

# 11. [Indices]

## Skill 11.1 Evaluating whole numbers in index form.

MM9 11 22 33 44  
MM10 1 22 33 44

- Observe the index. The index tells you how many times to multiply the base by itself.

5 to the power of 4  
Base  $5^4$  Index

$5^4 = 5 \times 5 \times 5 \times 5$  5 multiplied by itself 4 times

$6^0 = 1$ number to the power of 0 = 1	$3^1 = 3$ number to the power of 1 = itself	$4^2 = 4 \times 4 = 16$ 4 squared	$2^3 = 2 \times 2 \times 2 = 8$ 2 cubed
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**Q.**  $2^5 =$       **A.**  $2^5 =$   
 $= 2 \times 2 \times 2 \times 2 \times 2$  2 multiplied by itself 5 times  
 $= 32$

<b>a)</b> $3^4 =$ $= 3 \times 3 \times 3 \times 3 =$ <input type="text" value="81"/>	<b>b)</b> $2^3 =$ $= 2 \times 2 \times 2 =$ <input type="text"/>	<b>c)</b> $2^6 =$ $= \dots =$ <input type="text"/>
<b>d)</b> $5^2 =$ $= \dots =$ <input type="text"/>	<b>e)</b> $1^7 =$ $= \dots =$ <input type="text"/>	<b>f)</b> $4^2 =$ $= \dots =$ <input type="text"/>
<b>g)</b> $7^2 =$ $= \dots =$ <input type="text"/>	<b>h)</b> $6^3 =$ $= \dots =$ <input type="text"/>	<b>i)</b> $10^3 =$ $= \dots =$ <input type="text"/>
<b>j)</b> $3^5 =$ $= \dots =$ <input type="text"/>	<b>k)</b> $7^3 =$ $= \dots =$ <input type="text"/>	<b>l)</b> $9^2 =$ $= \dots =$ <input type="text"/>
<b>m)</b> $8^1 =$ $= \dots =$ <input type="text"/>	<b>n)</b> $9^0 =$ $= \dots =$ <input type="text"/>	<b>o)</b> $0^7 =$ $= \dots =$ <input type="text"/>
<b>p)</b> $4^3 =$ $= \dots =$ <input type="text"/>	<b>q)</b> $1^{10} =$ $= \dots =$ <input type="text"/>	<b>r)</b> $10^4 =$ $= \dots =$ <input type="text"/>

## Skill 11.2 Evaluating powers with fraction bases.

MM9 11 2 2 3 3 4 4  
MM10 1 1 2 2 3 3 4 4

- Observe the index. The index tells you how many times to multiply the numerator by itself and the denominator by itself.

numerator, 2 to the power of 3

Base  $\left(\frac{2}{5}\right)^3$  Index

denominator, 5 to the power of 3

2 multiplied by itself 3 times

$$\left(\frac{2}{5}\right)^3 = \frac{2 \times 2 \times 2}{5 \times 5 \times 5} = \frac{8}{125}$$

5 multiplied by itself 3 times

Q.  $\left(\frac{3}{7}\right)^2 =$

A.  $\left(\frac{3}{7}\right)^2 =$

$$= \frac{3 \times 3}{7 \times 7}$$

3 multiplied by itself 2 times

$$= \frac{9}{49}$$

7 multiplied by itself 2 times

a)  $\left(\frac{3}{10}\right)^3 =$

$$= \frac{3 \times 3 \times 3}{10 \times 10 \times 10} = \frac{27}{1000}$$

b)  $\left(\frac{1}{5}\right)^3 =$

$$= \frac{1 \times 1 \times 1}{5 \times 5 \times 5} = \frac{1}{125}$$

c)  $\left(\frac{2}{7}\right)^2 =$

$$= \frac{2 \times 2}{7 \times 7} = \frac{4}{49}$$

d)  $\left(\frac{1}{10}\right)^2 =$

$$= \frac{1 \times 1}{10 \times 10} = \frac{1}{100}$$

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

$$= \frac{2 \times 2 \times 2}{3 \times 3 \times 3} = \frac{8}{27}$$

f)  $\left(\frac{3}{8}\right)^2 =$

$$= \frac{3 \times 3}{8 \times 8} = \frac{9}{64}$$

g)  $\left(\frac{6}{11}\right)^2 =$

$$= \frac{6 \times 6}{11 \times 11} = \frac{36}{121}$$

h)  $\left(\frac{4}{9}\right)^2 =$

$$= \frac{4 \times 4}{9 \times 9} = \frac{16}{81}$$

i)  $\left(\frac{1}{4}\right)^4 =$

$$= \frac{1 \times 1 \times 1 \times 1}{4 \times 4 \times 4 \times 4} = \frac{1}{256}$$

j)  $\left(\frac{2}{3}\right)^5 =$

$$= \frac{2 \times 2 \times 2 \times 2 \times 2}{3 \times 3 \times 3 \times 3 \times 3} = \frac{32}{243}$$

k)  $\left(\frac{4}{5}\right)^3 =$

$$= \frac{4 \times 4 \times 4}{5 \times 5 \times 5} = \frac{64}{125}$$

l)  $\left(\frac{7}{10}\right)^3 =$

$$= \frac{7 \times 7 \times 7}{10 \times 10 \times 10} = \frac{343}{1000}$$

m)  $\left(\frac{3}{4}\right)^3 =$

$$= \frac{3 \times 3 \times 3}{4 \times 4 \times 4} = \frac{27}{64}$$

n)  $\left(\frac{5}{8}\right)^2 =$

$$= \frac{5 \times 5}{8 \times 8} = \frac{25}{64}$$

o)  $\left(\frac{6}{11}\right)^2 =$

$$= \frac{6 \times 6}{11 \times 11} = \frac{36}{121}$$

p)  $\left(\frac{3}{4}\right)^4 =$

$$= \frac{3 \times 3 \times 3 \times 3}{4 \times 4 \times 4 \times 4} = \frac{81}{256}$$

q)  $\left(\frac{3}{10}\right)^4 =$

$$= \frac{3 \times 3 \times 3 \times 3}{10 \times 10 \times 10 \times 10} = \frac{81}{10000}$$

r)  $\left(\frac{9}{13}\right)^2 =$

$$= \frac{9 \times 9}{13 \times 13} = \frac{81}{169}$$

### Skill 11.3 Multiplying powers with the same base.

MM9 1 1 2 2 3 3 4 4  
MM10 1 1 2 2 3 3 4 4

- Add the indices of like numbers or like pronumerals.

Example:  $8^3 \times 8^4 = \underbrace{8 \times 8 \times 8}_{8^3} \times \underbrace{8 \times 8 \times 8 \times 8}_{8^4}$   
 $= 8^{3+4}$   
 $= 8^7$

In general:  $a^m \times a^n = a^{m+n}$

- The size of the new index tells you how many times to multiply the base by itself.

**Q.** Evaluate  $6 \times 6^2$

**A.**  $6 \times 6^2$   
 $= 6^{1+2}$  *add the indices*  
 $= 6^3$   
 $= 6 \times 6 \times 6$   
 $= 216$

**a)** Evaluate  $2^3 \times 2$

$= 2^{3+1} = 2^4$   
 $= 2 \times 2 \times 2 \times 2 = \boxed{16}$

**b)** Evaluate  $3^2 \times 3^3$

$= \dots = \dots$   
 $= \dots = \boxed{\phantom{000}}$

**c)** Evaluate  $2 \times 2^2$

$= \dots = \dots$   
 $= \dots = \boxed{\phantom{000}}$

**d)** Evaluate  $5^3 \times 5$

$= \dots = \dots$   
 $= \dots = \boxed{\phantom{000}}$

**e)** Evaluate  $4 \times 4^2$

$= \dots = \dots$   
 $= \dots = \boxed{\phantom{000}}$

**f)** Evaluate  $3^2 \times 3^2$

$= \dots = \dots$   
 $= \dots = \boxed{\phantom{000}}$

**g)** Evaluate  $3 \times 3^4$

$= \dots = \dots$   
 $= \dots = \boxed{\phantom{000}}$

**h)** Evaluate  $5^2 \times 5$

$= \dots = \dots$   
 $= \dots = \boxed{\phantom{000}}$

**i)** Evaluate  $6^3 \times 6$

$= \dots = \dots$   
 $= \dots = \boxed{\phantom{000}}$

**j)** Simplify  $x^3 \times x^6$

$= \dots = \boxed{\phantom{000}}$

**k)** Simplify  $z \times z^3$

$= \dots = \boxed{\phantom{000}}$

**l)** Simplify  $y^3 \times y^2$

$= \dots = \boxed{\phantom{000}}$

**m)** Simplify  $d \times d^6$

$= \dots = \boxed{\phantom{000}}$

**n)** Simplify  $ab^2 \times a^4b^2$

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

**o)** Simplify  $fg^2 \times f^4g$

$= \dots = \boxed{\phantom{000}}$

**p)** Simplify  $cd^3 \times c^2d^2$

$= \dots = \boxed{\phantom{000}}$

**q)** Simplify  $bc \times b^3c^2$

$= \dots = \boxed{\phantom{000}}$

**r)** Simplify  $u^3v^2 \times uv^3$

$= \dots = \boxed{\phantom{000}}$

**s)** Simplify  $l^2m^3 \times lm^4$

$= \dots = \boxed{\phantom{000}}$

**t)** Simplify  $a^3b \times ab$

$= \dots = \boxed{\phantom{000}}$

**u)** Simplify  $g^2h^2 \times gh^2$

$= \dots = \boxed{\phantom{000}}$

- Subtract the indices of like numbers or like pronumerals.

Example:  $8^5 \div 8^3 = \frac{8^5}{8^3} = \frac{8 \times 8 \times \cancel{8} \times \cancel{8} \times \cancel{8}}{\cancel{8} \times \cancel{8} \times \cancel{8}}$   
 $= 8^{5-3} = 8^2 = 64$

In general:  $a^m \div a^n = a^{m-n}$

- The size of the new index tells you how many times to multiply the base by itself.  
 Hint: A number or a pronumeral without an index actually is to the power of 1.

Q. Evaluate  $2^9 \div 2^3$

A.  $2^9 \div 2^3$   
 $= 2^{9-3}$  *subtract the exponents*  
 $= 2^6$   
 $= 2 \times 2 \times 2 \times 2 \times 2 \times 2$   
 $= 64$

a) Evaluate  $4^3 \div 4$

$= 4^{3-1} = 4^2$   
 $= 4 \times 4 = 16$

b) Evaluate  $3^8 \div 3^4$

$= \dots = \dots$   
 $= \dots = \dots$

c) Evaluate  $2^7 \div 2^2$

$= \dots = \dots$   
 $= \dots = \dots$

d) Evaluate  $6^4 \div 6$

$= \dots = \dots$   
 $= \dots = \dots$

e) Evaluate  $9^6 \div 9^4$

$= \dots = \dots$   
 $= \dots = \dots$

f) Evaluate  $5^8 \div 5^5$

$= \dots = \dots$   
 $= \dots = \dots$

g) Evaluate  $\frac{8^8}{8^5}$

$= 8^{8-5} = 8^3$   
 $= \dots = \dots$

h) Evaluate  $\frac{7^4}{7^2}$

$= \dots = \dots$   
 $= \dots = \dots$

i) Evaluate  $\frac{10^9}{10^6}$

$= \dots = \dots$   
 $= \dots = \dots$

j) Simplify  $t^4 \div t^3$

$= \dots = \dots$

k) Simplify  $p^8 \div p^2$

$= \dots = \dots$

l) Simplify  $r^9 \div r^2$

$= \dots = \dots$

m) Simplify  $\frac{j^8}{j^3}$

$= \dots = \dots$

n) Simplify  $\frac{q^9}{q^4}$

$= \dots = \dots$

o) Simplify  $\frac{y^7}{y^5}$

$= \dots = \dots$

p) Simplify  $\frac{p^6 q^4}{p^3 q^2}$

$= (p^6 \div p^3) \times (q^4 \div q^2)$   
 $= p^{6-3} \times q^{4-2} = p^3 q^2$

q) Simplify  $\frac{a^5 b^3}{ab}$

$= \dots = \dots$

r) Simplify  $\frac{t^4 u^6}{tu^2}$

$= \dots = \dots$

## Skill 11.5 Multiplying powers with coefficients and with the same base.

MM9 11 22 33 44  
MM10 11 22 33 44

- Multiply the coefficients.
- Add the indices of like pronumerals.

Example:  $2a^3 \times 3a^2 = (2 \times 3) \times (a \times a \times a) \times (a \times a)$   
 $= 6a^{3+2} = 6a^5$

Hint: A number or a pronumeral without an index actually is to the power of 1.

**Q.** Simplify  $7a \times a^3$

**A.**  $7a \times a^3$

*multiply the coefficients*  $= (7 \times 1) \times (a^1 \times a^3)$   
 $= 7a^{1+3}$  *add the indices*  
 $= 7a^4$

**a)** Simplify  $3t^4 \times 3t$

$= (3 \times 3) \times (t^4 \times t^1)$   
 $= 9t^{4+1} = \boxed{9t^5}$

**b)** Simplify  $x^3 \times 2x$

$=$   
 $= \boxed{\phantom{000}}$

**c)** Simplify  $2p^2 \times 2p$

$=$   
 $= \boxed{\phantom{000}}$

**d)** Simplify  $2b \times 3b^2$

$=$   
 $= \boxed{\phantom{000}}$

**e)** Simplify  $2d^2 \times 4d^4$

$=$   
 $= \boxed{\phantom{000}}$

**f)** Simplify  $3m^3 \times 5m^5$

$=$   
 $= \boxed{\phantom{000}}$

**g)** Simplify  $4s^2 \times 6s^3$

$=$   
 $= \boxed{\phantom{000}}$

**h)** Simplify  $5a^4 \times 2a^6$

$=$   
 $= \boxed{\phantom{000}}$

**i)** Simplify  $7k^2 \times k^7$

$=$   
 $= \boxed{\phantom{000}}$

**j)** Simplify  $6c^6 \times 3c^5$

$=$   
 $= \boxed{\phantom{000}}$

**k)** Simplify  $2y \times y^7$

$=$   
 $= \boxed{\phantom{000}}$

**l)** Simplify  $7w^8 \times 4w$

$=$   
 $= \boxed{\phantom{000}}$

**m)** Simplify  $2r \times 8r$

$=$   
 $= \boxed{\phantom{000}}$

**n)** Simplify  $5g^4 \times 5g^4$

$=$   
 $= \boxed{\phantom{000}}$

**o)** Simplify  $y^8 \times 6y^5$

$=$   
 $= \boxed{\phantom{000}}$

**p)** Simplify  $10a^2 \times 2a^4$

$=$   
 $= \boxed{\phantom{000}}$

**q)** Simplify  $7p^3 \times 5p^6$

$=$   
 $= \boxed{\phantom{000}}$

**r)** Simplify  $3d^7 \times 12d$

$=$   
 $= \boxed{\phantom{000}}$

## Skill 11.6 Dividing powers with coefficients and with the same base.

MM9 11 22 33 44  
MM10 11 22 33 44

- Divide the coefficients.
- Subtract the indices of like pronumerals.

$$\begin{aligned} \text{Example: } 12a^5 \div 4a^2 &= (12 \div 4) \times (a^5 \div a^2) \\ &= 3 \times a^{5-2} \\ &= 3a^3 \end{aligned}$$

OR

$$\begin{aligned} \frac{12a^5}{4a^2} &= \frac{12 \times a \times a \times a \times \cancel{a} \times \cancel{a}}{4 \times \cancel{a} \times \cancel{a}} \\ &= \frac{12a^3}{4} = 3a^3 \end{aligned}$$

**Hint:** A number or a pronumeral without an index actually is to the power of 1.

**Q.** Simplify  $10j^6 \div 5j^3$

**A.**  $10j^6 \div 5j^3 =$

$$= (10 \div 5) \times (j^6 \div j^3)$$

subtract the indices

$$= 2 \times j^{6-3}$$

$$= 2j^3$$

**a)** Simplify  $8c^4 \div 2c^3$

$$= (8 \div 2) \times (c^4 \div c^3)$$

$$= 4 \times c$$

$$= \boxed{4c}$$

**b)** Simplify  $6a^5 \div 2a^2$

$$=$$

$$=$$

$$= \boxed{\phantom{000}}$$

**c)** Simplify  $8h^7 \div 2h^3$

$$=$$

$$=$$

$$= \boxed{\phantom{000}}$$

**d)** Simplify  $10m^9 \div 2m$

$$=$$

$$=$$

$$= \boxed{\phantom{000}}$$

**e)** Simplify  $5z^8 \div 5z^4$

$$=$$

$$=$$

$$= \boxed{\phantom{000}}$$

**f)** Simplify  $12f^7 \div 2f^2$

$$=$$

$$=$$

$$= \boxed{\phantom{000}}$$

**g)** Simplify  $\frac{8u^{11}}{4u^7}$

$$= (8 \div 4) \times (u^{11} \div u^7)$$

$$= 2 \times u^{11-7}$$

$$= \boxed{\phantom{000}}$$

**h)** Simplify  $\frac{12b^3}{6b}$

$$=$$

$$=$$

$$= \boxed{\phantom{000}}$$

**i)** Simplify  $\frac{6w^5}{2w^2}$

$$=$$

$$=$$

$$= \boxed{\phantom{000}}$$

**j)** Simplify  $\frac{18v^{12}}{9v^9}$

$$=$$

$$=$$

$$= \boxed{\phantom{000}}$$

**k)** Simplify  $\frac{25x^{13}}{5x}$

$$=$$

$$=$$

$$= \boxed{\phantom{000}}$$

**l)** Simplify  $\frac{16n^7}{2n^2}$

$$=$$

$$=$$

$$= \boxed{\phantom{000}}$$

**m)** Simplify  $\frac{7e^{10}}{e^6}$

$$=$$

$$=$$

$$= \boxed{\phantom{000}}$$

**n)** Simplify  $\frac{14q^6}{7q^6}$

$$=$$

$$=$$

$$= \boxed{\phantom{000}}$$

**o)** Simplify  $\frac{9w^6}{3w^2}$

$$=$$

$$=$$

$$= \boxed{\phantom{000}}$$

## Skill 11.7 Raising a product to a power.

MM9 11 22 33 44  
MM10 11 22 33 44

- Raise each number or pronumeral in the product to the index.

Example:  $(ab)^3 = a^3 \times b^3 = a^3b^3$

In general:  $(ab)^m = a^m \times b^m$

- Multiply from left to right.

Hint: A number or a pronumeral without an index actually is to the power of 1.

**Q.** Simplify  $5(2x)^3$

**A.**  $5(2x)^3$   
 $= 5 \times 2^3 \times x^3$   
 $= 5 \times 8 \times x^3$   
 $= 40x^3$

**a)** Simplify  $(2x)^4$

$= 2^4 \times x^4$   
 $= 16 \times x^4 = 16x^4$

**b)** Simplify  $(5y)^3$

$=$   
 $=$    $=$

**c)** Simplify  $(2v)^6$

$=$   
 $=$    $=$

**d)** Simplify  $(tu)^4$

$=$   
 $=$

**e)** Simplify  $(fg)^2$

$=$   
 $=$

**f)** Simplify  $(de)^f$

$=$   
 $=$

**g)** Simplify  $(6m)^3$

$=$   
 $=$

**h)** Simplify  $(7r)^2$

$=$   
 $=$

**i)** Simplify  $(3p)^4$

$=$   
 $=$

**j)** Simplify  $(2b)^2$

$=$   
 $=$

**k)** Simplify  $(5y)^3$

$=$   
 $=$

**l)** Simplify  $(4k)^3$

$=$   
 $=$

**m)** Simplify  $6(2y)^3$

$= 6 \times 2^3 \times y^3$   
 $= 6 \times 8 \times y^3 = 48y^3$

**n)** Simplify  $2(2q)^2$

$=$   
 $=$

**o)** Simplify  $4(2n)^3$

$=$   
 $=$

**p)** Simplify  $5(2v)^5$

$=$   
 $=$

**q)** Simplify  $3(4s)^2$

$=$   
 $=$

**r)** Simplify  $8(3h)^2$

$=$   
 $=$

- Multiply the indices of the number or pronumeral.

Example:  $(a^2)^4 = a^2 \times a^2 \times a^2 \times a^2 = a^{2+2+2+2}$   
 $= a^{2 \times 4}$   
 $= a^8$

In general:  $(a^m)^n = a^{m \times n}$

Hint: A number or a pronumeral without an index actually is to the power of 1.

**Q.** Simplify  $(m^y)^z$

**A.**  $(m^y)^z$   
 $= m^{y \times z}$  *multiply the exponents*  
 $= m^{yz}$

**a)** Simplify  $(y^4)^2$

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

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

**b)** Simplify  $(r^4)^4$

$=$   
 $=$   $=$   $\boxed{\phantom{00}}$

**c)** Simplify  $(x^2)^5$

$=$   
 $=$   $=$   $\boxed{\phantom{00}}$

**d)** Simplify  $(a^e)^f$

$=$   $=$   $\boxed{\phantom{00}}$

**e)** Simplify  $(p^q)^r$

$=$   $=$   $\boxed{\phantom{00}}$

**f)** Simplify  $(t^u)^v$

$=$   $=$   $\boxed{\phantom{00}}$

**g)** Simplify  $(d^2)^2$

$=$   
 $=$   $=$   $\boxed{\phantom{00}}$

**h)** Simplify  $(h^3)^2$

$=$   
 $=$   $=$   $\boxed{\phantom{00}}$

**i)** Simplify  $(n^4)^3$

$=$   
 $=$   $=$   $\boxed{\phantom{00}}$

**j)** Simplify  $(w^5)^0$

$=$   
 $=$   $=$   $\boxed{\phantom{00}}$

**k)** Simplify  $(a^4)^5$

$=$   
 $=$   $=$   $\boxed{\phantom{00}}$

**l)** Simplify  $(g^2)^5$

$=$   
 $=$   $=$   $\boxed{\phantom{00}}$

**m)** Simplify  $2(b^3)^2$

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

$= 2 \times b^{3 \times 2} = \boxed{4b^6}$

**n)** Simplify  $4(q^3)^3$

$=$   
 $=$   $=$   $\boxed{\phantom{00}}$

**o)** Simplify  $5(z^3)^2$

$=$   
 $=$   $=$   $\boxed{\phantom{00}}$

**p)** Simplify  $6(c^4)^3$

$=$   
 $=$   $=$   $\boxed{\phantom{00}}$

**q)** Simplify  $8(w^4)^2$

$=$   
 $=$   $=$   $\boxed{\phantom{00}}$

**r)** Simplify  $7(k^3)^5$

$=$   
 $=$   $=$   $\boxed{\phantom{00}}$

- Observe the index.

$$(-5)^2 = -5 \times -5 = +25$$

Even index  
Positive result

$$(-5)^3 = -5 \times -5 \times -5 = +25 \times -5 = -125$$

Odd index  
Negative result

**Q.** Evaluate  $(-4)^3$

**A.**  $(-4^3)$  odd index  
 $= -4 \times -4 \times -4$   
 $= -64$  negative result

**a)** Evaluate  $(-9)^2$  even index  
 $= -9 \times -9 = 81$   
 positive result

**b)** Evaluate  $(-2)^2$   
 $= \dots = \dots$

**c)** Evaluate  $(-1)^5$   
 $= \dots = \dots$

**d)** Evaluate  $(-4)^2$   
 $= \dots = \dots$

**e)** Evaluate  $(-8)^2$   
 $= \dots = \dots$

**f)** Evaluate  $(-2)^4$   
 $= \dots = \dots$

**g)** Evaluate  $(-1)^7$   
 $= \dots = \dots$

**h)** Evaluate  $(-2)^6$   
 $= \dots = \dots$

**i)** Evaluate  $(-3)^3$   
 $= \dots = \dots$

**j)** Evaluate  $(-5)^1$   
 $= \dots = \dots$

**k)** Evaluate  $(-4)^4$   
 $= \dots = \dots$

**l)** Evaluate  $(-7)^3$   
 $= \dots = \dots$

**m)** Evaluate  $(-6)^3$   
 $= \dots = \dots$

**n)** Evaluate  $(-7)^2$   
 $= \dots = \dots$

**o)** Evaluate  $(-5)^4$   
 $= \dots = \dots$

**p)** Evaluate  $(-3)^4$   
 $= \dots = \dots$

**q)** Evaluate  $(-5)^3$   
 $= \dots = \dots$

**r)** Evaluate  $(-10)^4$   
 $= \dots = \dots$

**s)** Evaluate  $(-10)^3$   
 $= \dots = \dots$

**t)** Evaluate  $(-12)^2$   
 $= \dots = \dots$

**u)** Evaluate  $(-1)^{12}$   
 $= \dots = \dots$

**v)** Evaluate  $(-15)^2$   
 $= \dots = \dots$

**w)** Evaluate  $(-11)^3$   
 $= \dots = \dots$

**x)** Evaluate  $(-1)^{123}$   
 $= \dots = \dots$

## Skill 11.10 Raising a number to a negative power.

MM9 11 22 33 44  
MM10 11 22 33 44

- Write the reciprocal of the base number.
- Raise this reciprocal to the corresponding positive index.

$$a^{-2} = \left(\frac{1}{a}\right)^2 = \frac{1}{a^2}$$

Negative index:  $a^{-2}$   
Base:  $a$   
Positive index:  $2$   
Reciprocal:  $\frac{1}{a}$

In general:  $a^{-n} = \frac{1}{a^n}$

**Q.** Evaluate  $4^{-2}$

**A.**  $4^{-2}$

$$= \frac{1}{4^2}$$

Write the reciprocal of 4

$$= \frac{1}{4 \times 4}$$

Multiply 4 by itself 2 times

$$= \frac{1}{16}$$

**a)** Evaluate  $10^{-3}$

$$= \frac{1}{10 \times 10 \times 10} = \frac{1}{1000}$$

**b)** Evaluate  $3^{-3}$

$$= \frac{1}{3 \times 3 \times 3} = \frac{1}{27}$$

**c)** Evaluate  $2^{-2}$

$$= \frac{1}{2 \times 2} = \frac{1}{4}$$

**d)** Evaluate  $4^{-3}$

$$= \frac{1}{4 \times 4 \times 4} = \frac{1}{64}$$

**e)** Evaluate  $7^{-1}$

$$= \frac{1}{7} = \frac{1}{7}$$

**f)** Evaluate  $8^{-2}$

$$= \frac{1}{8 \times 8} = \frac{1}{64}$$

**g)** Evaluate  $9^{-2}$

$$= \frac{1}{9 \times 9} = \frac{1}{81}$$

**h)** Evaluate  $2^{-4}$

$$= \frac{1}{2 \times 2 \times 2 \times 2} = \frac{1}{16}$$

**i)** Evaluate  $5^{-4}$

$$= \frac{1}{5 \times 5 \times 5 \times 5} = \frac{1}{625}$$

**j)** Evaluate  $6^{-3}$

$$= \frac{1}{6 \times 6 \times 6} = \frac{1}{216}$$

**k)** Evaluate  $5^{-2}$

$$= \frac{1}{5 \times 5} = \frac{1}{25}$$

**l)** Evaluate  $3^{-5}$

$$= \frac{1}{3 \times 3 \times 3 \times 3 \times 3} = \frac{1}{243}$$

**m)** Evaluate  $2^{-5}$

$$= \frac{1}{2 \times 2 \times 2 \times 2 \times 2} = \frac{1}{32}$$

**n)** Evaluate  $10^{-4}$

$$= \frac{1}{10 \times 10 \times 10 \times 10} = \frac{1}{10000}$$

**o)** Evaluate  $4^{-4}$

$$= \frac{1}{4 \times 4 \times 4 \times 4} = \frac{1}{256}$$

**p)** Evaluate  $2^{-6}$

$$= \frac{1}{2 \times 2 \times 2 \times 2 \times 2 \times 2} = \frac{1}{64}$$

**q)** Evaluate  $3^{-3}$

$$= \frac{1}{3 \times 3 \times 3} = \frac{1}{27}$$

**r)** Evaluate  $6^{-2}$

$$= \frac{1}{6 \times 6} = \frac{1}{36}$$

**s)** Evaluate  $10^{-2}$

$$= \frac{1}{10 \times 10} = \frac{1}{100}$$

**t)** Evaluate  $5^{-3}$

$$= \frac{1}{5 \times 5 \times 5} = \frac{1}{125}$$

**u)** Evaluate  $1^{-25}$

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