13. $\ln\left(\frac{x^4}{y^2z^5}\right) \Rightarrow \ln x^4 - \ln y^2 - \ln z^5$

$\Rightarrow \boxed{4\ln(x) - 2\ln(y) - 5\ln(z)}$

14. $\log_7 \frac{3x}{(y^{-2})^{1/3}(z)^{1/3}} \Rightarrow \log_7 \frac{3x}{y^{-2/3}z^{1/3}}$

$\Rightarrow \log_7 3x - \log_7 y^{-2/3} - \log_7 z^{1/3}$

$\Rightarrow \log_7 3x - \left(-\frac{2}{3}\right)\log_7(y) - \frac{1}{3}\log_7(z)$

$\Rightarrow \boxed{\log_7(3x) + \frac{2}{3}\log_7(y) - \frac{1}{3}\log_7(z)}$

15. $\log_7 47^{2/3} + \log_7 x^4 - \log_7 (y^3)^2$

$\Rightarrow \log_7 47^{2/3} + \log_7 x^4 - \log_7 y^6$

$\Rightarrow \boxed{\log_7\left(\frac{(47^{2/3})(x^4)}{y^6}\right)}$

16. $\ln(3x-2)^4 - \ln x^4 + \ln x^{2/5}$

$\boxed{\ln \frac{(3x-2)^4 x^{2/5}}{x^4}}$

17. switch forms

$\Rightarrow \log_3 81 = 6x+9$

$4 = 6x+9$

$-9 \quad -9$

$-5 = 6x$

$\frac{-5}{6} = \frac{6x}{6}$

$\boxed{\frac{-5}{6} = x}$

18. get base and exp. alone, then switch forms.

$\frac{22}{-22} + 4e^{3x} = \frac{24}{-22}$

$\frac{4e^{3x}}{4} = \frac{2}{4}$

$e^{3x} = \frac{1}{2}$

$\frac{\log_e \frac{1}{2}}{3} = \frac{3x}{3}$

$(\ln \frac{1}{2}) \div 3 = x$

$\boxed{x = -.231}$

19. $\log_6(x-5) + \log_6(14) = 3$

condense $\log_6(14 \cdot (x-5)) = 3$

simplify $\log_6(14x - 70) = 3$

switch forms $6^3 = 14x - 70$

$216 = 14x - 70$

$+70 \quad +70$

$\frac{286}{14} = \frac{14x}{14}$

$\boxed{20.429 = x}$ ← *always plug back in to be sure answer is in domain.

20. $\log_4(2x) + \log_4(x^2-5) = \log_4(3x)$

condense: $\log_4(2x \cdot (x^2-5)) = \log_4(3x)$

simplify $\log_4(2x^3 - 10x) = \log_4(3x)$

one-to-one property - inside of logs need to be equal

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

$-3x \quad -3x$

solve

$2x^3 - 13x = 0$

factor

$x(2x^2 - 13) = 0$

set each factor equal to zero

$x = 0$

$2x^2 - 13 = 0$

$+13 \quad +13$

$\frac{2x^2}{2} = \frac{13}{2}$

$\sqrt{x^2} = \sqrt{6.5}$

$x = \pm 2.55$

$x = \cancel{0}, \cancel{-2.55}, 2.55$

* when plugged in, must make inside of LOG > 0... If it doesn't ... it is not a solution.

21. $A = Pe^{rt}$

$P = 3000$

$r = .06$

$A = 3000 \cdot 3 = 9000$ ↑ triple

$\frac{3000e^{.06t}}{3000} = \frac{9000}{3000}$

$e^{.06t} = 3 \Rightarrow$ switch forms $\Rightarrow \log_e 3 = .06t$

$\frac{\ln 3}{.06} = \frac{.06t}{.06}$

$\frac{(\ln 3)}{.06} = t$

$18.3 = t$

Just over 18 years to triple $