

القوة
exponent
القاعدة
base

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

exponent
base

$$a^n = \underbrace{a \cdot a \cdot a \cdots a}_{n \text{ times}}$$

Ex ① $(-3)^3$ $n=3$ exponent
 $a=-3$ base

$$(-3)^3 = (-3)(-3)(-3) = (9)(-3) = -27$$

② $(-\frac{1}{2})^2 = (-\frac{1}{2})(-\frac{1}{2}) = \frac{1}{4}$

③ $(-4)^3 = (-4)(-4)(-4) = (16)(-4) = -64$

$$2 \cdot 3 = 2 \times 3 = (2)(3) = 2 \times 3$$

Rules of Exponents ← قواعد الأس

real numbers
 $a, b \in \mathbb{R}$

integers
 $m, n \in \mathbb{Z}$

Assume $a, b \in \mathbb{R}$, $m, n \in \mathbb{Z}$

$$(1) \quad a^m \cdot a^n = a^{m+n}$$

Exp $2^3 \times 2^2 = 2^{3+2} = 2^5 = \underbrace{2 \times 2 \times 2 \times 2 \times 2}_{= 32}$

$$2 \times 2 \times 2 \times 2 \times 2 = 32$$

$$(2) \quad \frac{a^m}{a^n} = a^m \times a^{-n} = a^{m+(-n)} = a^{m-n}$$

Exp $\frac{2^3}{2^2} = 2^{3-2} = 2^1 = 2$

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

$$\frac{5}{2^3} = 5 \times 2^{-3}$$

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

$$(3) \quad (a \cdot b)^m = a^m \cdot b^m$$

$$(2 \times 3)^4 = 2^4 \times 3^4$$

$$2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 3$$

(2^4)

$$= \underbrace{2 \times 2 \times 2 \times 2}_4 \times \underbrace{3 \times 3 \times 3}_9$$

$$= 16 \times 81$$

$$= 1296$$

$$(4) \quad (a^m)^n = a^{m \times n}$$

Exp $(4^2)^3 = 4^{2 \times 3} = 4^6$

$$= \underbrace{4 \times 4 \times 4}_4 \times \underbrace{4 \times 4 \times 4}_4$$
$$= 64 \times 64$$
$$= 4096$$

$$\left. \begin{array}{l} 2^3 \neq 2 \times 3 = 6 \\ 2^3 = 2 \times 2 \times 2 = 8 \end{array} \right\}$$

$$(5) \quad \left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}, \quad b \neq 0$$

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

$$= \frac{8}{27}$$

$$\frac{\text{بسط}}{\text{مقام}} = \frac{\text{numerator}}{\text{denominator}}$$

$$(6) \quad a^0 = 1 \quad \text{بسط} \quad a \neq 0$$

⑥ $a^0 = 1$ $\frac{a \neq 0}{\text{meaningless undefined}}$

$\underline{\text{Exp}} \quad \left(\frac{2}{3}\right)^0 = 1$ $\underline{\text{Exp}} \quad (-5)^0 = 1$	$\pi^0 = 1$ $e^0 = 1$	$\left(\frac{\sqrt{3}}{-\sqrt{3}}\right)^0 = 1$ $\left(-\frac{1}{2}\right)^0 = 1$
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⑦ $a^{-n} = \frac{1}{a^n}, \quad a \neq 0$

$\underline{\text{Exp}} \quad \textcircled{1} \quad \frac{-3}{2} = \frac{1}{2^3} = \frac{1}{8}$

$\textcircled{2} \quad \left(-\frac{1}{2}\right)^{\textcircled{3}} = \frac{(-1)^3}{2^3} = \frac{-1 \times -1 \times -1}{2 \times 2 \times 2} = \frac{-1}{8} \checkmark$

$= \left(-\frac{1}{2}\right)\left(-\frac{1}{2}\right)\left(-\frac{1}{2}\right)$
 $= \frac{-1}{8}$

$\frac{-1}{8} = \frac{1}{8} \checkmark$ $\frac{1}{3} = \frac{-1}{3} \checkmark$	$\frac{-1}{8} \neq 8$ $-\frac{1}{8} = -\frac{1}{8} \checkmark$
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$$\frac{-\sqrt{2}}{5} = -\sqrt{2} \times \frac{1}{5} \quad \checkmark$$

$$\begin{array}{l} -\sqrt{2} \rightarrow -1 \\ 5 \rightarrow 8 \end{array}$$

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

[8] $\left(\frac{a}{b}\right)^{-n} = \frac{a^{-n}}{b^{-n}} = \frac{b^n}{a^n} = \left(\frac{b}{a}\right)^n$

Exp ① $\left(\frac{2}{3}\right)^{-1} = \left(\frac{3}{2}\right)^1$

② $\left(\frac{4}{5}\right)^{-2} = \left(\frac{5}{4}\right)^2 = \frac{5^2}{4^2} = \frac{25}{16}$

$$\frac{-3}{2} = \frac{1}{2^{-3}}$$

or $\frac{4^{-2}}{5^{-2}} = \frac{\frac{1}{4^2}}{\frac{1}{5^2}} = \frac{\frac{1}{16}}{\frac{1}{25}} = \frac{1}{16} \times \frac{25}{1} = \frac{25}{16}$

or $\frac{1}{\left(\frac{4}{5}\right)^2} = \frac{1}{\left(\frac{4}{5}\right)\left(\frac{4}{5}\right)} = \frac{1}{\frac{16}{25}} = 1 \times \frac{25}{16} = \frac{25}{16}$

الغالب التالية
the following expressions

Exp Simplify the following expressions so that the positive exponents remain: الأس الموجب يبقى

$$① \quad 2 (\bar{y}^3)^{-2} = 2 \bar{y}^{-3 \times -2} = 2 \bar{y}^6$$

$$② \quad 2 (\bar{y}^3)^2 = 2 \bar{y}^{-6} = \frac{2}{\bar{y}^6}$$

$$③ \quad \frac{x^{-8}}{x^{-2}} = x^{-8 - (-2)} = x^{-8 + 2} = x^{-6} = \frac{1}{x^6}$$

$$④ \quad \bar{y}^{24} \div \bar{y}^{-4} = \frac{\bar{y}^{24}}{\bar{y}^{-4}} = \bar{y}^{24 - (-4)} = \bar{y}^{24 + 4} = \bar{y}^{28}$$

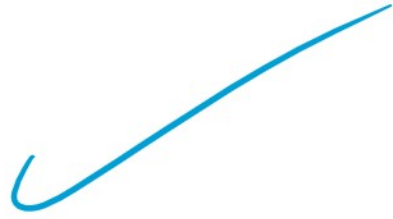
$$⑤ \quad \left(\frac{a^{-3} \times b^{-2} \times c^{-4}}{a^6 \times b^{-4} \times c^0} \right)^{-4} = \left(a^{-3-6} \times b^{-2-(-4)} \times c^{-4-0} \right)^{-4}$$

$$= \left(a^{-9} \cdot b^2 \cdot c^{-4} \right)^{-4} = a^{-9 \times -4} \cdot b^{2 \times -4} \cdot c^{-4 \times -4}$$

$$= a^b c$$

$$= a^{36} b^{-8} c^{16}$$

$$= \frac{a^{36} c^{16}}{b^8}$$



⑥ $y^{24} \times y^{-4} = y^{24+(-4)} = y^{20}$

$\rightarrow y^{24} \times \frac{1}{y^4} = \frac{y^{24}}{y^4} = y^{24-4} = y^{20}$

Exp ① write $\frac{x^2 y}{q w z^3}$ with all factors in the numerator
البسط

$$x^2 y^1 q^1 w^1 z^{-3}$$

② $\frac{3 x^5 (x^2 y^3)^0}{7 x^{-2} y^4}$ = denominator
القاسم

+ x 0

المقام

$$\frac{1}{1} = 1$$
$$\frac{-1}{-1} = \frac{1}{1} = 1$$

$$\frac{1}{7x^{-2}y^4 \cdot 3 \cdot x^{-5}}$$



Exp ① $0^5 = 0 \times 0 \times 0 \times 0 \times 0 = 0$

② $5^0 = 1$

③ $\left(\frac{1}{2}\right)^{-3} = \frac{1}{\left(\frac{1}{2}\right)^3} = \frac{1}{\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}} = \frac{1}{\frac{1}{8}}$
 $= 1 \times \frac{8}{1} = 8$

④ $0^{-4} = \frac{1}{0^4} = \frac{1}{0 \times 0 \times 0 \times 0} = \frac{1}{0}$ undefined meaning

⑤ $3 \cdot 8^0 = 3 \times 1 = 3$