

Fully-Worked Solutions

PRACTICE 1

Formative Practice

- 1 A Correct
B Correct
C Correct
D Wrong $\rightarrow 5^3 = 125$

Answer: D

- 2 (a) $2 \times 2 \times 2 \times 2 \times 2 = 2^5$ ☒
(b) $4 \times 4 \times 4 = 4^3$
 $4 \times 4 \times 4 = 3^4$ ☒
(c) $m \times m \times m \times m \times m \times m = m^6$ ☒
(d) $(-r) \times (-r) \times (-r) = -r^3$ ☒

3

Base	Index	Index form
2	10	2^{10}
4.3	8	4.3^8
$\frac{5}{7}$	3	$\left(\frac{5}{7}\right)^3$
$-1\frac{1}{2}$	6	$\left(-1\frac{1}{2}\right)^6$

- 4 (a) $2^4 = 2 \times 2 \times 2 \times 2 = 16$
 $4^2 = 4 \times 4 = 16$
 $16 = 2^4 \quad 4^2$
(b) $(-3)^3 = (-3) \times (-3) \times (-3) = -27$
 $3^{-3} = \left(\frac{1}{3}\right)^3 = \frac{1}{3} \times \frac{1}{3} \times \frac{1}{3} = \frac{1}{27}$
 $-27 = (-3)^3 \quad 3^{-3}$
(c) $\left(\frac{1}{6}\right)^3 = \frac{1}{6} \times \frac{1}{6} \times \frac{1}{6} = \frac{1}{216}$
 $\left(\frac{1}{3}\right)^5 = \frac{1}{3} \times \frac{1}{3} \times \frac{1}{3} \times \frac{1}{3} \times \frac{1}{3} = \frac{1}{243}$
 $\frac{1}{216} = \left(\frac{1}{6}\right)^3 \quad \left(\frac{1}{3}\right)^5$
(d) $0.1^3 = 0.1 \times 0.1 \times 0.1 = 0.001$
 $0.01^2 = 0.01 \times 0.01 = 0.0001$
 $0.0001 = 0.1^3 \quad 0.01^2$

5 (a) $8 \times 8 \times 8 = 512$
 $83 = 514$ ☒

(b) $2.3^4 = 27.9841$ ☒

(c) $\left(\frac{3}{5}\right)^4 = \frac{81}{625}$ ☒

(d) $1\frac{1}{3} \times 1\frac{1}{3} \times 1\frac{1}{3}$
 $= \frac{4}{3} \times \frac{4}{3} \times \frac{4}{3}$
 $= \frac{64}{27}$
 $= 2\frac{10}{27}$
 $\left(1\frac{1}{3}\right)^3 = 2\frac{1}{27}$ ☒

6 (a) $6 \overline{) 216}$
 $6 \overline{) 36}$
 $6 \overline{) 6}$
1

(b) $216 = 6 \times 6 \times 6$
 $= 6^3$

7 $x = a^8$ and $y = a^2$
A $xy = a^8 \times a^2$
 $= a^{8+2}$
 $= a^{10}$

B $\frac{x}{y} = \frac{a^8}{a^2}$
 $= a^{8-2}$
 $= a^6$
 $\neq a^4$

C $\frac{y}{x} = \frac{a^2}{a^8}$
 $= a^{2-8}$
 $= a^{-6}$
 $= \frac{1}{a^6}$

D $x = a^8$
 $= (a^2)^4$
 $= y^4$

Answer: B

8 (a) $2^5 \times 2^3 = (2 \times 2 \times 2 \times 2 \times 2) \times (2 \times 2 \times 2)$
 $= 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$
 $= 2^8$

$$(b) 2^5 + 3 = 2^8$$

$$(c) 2^5 \times 2^3 = 2^{5+3}$$

$$9 (a) 3^4 \times 3^2 \times 3^3 = 3^{4+2+3} = 3^9 \quad [X]$$

$$(b) m^3 \times m^6 \times m^5 = m^{3+6+5} = m^{14} \quad [\checkmark]$$

$$(c) p^9 \times p^4 \times p^3 = p^{9+4+3} = p^{16} \quad [X]$$

$$(d) y^8 \times y^2 \times y^{10} = y^{8+2+10} = y^{20} \quad [\checkmark]$$

$$10 (a) 5^7 \times 5^9 = 5^{16}$$

$$(b) k^4 \times k^6 = k^{10}$$

$$(c) t^5 \times t^{15} = t^{20}$$

$$(d) w^{18} \times w^8 = w^{26}$$

$$11 (a)$$

Division

$$\frac{5^7}{5^4}$$

Repeated multiplication

$$\frac{5^7}{5^4} = \frac{5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5}{5 \times 5 \times 5 \times 5} = 5^3$$

Subtraction of indices

$$\frac{5^7}{5^4} = 5^{7-4} = 5^3$$

$$(b) \frac{5^7}{5^4} = 5^{7-4}$$

$$12 (a) 3^9 \div 3^5 = 3^4$$

$$(b) 6^{11} \div 6^3 = 6^8$$

$$(c) m^{16} \div m^{10} = m^6$$

$$(d) s^7 \div s^2 = s^5$$

$$13 (a) 2^p \div 2^5 = 2^q$$

$$2^{p-5} = 2^q$$

$$p-5 = q$$

$$p-q = 5$$

(b)	p	8	14	17	21
	q	3	9	12	16

14

Repeated multiplication

$$7^5 \times 7^5 \times 7^5 = 7^{5+5+5} = 7^{15}$$

Multiplication of indices

$$7^5 \times 3 = 7^{15}$$

Number of the form

$$(7^5)^3$$

Generalisation

$$(7^5)^3 = 7^{5 \times 3}$$

$$15 (a) (p^3)^2 = p^{3 \times 2}$$

$$= p^{2 \times 3}$$

$$= (p^2)^3 \quad [\checkmark]$$

$$(b) (q^4)^6 = q^{4 \times 6}$$

$$= q^{24} \quad [\checkmark]$$

$$(c) (r^5)^4 = r^{5 \times 4}$$

$$= r^{20} \quad [X]$$

$$(d) (9^2)^9 = ((3^2)^2)^9$$

$$= (3^{2 \times 2})^9$$

$$= (3^4)^9$$

$$= 3^{4 \times 9}$$

$$= 3^{36} \quad [X]$$

$$16 (a) (2^9)^3 = 2^{27}$$

$$(b) (6^4)^5 = 6^{20}$$

$$(c) (x^3)^4 = x^{12}$$

$$(d) (y^6)^3 = y^{18}$$

$$17 (a) (3a^2)^3 = 3a^2 \times 3a^2 \times 3a^2$$

$$= (3 \times 3 \times 3) \times (a^2 \times a^2 \times a^2)$$

$$= 3^3 \times (a^2)^3$$

$$= 27 \times a^6$$

$$= 27a^6$$

$$(b) (h^3k^4n^7)^5 = (h^3)^5(k^4)^5(n^7)^5$$

$$= h^{15}k^{20}n^{35}$$

$$18 (a) (i) a^5 \div a^5 = \frac{a^5}{a^5}$$

$$= \frac{a \times a \times a \times a \times a}{a \times a \times a \times a \times a}$$

$$= 1$$

$$(ii) a^5 \div a^5 = a^{5-5}$$

$$= a^0$$

$$(b) (i) a^0 = 1 \text{ for non-zero value of } a. \quad [\checkmark]$$

$$(ii) a^0 = 1 \text{ for all values of } a. \quad [X]$$

$$(c) (i) 9.7^{15} \div 9.7^{15} = 1$$

$$(ii) \left(3\frac{7}{12}\right)^8 \div \left(3\frac{7}{12}\right)^8 = 1$$

19 (a)

(i) Repeated multiplication

(ii) Subtraction of indices

Division

$$a^2 \div a^3$$

$$\frac{a \times a}{a \times a \times a} = \frac{1}{a}$$

$$a^{2-3} = a^{-1}$$

$$(b) a^{-1} = \frac{1}{a}$$

$$20 (a) \checkmark$$

$$(b) X$$

$$(c) \checkmark$$

$$(d) \checkmark$$

$$21 (a) 2^{-13} = \frac{1}{2^{13}}$$

$$(b) \frac{1}{12^{-6}} = 12^6$$

$$(c) 5^{-4} = \frac{1}{5^4}$$

$$(d) \left(\frac{3}{2}\right)^{-2} = \left(\frac{2}{3}\right)^2$$

22

Number	$\frac{1}{3}$	$\frac{1}{14^2}$	$\frac{1}{10^5}$	$\left(\frac{4}{7}\right)^8$
Form a^{-n}	as	as	as	
	3^{-1}	14^{-2}	10^{-5}	$\left(\frac{7}{4}\right)^{-8}$

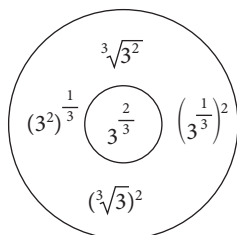
23 (a) $(2^3)^{\frac{1}{4}}$

(b) $\sqrt[5]{10^2}$

(c) $\sqrt[3]{6^2}$

(d) $(\sqrt[7]{3})^4$

24



25 (a) $x = 5, y = 4$

(b) $x = 7, y = 3$

26 (a) $2^4 \times 4 = 2^4 \times 2^2$
 $= 2^{4+2}$
 $= 2^6$

(b) $8^2 \div 2 = (2^3)^2 \div 2$
 $= 2^6 \div 2^1$
 $= 2^{6-1}$
 $= 2^5$

(c) $2^7 \times 2^6 \div 2^3 = 2^{7+6-3}$
 $= 2^{10}$

(d) $2^{15} \div (2^5)^2 \times 2^2 = 2^{15} \div 2^{10} \times 2^2$
 $= 2^{15-10+2}$
 $= 2^7$

27 (a) $3^4 \times 3^2 \times 3^8 = 3^{4+2+8}$
 $= 3^{14}$ [✓]

(b) $7^2 \times 7^5 \times 7^3 \times 7 = 7^2 \times 7^5 \times 7^3 \times 7^1$
 $= 7^{2+5+3+1}$
 $= 7^{11}$ [X]

(c) $(2^3)^3 \times 2^4 = 2^9 \times 2^4$
 $= 2^{9+4}$
 $= 2^{13}$ [X]

(d) $5^{10} \times (5^2)^4 = 5^{10} \times 5^8$
 $= 5^{10+8}$
 $= 5^{18}$ [✓]

28 (a) $2^{-2} \times 3^{-1} = \frac{1}{4} \times \frac{1}{3}$
 $= \frac{1}{12}$

(b) $7^{-1} \div 6^{-1} = \frac{1}{7} \div \frac{1}{6}$
 $= \frac{1}{7} \times 6$
 $= \frac{6}{7}$

29 (a) $32^{\frac{4}{5}} \times 27^{\frac{2}{3}} = (2^5)^{\frac{4}{5}} \times (3^3)^{\frac{2}{3}}$
 $= 2^4 \times 3^2$
 $= 16 \times 9$
 $= 144$

(b) $625^{\frac{1}{4}} \div 5^{-1} = (5^4)^{\frac{1}{4}} \div \frac{1}{5}$
 $= 5^1 \times 5$
 $= 25$

(c) $3^{\frac{1}{3}} \times 9^{-\frac{1}{4}} \times 3^{\frac{1}{6}} = 3^{\frac{1}{3}} \times (3^2)^{-\frac{1}{4}} \times 3^{\frac{1}{6}}$
 $= 3^{\frac{1}{3}} \times 3^{-\frac{1}{2}} \times 3^{\frac{1}{6}}$
 $= 3^{\frac{1}{3}-\frac{1}{2}+\frac{1}{6}}$
 $= 3^0$
 $= 1$

(d) $81^{-\frac{3}{4}} \div 49^{-\frac{1}{2}} \times \left(\frac{2}{3}\right)^{-1} = (3^4)^{-\frac{3}{4}} \div (7^2)^{-\frac{1}{2}} \times \left(\frac{2}{3}\right)^{-1}$
 $= 3^{-3} \div 7^{-1} \times \frac{3}{2}$
 $= \frac{1}{27} \div \frac{1}{7} \times \frac{3}{2}$
 $= \frac{1}{27} \times 7 \times \frac{3}{2}$
 $= \frac{7}{18}$

30 $2^{\frac{3}{2}} \times \left(2^{\frac{1}{8}} \times 3^{-\frac{1}{2}} \times 2^0\right)^4 = 2^{\frac{3}{2}} \times \left(2^{\frac{1}{8}} \times 3^{-\frac{1}{2}} \times 1\right)^4$
 $= 2^{\frac{3}{2}} \times \left(2^{\frac{1}{8}} \times 3^{-\frac{1}{2}}\right)^4$
 $= 2^{\frac{3}{2}} \times \left(2^{\frac{1}{8}}\right)^4 \times \left(3^{-\frac{1}{2}}\right)^4$
 $= 2^{\frac{3}{2}} \times 2^{\frac{1}{2}} \times 3^{-2}$
 $= 2^{\frac{3}{2}+\frac{1}{2}} \times \frac{1}{9}$
 $= 2^2 \times \frac{1}{9}$
 $= 4 \times \frac{1}{9}$
 $= \frac{4}{9}$

Answer: B

Summative Practice

1

$$\begin{array}{r} 6 \overline{) 1296} \\ 6 \overline{) 216} \\ 6 \overline{) 36} \\ 6 \overline{) 6} \\ 1 \end{array}$$

$$1296 = 6 \times 6 \times 6 \times 6$$

$$= 6^4$$

Alternative method

2	1 296
2	648
2	324
2	162
3	81
3	27
3	9
3	3
	1

$$\begin{aligned}
 1\ 296 &= 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 3 \\
 &= (2 \times 3) \times (2 \times 3) \times (2 \times 3) \times (2 \times 3) \\
 &= 6 \times 6 \times 6 \times 6 \\
 &= 6^4
 \end{aligned}$$

Answer: C

$$\begin{aligned}
 2 \quad 35^{\frac{1}{7}} &= (35^3)^{\frac{1}{7}} \\
 &= \sqrt[7]{35^3} \\
 \therefore m &= 3, n = 7
 \end{aligned}$$

Answer: A

$$\begin{aligned}
 3 \quad a^5 \times (a^n)^4 &= a^{17} \\
 a^5 \times a^{4n} &= a^{17} \\
 a^{5+4n} &= a^{17} \\
 5 + 4n &= 17 \\
 4n &= 12 \\
 n &= 3
 \end{aligned}$$

Answer: C

$$\begin{aligned}
 4 \quad 8^n \div 4^4 &= 2 \\
 (2^3)^n \div (2^2)^4 &= 2 \\
 2^{3n} \div 2^8 &= 2 \\
 2^{3n-8} &= 2^1 \\
 3n - 8 &= 1 \\
 3n &= 9 \\
 n &= 3
 \end{aligned}$$

Answer: A

$$\begin{aligned}
 5 \quad \text{A Wrong} \\
 (2^{-1})^0 &= \left(\frac{1}{2}\right)^0 \\
 &= 1
 \end{aligned}$$

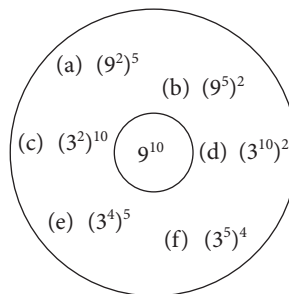
$$\begin{aligned}
 \text{B Wrong} \\
 \left(\frac{1}{2}\right)^{-3} &= 2^3
 \end{aligned}$$

$$\begin{aligned}
 \text{C Correct} \\
 (2^5)^{-1} &= (32)^{-1} \\
 &= \frac{1}{32}
 \end{aligned}$$

$$\begin{aligned}
 \text{D Wrong} \\
 \sqrt[3]{2^4} &= (2^4)^{\frac{1}{3}} \\
 &= 2^{\frac{4}{3}}
 \end{aligned}$$

Answer: C

6



$$\begin{aligned}
 7 \quad 2^m \times 2^n &= 2^5 \\
 2^{m+n} &= 2^5 \\
 m + n &= 5 \\
 \therefore m &= 2, n = 3; m = 4, n = 1; m = 3, n = 2
 \end{aligned}$$

$$\begin{aligned}
 8 \quad \frac{5^x}{5^4} &= 5^y \\
 (a) \quad 5^{x-4} &= 5^y \\
 x - 4 &= y \\
 (b) \quad \text{Apabila/When } y &= 3, x - 4 = 3 \\
 x &= 7
 \end{aligned}$$

$$\begin{aligned}
 9 \quad (10^2)^3 &= (\sqrt[5]{10})^k = (10^m)^{\frac{2}{3}} = (5^{\sqrt[5]{10^3}})^n \\
 (10^2)^3 &= \left(10^{\frac{1}{2}}\right)^k = (10^m)^{\frac{2}{3}} = \left(10^{\frac{3}{5}}\right)^n \\
 10^6 &= 10^{\frac{1}{2}k} = 10^{\frac{2}{3}m} = 10^{\frac{3}{5}n} \\
 6 &= \frac{1}{2}k \\
 \therefore k &= 12 \\
 6 &= \frac{2}{3}m \\
 \therefore m &= 9 \\
 6 &= \frac{3}{5}n \\
 \therefore n &= 10
 \end{aligned}$$

$$\begin{aligned}
 10 \quad (a) \quad 10p^{-3} &= \frac{10}{p^3} \\
 &= \frac{10}{15} \\
 &= \frac{2}{3}
 \end{aligned}$$

$$\begin{aligned}
 (b) \quad (i) \quad p^6 - 25 &= (p^3)^2 - 25 \\
 &= 15^2 - 25 \\
 &= 225 - 25 \\
 &= 200 \\
 (ii) \quad p^6 - 25 &= (p^3 + 5)(p^3 - 5) \\
 &= (15 + 5)(15 - 5) \\
 &= (20)(10) \\
 &= 200
 \end{aligned}$$

$$\begin{aligned}
 11 \quad 3^7 &= 2\ 187 \\
 (a) \quad 3^9 &= 3^7 \times 3^2 \\
 &= 2\ 187 \times 9 \\
 &= 19\ 683
 \end{aligned}$$

$$\begin{aligned}
 \text{(b) } 3^{-6} &= 3^1 \div 3^7 \\
 &= 3 \div 2\,187 \\
 &= \frac{3}{2\,187} \\
 &= \frac{1}{729}
 \end{aligned}$$

$$\begin{aligned}
 12 \quad \frac{(3^{-3})^2 \times 7^{-1} \times 9^5}{7 \times (3^{-1})^{-4}} &= \frac{3^{-6} \times 7^{-1} \times (3^2)^5}{7^1 \times 3^4} \\
 &= \frac{3^{-6} \times 7^{-1} \times 3^{10}}{7^1 \times 3^4} \\
 &= 3^{-6+10-4} \times 7^{-1-1} \\
 &= 3^0 \times 7^{-2} \\
 &= 1 \times \frac{1}{49} \\
 &= \frac{1}{49}
 \end{aligned}$$

$$\begin{aligned}
 13 \quad \frac{5^{-1} \times 25^{\frac{3}{4}}}{125^{\frac{2}{3}} \times \sqrt{5}} &= \frac{5^{-1} \times (5^2)^{\frac{3}{4}}}{(5^3)^{\frac{2}{3}} \times 5^{\frac{1}{2}}} \\
 &= \frac{5^{-1} \times 5^{\frac{3}{2}}}{5^2 \times 5^{\frac{1}{2}}} \\
 &= 5^{-1+\frac{3}{2}-2-\frac{1}{2}} \\
 &= 5^{-2} \\
 &= \frac{1}{25}
 \end{aligned}$$

$$\begin{aligned}
 14 \quad 8^{x+5} \times 32^{6-x} &= (2^3)^{x+5} \times (2^5)^{6-x} \\
 &= 2^{3(x+5)} \times 2^{5(6-x)} \\
 &= 2^{3(x+5)+5(6-x)} \\
 &= 2^{3x+15+30-5x} \\
 &= 2^{45-2x}
 \end{aligned}$$

$$\begin{aligned}
 15 \quad (4h^5k^2)^3 \times \frac{1}{2}h^{-9}k^4 &= 4^3(h^5)^3(k^2)^3 \times \frac{1}{2}h^{-9}k^4 \\
 &= 64h^{15}k^6 \times \frac{1}{2}h^{-9}k^4 \\
 &= 32h^{15-9}k^{6+4} \\
 &= 32h^6k^{10}
 \end{aligned}$$