

# Know your Powers!

$2^0 = 1$	$3^0 = 1$	$4^0 = 1$	$5^0 = 1$
$2^1 = 2$	$3^1 = 3$	$4^1 = 4$	$5^1 = 5$
$2^2 = 4$	$3^2 = 9$	$4^2 = 16$	$5^2 = 25$
$2^3 = 8$	$3^3 = 27$	$4^3 = 64$	$5^3 = 125$
$2^4 = 16$	$3^4 = 81$	$4^4 = 256$	$5^4 = 625$
$2^5 = 32$	$3^5 = 243$	$4^5 = 1024$	
$2^6 = 64$	$3^6 = 729$		
$2^7 = 128$	$3^7 = 2187$		

$$2^x = 32$$

$$* \frac{\log 32}{\log 2} = 5$$

$$\cancel{2^x} = \cancel{2}^5$$

$$\boxed{x=5}$$

Remember:

$$a^6 \times a^4 = a^{6+4} = a^{10}$$

$$\frac{a^6}{a^4} = a^{6-4} = a^2$$

$$(a^6)^4 = a^{24}$$

$$\textcircled{1} \quad 7^x + 11 = 60 \quad -11$$

$$7^x = 49$$

$$7^x = 7^2$$

$$x = 2$$

$$\textcircled{2} \quad \frac{15 \cdot 3^{2x-3}}{15} = \frac{5}{15}$$

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

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

$$2x - 3 = -1 \quad +3$$

$$2x = 2$$

$$x = 1$$

$$\textcircled{3} \quad \frac{48}{6} = \frac{6(2)^{x-1}}{6}$$

$$8 = 2^{x-1}$$

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

$$3 = x - 1$$

$$4 = x$$

$$\textcircled{4} \quad \frac{27^x}{9^{2x-1}} = 3^{x+4}$$

$$\frac{(3^3)^x}{(3^2)^{2x-1}} = 3^{x+4}$$

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

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

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

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

$$-x + 2 = x + 4$$

$$-2x = 2$$

$$x = -1$$

ANSWERS → Exercise 5.

1.  $2^{2x+5} = 2^{x-6}$  Since the bases are the same, the exponents must be the same!  
 $2x+5 = x-6$   
 $x = -11$

2.  $2^{3x} = 8$   
 $2^{3x} = 2^3$   
 $\frac{3x}{3} = \frac{3}{3}$   
 $x = 1$

3.  $2^{2x-5} = (32)(2^{x+2})$   
 $2^{2x-5} = (2^5)(2^{x+2})$   
 $2^{2x-5} = 2^{5+x+2}$   
 $2^{2x-5} = 2^{x+7}$   
 $2x-5 = x+7$   
 $x = 12$

$$4. \begin{aligned} 5^{-x-4} &= 125^{2x} \\ 5^{-x-4} &= (5^3)^{2x} \\ 5^{-x-4} &= 5^{6x} \end{aligned}$$

$$\begin{aligned} -x-4 &= 6x \\ -4 &= \frac{7x}{7} \\ \frac{-4}{7} &= x \end{aligned}$$

$$5. \begin{aligned} (16)(2^{x-4}) &= (64)(2^{3x+4}) \\ (2^4)(2^{x-4}) &= (2^6)(2^{3x+4}) \\ 2^{4+x-4} &= 2^{6+3x+4} \end{aligned}$$

$$\begin{aligned} 2^x &= 2^{3x+10} \\ x &= 3x+10 \\ -2x &= 10 \\ \frac{-2x}{-2} &= \frac{10}{-2} \\ x &= -5 \end{aligned}$$

$$6. \quad 27^{x-5} = 9^{2x+5}$$

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

$$3^{3x-15} = 3^{4x+10}$$

$$3x-15 = 4x+10$$

$$-25 = x$$

$$7. \quad 4^x = 1$$

$$4^x = 4^0$$

$$x = 0$$

$$8. \left(\frac{1}{4}\right)^{x+3} = 2^{-3x+5}$$

$$\left(\frac{1}{2^2}\right)^{x+3} = 2^{-3x+5}$$

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

$$2^{-2x-6} = 2^{-3x+5}$$

$$-2x-6 = -3x+5$$

$$x = 11$$

$$9. \left(\frac{1}{125}\right)^{3x-9} = \left(\frac{1}{5}\right)^{5x-8}$$

$$\left(\frac{1}{5^3}\right)^{3x-9} = \left(\frac{1}{5}\right)^{5x-8}$$

$$(5^{-3})^{3x-9} = (5^{-1})^{5x-8}$$

$$5^{-9x+27} = 5^{-5x+8}$$

$$-9x+27 = -5x+8$$

$$\frac{19}{4} = \frac{4x}{4}$$

$$\frac{19}{4} = x$$

$$10. \frac{1}{32} \cdot \left(\frac{1}{16}\right)^{x+6} = 2^{-7} \cdot \left(\frac{1}{2}\right)^{5x+2}$$

$$\frac{1}{2^5} \cdot \left(\frac{1}{2^4}\right)^{x+6} = 2^{-7} \cdot (2^{-1})^{5x+2}$$

$$(2^{-5})(2^{-4})^{x+6} = (2^{-7})(2^{-5x-2})$$

$$(2^{-5})(2^{-4x-24}) = 2^{-7+(-5x-2)}$$

$$2^{-5+(-4x-24)} = 2^{-7-5x-2}$$

$$2^{-5-4x-24} = 2^{-9-5x}$$

$$2^{-29-4x} = 2^{-9-5x}$$

$$-29-4x = -9-5x$$

$$x = 20$$

$$11. 7^x + 11 = 60$$

$$7^x = 49$$

$$7^x = 7^2$$

$$x = 2$$

$$12. 15 \cdot 3^{2x-3} = 5$$

$$3^{2x-3} = \frac{5}{15}$$

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

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

$$2x - 3 = -1$$

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

$$x = 1$$

$$13. 48 = 6(2)^{x-1}$$

$$\frac{48}{6} = (2)^{x-1}$$

$$8 = (2)^{x-1}$$

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

$$3 = x - 1$$

$$4 = x$$



$$14. \quad 8(2)^{x+3} = 128$$

$$(2)^{x+3} = \frac{128}{8}$$

$$8$$

$$(2)^{x+3} = 16$$

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

$$x+3 = 4$$

$$x = 1$$

$$15. \frac{27^x}{9^{2x-1}} = 3^{x+4}$$

$$\frac{(3^3)^x}{(3^2)^{2x-1}} = 3^{x+4}$$

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

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

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

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

$$-x+2 = x+4 \rightarrow -1 = x$$

$$-2 = 2x$$

$$16. 8^{1/4} \cdot \left(\frac{1}{4}\right)^{x/2} = 16^{3/4}$$

$$(2^3)^{1/4} \cdot \left(\frac{1}{2^2}\right)^{x/2} = (2^4)^{3/4}$$

$$2^{3/4} \cdot (2^{-2})^{x/2} = 2^{12/4}$$

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

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

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

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

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

$$\frac{3}{4} - \frac{12}{4} = x$$

$$-\frac{9}{4} = x$$

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$$17. \frac{(9^{2x-1}) \cdot (3^{3x})^2}{(27^{x+2})^4} = 1$$

$$\frac{[(3^2)^{2x-1}](3^{6x})}{[(3^3)^{x+2}]^4} = 3^0$$

$$\frac{(3^{4x-2})(3^{6x})}{(3^{3x+6})^4} = 3^0$$

$$\frac{3^{4x-2+6x}}{3^{12x+24}} = 3^0$$

$$\frac{3^{10x-2}}{3^{12x+24}} = 3^0$$

$$3^{10x-2-(12x+24)} = 3^0$$

$$3^{10x-2-12x-24} = 3^0$$

$$3^{-2x-26} = 3^0$$

$$-2x - 26 = 0$$

$$\frac{-2x}{-2} = \frac{26}{-2}$$

$$x = -13.$$