More Exponential Equations

Instructions: *Use logarithms to simplify each equation, then solve.*

MILD: *Mixed bases, low algebra load; some resolve quickly, some expose impossibility.*

1. $2^{x-2} = 3^0$

2. $3^{x+1} = 2^0$

3. $5^x = 1$

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

5. $\sqrt{9}^{\,x} = 2^3$

MEDIUM: *Bases cannot match directly; rewriting helps but does not "solve" everything.*

6. $2^{x-1} = 3^2$

7. $3^{x+2} = 5^1$

8. $5^x = 25 \cdot 3^0$

9. $\left(\frac{1}{8}\right)^x = 3^2$

10. $\sqrt{27}^{\,x} = 2^{x+1}$

SPICY: *Variables entangled in exponents on incompatible bases.*

11. $2^{x-2} = 3^{x-1}$

12. $3^{x+1} = 5^{x-2}$

13. $\left(\frac{1}{4}\right)^x = 2^{1-x} \cdot 3^0$

14. $9^x = 3^x \cdot 2^x$

15. $\sqrt{125}^{\,x} = 3^{2x-1}$

EXTRA SPICY: *Structural reasoning required; several equations have no solution.*

16. $2^x = 3^x$

17. $5^{x+1} = 3^{x-1}$

18. $\left(\frac{2}{3}\right)^x = 1$

19. $2^{2x-1} = 3^x \cdot 2^x$

20. $\sqrt{27}^{\,2x-1} = 2^{x+1}$

CHALLENGE

21. $\sqrt[3]{\frac{27^{2x-1}}{3^{x+1}}} = 9$

22. $\left(\frac{125}{216}\right)^{-\frac{x}{4}} = \left(\frac{6}{5}\right)^{3x-3}$

23. $3^{(2x+1)} = \left(\frac{1}{5}\right)^{(x-3)}$