

Warm up

1. Solve: $2 \log_5 x = 3 \log_5 4$

2. Solve: $\log_3 (x - 1)^2 = 2$

3. What is the inverse of: $y = \log_8 (x+3)$

4. Find all of the asymptotes for: $f(x) = \frac{x^2 + 8x - 20}{x - 1}$

5. Find the partial fraction decomposition $\frac{7x + 1}{x^2 - x - 2}$

Warm up

1. $x = 8$

2. $x = 4$

3. the inverse is: $8^x - 3 = y$

4. Vertical: $x = 1$; Slant: $y = x + 9$

5. $\frac{5}{x - 2} + \frac{2}{x + 1}$

Homework

4. $3 \cdot 4^{x/2} = 96$ 5

8. $\log_2 x = 5$ 32

12. $0.98^x = 1.6 \approx -23.2644$

25. $\log x^2 = 6$ $x = 1000$ or $x = -1000$

27. $\log x^4 = 2 \pm \sqrt{10}$

37. $\ln(x - 3) + \ln(x + 4) = 3 \ln 2$ 4

$$4^x = a$$

Quadratic Substitution

$$4^{2x} + 4^x - 6 = 0$$

$$a^2 + a - 6 = 0$$

$$(a+3)(a-2) = 0$$

$$a+3=0 \quad a-2=0$$

$$a = -3 \quad a = 2$$

$$4^x = -3$$

~~$$\log 4^x = \log -3$$~~

$$4^x = 2$$

$$\log 4^x = \log 2$$

$$x \log 4 = \log 2$$

$$x = \frac{1}{2}$$

- Steps:
1. REPLACE BASE + EXPONENT WITH a
 2. FACTOR
 3. SOLVE FOR a
 4. REPLACE BASE AND EXPONENT $\rightarrow a$
 5. SOLVE FOR x

Try this one...

$$a = 2^x$$

$$2^{2x} + 2^x - 30 = 0$$

$$a^2 + a - 30 = 0$$

$$(a+6)(a-5) = 0$$

$$a = 5$$

$$2^x = 5$$

$$\times \log 2 = \log 5$$

$$x = 2.32$$

$$a = 3^x$$

$$3^{2x} + 4 \cdot 3^x - 21 = 0$$

$$a^2 + 4a - 21 = 0$$

$$(a+7)(a-3) = 0$$

$$a = 3$$

$$3^x = 3$$

$$x = 1$$

How to...

Solve Logarithmic Equations using Exponentiation

Raise both sides to the same base.

- This is called exponentiation.
- **Remember...** A base raised to a log with the same base rule:

$$b^{\log_b x} = x$$

$$\log_5(2x-3) = 2$$

$$\begin{aligned}2x-3 &= 25 \\ 2x &= 28 \\ x &= 14\end{aligned}$$

$$\log_2(x+9) = 6$$

$$\begin{aligned}x+9 &= 64 \\ x &= 55\end{aligned}$$

Solving for e...

$$e^x = 8$$

$$\ln e^x = \ln 8$$

$$x = \ln 8$$

$$x = 2.08$$

$$\frac{400}{400} e^{0.2x} = \frac{600}{400}$$

$$e^{0.2x} = 1.5$$

$$\ln e^{0.2x} = \ln 1.5$$

$$0.2x = .405$$

$$x = 2.027$$

Try on your own...

$$500 e^{0.3x} = 600$$

Solving "e" Applications

When do we use:

$$A = P (1 + r/n)^{nt}$$

$$A = Pe^{rt}$$

Continuously

$$A = Ce^{kt}$$

1/2 life
biology

P = PRINCIPAL

r = rate

n = number of times
you compound in 1 yr.

t = time (years)

6. Will invests \$2000 in a bond trust that pays 9% interest compounded semiannually. His friend Henry invests \$2000 in a CD that pays 8.5% compounded continuously. Who has more money after 20 years, Will or Henry?

$$2000 \cdot \left(1 + \frac{.09}{2}\right)^{2(20)}$$

$$2000 e^{.085(20)}$$

\$ 11632.70

\$ 10947.90

9. Iodine-131 is a radioactive material that decays according to the equation $A = A_0 e^{-0.087t}$, where A_0 is the initial amount present and A is the amount present at time t (in days). What is the half-life of iodine-131?

$$A = A_0 e^{-0.087t}$$
$$300 = 600 e^{-0.087t} \quad t = 7.97 \text{ days}$$
$$\frac{1}{2} = e^{-0.087t}$$
$$\ln \frac{1}{2} = \ln e^{-0.087t}$$
$$-.693 = -.087t$$

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10. A culture of bacteria obeys the law of uninhibited growth. If 500 bacteria are present initially and there are 800 after 1 hour, how many will be present in the culture after 5 hours?

$$Ce^{kt}$$
$$800 = 500e^{k \cdot 1}$$
$$1.6 = e^k$$
$$\ln 1.6 = \ln e^k$$
$$k = .47$$
$$A = 500e^{(.47)(5)}$$

5243 bacteria

