

## 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...

Also, pro tip; when you see 1 you should think  $2^0$  or  $3^0$  or  $5^0$  or ...

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  $5^x \times 25^3 = 5^{2x-1}$ .  $x = 7$
  7. Solve  $4^x \times 8^{x-1} = 2 \times 4^{3x+1}$ .  $x = -6$
  8. Solve  $8 \times 2^{x-1} = 4^{2x-1}$ .  $x = \frac{4}{3}$
  9. Solve  $16 \times 8^{2x+1} = 2 \times 16^x$ .  $x = -3$
  10. Solve  $32^x = \frac{8^x}{2^{x+1}}$ .  $x = -\frac{1}{3}$
  11. Solve  $\frac{2^{x+1}}{4} = \frac{4^{x+3}}{8^x}$ .  $x = \frac{7}{2}$
  12. Solve  $\frac{9^x}{27^{x+1}} = \frac{3^x}{81^{1-x}}$ .  $x = \frac{1}{6}$
  13. Solve  $\frac{5^{-2x+1}}{25^{3-x}} = \frac{125^x}{5^{x-4}}$ .  $x = -\frac{9}{2}$
  14. Solve  $8 \times \frac{2^{2-x}}{4^{3-2x}} = \frac{8^x}{4^{2+x}}$ .  $x = -\frac{3}{2}$
  15. Solve  $1 = 8^2 \times 4^{x-1} \times 2^{x+1}$ .  $x = -\frac{5}{3}$
  16. Solve  $\frac{7^x}{49^{6-x}} = \frac{343^{1-x}}{7^{2x-3}}$ .  $\frac{9}{4}$
  17. Solve  $8^{ax} = 4^{bx+1}$ .  $x = \frac{2}{3a-2b}$
  18. Solve  $27^{ax+b} = 3^{cx-a}$ .  $x = \frac{a+3b}{c-3a}$
  19. Solve  $9^{ax} \times 27^x \times 3^{ax} = 1$ .  $x = 0$
  20. Solve  $\frac{5^{ax-2}}{25^{b-x}} = 125^{cx+d}$ .  $x = \frac{3d+2+2b}{a+2-3c}$
  21. Solve  $\frac{2^{ax}}{2^{3-bx}} = \frac{4^{4+cx}}{8^{k-x}}$ .  $x = \frac{11-3k}{a+b-2c-3}$
- Only do the following if you've studied solving quadratics by factorisation.
22. Solve  $4^{x+2} = 2^{x^2+5}$ .  $x = 1$  (repeated)
  23. Solve  $3^{x^2+2} = 27^x$ .  $x = 1$  or  $x = 2$
  24. Solve  $5^{2x^2} = 25^{2x+3}$ .  $x = 3$  or  $x = -1$
  25. Solve  $(x^2 + 5x + 5)^{x^2+11x+30} = 1$ .