

Applying Exponent Rules to Solve Equations

Solve for any variables.

1. $3^{3x} = 3^{x+1} \cdot 3^{x+2}$

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

$$3x = 2x + 3$$

$$\begin{array}{r} -2x \quad -2x \\ \hline \end{array}$$

$$\boxed{x = 3}$$

2. $\frac{4^{5h}}{4^{2h+2}} = 4^2$

$$5h - (2h + 2) = 2$$

$$4 \quad 3h - 2 = 4^2$$

$$3h - 2 = 2$$

$$\begin{array}{r} +2 \quad +2 \\ \hline \end{array}$$

$$3h = 4$$

$$\boxed{h = \frac{4}{3}}$$

3. $5^{2w} \cdot 5^5 = (5^w)^3$

$$5^{2w+5} = 5^{3w}$$

$$2w + 5 = 3w$$

$$\begin{array}{r} -2w \quad -2w \\ \hline \end{array}$$

$$\boxed{5 = w}$$

4. $7^{5x-8} \cdot 7^{x+8} = (7^{x-10})^2$

$$7^{6x+0} = 7^{2x-20}$$

$$6x = 2x - 20$$

$$\begin{array}{r} -2x \quad -2x \\ \hline \end{array}$$

$$4x = -20$$

$$\boxed{x = -5}$$

5. $10^{10g-12} \cdot 10^{10-6g} = \frac{10^{8g+12}}{10^{5g}}$

$$10^{4g-2} = 10^{3g+12}$$

$$4g - 2 = 3g + 12$$

$$\begin{array}{r} -3g \quad -3g \\ \hline \end{array}$$

$$g - 2 = 12$$

$$\begin{array}{r} +2 \quad +2 \\ \hline \end{array}$$

$$\boxed{g = 14}$$

6. $2^{7n+6} \cdot 2^{-4n-7} = (2^{-3})^n$

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

$$3n - 1 = -3n$$

$$\begin{array}{r} -3n \quad -3n \\ \hline \end{array}$$

$$\frac{-1}{-6} = \frac{-6n}{-6}$$

$$\boxed{\frac{1}{6} = n}$$

7. $\left(\frac{13^{10m-5}}{13^{2m+3}}\right)^2 = 13^{3m+2} \cdot 13^{11m+5}$

$$(13^{8m-2})^2 = 13^{14m+7}$$

$$13^{16m-4} = 13^{14m+7}$$

$$16m - 4 = 14m + 7$$

$$\begin{array}{r} -14m \quad -14m \\ \hline \end{array}$$

$$2m - 4 = 7$$

$$\begin{array}{r} +4 \quad +4 \\ \hline \end{array}$$

$$2m = 11$$

$$\boxed{m = \frac{11}{2}}$$

8. $\frac{6^{7p}}{6^{32}} = 6^{10}$

$$6^{7p-32} = 6^{10}$$

$$7p - 32 = 10$$

$$\begin{array}{r} +32 \quad +32 \\ \hline \end{array}$$

$$\frac{7p}{7} = \frac{42}{7}$$

$$\boxed{p = 6}$$

$$9. (8^{4+2k})^2 \cdot 8^{10} = 8^k$$

$$8^{8+4k} \cdot 8^{10} = 8^k$$

$$8^{18+4k} = 8^k$$

$$18+4k = k$$

$$\begin{array}{r} 18+4k = k \\ -4k \quad -4k \\ \hline 18 = -3k \\ -3 \quad -3 \end{array}$$

$$\boxed{-6 = k}$$

$$11. \left(\frac{14^{6b+5}}{14^{2b+4}}\right)^9 = (14^{8b+1} \cdot 14^{b+2})^2$$

$$(14^{4b+1})^9 = (14^{9b+3})^2$$

$$14^{36b+9} = 14^{18b+6}$$

$$36b+9 = 18b+6$$

$$\begin{array}{r} 36b+9 = 18b+6 \\ -18b \quad -18b \\ \hline 18b+9 = 6 \\ -9 \quad -9 \end{array}$$

$$\frac{18b}{18} = \frac{-3}{18}$$

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

$$13. (15^f \cdot 15^2)^5 = 15^{4f+1} \cdot 15^{5-6f}$$

$$(15^{f+2})^5 = 15^{-2f+6}$$

$$15^{5f+10} = 15^{-2f+6}$$

$$5f+10 = -2f+6$$

$$\begin{array}{r} 5f+10 = -2f+6 \\ +2f \quad +2f \\ \hline 7f+10 = 6 \\ -10 \quad -10 \end{array}$$

$$7f = -4$$

$$\frac{7f}{7} = \frac{-4}{7}$$

$$\boxed{f = -\frac{4}{7}}$$

$$10. \frac{9^{2m}}{9^{16}} = (9^{m+1} \cdot 9^{m+3})^3$$

$$9^{2m-16} = (9^{2m+4})^3$$

$$9^{2m-16} = 9^{6m+12}$$

$$2m-16 = 6m+12$$

$$\begin{array}{r} 2m-16 = 6m+12 \\ -2m \quad -2m \\ \hline -16 = 4m+12 \\ -12 \quad -12 \\ \hline -28 = 4m \\ \frac{-28}{4} = \frac{4m}{4} \end{array}$$

$$\boxed{m = -7}$$

$$12. 20^{2y-41} \cdot 20^1 = \frac{20^{45}}{20^{3y}}$$

$$20^{2y-40} = 20^{45-3y}$$

$$2y-40 = 45-3y$$

$$\begin{array}{r} 2y-40 = 45-3y \\ +3y \quad +3y \\ \hline 5y-40 = 45 \\ +40 \quad +40 \end{array}$$

$$5y-40 = 45$$

$$\frac{5y}{5} = \frac{85}{5}$$

$$\boxed{y = 17}$$

$$14. 2^{3k+2} \cdot 2^{2k-10} = \frac{2^{2k+12}}{2^{2k}}$$

$$2^{5k-8} = 2^{3k+12}$$

$$5k-8 = 3k+12$$

$$\begin{array}{r} 5k-8 = 3k+12 \\ -3k \quad -3k \\ \hline 2k-8 = 12 \\ +8 \quad +8 \end{array}$$

$$2k-8 = 12$$

$$2k = 20$$

$$\boxed{k = 10}$$

$$2k+12 = (-k)$$