

$$3^3 = 27$$

$$3^2 = 9$$

$$3^1 = 3$$

$$3^0 = 1$$

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

$$3^{-2} = \frac{1}{9}$$

$$3^{-3} = \frac{1}{27}$$

Importante señalar que

la conexión entre a^n y a^{-n}

es que son recíprocos.

Por tanto definimos las potencias

negativas como el recíproco de la potencia

$$a^{-n} = \frac{1}{a^n}$$

Problemas

2.28)

$$(a) 1^{-5} = \frac{1}{1^5} = \frac{1}{1} = 1$$

$$(b) 10^{-4} = \frac{1}{10^4} = \frac{1}{10,000}$$

$$(c) 2^{-3} = \frac{1}{2^3} = \frac{1}{8}$$

$$(d) 56 \cdot 2^{-3} = 56 \cdot \frac{1}{2^3} \\ = 56 \cdot \frac{1}{8} = 7$$

$$\begin{array}{r} 56 \\ \times 8 \\ \hline 448 \end{array}$$

$$(e) 56 \div 2^{-3} = 56 \div \frac{1}{2^3}$$

$$= 56 \cdot 2^3 = 56 \cdot 8 = 448$$

2.29)

$$a) 3^5 \cdot 3^{-5} = 3^5 \cdot \frac{1}{3^5} = 1$$

$$b) 3^6 \cdot 3^{-4} = 3^6 \div 3^4 = 3^2 = 9$$

$$c) 3^{-1} \cdot 3^{-2} = \frac{1}{3} \cdot \frac{1}{9} = \left(\frac{1}{27}\right)$$

$$d) 3^{15} \cdot 3^{-5} \cdot 3^{-4} \cdot 3^{-3} \\ 3^{15} \cdot \frac{1}{3^5} \cdot \frac{1}{3^4} \cdot \frac{1}{3^3} = 3^{15} \cdot \frac{1}{3^{12}} \\ = 3^3 = 27$$

2.30)

$$a) \frac{1}{2^{-3}} = 2^3 = 8$$

$$b) \frac{1}{5^{-2}} = 5^2 = 25$$

$$c) \frac{1}{a^{-n}} \text{ y } a^n, \quad \left(\frac{1}{a^{-n}} = a^n \right)$$

ya que a^{-n} es el recíproco de

a^n , el recíproco del recíproco

es a^n .

2.31)

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

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

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

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

2.32)

$$a) -3^{-2} = \frac{1}{-3^2} = -\frac{1}{9}$$

$$e) \frac{1}{(-2)^{-3}} = (-2)^3 = -(2)^3 = -8$$

$$b) (-3)^{-2} = \frac{1}{(-3)^2} = \frac{1}{9}$$

$$c) (-2)^{-3} = \frac{1}{(-2)^3} = -\frac{1}{8}$$

$$d) \frac{1}{(-3)^{-2}} = (-3)^2 = 9$$

2.33)

$$a) \quad 2^{-3} \quad \vee \quad (2^{-1})^3 \quad 2^{-3} = (2^{-1})^3$$

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

$$b) \quad 2^{-n} = \frac{1}{2^n} \quad , \quad (2^{-1})^n$$

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

$$2^{-n} = (2^{-1})^n$$

$$c) \quad a^{-n} = \frac{1}{a^n} \quad , \quad (a^{-1})^n$$

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

$$(a^{-n} = (a^{-1})^n)$$

2.34)

$$a^{-6} b^{-6} = (ab)^{-6}$$

$$a^{-6} b^{-6} = \frac{1}{a^6} \cdot \frac{1}{b^6} = \frac{1}{a^6 \cdot b^6}$$

$$(ab)^{-6} = \frac{1}{(ab)^6} = \frac{1}{a^6 \cdot b^6}$$

$$a^{-6} \cdot b^{-6} = (ab)^{-6}$$

2.35)

$$a) \quad -4^{16} = (2 \cdot 2)^{16} = 2^{16} \cdot 2^{16}$$

$$= 2^{32}$$

$$(-2)^{34} = 2^{34}$$

$$16^8 = (2^4)^8 = 2^{32}$$

$$b) \quad \left(\frac{1}{8}\right)^{-11} = 8^{11} = (2^3)^{11} = 2^{33}$$

$$(2^{-4})^{-8} = 2^{32}$$

$$c) \quad \left(\frac{1}{8}\right)^{-11} = 2^{33}$$

$$4^{16} = 2^{32}$$

$$(-2)^{34} = 2^{34}$$

$$16^8 = (2^4)^8 = 2^{32}$$

$$(2^{-4})^{-8} = 2^{32}$$

2.36)

$$(x^4 y^{-2})(x^{-1} y^5)$$

$$(x^4 \cdot x^{-1})(y^{-2} \cdot y^5)$$

$$x^3 \cdot y^3 = (x \cdot y)^3$$

Exercises

2.4.1)

$$(a) 2^{(-1)^{11}} = 2^{-1} = \frac{1}{2}$$

$$(b) 3^7 \cdot 3^{-4} = 3^7 \cdot \frac{1}{3^4} = 3^3 = \boxed{27}$$

$$(c) 2^3 \div 2^{-4} = 2^3 \div \frac{1}{2^4} \\ = 2^3 \cdot 2^4 = 2^7 = \boxed{128}$$

$$(d) 1 \div 5^{-2} = 1 \div \frac{1}{5^2} \\ = 1 \cdot 5^2 = \boxed{25}$$

$$(e) (-3)^{-5} \cdot 3^3 = \frac{1}{(-3)^5} \cdot 3^3 = -\frac{1}{3^5} \cdot 3^3 \\ = -\left(3^3 \div 3^5\right) \\ = -(3^{-2}) = -\frac{1}{9}$$

$$(f) \left(\frac{1}{4}\right)^{-3} \cdot 8^{-2} = 4^3 \cdot \frac{1}{8^2} \\ = 4^3 \cdot \frac{1}{4^2 \cdot 2^2} \\ = 4 \cdot \frac{1}{2^2} = \boxed{1}$$

$$243 = 3^5$$

2.4.4)

$$3^3 + 3^3 + 3^3 = 243 \cdot 3^k$$

$$3^3(3) = 3^4$$

$$3^4 = 3^5 \cdot 3^{-1}$$

$$k = \boxed{-1}$$

2.4.2)

$$2 \div 2^{-4} = 2 \div \frac{1}{2^4} \\ = 2 \cdot 2^4 = 2^5 = \boxed{32}$$

2.4.3) $15(1)^2(-1)^{-3} + 18(-1)(1)^{-1} + 27(1)(-1)^4$

$$15 \cdot \frac{1}{(-1)^3} + 18(-1)\left(\frac{1}{1}\right) + 27(1)(1) = -15 - 18 + 27 \\ = \boxed{-6}$$

2.4.5)

$$2^{12} = (2^3)^4 = 8^4 = \left(\frac{1}{8}\right)^{-4}$$

$$2^{12} = \left(\frac{1}{8}\right)^{-4}$$

2.4.6)

$$(6a^2b)^2 \div 3a^2b^3 = 6^2 a^4 b^2 \div 3a^2 b^3$$

$$= 36 a^4 b^2 \div 3a^2 b^3$$

$$= \boxed{12 a^2 b^{-1}}$$