By John Becking

Exponents

Law 1 Expand to simplify

YouTube Video: https://youtu.be/1f7FZun34Sk

Exercise 1

Expand and then Simplify

e.g. A	$3^4 \times 3^2$ $= 3.3.3.3 \times 3.3$ $= 3^6$	e.g. B	$4^2 x^3 \times 4^3 x^2 \times 4$ $= 4.4. xxx \times 4.4.4xx \times 4$ $= 4^6 x^5$

1	$2^5 \times 2^3$	2	$5 \times 5^2 \times 5$
3	$x^2 \times x^3 \times x^4$	4	$y^2 \times y^2 \times y^2 \times y^2$
5	$2y^2 \times 2^5 y^3$	6	$3^2 . 5^2 x^2 \times 5^3 x^4$
7	$3^3 x^2 y^4 \times 3^4 x^3 y$	8	$a^3 b c^3 \times 3a^4 c^2 \times 2b^4 c$

Law 1

YouTube Video: https://youtu.be/RSM9GHxdM0s

Exercise 2

Use Law 1 to simplify the following:

e.g. A	$3^4 \times 3^2$ $= 3^{4+2}$ $= 3^6$	e.g. B	$4^2 x^3 \times 4^3 x^2 \times 4$ $= 4^{2+3+1} x^{3+2}$ $= 4^6 x^5$

1	$2^5 \times 2^3$	2	$5 \times 5^2 \times 5$
3	$x^2 \times x^3 \times x^4$	4	$y^2 \times y^2 \times y^2 \times y^2$
5	$2y^2 \times 2^5 y^3$	6	$3^2 . 5^2 x^2 \times 5^3 x^4$
7	$3^3 x^2 y^4 \times 3^4 x^3 y$	8	$a^3 b c^3 \times 3a^4 c^2 \times 2b^4 c$
9	$3^p \times 3^3$	10	$x^a \times x^{2a}$
*11	$x^{2a+1} \times x^{2a-4}$	*12	$y^{2a+b} \times y^{a+3b}$
*13	$2^2 y^{2b-3} z^{2a} \times 2^3 y^{2+b} z^{3a}$		

Negative Exponents

YouTube Video: https://youtu.be/0-Id8-Mef58

Exercise 3

Make all the exponents Positive

e.g. A	3^{-4} $= \dfrac{1}{3^4}$	e.g. B	$= \dfrac{1}{y^{-1}}$ $= \dfrac{y}{1}$ $= y$
e.g. C	$\dfrac{a^{-2}}{b^{-8}}$ $= \dfrac{b^8}{a^2}$	e.g. D	$\dfrac{2a^2 b^{-3}}{cd^{-4}}$ $= \dfrac{2a^2 d^4}{cb^3}$ Notice only the bases with negative exponents "move"

1	2^{-5}	2	$\dfrac{1}{y^{-3}}$
3	$2x^{-2}$	4	$3^{-6}y^2$
5	$\dfrac{1}{3p^{-7}}$	6	$\dfrac{1}{7^{-7}t^7}$
7	$\dfrac{11}{r^{-3}}$	8	$\dfrac{y^{-1}}{z}$
9	$\dfrac{2x^{-2}}{3^{-1}y^2}$	10	$\dfrac{3.5^{-2}}{a^{-1}b^{-3}}$
11	$\dfrac{ab^2 c^{-3}}{d^{-1}e^4}$	12	$\dfrac{3s^{-4}t^{-3}u^{-1}}{w^3 x^{-3}}$

Law 2 by Expansion

YouTube Video: https://youtu.be/0dv2GdIxpik

Exercise 4

Expand and then Simplify

e.g. A	$\dfrac{2^8}{2^4}$ $= \dfrac{2.2.2.2.2.2.2.2}{2.2.2.2}$ $= \dfrac{{}^1\!2.\,{}^1\!2.\,{}^1\!2.\,{}^1\!2.2.2.2.2}{{}_1 2.\,{}_1 2.\,{}_1 2.\,{}_1 2}$ $= \dfrac{1.1.1.1.2.2.2.2}{1.1.1.1}$ $= \dfrac{2^4}{1}$ $= 16$	e.g. B	$\dfrac{x^6}{x^7}$ $= \dfrac{xxxxxx}{xxxxxxx}$ $= \dfrac{{}^1\!x\,{}^1\!x\,{}^1\!x\,{}^1\!x\,{}^1\!x\,{}^1\!x}{{}_1 x\,{}_1 x\,{}_1 x\,{}_1 x\,{}_1 x\,{}_1 x\, x}$ $= \dfrac{1.1.1.1.1.1}{1.1.1.1.1.1x}$ $= \dfrac{1}{x}$

e.g. C	e.g. D
$\dfrac{11^2 a^4}{11^4 a}$	$\dfrac{2.3^2 x^3 y^2}{5.2^4 x^2 y^2}$
$=\dfrac{11.11aaaa}{11.11.11.11a}$	$=\dfrac{2.3xxxyy}{5.2.2.2.2xxyy}$
$=\dfrac{{}^1\cancel{11}.{}^1\cancel{11}.{}^1\cancel{a}aaa}{{}_1\cancel{11}.{}_1\cancel{11}.11.11\ {}_1\cancel{a}}$	$=\dfrac{{}^1\cancel{2}.3.3\ {}^1\cancel{x}\ {}^1\cancel{x}x\ {}^1\cancel{y}\ {}^1\cancel{y}}{5.\ {}_1\cancel{2}.2.2.2\ {}_1\cancel{x}\ {}_1\cancel{x}\ {}_1\cancel{y}\ {}_1\cancel{y}}$
$=\dfrac{1.1.1aaa}{1.1.11.11.1}$	$=\dfrac{1.3.3.1.1.x.1.1}{5.1.2.2.2}$
$=\dfrac{a^3}{11^2}$	$=\dfrac{9x}{40}$
$=\dfrac{a^3}{121}$	

1	$\dfrac{5^3}{5}$	2	$\dfrac{y^4}{y^3}$
3	$\dfrac{3^4}{3^6}$	4	$\dfrac{x^2}{x^5}$
5	$\dfrac{2^2 a^3}{2^4}$	6	$\dfrac{3^3 b^3}{b^4}$
7	$\dfrac{5^3}{5^2 c^3}$	8	$\dfrac{7^2}{7d^2}$
9	$\dfrac{2x^2}{2^3 x^2}$	10	$\dfrac{3.5^3}{3^2.5^4}$

Law 2

YouTube Video: https://youtu.be/LTj56Ui7vEo

Exercise 5

Use Law 2 to remove the fraction and then simplify

e.g. A	e.g. B
$\dfrac{3^5}{3^2}$	$\dfrac{x^3}{x^6}$
$=3^{5-2}$	$=x^{3-6}$
$=3^3$	$=x^{-3}$
$=27$	
e.g. C	e.g. D
$\dfrac{11^2 a^4}{11^{-4} a}$	$\dfrac{2.3^2 x^3 y^2}{2^4.5 x^2 y^2}$
$=11^{2-(-4)} a^{4-1}$	$=2^{1-4}.3^2.5^{-1} x^{3-2} y^{2-2}$
$=11^6 a^3$	$=2^{-3}.3^2.5^{-1} xy^0 \quad \{y^0 = 1\}$
	$=2^{-3}.3^2.5^{-1} x$

1	$\dfrac{5^3}{5}$		2	$\dfrac{y^4}{y^3}$
3	$\dfrac{3^4}{3^6}$		4	$\dfrac{x^2}{x^5}$
5	$\dfrac{2^2 a^3}{2^4}$		6	$\dfrac{3^3 b^3}{b^4}$
7	$\dfrac{5^3}{5^2 c^3}$		8	$\dfrac{7^2}{7d^2}$
9	$\dfrac{2x^2}{2^3 x^2}$		10	$\dfrac{3.5^3}{3^2 \cdot 5^4}$
11	$\dfrac{x^{-2} y}{x^2 y^3}$		12	$\dfrac{a^3 b^{-2} c^4}{ab^{-1} c^{-1}}$

Law 3 Investigating

YouTube Video: https://youtu.be/fvXAcp0HbO0

Exercise 6

Simplify the following:

e.g. A	$(2x^3)^4$	e.g. B	$(5^3 ab^{-2})^2$
	$= 2x^3 . 2x^3 . 2x^3 . 2x^3$		$= (5^3 ab^{-2})(5^3 ab^{-2})$
	$= 2^{1+1+1} . x^{3+3+3}$		$5^{3+3} a^{1+1} b^{-2+(-2)}$
	$= 2^3 x^9$		$= 5^6 a^2 b^{-4}$
e.g. C	$\left(\dfrac{x^5}{3^3}\right)^2$		
	$= \left(\dfrac{x^5}{3^3}\right)\left(\dfrac{x^5}{3^3}\right)$		
	$= \dfrac{x^{5+5}}{3^{3+3}}$		
	$= \dfrac{x^{10}}{3^6}$		

1	$(a^2)^3$	2	$(3b^3)^2$
3	$(-2^2 c^5)^3$	4	$\left(\dfrac{r^2}{t^5}\right)^2$
5	$\left(\dfrac{4x}{x^5 y^3}\right)^2$	6	$((x^3)^2 x^{-1})^3$

Law 3

Exercise 7

Use Law 3 to Simplify

e.g. A $(3^2)^5$ $= 3^{2\times5}$ $= 3^{10}$	e.g. B $(x^3)^6$ $= x^{3\times6}$ $= x^{18}$
e.g. C $(5^3x^5)^5$ $= 5^{3\times5}x^{5\times5}$ $= 5^{15}x^{25}$	e.g. D $(11a^3b^{-2})^4$ $= 11^{1\times4}a^{3\times4}b^{-2\times4}$ $= 11^4a^{12}b^{-8}$

1     $(2^7)^8$

2     $(t^6)^2$

3     $(s^{-2})^5$

4     $(u^2)^{-4}$

5     $(3^{-2})^{-5}$

6     $(3^2a^2)^5$

7     $(7^{-3}c^2)^{-5}$

8     $(13^{-7}b^{-2})^{-8}$

9     $(3^2a^2(d^2)^2)^5$

*10 $(3^x)^5$

*11 $(5^{2y}a^{3y})^5$

*12 $(7^{2z}a^{3z})^{5y}$

Square and Cube Roots

YouTube Video: https://youtu.be/p-tJBjzmwPQ

Exercise 8

Simplify

e.g. A	$\sqrt{5^4}$	e.g. B	$\sqrt{a^{14}}$
	$= 5^{4 \div 2}$		$= a^{14 \div 2}$
	$= 5^2$		$= a^7$
e.g. C	$\sqrt[3]{3^9}$	e.g. D	$\sqrt[3]{b^{18}}$
	$= 3^{9 \div 3}$		$= b^{18 \div 3}$
	$= 3^3$		$= b^6$

e.g. E $\sqrt{441c^4}$

$\sqrt{3^2.7^2c^4}$ $\{441 = 3^2.7^2\}$

$= 3^{2 \div 2}.7^{2 \div 2}c^{4 \div 2}$

$= 3.7c^2$

$= 21c^2$

1	$\sqrt{7^6}$	2	$\sqrt{w^{12}}$
3	$\sqrt{19^{30}}$	4	$\sqrt{2^4 x^{10}}$
5	$\sqrt[3]{7^6}$	6	$\sqrt[3]{p^{21}}$
7	$\sqrt[3]{2^{18} q^{27}}$	8	$\sqrt[3]{11^3 q^{-24}}$
9	$\left(\sqrt{x^2}\right)^2$	*10	$\sqrt{2^{4a}}$
11	$\sqrt{1024 a^{10}}$	12	$\sqrt[3]{3375 b^{-3}}$

Answers

Exercise 1

1 $2^5 \times 2^3$
   $= 2.2.2.2.2 \times 2.2.2$
   $= 2^8$

2 $5 \times 5^2 \times 5$
   $= 5 \times 5.5 \times 5$
   $= 5^4$

3 $x^2 \times x^3 \times x^4$
   $= xx \times xxx \times xxxx$
   $= x^9$

4 $y^2 \times y^2 \times y^2 \times y^2$
   $= yy \times yy \times yy \times yy$
   $= y^8$

5 $2y^2 \times 2^5 y^3$
   $= 2yy \times 2.2.2.2.2yyy$
   $= 2^6 y^5$

6 $3^2.5^2 x^2 \times 5^3 x^4$
   $= 3.3.5.5xx \times 5.5.5xxxx$
   $= 3^2 5^5 x^6$

7 $3^3 x^2 y^4 \times 3^4 x^3 y$
   $= 3.3.3xxyyyy \times 3.3.3.3xxxy$
   $= 3^7 x^5 y^5$

8 $a^3 bc^3 \times 3a^4 c^2 \times 2b^4 c$
   $= aaabccc \times 3aaaacc \times 2bbbbc$
   $= 3.2a^7 b^5 c^6$
   $= 6a^7 b^5 c^6$

Exercise 2

1 $2^5 \times 2^3$
   $= 2^{5+3}$
   $= 2^8$

2 $5 \times 5^2 \times 5$
   $= 5^{1+2+1}$
   $= 5^4$

3 $x^2 \times x^3 \times x^4$
   $= x^{2+3+4}$
   $= x^9$

4 $y^2 \times y^2 \times y^2 \times y^2$
   $= y^{2+2+2+2}$
   $= y^8$

5 $2y^2 \times 2^5 y^3$
   $= 2^{1+5} y^{2+3}$
   $= 2^6 y^5$

6 $3^2.5^2 x^2 \times 5^3 x^4$
   $= 3^2.5^{2+3} x^{2+4}$
   $= 3^2 5^5 x^6$

7 $3^3 x^2 y^4 \times 3^4 x^3 y$
   $= 3^{3+4} x^{2+3} y^{4+1}$
   $= 3^7 x^5 y^5$

8 $a^3 bc^3 \times 3a^4 c^2 \times 2b^4 c$
   $= 3.2a^{3+4} b^{1+4} c^{3+2+1}$
   $= 3.2a^7 b^5 c^6$
   $= 6a^7 b^5 c^6$

9 $3^p \times 3^3$
   $= 3^{p+3}$

10 $x^a \times x^{2a}$
    $= a^{a+2a}$
    $= x^{3a}$

11 $x^{2a+1} \times x^{2a-4}$
    $= x^{2a+1+(2a-4)}$
    $= x^{4a-3}$

12 $y^{2a+b} \times y^{a+3b}$
    $= y^{2a+b+(a+3b)}$
    $= y^{3a+4b}$

13 $2^2 y^{2b-3} z^{2a} \times 2^3 y^{2+b} z^{3a}$
    $= 2^{2+3} y^{2b-3+(2+b)} z^{2a+3a}$
    $= 2^5 y^{3b-1} z^{5a}$

Exercise 3

1. 2^{-5}

   $= \dfrac{1}{2^5}$

2. $\dfrac{1}{y^{-3}}$

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

   $= y^3$

3. $2x^{-2}$

   $= \dfrac{2}{x^2}$

4. $3^{-6}y^2$

   $= \dfrac{y^2}{3^6}$

5. $\dfrac{1}{3p^{-7}}$

   $= \dfrac{p^7}{3}$

6. $\dfrac{1}{7^{-7}t^7}$

   $= \dfrac{7^7}{t^7}$

7. $\dfrac{11}{r^{-3}}$

   $= \dfrac{11r^3}{1}$

   $= 11r^3$

8. $\dfrac{y^{-1}}{z}$

   $= \dfrac{1}{yz}$

9. $\dfrac{2x^{-2}}{3^{-1}y^2}$

   $= \dfrac{2.3}{x^2y^2}$

   $= \dfrac{6}{x^2y^2}$

10. $\dfrac{3.5^{-2}}{a^{-1}b^{-3}}$

    $= \dfrac{3ab^3}{5^2}$

    $= \dfrac{3ab^3}{25}$

11. $\dfrac{ab^2c^{-3}}{d^{-1}e^4}$

    $= \dfrac{ab^2d}{c^3e^4}$

12. $\dfrac{3s^{-4}t^{-3}u^{-1}}{w^3x^{-3}}$

    $= \dfrac{3x^3}{s^4t^3uw^3}$

Exercise 4

1. $\dfrac{5^3}{5}$

   $= \dfrac{5.5.5}{5}$

   $= \dfrac{{}^1 \cancel{5}.5.5}{{}_1\cancel{5}}$

   $= \dfrac{1.5.5}{1}$

   $= 25$

2. $\dfrac{y^4}{y^3}$

   $= \dfrac{yyyy}{yyy}$

   $= \dfrac{{}^1\cancel{y}\; {}^1\cancel{y}\; {}^1\cancel{y}\; y}{{}_1\cancel{y}\; {}_1\cancel{y}\; {}_1\cancel{y}}$

   $= \dfrac{1.1.1y}{1.1.1}$

   $= y$

3. $\dfrac{3^4}{3^6}$

   $= \dfrac{3.3.3.3}{3.3.3.3.3.3}$

   $= \dfrac{{}^1\cancel{3}.\; {}^1\cancel{3}.\; {}^1\cancel{3}.\; {}^1\cancel{3}}{{}_1\cancel{3}.\; {}_1\cancel{3}.\; {}_1\cancel{3}.\; {}_1\cancel{3}.3.3}$

   $= \dfrac{1.1.1.1}{1.1.1.1.3.3}$

   $= \dfrac{1}{9}$

4. $\dfrac{x^2}{x^5}$

   $= \dfrac{xx}{xxxxx}$

   $= \dfrac{{}^1\cancel{x}\; {}^1\cancel{x}}{{}_1\cancel{x}\; {}_1\cancel{x}\; xxx}$

   $= \dfrac{1.1}{1.1xxx}$

   $= \dfrac{1}{x^3}$

5 $\dfrac{2^2 a^3}{2^4}$

$= \dfrac{2.2aaa}{2.2.2.2}$

$= \dfrac{{}^1\cancel{2}.\ {}^1\cancel{2}aaa}{{}_1\cancel{2}\ {}_1\cancel{2}2.2}$

$= \dfrac{1.1.aaa}{1.1.2.2}$

$= \dfrac{a^3}{4}$

6 $\dfrac{3^3 b^3}{b^4}$

$= \dfrac{3.3.3bbb}{bbbb}$

$= \dfrac{3.3.3\ {}^1\cancel{b}\ {}^1\cancel{b}\ {}^1\cancel{b}}{{}_1\cancel{b}\ {}_1\cancel{b}\ {}_1\cancel{b}\, b}$

$= \dfrac{3.3.3.1.1.1}{1.1.1b}$

$= \dfrac{27}{b}$

7 $\dfrac{5^3}{5^2 c^3}$

$= \dfrac{5.5.5}{5.5ccc}$

$= \dfrac{{}^1\cancel{5}\ {}^1\cancel{5}5}{{}_1\cancel{5}\ {}_1\cancel{5}ccc}$

$= \dfrac{1.1.5}{1.1ccc}$

$= \dfrac{5}{c^3}$

8 $\dfrac{7^2}{7d^2}$

$= \dfrac{7.7}{7dd}$

$= \dfrac{{}^1\cancel{7}.7}{{}_1\cancel{7}\, dd}$

$= \dfrac{1.7}{1dd}$

$= \dfrac{7}{d^2}$

9 $\dfrac{2x^2}{2^3 x^2}$

$= \dfrac{2xx}{2.2.2xx}$

$= \dfrac{{}^1\cancel{2}.\ {}^1\cancel{x}\ {}^1\cancel{x}}{{}_1\cancel{2}2.2\ {}_1\cancel{x}\ {}_1\cancel{x}}$

$= \dfrac{1.1.1}{1.2.2.1.1}$

$= \dfrac{1}{4}$

10 $\dfrac{3.5^3}{3^2.5^4}$

$= \dfrac{3.5.5.5}{3.3.5.5.5.5}$

$= \dfrac{{}^1\cancel{3}.\ {}^1\cancel{5}.\ {}^1\cancel{5}.\ {}^1\cancel{5}}{{}_1\cancel{3}3.\ {}_1\cancel{5}\ {}_1\cancel{5}.\ {}_1\cancel{5}5}$

$= \dfrac{1.1.1.1}{1.3.1.1.5}$

$= \dfrac{1}{15}$

Exercise 5

1 $\dfrac{5^3}{5}$

$= 5^{3-1}$

$= 5^2$

$= 25$

2 $\dfrac{y^4}{y^3}$

$= y^{4-3}$

$= y$

3 $\dfrac{3^4}{3^6}$

$= 3^{4-6}$

$= 3^{-2}$

4 $\dfrac{x^2}{x^5}$

$= x^{2-5}$

$= x^{-3}$

5 $\dfrac{2^2 a^3}{2^4}$

$= 2^{2-4} a^3$

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

6 $\dfrac{3^3 b^3}{b^4}$

$= 3^3 b^{3-4}$

$= 3^3 b^{-1}$

$= 27b^{-1}$

7 $\dfrac{5^3}{5^2 c^3}$

$= 5^{3-2} c^{-3}$

$= 5c^{-3}$

8 $\dfrac{7^2}{7d^2}$

$= 7^{2-1} d^{-2}$

$= 7d^{-2}$

9 $\dfrac{2x^2}{2^3 x^2}$

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

$= 2^{-2} x^0$

$= 2^{-2}$

10 $\dfrac{3.5^3}{3^2.5^4}$

$= 3^{1-2}.5^{3-4}$

$= 3^{-1}.5^{-1}$

11    $\dfrac{x^{-2}y}{x^2y^3}$

$= x^{-2-2}y^{1-3}$

$= x^{-4}y^{-2}$

12    $\dfrac{a^3b^{-2}c^4}{ab^{-1}c^{-1}}$

$= a^{3-1}b^{-2-(-1)}c^{4-(-1)}$

$= a^2b^{-1}c^5$

Exercise 6

1    $(a^2)^3 = a^2.a^2.a^2$

$= a^{2+2+2}$

a^6

2    $(3b^3)^2 = 3b^3.3b^3$

$= 3^{1+1}b^{3+3}$

$= 3^2b^6$

$= 9b^6$

3    $(-2^2c^5)^3$

$= (-2^2c^5)(-2^2c^5)(-2^2c^5)$ $\{-ve \times -ve \times -ve = -ve\}$

$= -2^{2+2+2}c^{5+5+5}$

$= -2^6c^{15}$

4    $\left(\dfrac{r^2}{t^5}\right)^2$

$= \left(\dfrac{r^2}{t^5}\right)\left(\dfrac{r^2}{t^5}\right)$

$= \dfrac{r^{2+2}}{t^{5+5}}$

$= \dfrac{r^4}{t^{10}}$

5    $\left(\dfrac{4x}{x^5y^3}\right)^3 = \left(\dfrac{4x}{x^5y^3}\right)\left(\dfrac{4x}{x^5y^3}\right)\left(\dfrac{4x}{x^5y^3}\right)$

$= \dfrac{4^{1+1+1}x^{1+1+1}}{x^{5+5+5}y^{3+3+3}}$

$= \dfrac{4^3x^3}{x^{15}y^9}$

$= 4^3x^{3-15}y^{-9}$

$= 64x^{-12}y^{-9}$

6    $((x^3)^2x^{-1})^3$

$= (x^3.x^3.x^{-1})^3$

$= \left(x^{3+3+(-1)}\right)^3$

$= (x^5)^3$

$= x^5.x^5.x^5$

$= x^{5+5+5}$

$= x^{15}$

Exercise 7

1    $(2^7)^8$

$= 2^{7\times8}$

$= 2^{56}$

2    $(t^6)^2$

$= t^{6\times2}$

$= t^{12}$

3    $(s^{-2})^5$

$= s^{-2\times5}$

$= s^{-10}$

4    $(u^2)^{-4}$

$= u^{2\times(-4)}$

$= u^{-8}$

5    $(3^{-2})^{-5}$

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

$= 3^{10}$

6    $(3^2a^2)^5$

$= 3^{2\times5}a^{2\times5}$

$= 3^{10}a^{10}$

7    $(7^{-3}c^2)^{-5}$

$= 7^{-3\times(-5)}c^{2\times(-5)}$

$= 7^{15}c^{-10}$

8    $(13^{-7}b^{-2})^{-8}$

$= 13^{-7\times(-8)}c^{-2\times(-8)}$

$= 13^{56}c^{16}$

9    $(3^2a^2(d^2)^2)^5$

$= (3^2a^2d^{2\times2})^5$

$= 3^{2\times5}a^{2\times5}d^{4\times5}$

$= 3^{10}a^{10}d^{20}$

*10 $(3^x)^5$

$= 3^{x\times5}$

$= 3^{5x}$

*11 $(5^{2y}a^{3y})^5$

$= 5^{2y \times 5}a^{3y \times 5}$

$= 5^{10y}a^{15y}$

*12 $(7^{2z}a^{3z})^{5y}$

$= 7^{2z \times 5y}a^{3z \times 5y}$

$= 7^{10yz}a^{15yz}$

Exercise 8

1      $\sqrt{7^6}$

$= 7^{6 \div 2}$

$= 7^3$

2      $\sqrt{w^{12}}$

$= w^{12 \div 2}$

$= w^6$

3      $\sqrt{19^{30}}$

$= 19^{30 \div 2}$

$= 19^{15}$

4      $\sqrt{2^4 x^{10}}$

$= 2^{4 \div 2}x^{10 \div 2}$

$= 2^2 x^5$

$= 4x^5$

5      $\sqrt[3]{7^6}$

$= 7^{6 \div 3}$

$= 7^2$

$= 49$

6      $\sqrt[3]{p^{21}}$

$= p^{21 \div 3}$

$= p^7$

7      $\sqrt[3]{2^{18} q^{27}}$

$= 2^{18 \div 3}q^{27 \div 3}$

$= 2^6 q^9$

8      $\sqrt[3]{11^3 q^{-24}}$

$= 11^{3 \div 3}q^{-24 \div 3}$

$= 11q^{-8}$

9      $\left(\sqrt{x^2}\right)^2$

$= (x)^2$

$= x^2$

*10 $\sqrt{2^{4a}}$

$= 2^{4a \div 2}$

$= 2^{2a}$

11      $\sqrt{1024a^{10}}$

$\sqrt{2^{10}a^{10}}$

$= 2^{10 \div 2}a^{10 \div 2}$

$= 2^5 a^5$

12      $\sqrt[3]{3375b^{-3}}$

$\sqrt[3]{3^3 . 5^3 b^{-3}}$

$= 3^{3 \div 3} . 5^{3 \div 3}b^{-3 \div 3}$

$= 3.5b^{-1}$

$= 15b^{-1}$