

Algebra 2 · Solving Exponential and Logarithmic Equations · Worksheet

Common Core F-LE.A.4, A-SSE.B.3c · mathovore.fr

Name: _____ Date: ____/____/____ Score: _____

These problems practice solving exponential equations with a common base or with logarithms, solving logarithmic equations, and checking for extraneous solutions. The last problems apply the methods to interest, population, half-life, earthquakes and pH.

Problems run from easy to hard and match Common Core standards F-LE.A.4 and A-SSE.B.3c at the Algebra 2 level. Round only at the final step.

Algebra 2 Common Core: F-LE.A.4 · A-SSE.B.3c

Problem 1: Same base

Solve each equation.

- a. $2^x = 32$
- b. $3^x = 81$
- c. $5^x = \frac{1}{125}$
- d. $4^x = 8$

Problem 2: Rewrite to a common base

Solve each equation by writing both sides with the same base.

- a. $2^{3x-1} = 64$
- b. $9^x = 27^{x-1}$
- c. $\left(\frac{1}{4}\right)^{x+1} = 16$
- d. $8^x = \frac{1}{32}$

Problem 3: Logarithmic to exponential form

Solve each equation by rewriting it in exponential form.

- a. $\log_6 x = 2$
- b. $\log_2 x = -4$
- c. $\log_4 x = \frac{3}{2}$

d. $\ln x = 3$ (give a decimal to three places)

Problem 4: One-step exponential equations

Solve each equation. Round to four decimal places.

a. $3^x = 20$

b. $2^x = 100$

c. $10^x = 45$

d. $e^x = 12$

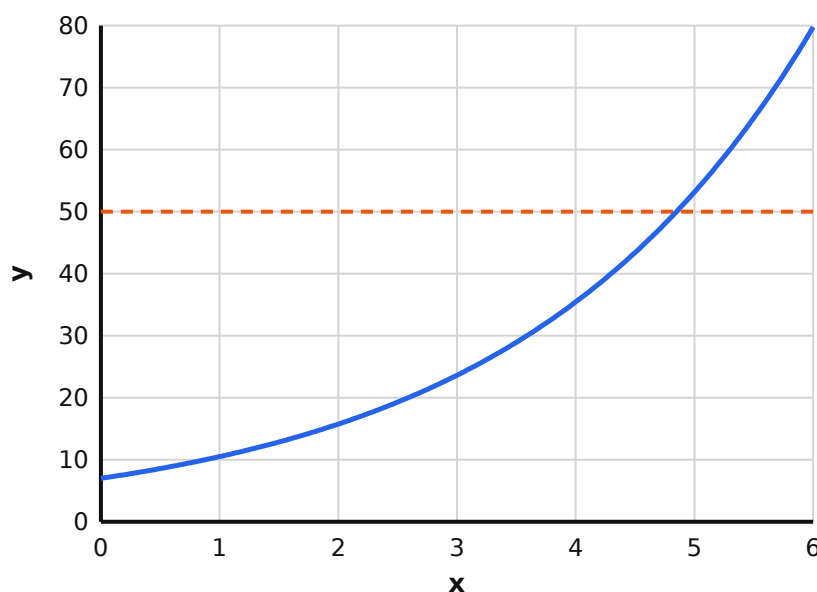
Problem 5: Isolate the power first

Solve each equation. Give exact answers when possible and decimals to three places otherwise.

a. $4 \cdot 5^x = 100$

b. $3 \cdot 2^x + 5 = 53$

c. $7(1.5)^x = 50$ (the graph of $y = 7(1.5)^x$ and the line $y = 50$ is shown)



The curve $y = 7(1.5)^x$ and the line $y = 50$.

Problem 6: Exponents with a coefficient

Solve each equation. Round to three decimal places.

a. $2^{3x} = 50$

b. $5^{2x-1} = 40$

Problem 7: Equations with base e

Solve each equation. Round to four decimal places.

- a. $3e^{2x} = 45$
- b. $5e^{0.3x} - 2 = 18$

Problem 8: Solve a formula for time

Solve each formula for t . Then find t when $P = 2000$, $A = 3500$ and $r = 0.05$, to two decimal places.

- a. $A = Pe^{rt}$
- b. $A = P(1+r)^t$

Problem 9: Simple logarithmic equations

Solve each equation.

- a. $\log_2(x+5) = 4$
- b. $\log_3(2x-1) = 2$
- c. $\log(x-4) = 1$
- d. $\ln(3x) = 2$ (decimal to three places)

Problem 10: Isolate the logarithm

Solve each equation.

- a. $3\log_2 x - 4 = 8$
- b. $2\ln(x+1) = 6$ (decimal to three places)
- c. $4\log_5(x-2) + 3 = 11$

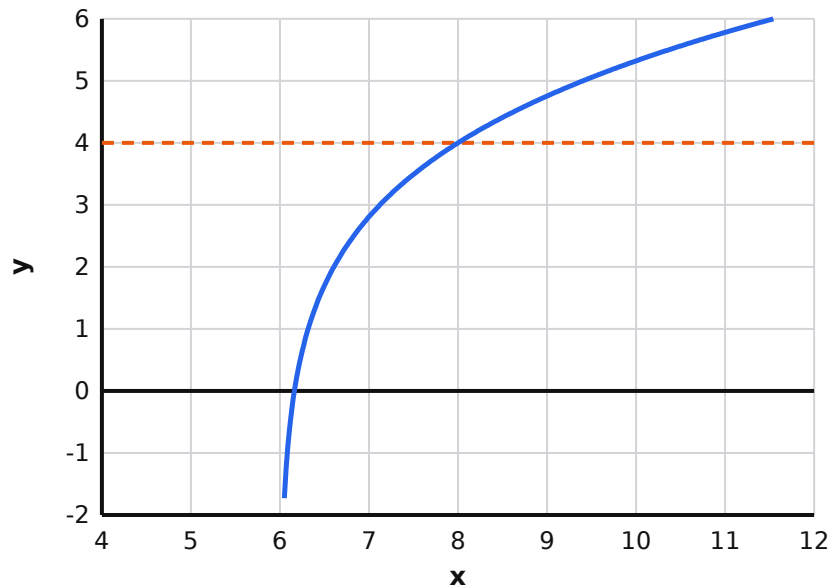
Problem 11: Equal logarithms

Solve each equation. Check every answer in the original equation.

- a. $\log_5(3x+1) = \log_5(x+9)$
- b. $\ln(2x-3) = \ln(x+5)$
- c. $\log_2(x^2) = \log_2(5x-6)$

Problem 12: Add two logarithms

Solve each equation. The graph of $y = \log_2 x + \log_2(x-6)$ is shown for part (a).



Part (a): the curve and the line $y = 4$.

a. $\log_2 x + \log_2(x-6) = 4$

b. $\log_3 x + \log_3(x+6) = 3$

Problem 13: Subtract two logarithms

Solve each equation.

a. $\log_3(x+8) - \log_3 x = 2$

b. $\ln(x+5) - \ln(x-1) = \ln 3$

Problem 14: Reject extraneous solutions

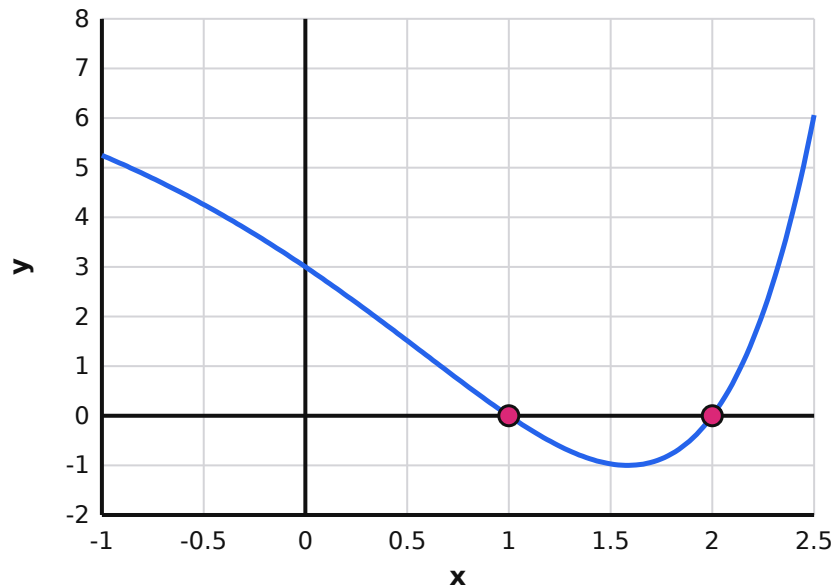
Solve each equation and name any extraneous solution.

a. $\log x + \log(x-3) = 1$

b. $\log_4(x+2) + \log_4(x-1) = 1$

Problem 15: Quadratic form

Solve $2^{2x} - 6 \cdot 2^x + 8 = 0$. Use the substitution $u = 2^x$. The graph of $y = 4^x - 6 \cdot 2^x + 8$ is shown.



The graph of $y = 4^x - 6(2^x) + 8$.

Problem 16: Quadratic form with e

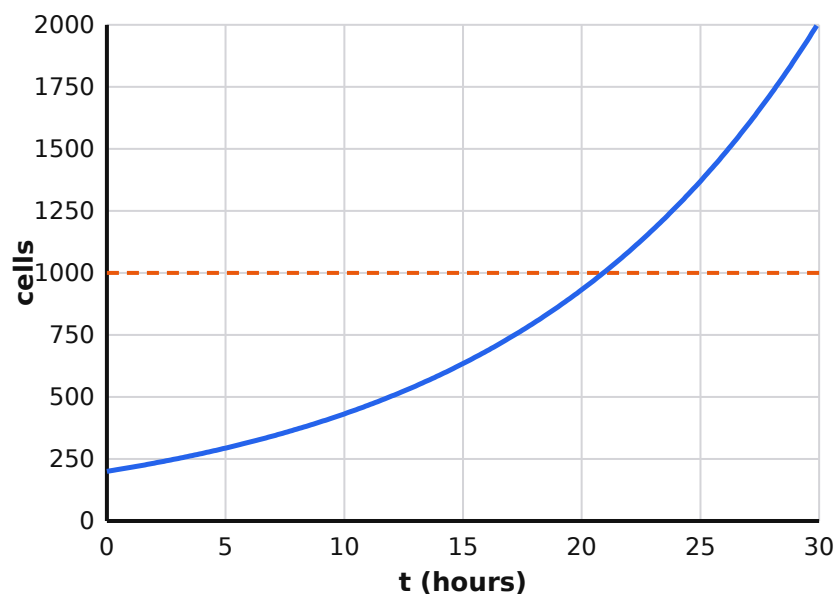
Solve $e^{2x} - 5e^x + 6 = 0$. Round to four decimal places.

Problem 17: Equivalent growth rates

A town has population $P(t) = 12000(1.035)^t$, where t is in years. Write P in the form $12000e^{kt}$, and find the equivalent growth rate per month as a percent to three decimal places.

Problem 18: Bacteria growth

A colony starts with 200 cells and grows 8% each hour, so $N(t) = 200(1.08)^t$. When does it reach 1,000 cells? Find the doubling time too. The graph with the line $N = 1000$ is shown.



The colony and the target of 1,000 cells.

Problem 19: Compound interest

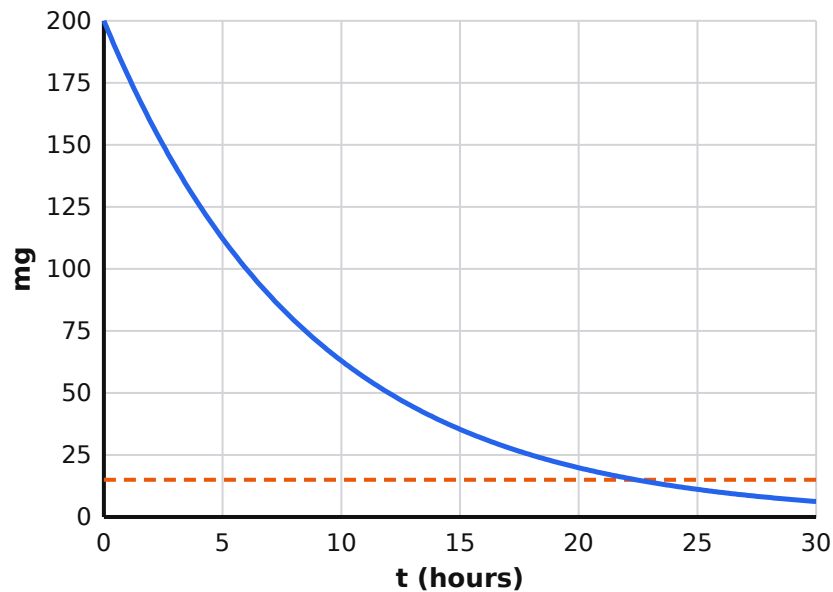
Aisha invests \\$3,000 at 4.5% compounded quarterly, so $A = 3000\left(1 + \frac{0.045}{4}\right)^{4t}$. How many years until the account reaches \\$5,000?

Problem 20: Continuous compounding

Liam deposits \\$1,500 at 3.2% compounded continuously, so $A = 1500e^{0.032t}$. Find the time to double, and the time to reach \\$4,000.

Problem 21: Medicine half-life

A patient takes a 200 mg dose of a drug with half-life 6 hours, so $N(t) = 200\left(\frac{1}{2}\right)^{t/6}$. When do 15 mg remain? The graph with the line $N = 15$ is shown.



Drug amount over time.

Problem 22: Earthquake comparison

Magnitude is $M = \log \frac{I}{I_0}$. Noah compares two earthquakes. (a) How many times as intense is a magnitude 7.6 quake as a magnitude 5.2 quake? (b) A quake is 250 times as intense as a magnitude 5.2 quake. Find its magnitude to the nearest tenth.

Problem 23: pH and decibels

(a) Sofia measures a drink with pH 3.8. Find $[H^+]$ from $\text{pH} = -\log[H^+]$, in scientific notation with three significant digits. (b) A siren is 95 dB. Find $\frac{I}{I_0}$ from $L = 10\log \frac{I}{I_0}$, in scientific notation with three significant digits.