

15. [Indices / Square Roots]

Skill 15.1 Expressing powers as products and products as powers.

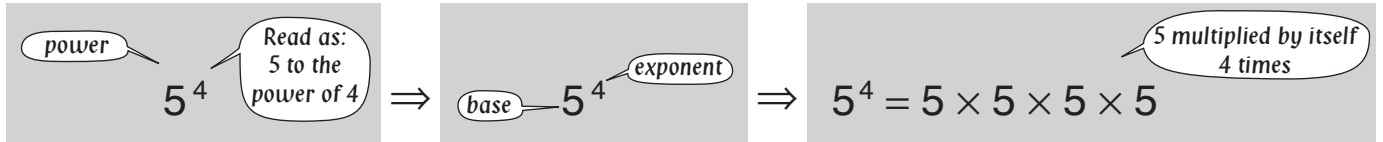
MM7 1 2 2 3 3 4 4
MM8 1 1 2 2 3 3 4 4

To write a product as a power:

- Write the factor as the base.
- Count how many times the factor is multiplied by itself and make the result the index.

To write a power as a product:

- Multiply the base by itself the same number of times as indicated by the index.



Q. Write the power as a product:

$$7^4 =$$

A. $7^4 =$

$$= 7 \times 7 \times 7 \times 7$$

7 multiplied by itself 4 times

a) Write the product as a power:

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

$$6^5$$

5 factors of 6 \Rightarrow
6 is the base
5 the exponent

b) Write the product as a power:

$$2 \times 2 \times 2 =$$

c) Write the product as a power:

$$5 \times 5 =$$

d) Write the product as a power:

$$4 \times 4 \times 4 \times 4 \times 4 \times 4 =$$

e) Write the power as a product:

$$8^3 =$$

f) Write the power as a product:

$$3^4 =$$

g) Write the power as a product:

$$2^5 =$$

h) Write the power as a product:

$$9^3 =$$

i) Write the product as a power:

$$1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 =$$

j) Write the product as a power:

$$7 \times 7 \times 7 =$$

k) Write the power as a product:

$$6^4 =$$

l) Write the product as a power:

$$2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 =$$

Skill 15.2 Squaring whole numbers.

MM7 1 1 2 2 3 4 4
MM8 1 1 2 3 3 4 4

- Multiply the number by itself.

$$1^2 = \text{one squared}$$

$$= \overset{1}{\square} 1 = 1 \text{ square}$$

$$= 1 \times 1 = 1$$

$$2^2 = \text{two squared}$$

$$= \begin{array}{|c|c|} \hline \square & \square \\ \hline \square & \square \\ \hline \end{array} = 4 \text{ squares}$$

$$= 2 \times 2 = 4$$

$$3^2 = \text{three squared}$$

$$= \begin{array}{|c|c|c|} \hline \square & \square & \square \\ \hline \square & \square & \square \\ \hline \square & \square & \square \\ \hline \end{array} = 9 \text{ squares}$$

$$= 3 \times 3 = 9$$

$$4^2 = \text{four squared}$$

$$= \begin{array}{|c|c|c|c|} \hline \square & \square & \square & \square \\ \hline \square & \square & \square & \square \\ \hline \square & \square & \square & \square \\ \hline \square & \square & \square & \square \\ \hline \end{array} = 16 \text{ squares}$$

$$= 4 \times 4 = 16$$

Q. $90^2 =$

A. $90^2 =$
 $= 90 \times 90$
 $= 8100$

90 multiplied by itself 2 times

$$\begin{array}{r} 8 \\ \times 90 \\ \hline 8100 \end{array}$$

a) $7^2 =$ *7 multiplied by itself 2 times*

$$= 7 \times 7 = \boxed{49}$$

b) $3^2 =$

$$= \dots = \boxed{}$$

c) $2^2 =$

$$= \dots = \boxed{}$$

d) $10^2 =$

$$= \dots = \boxed{}$$

e) $5^2 =$

$$= \dots = \boxed{}$$

f) $1^2 =$

$$= \dots = \boxed{}$$

g) $12^2 =$

$$= \dots = \boxed{}$$

h) $11^2 =$

$$= \dots = \boxed{}$$

i) $0^2 =$

$$= \dots = \boxed{}$$

j) $4^2 =$

$$= \dots = \boxed{}$$

k) $9^2 =$

$$= \dots = \boxed{}$$

l) $20^2 =$

$$= \dots = \boxed{}$$

m) $50^2 =$

$$= \dots = \boxed{}$$

n) $30^2 =$

$$= \dots = \boxed{}$$

o) $70^2 =$

$$= \dots = \boxed{}$$

p) $80^2 =$

$$= \dots = \boxed{}$$

q) $40^2 =$

$$= \dots = \boxed{}$$

r) $60^2 =$

$$= \dots = \boxed{}$$

Skill 15.3 Calculating powers of 10.

- Put the same number of zeros in the answer as the index shows.

Example: $10^4 \Rightarrow$ index is 4 so the answer ends in 4 zeros
 $10^4 = 10\,000$

Q. $10^5 =$

A. $10^5 =$ Index is 5

$= 10 \times 10 \times 10 \times 10 \times 10$

$= \mathbf{100\,000}$ Answer ends in 5 zeros

a) $10^9 =$ 10 multiplied by itself 9 times

$= 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$

$=$ 1 000 000 000

b) $10^2 =$

$=$
 $=$

c) $10^7 =$

$=$
 $=$

d) $10^4 =$

$=$
 $=$

e) $10^1 =$

$=$
 $=$

f) $10^5 =$

$=$
 $=$

g) $10^6 =$

$=$
 $=$

h) $10^3 =$

$=$
 $=$

i) $10^8 =$

$=$
 $=$

j) $10^{10} =$

$=$
 $=$

Hint: Finding the square root of a number is the reverse of the procedure for squaring a number.

EITHER

- Use trial and error to find the number that, when multiplied by itself, equals the original number.

Example: The square root of 25

$\sqrt{25}$ = the number that when multiplied by itself equals 25

$5 \times 5 = 25$ so

$\sqrt{25} = \sqrt{5 \times 5} = 5$

OR

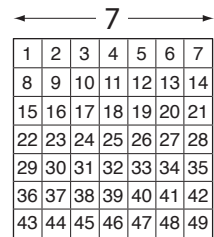
- Arrange that number of tiles in a square.
- Count the number of tiles along one side length.



Q. $\sqrt{49} =$

A. $\sqrt{49} =$
 $= \sqrt{7 \times 7}$
 $= 7$

The square root of 49 means:
 "what number multiplied by itself equals 49"
 $7 \times 7 = 49$
 $7^2 = 49$



a) $\sqrt{25} =$ *5 multiplied by itself*
 $= \sqrt{5 \times 5} =$

b) $\sqrt{9} =$
 $=$

c) $\sqrt{36} =$
 $=$

d) $\sqrt{4} =$
 $=$

e) $\sqrt{16} =$
 $=$

f) $\sqrt{100} =$
 $=$

g) $\sqrt{144} =$
 $=$

h) $\sqrt{121} =$
 $=$

i) $\sqrt{64} =$
 $=$

j) $\sqrt{900} =$
 $=$

k) $\sqrt{4900} =$
 $=$

l) $\sqrt{2500} =$
 $=$

m) $\sqrt{8100} =$
 $=$

n) $\sqrt{3600} =$
 $=$

o) $\sqrt{12100} =$
 $=$

Skill 15.5 Evaluating powers of whole numbers.

MM7 1 1 2 2 3 3 4 4
MM8 1 1 2 2 3 3 4 4

- Observe the index.
- Multiply the number (base) the same number of times by itself as the index shows.
(see skill 15.1, page 117)

Hints: Any number raised to the power of zero (except 0) equals 1.

Example $6^0 = 1$

Any number raised to the power of one equals the number itself.

Example $6^1 = 6$

Q. $5^4 =$

A. $5^4 =$
 $= 5 \times 5 \times 5 \times 5$
 $= 125 \times 5$
 $= 625$

5 multiplied by itself
4 times

"5 raised to the power of 4"
means 4 lots of 5 in the
equation.

a) $3^5 =$

3 multiplied by itself
5 times

$= 3 \times 3 \times 3 \times 3 \times 3$
 $= 9 \times 9 \times 3 = 243$

b) $2^4 =$

$=$
 $=$ $=$

c) $4^3 =$

$=$
 $=$ $=$

d) $1^4 =$

$=$
 $=$

e) $2^5 =$

$=$
 $=$

f) $4^4 =$

$=$
 $=$

g) $3^4 =$

$=$
 $=$

h) $0^2 =$

$=$
 $=$

i) $2^6 =$

$=$
 $=$

j) $4^0 =$

$=$
 $=$

k) $3^3 =$

$=$
 $=$

l) $5^3 =$

$=$
 $=$

m) $3^6 =$

$=$
 $=$

n) $8^3 =$

$=$
 $=$

o) $4^5 =$

$=$
 $=$

p) $7^0 =$

$=$
 $=$

q) $2^8 =$

$=$
 $=$

r) $9^3 =$

$=$
 $=$

Skill 15.6 Finding powers of negative whole numbers.

MM7 11 22 33 44
MM8 11 22 33 44

- Observe the index.
- Multiply the number (base) the same number of times by itself as the index shows.
(see skill 15.1, page 117)
- Give the result a sign:

even index

$$(-5)^2 = -5 \times (-5)$$

$$= +25$$

positive result

odd index

$$(-5)^3 = -5 \times (-5) \times (-5)$$

$$= +25 \times (-5)$$

$$= -125$$

negative result

Q. $(-6)^3 =$

A. $(-6^3) =$ odd index

$$= -6 \times (-6) \times (-6)$$

$$= 36 \times (-6)$$

$$= -(6)^3$$

negative result

“-6 raised to the power of 3” means 3 lots of -6 in the equation.

a) $(-3)^4 =$ even index

$$= -3 \times (-3) \times (-3) \times (-3)$$

$$= 9 \times 9$$

positive result

$$= \boxed{81}$$

b) $(-2)^4 =$

$$=$$

$$=$$

$$= \boxed{}$$

c) $(-6)^2 =$

$$=$$

$$=$$

$$= \boxed{}$$

d) $(-1)^7 =$

$$=$$

$$= \boxed{}$$

e) $(-3)^3 =$

$$=$$

$$=$$

$$= \boxed{}$$

f) $(-4)^2 =$

$$=$$

$$=$$

$$= \boxed{}$$

g) $(-2)^3 =$

$$=$$

$$= \boxed{}$$

h) $(-5)^2 =$

$$=$$

$$=$$

$$= \boxed{}$$

i) $(-3)^5 =$

$$=$$

$$=$$

$$= \boxed{}$$

j) $(-4)^4 =$

$$=$$

$$= \boxed{}$$

k) $(-1)^9 =$

$$=$$

$$=$$

$$= \boxed{}$$

l) $(-7)^2 =$

$$=$$

$$=$$

$$= \boxed{}$$

m) $(-2)^6 =$

$$=$$

$$= \boxed{}$$

n) $(-12)^2 =$

$$=$$

$$=$$

$$= \boxed{}$$

o) $(-10)^3 =$

$$=$$

$$=$$

$$= \boxed{}$$