)(a+6)\}$

b 4^x-2^x-20
$=(2^x)^2-2^x-20$
$=(2^x+4)(2^x-5)$
$\{a^2-a-20=(a+4)(a-5)\}$

c $9^x+9(3^x)+14$
$=(3^x)^2+9(3^x)+14$
$=(3^x+2)(3^x+7)$
$\{a^2+9a+14=(a+2)(a+7)\}$

d $9^x+4(3^x)-5$
$=(3^x)^2+4(3^x)-5$
$=(3^x+5)(3^x-1)$
$\{a^2+4a-5=(a+5)(a-1)\}$