

F Michaelmas Equating Powers

Whenever you see 4 you should think 2^2 .

Whenever you see 8 you should think 2^3 .

Whenever you see 27 you should think 3^3 .

Whenever you see 64 you should think 4^3 or 8^2 or 2^6 .

Etcetera...

All of these problems reduce to

$$k^{\text{fish}} = k^{\text{dog}} \quad \Rightarrow \quad \text{fish} = \text{dog}.$$

Questions

1. Solve $2^{x+1} = 4^x$. $x = 1$
 2. Solve $8^{3x} = 2^{x-2}$. $x = -\frac{1}{4}$
 3. Solve $3^{2x-1} = 9^{4x}$. $x = -\frac{1}{6}$
 4. Solve $27^{3-x} = 81^{2x}$. $x = \frac{9}{11}$
 5. Solve $2 \times 2^{2x+1} = 8^{x-1}$. $x = 5$
 6. Solve $8 \times 2^{x-1} = 4^{2x-1}$. $x = \frac{4}{3}$
 7. Solve $16 \times 8^{2x+1} = 2 \times 16^x$. $x = -3$
 8. Solve $32^x = \frac{8^x}{2^{x+1}}$. $x = -\frac{1}{3}$
 9. Solve $\frac{2^{x+1}}{4} = \frac{4^{x+3}}{8^x}$. $x = \frac{7}{2}$
 10. Solve $\frac{9^x}{27^{x+1}} = \frac{3^x}{81^{1-x}}$. $x = \frac{1}{6}$
 11. Solve $\frac{5^{-2x+1}}{25^{3-x}} = \frac{125^x}{5^{x-4}}$. $x = -\frac{9}{2}$
 12. Solve $8 \times \frac{2^{2-x}}{4^{3-2x}} = \frac{8^x}{4^{2+x}}$. $x = -\frac{3}{2}$
 13. Solve $1 = 8^2 \times 4^{x-1} \times 2^{x+1}$. \square
 14. Solve $\frac{7^x}{49^{6-x}} = \frac{343^{1-x}}{7^{2x-3}}$. $\frac{9}{4}$
 15. Solve $8^{ax} = 4^{bx+1}$. $x = \frac{2}{3a-2b}$
 16. Solve $27^{ax+b} = 3^{cx-a}$. $x = \frac{a+3b}{c-3a}$
 17. Solve $9^{ax} \times 27^x \times 3^{ax} = 1$. \square
 18. Solve $\frac{5^{ax-2}}{25^{b-x}} = 125^{cx+d}$. $x = \frac{3d+2+2b}{a+2-3c}$
 19. Solve $\frac{2^{ax}}{2^{3-bx}} = \frac{4^{4+cx}}{8^{k-x}}$. $x = \frac{8-3k+3}{a+b-2c-3}$
- Only do the following if you've studied solving quadratics by factorisation.
20. Solve $4^{x+2} = 2^{x^2+5}$. $x = 1$ (repeated)
 21. Solve $3^{x^2+2} = 27^x$. $x = 1$ or $x = 2$
 22. Solve $5^{2x^2} = 25^{2x+3}$. $x = 3$ or $x = -1$
 23. Solve $(x^2 + 5x + 5)^{x^2+11x+30} = 1$.