

Fully-worked Solutions

Practice 1

Formative Practice

- 1 A Correct
 B Correct
 C Correct
 D Wrong

Answer: D

2

Repeated multiplication	Index form
$5 \times 5 \times 5 \times 5$	5^4
$7 \times 7 \times 7 \times 7 \times 7 \times 7$	7^6
$(-2) \times (-2) \times (-2) \times (-2) \times (-2)$	$(-2)^5$
$k \times k \times k \times k \times k \times k \times k$	k^7

- 3 (a) 7^3
 (b) 5.4^{10}
 (c) $(-a)^9$
 (d) m^x

4

Number	Index form
(a) 256	2^8
(b) 243	3^5
(c) 625	5^4
(d) 1 000 000	10^6

- 5 (a) $1.6^3 = 1.6 \times 1.6 \times 1.6$
 $= (1.6 \times 1.6) \times 1.6$
 $= 2.56 \times 1.6$
 $= 4.096$
 (b) $0.3^4 = 0.3 \times 0.3 \times 0.3 \times 0.3$
 $= (0.3 \times 0.3) \times (0.3 \times 0.3)$
 $= 0.09 \times 0.09$
 $= 0.0081$
 (c) $\left(\frac{4}{7}\right)^3 = \frac{4}{7} \times \frac{4}{7} \times \frac{4}{7}$
 $= \left(\frac{4}{7} \times \frac{4}{7}\right) \times \frac{4}{7}$
 $= \frac{16}{49} \times \frac{4}{7}$
 $= \frac{64}{343}$

$$\begin{aligned} \text{(d)} \left(1\frac{1}{2}\right)^5 &= \left(\frac{3}{2}\right)^5 \\ &= \frac{3}{2} \times \frac{3}{2} \times \frac{3}{2} \times \frac{3}{2} \times \frac{3}{2} \\ &= \left(\frac{3}{2} \times \frac{3}{2}\right) \times \left(\frac{3}{2} \times \frac{3}{2}\right) \times \frac{3}{2} \\ &= \frac{9}{4} \times \frac{9}{4} \times \frac{3}{2} \\ &= \left(\frac{9}{4} \times \frac{9}{4}\right) \times \frac{3}{2} \\ &= \frac{81}{16} \times \frac{3}{2} \\ &= \frac{243}{32} \\ &= 7\frac{19}{32} \end{aligned}$$

- 6 (a)
$$\begin{array}{r} 6 \overline{) 216} \\ \underline{6} \\ 36 \\ \underline{36} \\ 0 \end{array}$$

 (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) $3^4 \times 3^2 \times 3^3 = 3^{4+2+3}$

$= 3^9$ [X]

(b) $m^3 \times m^6 \times m^5 = m^{3+6+5}$

$= m^{14}$ [✓]

(c) $p^9 \times p^4 \times p^3 = p^{9+4+3}$

$= p^{16}$ [X]

(d) $y^8 \times y^2 \times y^{10} = y^{8+2+10}$

$= y^{20}$ [✓]

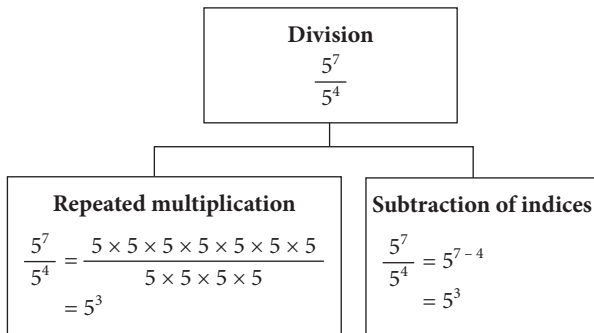
10 (a) $5^7 \times 5^9 = 5^{16}$

(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)



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

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

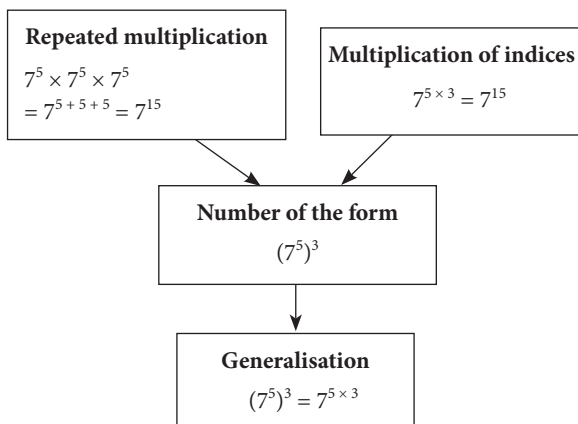
$p-5 = q$

$p-q = 5$

(b)

p	8	14	17	21
q	3	9	12	16

14



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

$= p^{2 \times 3}$

$= (p^2)^3$ [✓]

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

$= q^{24}$ [✓]

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

$= r^{20}$ [X]

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

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

$= (3^4)^9$

$= 3^{4 \times 9}$

$= 3^{36}$ [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) $a^5 \div a^5 = a^{5-5}$

$= a^0$

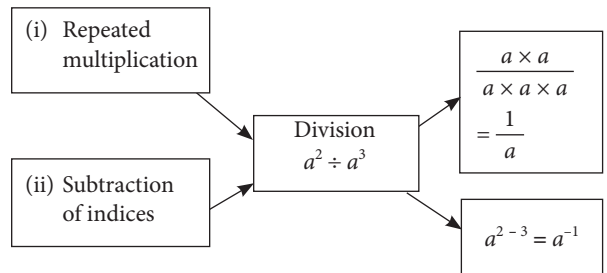
(b) (i) $a^0 = 1$ for non-zero value of a . [✓]

(ii) $a^0 = 1$ for all values of a . [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)



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

20 (a) ✓ (b) X (c) ✓ (d) ✓

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

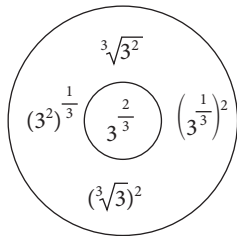
23 (a) $(2^3)^{\frac{1}{4}}$

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

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

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

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

(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

$$\begin{array}{r} 6 \overline{) 1296} \\ \underline{6} \\ 6 \\ \underline{6} \\ 6 \\ \underline{6} \\ 0 \end{array}$$

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

$$= 6^4$$

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

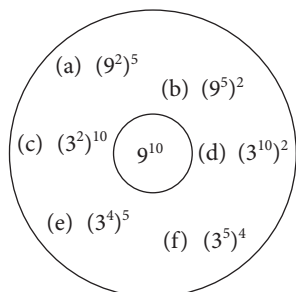
$$\begin{aligned}
 4 \quad 8^n \div 4^4 &= 2 \\
 (2^3)^n \div (2^2)^4 &= 2 \\
 2^{3n} \div 2^8 &= 2 \\
 2^{3n-8} &= 2^1 \\
 3n - 8 &= 1 \\
 3n &= 9 \\
 n &= 3
 \end{aligned}$$

Answer: A

- 5 A Wrong
B Wrong
C Correct
D Wrong

Answer: C

6



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

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

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

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

$$\begin{aligned}
 11 \quad 3^7 &= 2\ 187 \\
 (a) \quad 3^9 &= 3^7 \times 3^2 \\
 &= 2\ 187 \times 9 \\
 &= 19\ 683 \\
 (b) \quad 3^{-6} &= 3^1 \div 3^7 \\
 &= 3 \div 2\ 187 \\
 &= \frac{3}{2\ 187} \\
 &= \frac{1}{729}
 \end{aligned}$$

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

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

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

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