

6.6. Log and Exp Equations

Like bases

$$7^{\boxed{-9v-8}} = 7^{\boxed{-v}}$$

$$-9v - 8 = -v$$

$$-9v = -v + 8$$

$$-9v + v = 8; \quad -8v = 8; \quad \boxed{v = -1}$$

Key: to solve an exp equation with the same bases, we equate the exponent.

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E.g. 2

$$g^{-3n} \cdot \frac{1}{81} = g^{n+2}$$

$$g^{-3n} \cdot g^{-2} = g^{n+2}$$

$$\boxed{g}^{\boxed{-3n-2}} = \boxed{g}^{\boxed{n+2}}$$

$$\begin{aligned} -3n - 2 &= n + 2 \\ -3n - n &= 2 + 2 \\ -4n &= 4 \\ \boxed{n = -1} \end{aligned}$$

E.g. 3

$$2^{5x-7} = 8, \text{ Solve for } x.$$

$$\boxed{2}^{\boxed{5x-7}} = \boxed{2}^{\boxed{3}}; \quad 5x - 7 = 3; \quad 5x = 10; \quad \boxed{x = 2}.$$

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E.g. We need to take $\ln$.

$$\frac{g e^{gt}}{g} = \frac{100}{g}$$

$$\boxed{e}^{\boxed{gt}} = \frac{100}{g}$$

Take the $\ln$ of both sides

$$\ln(e^{gt}) = \ln\left(\frac{100}{g}\right)$$

$$\frac{gt}{g} = \frac{\ln\left(\frac{100}{g}\right)}{g} \rightarrow \boxed{t = \frac{\ln\left(\frac{100}{g}\right)}{g}}$$

$$\approx 0.2675495$$

Important Property:

$$\ln(e^x) = x$$

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E.g.

$$8e^{8-8x} + 7 = -33. \text{ Solve for } x$$

$$8e^{8-8x} = -33 - 7$$

$$\frac{8e^{8-8x}}{8} = \frac{-40}{8}$$

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

$$\ln(e^{8-8x}) = \ln(-5) \rightarrow \text{undefined.}$$

$$8 - 8x = \boxed{\ln(-5)}$$

NO SOLUTION

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E.g.

$$8^{x+1} = 7^{8x-1}$$

Take $\ln$ of both sides

$$\ln(8^{x+1}) = \ln(7^{8x-1})$$

$$(x+1) \ln(8) = (8x-1) \ln(7) \quad (\text{Power Rule})$$

$$(\ln 8)x + \ln 8 = (8 \ln 7)x - \ln 7$$

$$(\ln 8)x - (8 \ln 7)x = -\ln 7 - \ln 8$$

$$\frac{(\ln 8 - 8 \ln 7)x}{\ln 8 - 8 \ln 7} = \frac{-\ln 7 - \ln 8}{\ln 8 - 8 \ln 7} \approx 0.29844.$$

Key Property (Power Rule)

$$\ln(M^p) = p \ln(M)$$

Log Equations

$$\text{E.g. } \frac{-9 \cdot \log_7(x)}{-9} = \frac{18}{-9}$$

$$\log_7(x) = -2$$

$$x = 7^{-2} = \frac{1}{7^2} = \frac{1}{49}$$

$$\boxed{x = \frac{1}{49}}$$

$$\text{E.g. } 10 - 4 \ln(7-3x) = 6$$

$$-4 \ln(7-3x) = 6 - 10 = -4$$

$$\frac{-4 \ln(7-3x)}{-4} = \frac{-4}{-4}$$

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