Indices - Lesson 2

Indices - Powers of Powers

LI

- Know how to work out powers of powers.
- Simplify expressions using powers of powers.

SC

- Notation.

Reminder on previous lesson

a^0 equals 1

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Powers of Powers

$$(10^3)^2 = (10 \times 10 \times 10)^2$$

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

$$= 1\,000\,000$$

$$\therefore \quad (10^3)^2 = 10^6$$

We thus have the 4^{th} Rule of Indices :

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

(m, n are any numbers)

Example 1

Simplify :

(a) $(2^{3})^{4}$

$= 2^{3 \times 4}$

$= 2^{12}$

(b) $(3^{0})^{-5}$

$= 3^{0 \times (-5)}$

$= 3^{0}$

$= 1$

(c) $(4^{-1})^{-18}$

$= 4^{(-1) \times (-18)}$

$= 4^{18}$

(d) $(6^{5})^{8}$

$= 6^{5 \times 8}$

$= 6^{40}$

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Example 2

Simplify :

(a) $(2x^4)^5$

$= 2^5 \times (x^4)^5$

$= 32 \times x^{20}$

$= \boxed{32x^{20}}$

(b) $(3y^{-4})^{-3}$

$= 3^{-3} \times (y^{-4})^{-3}$

$= 3^{-3} \times y^{12}$

$= \boxed{\dfrac{y^{12}}{27}}$

(c) $(2a^3b^4)^5$

$= 2^5 \times (a^3)^5 \times (b^4)^5$

$= 32 \times a^{15} \times b^{20}$

$= \boxed{32a^{15}b^{20}}$

(d) $(3c^{-12}x^{15}w^{32})^{-4}$

$= 3^{-4} \times (c^{-12})^{-4} \times (x^{15})^{-4} \times (w^{32})^{-4}$

$= 3^{-4} \times c^{48} \times x^{-60} \times w^{-128}$

$= \boxed{\dfrac{c^{48}x^{-60}w^{-128}}{81}}$

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1 Simplify the following.

a $(3^4)^5$ **b** $(2^3)^4$ **c** $(10^5)^3$ **d** $(t^3)^{-4}$ **e** $(a^7)^3$

2 Simplify the following.

a $(3y)^2$ **b** $(x^3y^4)^5$ **c** $(ab^3)^4$

d $(3p^4q^2)^3$ **e** $(2t^3u^{-2})^4$ **f** $(10u^{-5}v^{-2})^3$

3 Simplify the following.

a $(6^4)^3$ **b** $(2^7)^4$ **c** $(a^5)^6$

d $(t^{-3})^7$ **e** $(x^{-2})^{-5}$ **f** $(6a^3b^4)^2$

g $(2x^{-3}y^5)^4$ **h** $(3a^6b^{-3})^5$ **i** $(x^4y^{-2}z^3)^3$

Answers

1 **a** 3^{20}	**2** **a** $9y^2$	**3** **a** 6^{12}
b 2^{12}	**b** $x^{15}y^{20}$	**b** 2^{28}
c 10^{15}	**c** a^4b^{12}	**c** a^{30}
d t^{-12}	**d** $27p^{12}q^6$	**d** $t^{-21} = \frac{1}{t^{21}}$
e a^{21}	**e** $16t^{12}u^{-8} = \frac{16t^{12}}{u^8}$	**e** x^{10}
	f $1{,}000u^{-15}v^{-6} = \frac{1{,}000}{u^{15}v^6}$	**f** $36a^6b^8$
		g $16x^{-12}y^{20} = \frac{16y^{20}}{x^{12}}$
		h $243a^{30}b^{-15} = \frac{243a^{30}}{b^{15}}$
		i $x^{12}y^{-6}z^9$

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