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24.1/24.2 Solving Exponential Equations

Method 1: Without logs

Isolate the exponent, then write both sides in terms of the same base.

★ Doesn't always work! ★

Ex #1 $\frac{6(4^x)}{6} = \frac{96}{6}$

$4^x = 16$

$4^x = 4^2$

$\boxed{x = 2}$

Ex #2 $3^x - 1 = 80$

$+1 \quad +1$

$3^x = 81$

$3^x = 3^4$

$\boxed{x = 4}$

Ex #3 $5^{4x} = 125^{x-1}$

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

$5^{4x} = 5^{3x-3}$

$4x = 3x - 3$

$-3x \quad -3x$

$\boxed{x = -3}$

Ex #4 $6^{3x-4} = 36^{x+1}$

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

$6^{3x-4} = 6^{2x+2}$

$3x - 4 = 2x + 2$

$-2x \quad -2x$

$x - 4 = 2$

$+4 \quad +4$

$\boxed{x = 6}$

Ex #5 $2^x = \frac{1}{32}$

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

$\boxed{x = -5}$

Ex #6 $(\frac{1}{7})^x = \frac{1}{49}$

$(\frac{1}{7})^x = (\frac{1}{7})^2$

$\boxed{x = 2}$

Method 2: with logs

Isolate the exponent, then take log of both sides. ★Always works★

Ex #7 $3^x = 32$

$\log_3 3^x = \log_3 32$

$\boxed{x = \log_3 32}$ ← exact answer

in calculator put $\log(32)/\log(3)$

$\boxed{x \approx 3.155}$ ← approximate/rounded answer

Ex #8 $5^x = 610$

$\log_5 5^x = \log_5 610$

$x = \log_5 610$

$x \approx 3.985$

Ex #9 $e^x = 91$

$\ln e^x = \ln 91$

$x = \ln 91$

$x \approx 4.511$

Ex #10 $4^{x-2} = 35.6$

$\log_4 4^{x-2} = \log_4 35.6$

$x - 2 = \log_4 35.6$

$+2 \quad +2$

$x = \log_4(35.6) + 2$

$x \approx 4.577$

Ex #11 $4.2^{x+4} + 0.8 = 5.7$

$-0.8 \quad -0.8$

$4.2^{x+4} = 4.9$

$\log_{4.2} 4.2^{x+4} = \log_{4.2} 4.9$

$x + 4 = \log_{4.2} 4.9$

$-4 \quad -4$

$x = \log_{4.2}(4.9) - 4$

$x \approx -2.893$

Ex #12 $e^{2x-4} = 148$

$\ln e^{2x-4} = \ln 148$

$2x - 4 = \ln 148$

$+4 \quad +4$

$\frac{2x}{2} = \frac{\ln(148) + 4}{2}$

$x = \frac{\ln(148) + 4}{2}$

$x \approx 4.499$

$(\ln(148)+4)/2$

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