

SOLVING EXPONENTIAL EQUATIONS

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

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

$$a^n \cdot a^m = a^{n+m}$$

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

$$(a^x)^y = a^{x \cdot y}$$

BASE → exponent ↓	2	3	4	5	6
0	1	1	1	1	1
1	2	3	4	5	6
2	4	9	16	25	36
3	8	27	64	125	216
4	16	81	256	625	1296
5	32	243	1024	3125	7776
6	64	729	4096	15625	46,656

Practice changing bases

① 64^{3-x}

$$(8^2)^{3-x}$$

OR $(4^3)^{3-x}$

$$8^{6-2x}$$

OR 4^{9-3x}

② 81^{3x+1}

$$(9^2)^{3x+1}$$

OR 4

$$(3^4)^{3x+1} = 9^{6x+2} = 3^{12x+4}$$

$$\textcircled{3} \left(\frac{1}{625}\right)^{2x} = \left(\frac{1}{5^4}\right)^{2x} = \left(5^{-4}\right)^{2x} \quad \text{mult.}$$

$$= 5^{-8x}$$

$$\textcircled{4} \left(\frac{1}{243}\right)^{x-4} = \left(\frac{1}{3^5}\right)^{x-4} = \left(3^{-5}\right)^{x-4}$$

$$\boxed{3^{-5x+20}}$$

Solve (by making the bases the same.)

$$\textcircled{1} 5^{x-1} = 5^{6x+9}$$

→ already have like bases

→ set exponents =

$$\begin{array}{r} x-1 = 6x+9 \\ +1 \quad \quad +1 \end{array}$$

$$\begin{array}{r} 1x = 6x+10 \\ -6x \quad -6x \end{array}$$

$$\begin{array}{r} -5x = 10 \\ -5 \quad \quad -5 \end{array}$$

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

$$\textcircled{2} 3^{4x-1} = 27^{4x-3}$$

$$3^{4x-1} = (3^3)^{4x-3}$$

$$3^{4x-1} = 3^{12x-9}$$

$$\begin{array}{r} 4x-1 = 12x-9 \\ +1 \quad \quad +1 \end{array}$$

$$\begin{array}{r} 4x = 12x-8 \\ -12x \quad -12x \end{array}$$

$$\begin{array}{r} -8x = -8 \\ -8 \quad \quad -8 \end{array}$$

$$\boxed{x = 1}$$

$$\textcircled{3} 6^{x+1} = 36^{x-1}$$

$$(3) \quad 6^{x+1} = 36^{x-1}$$

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

$$6^{x+1} = 6^{2x-2}$$

$$\begin{array}{r} x+1 = 2x-2 \\ +2 \qquad +2 \end{array}$$

$$\begin{array}{r} x+3 = 2x \\ -x \qquad -x \end{array}$$

$$\boxed{3 = x}$$

$$(5) \quad 216^{1-3x} = 36^1$$

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

$$6^{3-9x} = 6^2$$

$$\begin{array}{r} 3-9x = 2 \\ -3 \qquad -3 \end{array}$$

$$\begin{array}{r} -9x = -1 \\ -9 \qquad -9 \end{array}$$

$$\boxed{x = \frac{1}{9}}$$

$$(4) \quad 125^{x+3} = \left(\frac{1}{25}\right)^{3x-6}$$

$$(5^3)^{x+3} = \left(\frac{1}{5^2}\right)^{3x-6}$$

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

$$5^{3x+9} = 5^{-6x+12}$$

$$3x+9 = -6x+12$$

$$\begin{array}{r} +6x \qquad +6x \end{array}$$

$$\begin{array}{r} 9x+9 = 12 \\ -9 \qquad -9 \end{array}$$

$$\begin{array}{r} 9x = 3 \\ \frac{9}{9} \qquad \frac{3}{9} \end{array}$$

$$\boxed{x = \frac{1}{3}}$$