

Exponential Equations Not Requiring Logarithms

Solve each equation.

1) $4^{2x+3} = 1$

$(2^2)^{2x+3} = 2^0$

$2(2x+3) = 0$

$4x+6 = 0$

$4x = -6$

$x = -\frac{3}{2}$

2) $5^{3-2x} = 5^{-x}$

$3-2x = -x$

$3 = x$

3) $3^{1-2x} = 243$

$3^{1-2x} = 3^5$

$x = -2$

$1-2x = 5$

$-2x = 4$

4) $3^{2a} = 3^{-a}$

$2a = -a$

$3a = 0$

$a = 0$

5) $4^{3x-2} = 1$

$4^{3x-2} = 4^0$

$x = \frac{2}{3}$

$3x-2 = 0$

$3x = 2$

6) $4^{2p} = 4^{-2p-1}$

$2p = -2p-1$

$4p = -1$

$p = -\frac{1}{4}$

7) $6^{-2a} = 6^{2-3a}$

$-2a = 2-3a$

$a = 2$

8) $2^{2x+2} = 2^{3x}$

$2x+2 = 3x$

$2 = x$

9) $6^{3m} \cdot 6^{-m} = 6^{-2m}$

$6^{3m-m} = 6^{-2m}$

$m = 0$

$2m = -2m$

$4m = 0$

10) $\frac{2^x}{2^x} = 2^{-2x}$

$2^0 = 2^{-2x}$

$0 = -2x$

$x = 0$

11) $10^{-3x} \cdot 10^x = \frac{1}{10}$

$10^{-3x+x} = 10^{-1}$

$-3x+x = -1$

$-2x = -1$

$x = \frac{1}{2}$

12) $3^{-2x+1} \cdot 3^{-2x-3} = 3^{-x}$

$3^{-2x+1-2x-3} = 3^{-x}$

$-4x-2 = -x$

$-2 = 3x$

$-\frac{2}{3} = x$

$$13) 4^{-2x} \cdot 4^x = 64$$

$$4^{-2x+x} = 4^3$$

$$-x = 3$$

$$\boxed{x = -3}$$

$$15) 2^x \cdot \frac{1}{32} = 32$$

$$2^x \cdot 2^{-5} = 2^5$$

$$\boxed{x = 10}$$

$$2^{x-5} = 2^5$$

$$x - 5 = 5$$

$$17) 64 \cdot 16^{-3x} = 16^{3x-2}$$

$$4^3 \cdot 4^{2(-3x)} = 4^{2(3x-2)}$$

$$4^{3-6x} = 4^{6x-4}$$

$$\boxed{x = \frac{7}{12}}$$

$$3 - 6x = 6x - 4$$

$$7 = 12x$$

$$19) 81 \cdot 9^{-2b-2} = 27$$

$$3^4 \cdot 3^{2(-2b-2)} = 3^3 \quad -4b = 3$$

$$4 + 2(-2b-2) = 3$$

$$\boxed{b = -\frac{3}{4}}$$

$$4 - 4b - 4 = 3$$

$$21) \left(\frac{1}{6}\right)^{3x+2} \cdot 216^{3x} = \frac{1}{216}$$

$$(6^{-1})^{3x+2} \cdot (6^3)^{3x} = 6^{-3}$$

$$\boxed{x = -\frac{1}{6}}$$

$$-1(3x+2) + 9x = -3$$

$$-3x - 2 + 9x = -3$$

$$6x = -1$$

$$23) 16^r \cdot 64^{3-3r} = 64$$

$$(4^2)^r \cdot (4^3)^{3-3r} = 4^3$$

$$2r + 3(3-3r) = 3$$

$$2r + 9 - 9r = 3$$

$$-7r = -6$$

$$\boxed{r = \frac{6}{7}}$$

$$14) 6^{-2x} \cdot 6^{-x} = \frac{1}{216}$$

$$6^{-2x-x} = 6^{-3}$$

$$-3x = -3$$

$$\boxed{x = 1}$$

$$16) 2^{-3p} \cdot 2^{2p} = 2^{2p}$$

$$2^{-3p+2p} = 2^{2p}$$

$$-p = 2p$$

$$0 = 3p$$

$$\boxed{p = 0}$$

$$18) \frac{81^{3n+2}}{243^{-n}} = 3^4$$

$$\frac{3^{4(3n+2)}}{3^{5(-n)}} = 3^4$$

$$\frac{4(3n+2) - 5(-n)}{3} = 3^4$$

$$4(3n+2) - 5(-n) = 4$$

$$12n + 8 + 5n = 4$$

$$17n = -4$$

$$\boxed{n = -\frac{4}{17}}$$

$$20) 9^{-3x} \cdot 9^x = 27$$

$$9^{-3x+x} = 3^3$$

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

$$-4x = 3$$

$$\boxed{x = -\frac{3}{4}}$$

$$22) 243^{k+2} \cdot 9^{2k-1} = 9$$

$$(3^5)^{k+2} \cdot (3^2)^{2k-1} = 3^2$$

$$5(k+2) + 2(2k-1) = 2$$

$$5x + 10 + 4x - 2 = 2$$

$$9k + 8 = 2$$

$$9k = -6$$

$$\boxed{x = -\frac{2}{3}}$$

$$24) 16^{2p-3} \cdot 4^{-2p} = 2^4$$

$$(2^4)^{2p-3} \cdot (2^2)^{-2p} = 2^4$$

$$4(2p-3) + 2(-2p) = 4$$

$$8p - 12 - 4p = 4$$

$$4p = 16$$

$$\boxed{p = 4}$$