#46 $\log 12 + \frac{1}{2}\log 7 - \log 2$

$= \log 12 + \log 7^{1/2} - \log 2$

$= \log \frac{6\sqrt{7}}{2}$

$= \log (6\sqrt{7})$

#48. $\log_5 x + \log_5 (x+1) = \log_5 20$

$\log_5 (x^2 + x) = \log_5 20$

$x^2 + x = 20$

$x^2 + x - 20 = 0$

$(x+5)(x-4) = 0$

$x = -5$ or $\boxed{x = 4}$

#47. $\log x + \log(x-1) = \log 4x$

$\log(x^2 - x) = \log(4x)$

$x^2 - x = 4x$

$x^2 - 5x = 0$

$x(x-5) = 0$

~~$x = 0$~~ or $\boxed{x = 5}$

#13. $\log_2 6 - \log_2 15 + \log_2 20$

$\log_2\left(\frac{6}{15}\right) + \log_2 20$

$\log_2\left(\frac{\cancel{6}^{2} \cdot \cancel{20}^{4}}{\cancel{15}_{\cancel{3}}}\right) = \log_2 8 = 3$

#31. $\ln \sqrt{ab} = \ln (ab)^{1/2} = \frac{1}{2} \ln (ab)$

$= \frac{1}{2} [\ln a + \ln b]$

#32. $\ln \sqrt[3]{3r^2 s} = \ln (3r^2 s)^{1/3}$

$= \frac{1}{3} \ln (3 \cdot r^2 \cdot s)$

$= \frac{1}{3} [\ln 3 + 2 \ln r + \ln s]$

Exponential Equations

$x^2 = 9 \leftarrow$ not exponential

$2^x = 9 \leftarrow$ exponential (variable in exponent)

$\ln 2^x = \ln 9$

$\frac{x \cdot \cancel{\ln 2}}{\cancel{\ln 2}} = \frac{\ln 9}{\ln 2} \rightarrow \boxed{x = \frac{\ln 9}{\ln 2}}$

Ex. $3^{x+1} = 4^{2x-1}$

$\ln 3^{x+1} = \ln 4^{2x-1}$

$(x+1)\ln 3 = (2x-1)\ln 4$

$\log a^b = b \cdot \log a$

$x\ln 3 + \ln 3 = 2x\ln 4 - \ln 4$ ← distr.

$x\ln 3 - 2x\ln 4 = -\ln 4 - \ln 3$

$\dfrac{x(\ln 3 - 2\ln 4)}{\ln 3 - 2\ln 4} = \dfrac{-\ln 4 - \ln 3}{\ln 3 - 2\ln 4}$

$$x = \frac{-\ln 4 - \ln 3}{\ln 3 - 2\ln 4}$$

Ex. $8^{2x} = 4^{x+3}$

$2x \ln 8 = (x+3) \ln 4$

$2x \ln 8 = x \ln 4 + 3 \ln 4$

$2x \ln 8 - x \ln 4 = 3 \ln 4$

$x(2 \ln 8 - \ln 4) = 3 \ln 4$

$$x = \frac{3 \ln 4}{2 \ln 8 - \ln 4}$$

Try Again $8^{2x} = 4^{x+3}$

$(a^m)^n = a^{mn}$

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

$2^{6x} = 2^{2x+6}$

$6x = 2x + 6$

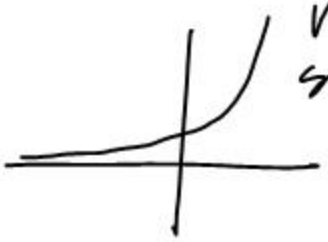
$4x = 6 \rightarrow x = \frac{3}{2}$

Ex $e^{2x} - e^x - 6 = 0$

$(e^x + 2)(e^x - 3) = 0$

$e^x + 2 = 0$ or $e^x - 3 = 0$

$e^x = -2$ $\qquad$ $e^x = 3$



$\ln e^x = \ln 3$

$x = \ln 3$

Alternative

$e^{2x} - e^x - 6 = 0$

$y = e^x$

$y^2 - y - 6 = 0$

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

$y = -2$ or $y = 3$

$e^x = -2$ or $e^x = 3$

Ex: $e^x - 12e^{-x} - 1 = 0$

$e^x[e^x - 12e^{-x} - 1] = e^x[0]$

$e^{2x} - 12 - e^x = 0$

$e^{2x} - e^x - 12 = 0$

$(e^x \quad 3)(e^x - 4) = 0$

$e^x + 3 = 0$ or $e^x - 4 = 0$

no sol.

$e^x = 4$

$\boxed{x = \ln 4}$

HW p. 338 #3, 9, 13, 21, 22, 23 29, 31 give an exact answer in terms of natural logs

#9. $3e^x = 10$

$e^x = \frac{10}{3}$

$x = \ln\left(\frac{10}{3}\right)$