

## Ejercicio 13

$$a) \quad (-12)^{18} : \underbrace{[(-36)^8 : 3^8]}_{(-36:3)^8} \cdot (2^2)^5 = \underbrace{(-12)^{18} : (-12)^8}_{(-12)^{18-8}} \cdot 2^{10} = \underbrace{(-12)^{10} \cdot 2^{10}}_{(-12 \cdot 2)^{10}} = (-24)^{10} = 24^{10}$$

$$b) \quad \underbrace{[3^4 \cdot (-2)^4]^{-1}}_{[3 \cdot (-2)]^4} : \underbrace{[(-12)^3 : 2^3]^2}_{(-12:2)^3} \cdot 6^5 = [(-6)^4]^{-1} : [(-6)^3]^2 \cdot 6^5 = \underbrace{(-6)^{-4}}_{\text{exponente par}} : \underbrace{(-6)^6}_{\text{exponente par}} \cdot 6^5 = 6^{-4} : 6^6 \cdot 6^5 =$$

$$= 6^{-4-6+5} = 6^{-5} = \left(\frac{1}{6}\right)^5$$

<p>Recuerda</p> <p>si <math>n</math> es par <math>\Rightarrow (-a)^n = a^n</math></p> <p>si <math>n</math> es impar <math>\Rightarrow (-a)^n = -a^n</math></p>
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$$c) \quad \underbrace{[(-18)^4 : 3^4]^2}_{(-18:3)^4} \cdot \underbrace{[(-2)^{11} \cdot (-3)^{11}]^{-1}}_{[(-2) \cdot (-3)]^{11}} = [(-6)^4]^2 \cdot (6^{11})^{-1} = \underbrace{(-6)^8}_{\text{exponente par}} \cdot 6^{-11} = 6^8 \cdot 6^{-11} = 6^{8+(-11)} = 6^{-3} = \left(\frac{1}{6}\right)^3$$

$$d) \quad \underbrace{[(-4)^8 : (-4)^{-1}]}_{(-4)^{8-(-1)}} \cdot \underbrace{(6^3)^3}_{(4 \cdot 6)^4} : (24^{-1})^3 = \underbrace{(-4)^9 \cdot 6^9}_{(4 \cdot 6)^4} : 24^{-3} = \underbrace{(-24)^9}_{\text{exponente impar}} : 24^{-3} = -24^9 : 24^{-3} = -24^{9-(-3)} = -24^{12}$$

$$e) \quad \underbrace{(-2)^7}_{\text{exponente impar}} \cdot 32^{-1} : 16^3 = -2^7 \cdot (2^5)^{-1} : (2^4)^3 = -2^7 \cdot 2^{-5} : 2^{12} = -2^{7+(-5)-12} = -2^{-10} = -\left(\frac{1}{2}\right)^{10}$$

$$f) \quad \left[7^3 \cdot \left(\frac{1}{2}\right)^3\right]^4 \cdot \left[\left(\frac{2}{7}\right)^5 : \left(\frac{2}{7}\right)^3\right]^7 : \underbrace{\left(\frac{3}{7}\right)^2}_{\text{exponente par}} =$$

$$= \left[\left(\frac{7}{2}\right)^3\right]^4 \cdot \left[\left(\frac{2}{7}\right)^2\right]^7 : \left(\frac{3}{7}\right)^2 =$$

$$= \left(\frac{7}{2}\right)^{12} \cdot \left(\frac{2}{7}\right)^{14} : \left(\frac{3}{7}\right)^2 =$$

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

$$= \underbrace{\left(\frac{2}{7}\right)^{-12} \cdot \left(\frac{2}{7}\right)^{14}}_{\left(\frac{2}{7}\right)^{-12+14}} : \left(\frac{3}{7}\right)^2 =$$

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

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

$$g) \quad \underbrace{\left(-\frac{4}{3}\right)^2}_{\text{exponente par}} : \left[\left(\frac{3}{4}\right)^4 \cdot \left(\frac{3}{4}\right)\right]^{-1} \cdot \left(-\frac{4}{5}\right)^3 =$$

$$= \left(\frac{4}{3}\right)^2 : \left[\left(\frac{3}{4}\right)^5\right]^{-1} \cdot \left(-\frac{4}{5}\right)^3 =$$

$$= \left(\frac{4}{3}\right)^2 : \left(\frac{3}{4}\right)^{-5} \cdot \left(-\frac{4}{5}\right)^3 =$$

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

$$= \left(\frac{3}{4}\right)^{-2} : \left(\frac{3}{4}\right)^{-5} \cdot \left(-\frac{4}{5}\right)^3 =$$

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

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

$$\begin{aligned}
 \text{h)} \quad & \underbrace{\left(-\frac{3}{5}\right)^9}_{\substack{\text{exponente} \\ \text{impar}}} : \left[ \left(\frac{5}{3}\right)^2 : \left(\frac{5}{3}\right)^{-4} \right]^2 : \left(\frac{9}{25}\right)^{10} = \\
 & = - \left(\frac{3}{5}\right)^9 : \left[ \left(\frac{5}{3}\right)^6 \right]^2 : \left(\frac{9}{25}\right)^{10} = \\
 & = - \left(\frac{3}{5}\right)^9 : \left(\frac{5}{3}\right)^{12} : \left(\frac{9}{25}\right)^{10} = \\
 & = - \left(\frac{3}{5}\right)^9 : \left(\frac{3}{5}\right)^{-12} : \left(\frac{9}{25}\right)^{10} = \\
 & = - \left(\frac{3}{5}\right)^{21} : \left(\frac{9}{25}\right)^{10} = \\
 & = - \left(\frac{3}{5}\right)^{21} : \left(\left(\frac{3}{5}\right)^2\right)^{10} = \\
 & = - \left(\frac{3}{5}\right)^{21} : \left(\frac{3}{5}\right)^{20} = - \left(\frac{3}{5}\right)^1 = -\frac{3}{5}
 \end{aligned}$$

$$\begin{aligned}
 \text{i)} \quad & \left[ \left(\frac{2}{3}\right)^2 \right]^3 : \left[ (-3)^3 \cdot \left(-\frac{1}{5}\right)^3 \right]^{-2} \cdot \left(\frac{25}{16}\right)^3 = \\
 & = \left(\frac{2}{3}\right)^6 : \left[ \left(\frac{3}{5}\right)^3 \right]^{-2} \cdot \left(\frac{25}{16}\right)^3 = \\
 & = \left(\frac{2}{3}\right)^6 : \left(\frac{3}{5}\right)^{-6} \cdot \left(\frac{25}{16}\right)^3 = \\
 & = \left(\frac{2}{3}\right)^6 : \left(\frac{5}{3}\right)^6 \cdot \left(\frac{25}{16}\right)^3 = \\
 & = \left(\frac{2}{5}\right)^6 \cdot \left(\left(\frac{5}{4}\right)^2\right)^3 = \\
 & = \left(\frac{2}{5}\right)^6 \cdot \left(\frac{5}{4}\right)^6 = \left(\frac{2 \cdot 5}{5 \cdot 4}\right)^6 = \left(\frac{1}{2}\right)^6
 \end{aligned}$$

$$\begin{aligned}
 \text{j)} \quad & \underbrace{\left(-\frac{1}{5}\right)^8}_{\substack{\text{exponente} \\ \text{par}}} : \left[ \left(\frac{2}{3}\right)^2 : \left(\frac{3}{2}\right)^2 \right]^2 \cdot \left(\frac{100}{9}\right)^5 = \\
 & = \left(\frac{1}{5}\right)^8 : \left[ \left(\frac{2}{3}\right)^2 : \left(\frac{2}{3}\right)^{-2} \right]^2 \cdot \left(\frac{100}{9}\right)^5 = \\
 & = \left(\frac{1}{5}\right)^8 : \left[ \left(\frac{2}{3}\right)^4 \right]^2 \cdot \left(\frac{100}{9}\right)^5 = \\
 & = \left(\frac{1}{5}\right)^8 : \left(\frac{2}{3}\right)^8 \cdot \left(\frac{100}{9}\right)^5 = \\
 & = \left(\frac{3}{10}\right)^8 \cdot \left(\frac{100}{9}\right)^5 = \\
 & = \left(\frac{3}{10}\right)^8 \cdot \left(\left(\frac{10}{3}\right)^2\right)^5 = \\
 & = \left(\frac{3}{10}\right)^8 \cdot \left(\frac{10}{3}\right)^{10} = \\
 & = \left(\frac{10}{3}\right)^{-8} \cdot \left(\frac{10}{3}\right)^{10} = \left(\frac{10}{3}\right)^2
 \end{aligned}$$

$$\begin{aligned}
 \text{k)} \quad & \underbrace{\left(-\frac{5}{2}\right)^{15}}_{\substack{\text{exponente} \\ \text{impar}}} : \left[ \left(\frac{1}{6}\right)^3 : \left(\frac{1}{3}\right)^3 \right]^5 \cdot \left(\frac{25}{16}\right)^{-8} = \\
 & = - \left(\frac{5}{2}\right)^{15} : \left[ \left(\frac{1}{2}\right)^3 \right]^5 \cdot \left(\frac{25}{16}\right)^{-8} = \\
 & = - \left(\frac{5}{2}\right)^{15} : \left(\frac{1}{2}\right)^{15} \cdot \left(\frac{25}{16}\right)^{-8} = \\
 & = - \left(\frac{5}{4}\right)^{15} \cdot \left(\frac{25}{16}\right)^{-8} = \\
 & = - \left(\frac{5}{4}\right)^{15} \cdot \left(\frac{5}{4}\right)^{-16} = \\
 & = - \left(\frac{5}{4}\right)^{-1} = -\frac{4}{5}
 \end{aligned}$$

$$\begin{aligned}
 1) \quad & \underbrace{\left(-\frac{9}{25}\right)^{10}}_{\text{exponente par}} : \left(\frac{5}{3}\right)^{-2} \cdot \left[\left(\frac{2}{3}\right)^{14} \cdot \left(\frac{2}{3}\right)^{-5}\right]^2 : \left(-\frac{2}{5}\right)^{15} = \\
 & = \left(\frac{9}{25}\right)^{10} : \left(\frac{3}{5}\right)^2 \cdot \left[\left(\frac{2}{3}\right)^9\right]^2 : \left(-\frac{2}{5}\right)^{15} = \\
 & = \left(\left(\frac{3}{5}\right)^2\right)^{10} : \left(\frac{3}{5}\right)^2 \cdot \left(\frac{2}{3}\right)^{18} : \left(-\frac{2}{5}\right)^{15} = \\
 & = \left(\frac{3}{5}\right)^{20} : \left(\frac{3}{5}\right)^2 \cdot \left(\frac{2}{3}\right)^{18} : \left(-\frac{2}{5}\right)^{15} = \\
 & = \left(\frac{3}{5}\right)^{18} \cdot \left(\frac{2}{3}\right)^{18} : \left(-\frac{2}{5}\right)^{15} = \\
 & = \left(\frac{2}{5}\right)^{18} : \underbrace{\left(-\frac{2}{5}\right)^{15}}_{\text{exponente impar}} = \left(\frac{2}{5}\right)^{18} : \left(-\left(\frac{2}{5}\right)^{15}\right) = \boxed{-\left(\frac{2}{5}\right)^3}
 \end{aligned}$$

### Ejercicio 14

$$a) \quad \frac{\overbrace{30^9 : (-3)^9}^{[30 : (-3)]^9} : (-10)^3}{(25^4 : 5^5)^5 \cdot 125^{-3}} = \frac{(-10)^9 : (-10)^3}{[(5^2)^4 : 5^5]^5 \cdot (5^3)^{-3}} = \frac{(-10)^6}{(5^8 : 5^5)^5 \cdot 5^{-9}} = \frac{(-10)^6}{(5^3)^5 \cdot 5^{-9}} = \frac{(-10)^6}{5^{15} \cdot 5^{-9}} = \frac{(-10)^6}{5^6} = (-2)^6 = 64$$

$$b) \quad \frac{(8^3 \cdot 2^4)^2 : 16}{10^{15} : (-5)^{15} \cdot (2^3)^3} = \frac{[(2^3)^3 \cdot 2^4]^2 : 2^4}{\underbrace{(-2)^{15}}_{\text{exp. impar}} \cdot 2^9} = \frac{(2^9 \cdot 2^4)^2 : 2^4}{-2^{15} \cdot 2^9} = \frac{(2^{13})^2 : 2^4}{-2^{24}} = \frac{2^{26} : 2^4}{-2^{24}} = \frac{2^{22}}{-2^{24}} = -\frac{1}{2^2} = -\frac{1}{4}$$

$$c) \quad \frac{(4^5 \cdot 2^{-7})^3 \cdot (3^3)^3}{[(-8)^{11} \cdot (-3)^{11}] : [(-4)^8 : (-4)^{-3}]} = \frac{[(2^2)^5 \cdot 2^{-7}]^3 \cdot 3^9}{24^{11} : (-4)^{11}} = \frac{(2^{10} \cdot 2^{-7})^3 \cdot 3^9}{(-6)^{11}} = \frac{(2^3)^3 \cdot 3^9}{(-6)^{11}} = \frac{2^9 \cdot 3^9}{(-6)^{11}} = \frac{6^9}{\underbrace{(-6)^{11}}_{\text{exp. impar}}} = \\
 = \frac{6^9}{-6^{11}} = -\frac{1}{6^2} = -\frac{1}{36}$$

<p>Recuerda</p> <p>si <math>n</math> es par <math>\Rightarrow (-a)^n = a^n</math></p> <p>si <math>n</math> es impar <math>\Rightarrow (-a)^n = -a^n</math></p>
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$$d) \quad \frac{(2^{-5} \cdot 16^2)^3 \cdot (-6)^9}{(-3)^{11} \cdot [(-4)^8 : (-4)^{-3}]} = \frac{[2^{-5} \cdot (2^4)^2]^3 \cdot (-6)^9}{(-3)^{11} \cdot (-4)^{11}} = \frac{(2^{-5} \cdot 2^8)^3 \cdot (-6)^9}{12^{11}} = \frac{(2^3)^3 \cdot (-6)^9}{12^{11}} = \frac{2^9 \cdot (-6)^9}{12^{11}} = \\
 = \frac{\overbrace{(-12)^9}^{\text{exp. impar}}}{12^{11}} = \frac{-12^9}{12^{11}} = -\frac{1}{12^2} = -\frac{1}{144}$$

$$\begin{aligned}
 \text{e)} \quad & \frac{18^{-7} \cdot \overbrace{(-10)^3}^{\text{exp. impar}} \cdot 54^4}{27 \cdot \underbrace{(-25)^4}_{\text{exp. par}} \cdot 15^{-6}} = -\frac{18^{-7} \cdot 10^3 \cdot 54^4}{27 \cdot 25^4 \cdot 15^{-6}} = -\frac{10^3 \cdot 54^4 \cdot 15^6}{27 \cdot 25^4 \cdot 18^7} = -\frac{(2 \cdot 5)^3 \cdot (2 \cdot 3^3)^4 \cdot (3 \cdot 5)^6}{3^3 \cdot (5^2)^4 \cdot (2 \cdot 3^2)^7} = \\
 & = -\frac{2^3 \cdot 5^3 \cdot 2^4 \cdot 3^{12} \cdot 3^6 \cdot 5^6}{3^3 \cdot 5^8 \cdot 2^7 \cdot 3^{14}} = -\frac{2^7 \cdot 3^{18} \cdot 5^9}{2^7 \cdot 3^{17} \cdot 5^8} = -\frac{3 \cdot 5}{1} = -15
 \end{aligned}$$

$$\begin{aligned}
 \text{f)} \quad & \frac{\overbrace{\left(-\frac{1}{7}\right)^{-12}}^{\text{exp. par}} \cdot \left(\frac{8}{49}\right)^4 \cdot 14^{-5}}{\underbrace{(-4)^3}_{\text{exp. impar}} \cdot \underbrace{((-6)^0)^5}_{(-6)^0=1}} = \frac{\left(\frac{1}{7}\right)^{-12} \cdot \left(\frac{2^3}{7^2}\right)^4 \cdot (2 \cdot 7)^{-5}}{-4^3} = -\frac{7^{12} \cdot (2^3 \cdot 7^{-2})^4 \cdot 2^{-5} \cdot 7^{-5}}{(2^2)^3} = -\frac{7^{12} \cdot 2^{12} \cdot 7^{-8} \cdot 2^{-5} \cdot 7^{-5}}{2^6} = \\
 & = -\frac{7^{12} \cdot 2^{12}}{2^6 \cdot 7^8 \cdot 2^5 \cdot 7^5} = -\frac{7^{12} \cdot 2^{12}}{7^{13} \cdot 2^{11}} = -\frac{2}{7}
 \end{aligned}$$

<p>Recuerda: <math>\frac{A^n}{B^m} = A^n \cdot \frac{1}{B^m} = A^n \cdot B^{-m}</math></p>
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