2.13A Exponential and Logarithmic Equations and Inequalities

AP Precalculus

2.13A Practice

CALCULATOR ACTIVE: Instructions: Solve each equation. Have exact answer and answer rounded to nearest thousandth.

1) $log_5 x = 2$

$5^2 = x$

$25 = x$

2) $e^{-x} = 3.65$

$\ln e^{-x} = \ln 3.65$

$-x = \ln 3.65$

$x = -\ln 3.65 \approx -1.295$

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

$\log(x(x-3)) = 1$

$\log(x^2 - 3x) = 1$

$x^2 - 3x = 10$

$x^2 - 3x - 10 = 0$

$(x-5)(x+2) = 0 \rightarrow x = 5$ and ~~$x = -2$~~

$\log(-2)$ is not Real

4) $\frac{80e^{0.045x}}{80} = \frac{240}{80}$

$e^{.045x} = 3$

$\ln e^{.045x} = \ln 3$

$\frac{.045x}{.045} = \frac{\ln 3}{.045}$

$x = \frac{\ln 3}{.045} \approx 24.414$

5) $log_3(5-2x) = log_3(3x+1)$

$5 - 2x = 3x + 1$

$4 = 5x$

$\frac{4}{5} = x$

6) $3 - log_4(x+3) = 5$

$-\log_4(x+3) = 2$

$\log_4(x+3) = -2$

$x + 3 = 4^{-2}$

$x = \frac{1}{16} - 3$

$x = -2.9375$

7) $\ln 12 = \ln(2x+3) - \ln(x-4)$

$\ln 12 = \ln\left(\frac{2x+3}{x-4}\right)$

$12 = \frac{2x+3}{x-4}$

$12(x-4) = 2x+3$

$12x - 48 = 2x + 3$

$10x = 51$

$x = 5.1$

8) $e^{2x-1} + 68 = 207$

$e^{2x-1} = 139$

$\ln e^{2x-1} = \ln 139$

$2x - 1 = \ln 139$

$2x = \ln 139 + 1$

$x = \frac{\ln 139 + 1}{2}$

≈ 2.967

9) $log_2(3x-52) - 4 = log_2(x)$

$\log_2(3x-52) - \log_2(x) = 4$

$\log_2\left(\frac{3x-52}{x}\right) = 4$

$2^4 = \frac{3x-52}{x}$

$16 = \frac{3x-52}{x}$

$16x = 3x - 52$

$13x = -52$

$x = -4$ ✗ $\log_2(x)$ doesn't work

NO SOLUTION

10) $log_3\sqrt{2x+3}=1$

$3^1 = \sqrt{2x+3}$

$3^2 = \left(\sqrt{2x+3}\right)^2$

$9 = 2x+3$

$6 = 2x$

$3 = x$

11) $\ln x + \ln(x-10) = \ln 24$

$\ln(x(x-10)) = \ln 24$

$x(x-10) = 24$

$x^2 - 10x = 24$

$x^2 - 10x - 24 = 0$

$(x-12)(x+2) = 0$

$x = 12$ or ~~$x = -2$~~ $\ln(-2)$ is not real

12) $3(2^{x+4}) - 12 = -10$

$3(2^{x+4}) = 2$

$(2^{x+4}) = \frac{2}{3}$

$\log_2 2^{x+4} = \log_2 \frac{2}{3}$

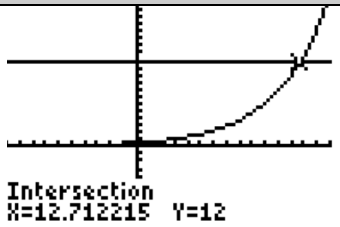
$x+4 = \log_2 \frac{2}{3}$

$x = \log_2 \frac{2}{3} - 4 \approx -4.585$

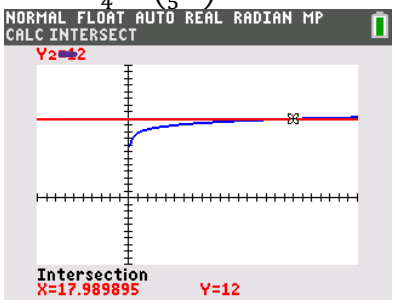
CALCULATOR ACTIVE: Instructions: Solve each equation with a graphing calculator. Round to nearest thousandth.

13) $0.5e^{\frac{x}{4}} = 12$

$x = 12.712$



14) $\frac{3}{4}\ln\left(\frac{4}{5}x\right) + 10 = 12$



17.99

CALCULATOR ACTIVE: Instructions: Solve.

15) Use the formula for continuously compounded to solve. $A = Pe^{rt}$, where A is how much money we currently have, P is the principal (how much we started with), r is the interest rate and t, is the amount of time in years.

Mr. Kelly currently has $450,000 in an investment account. He originally put in $200,000 into the account which earns 4.5% interest. How many years has he been investing in this account?

t

$\ln 2.25 = .045t$

$450{,}000 = (200{,}000)e^{.045t}$

$2.25 = e^{.045t}$

$\ln 2.25 = \ln e^{.045t}$

$\frac{\ln 2.25}{.045} = t$

18 yrs $= t$

2.13A Exponential and Logarithmic Equations and Inequalities

2.13A Test Prep

16. Consider the functions f and g given by $f(x) = \ln(-x + 8)$ and $g(x) = \ln(x + 2) + \ln(x - 8)$. In the xy-plane, what are all the x-coordinates of the points of intersection of the graphs of f and g?

(A) x = 8
(B) x = -3
(C) x = 8 and x = -3
(D) No solution

$\ln(-x+8) = \ln(x+2) + \ln(x-8)$

$\ln(-x+8) = \ln[(x+2)(x-8)]$

$-x+8 = x^2 - 8x + 2x - 16$

$-x+8 = x^2 - 6x - 16$

$0 = x^2 - 5x - 24$

$0 = (x-8)(x+3)$

$x = 8$ or -3

$\ln(-8+8)$

$\ln(0)$ ✗

ARGUMENT $\neq 0$

$x \neq -3$ because when you put it back into the equation it would make all the arguments negative

17. Solve the equation $log_b a + log_b 5 = c$ for a.

(A) $\frac{5}{b^c}$
(B) $5b^c$
(C) $b^c - 5$
(D) $\frac{b^c}{5}$

$\log_b 5a = c$

$b^c = 5a$

$\frac{b^c}{5} = a$

18. What are all values of x for which $\ln(x^5) = \ln(x^3) + 16$?

(A) $x = e^8$ *and* $x = -e^8$
(B) $x = -e^8$
(C) $x = e^8$
(D) $x = 8$ *and* $x = -8$

$\ln x^5 - \ln x^3 = 16$

$\ln \frac{x^5}{x^3} = 16$

$\ln x^2 = 16$

$\pm\sqrt{e^{16}} = \sqrt{x^2}$

e^8 or $-e^8$ → does not work because cannot take ln of a negative #