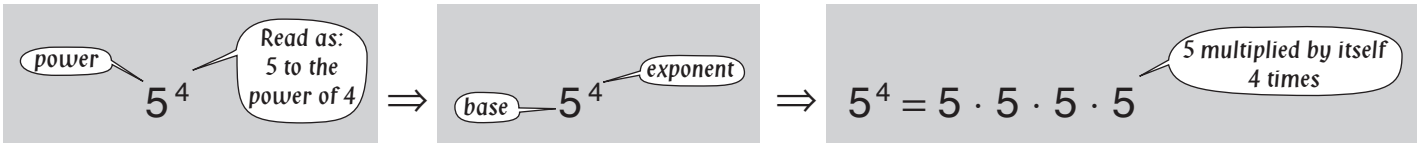
15. [Exponents / Square Roots]

Skill 15.1 Expressing powers as products and products as powers.

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 exponent.

To write a power as a product:
- Multiply the base by itself the same number of times as indicated by the exponent.



Q. Write the power as a product:

$7^4 =$

A. $7^4 =$

$= 7 \cdot 7 \cdot 7 \cdot 7$ (7 multiplied by itself 4 times)

a) Write the product as a power:

$6 \cdot 6 \cdot 6 \cdot 6 \cdot 6 =$ (5 factors of 6 $\Rightarrow$ 6 is the base, 5 the exponent)

6^5

b) Write the product as a power:

$2 \cdot 2 \cdot 2 =$

c) Write the product as a power:

$5 \cdot 5 =$

d) Write the product as a power:

$4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 =$

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:

$1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 =$

j) Write the product as a power:

$7 \cdot 7 \cdot 7 =$

k) Write the power as a product:

$6^4 =$

l) Write the product as a power:

$2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 =$

Skill 15.2 Squaring whole numbers.

- Multiply the number by itself.

1^2 = one squared

= 1 square = 1 × 1 = **1**

2^2 = two squared

= 4 squares = 2 × 2 = **4**

3^2 = three squared

= 9 squares = 3 × 3 = **9**

4^2 = four squared

= 16 squares = 4 × 4 = **16**

Q. $90^2 =$

A. $90^2 =$ *90 multiplied by itself 2 times*

$= 90 \cdot 90$

$= \mathbf{8100}$

$$\begin{array}{r} {\scriptstyle 8}\ 9\ 0 \\ \times\ 9\ 0 \\ \hline 8\ 1\ 0\ 0 \end{array}$$

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

$= 7 \cdot 7 =$ 49

b) $3^2 =$ ..... = ☐

c) $2^2 =$ ..... = ☐

d) $10^2 =$ ..... = ☐

e) $5^2 =$ ..... = ☐

f) $1^2 =$ ..... = ☐

g) $12^2 =$ ..... = ☐

h) $11^2 =$ ..... = ☐

i) $0^2 =$ ..... = ☐

j) $4^2 =$ ..... = ☐

k) $9^2 =$ ..... = ☐

l) $20^2 =$ ..... = ☐

m) $50^2 =$ ..... = ☐

n) $30^2 =$ ..... = ☐

o) $70^2 =$ ..... = ☐

p) $80^2 =$ ..... = ☐

q) $40^2 =$ ..... = ☐

r) $60^2 =$ ..... = ☐

Skill 15.3 Calculating powers of 10.

- Put the same number of zeros in the answer as the exponent.
  Example: $10^4 \Rightarrow$ exponent is 4 so the answer ends in 4 zeros
  $10^4 = 10{,}000$

Q. $10^5 =$

A. $10^5 =$ (Exponent 5)
$= 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10$
$= \mathbf{100{,}000}$ (Answer ends in 5 zeros)

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

$= 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10$

$=$ 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) $10^{10} =$

$=$ .....

$=$

Skill 15.4 Finding square roots of whole numbers.

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

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

OR

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

5

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Q. $\sqrt{49} =$

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

The square root of 49 means: "what number multiplied by itself equals 49"

$7 \times 7 = 49$

$7^2 = 49$

7

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49

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

$= \sqrt{5 \cdot 5}$ ..... $= \boxed{5}$

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) $\sqrt{12{,}100} =$

$=$ ..... $=$ ☐

Skill 15.5 Evaluating powers of whole numbers.

- Observe the exponent.
- Multiply the number (base) the same number of times by itself as the exponent.
  (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 multiplied by itself 4 times*)

$= 5 \cdot 5 \cdot 5 \cdot 5$

$= 125 \cdot 5$

$= \mathbf{625}$

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

a) $3^5 =$ (*3 multiplied by itself 5 times*)

$= 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$

$= 9 \cdot 9 \cdot 3$ $= 243$

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.

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

even exponent
$(-5)^{②} = -5 \cdot (-5)$
$= +25$ positive result

odd exponent
$(-5)^{③} = -5 \cdot (-5) \cdot (-5)$
$= +25 \cdot (-5)$
$= -125$ negative result

Q. $(-6)^3 =$

A. $(-6)^3 =$ odd exponent
$= -6 \cdot (-6) \cdot (-6)$
$= 36 \cdot (-6)$
$= \mathbf{-216}$ negative result

"–6 raised to the power of 3" means 3 lots of –6 in the equation.

a) $(-3)^4 =$ even exponent
$= -3 \cdot (-3) \cdot (-3) \cdot (-3)$
$= 9 \cdot 9$ positive result $= 81$

b) $(-2)^4 =$
$=$ .....
$=$ ..... $=$ ☐

c) $(-6)^2 =$
$=$ .....
$=$ ..... $=$ ☐

d) $(-1)^7 =$
$=$ .....
$=$ ..... $=$ ☐

e) $(-3)^3 =$
$=$ .....
$=$ ..... $=$ ☐

f) $(-4)^2 =$
$=$ .....
$=$ ..... $=$ ☐

g) $(-2)^3 =$
$=$ .....
$=$ ..... $=$ ☐

h) $(-5)^2 =$
$=$ .....
$=$ ..... $=$ ☐

i) $(-3)^5 =$
$=$ .....
$=$ ..... $=$ ☐

j) $(-4)^4 =$
$=$ .....
$=$ ..... $=$ ☐

k) $(-1)^9 =$
$=$ .....
$=$ ..... $=$ ☐

l) $(-7)^2 =$
$=$ .....
$=$ ..... $=$ ☐

m) $(-2)^6 =$
$=$ .....
$=$ ..... $=$ ☐

n) $(-12)^2 =$
$=$ .....
$=$ ..... $=$ ☐

o) $(-10)^3 =$
$=$ .....
$=$ ..... $=$ ☐