10.1 Use box, star, squiggly patterns to change forms:

$$\square^{\star} = @ \longleftrightarrow \log_{\square} @ = \star$$

1. $2^7 = 128 \rightarrow \log_2 128 = 7$

2. $3^{-4} = \frac{1}{81} \rightarrow \log_3 \frac{1}{81} = -4$

3. $\left(\frac{1}{7}\right)^3 = \frac{1}{343} \rightarrow \log_{\frac{1}{7}}\left(\frac{1}{343}\right) = 3$

4. $8^{-2} = \frac{1}{64} \rightarrow \log_8 \frac{1}{64} = -2$

5. $\log_3 243 = 5 \longrightarrow 3^5 = 243$

6. $\log_4 64 = 3 \longrightarrow 4^3 = 64$

7. $\log_9 3 = \frac{1}{2} \longrightarrow 9^{\frac{1}{2}} = 3$

8. $\log_5 \frac{1}{25} = -2 \longrightarrow 5^{-2} = \frac{1}{25}$

10.2 ① Combine logs together using the properties of logs
② If there is <u>one</u> log on each side of =, drop the logs
③ if there is only a log on one side of =, use box, star, squiggly to change forms and solve for x.

9. $\underbrace{\log_5 4 + \log_5 2x}_{\text{combine}} = \log_5 24$

$\log_5(4 \cdot 2x) = \log_5 24$ ← log on both sides so drop the logs.

$\downarrow$

$\frac{8x}{8} = \frac{24}{8}$

$x = 3$

10. $\underbrace{\log_4 20 - \log_4 x}_{\text{combine}} = \log_4 5$

$$\log_4 \frac{20}{x} = \log_4 5$$ DROP LOGS

$$\cancel{x} \cdot \frac{20}{\cancel{x}} = 5 \cdot x$$ SOLVE FOR X

$$\frac{20}{5} = \frac{5x}{5}$$

$$4 = x$$

11. $\underbrace{\log_8 y + \log_8 2}_{\text{combine}} = 1$

$$\log_8(y \cdot 2) = 1$$

$$\log_8(2y) = 1$$

LOG on only one side so we must CHANGE to exponential form.

$$8^1 = 2y$$

$$\frac{8}{2} = \frac{2y}{2}$$

solve for y.

$$4 = y$$

12. $$\underbrace{\log_2(x+19) - \log_2(x-2)}_{\text{combine}} = 3$$

$$\log_2 \frac{(x+19)}{(x-2)} = 3$$ ← log on only one side, so we change to exponential form

UP DOWN OVER 2 HIT

$$2^3 = \frac{(x+19)}{(x-2)}$$ solve for x.

$$(x-2)\cdot 8 = \frac{(x+19)}{\cancel{(x-2)}}\cancel{(x-2)}$$

$$8x - 16 = x + 19$$
$$-x + 16 \quad -x + 16$$

$$\frac{7x}{7} = \frac{35}{7}$$

$$x = 5$$

10.4 • take the log of both sides to get the variable out of the exponent.
• find the logs on calculator in decimal form.

13. $4^{3x} = 12$ • take log of both sides

$\log 4^{3x} = \log 12$ • bring power down in front

$(3x)\log 4 = \log 12$ • turn logs into decimals on calculator

$\dfrac{(3x)(.602)}{.602} = \dfrac{1.079}{.602}$

$\dfrac{3x}{3} = \dfrac{1.793}{3}$

$x = .598$

14. $6^{x+2} = 6^5$ take log of both sides

$$\log 6^{(x+2)} = \log 6^5$$

$$\frac{(x+2)\cdot \cancel{\log 6}}{\cancel{\log 6}} = \frac{5\cdot \cancel{\log 6}}{\cancel{\log 6}}$$

$$(x+2) = 5$$

$$-2 \quad -2$$

$$x = 3$$

15. $5^{4x-2} = 120$

$$\log 5^{4x-2} = \log 120$$

$$(4x-2)\log 5 = \log 120$$

$$\frac{(4x-2)(.699)}{.699} = \frac{2.079}{.699}$$

$$4x-2 = 2.975$$

$$+2 \quad +2$$

$$\frac{4x}{4} = \frac{4.975}{4}$$

$$x = 1.244$$

16. $2^{x+5} = 3^{x-2}$

$\log 2^{x+5} = \log 3^{x-2}$

$(x+5)(\log 2) = (x-2)(\log 3)$

$(x+5)(.301) = (x-2)(.477)$

$.301x + 1.505 = .477x - .954$

$\quad\quad\quad + .954 \quad\quad\quad\quad + .954$

$-.301x \quad\quad\quad\quad -.301x$

$\dfrac{2.459}{.176} = \dfrac{.176x}{.176}$

$13.972 = x$

10.5 Same steps as 10.4 except the base is "e" so we use natural logs (ln)

17. $4e^{2x}+2=12$ get e by itself

$$-2 \quad -2$$

$$\frac{4e^{2x}}{4}=\frac{10}{4}$$

$$e^{2x}=2.5$$ take ln of both sides

$$\cancel{\ln e}^{2x}=\ln 2.5$$

$$\frac{2x}{2}=\frac{.916}{2}$$

$$x=.458$$

18. $e^{-2x} = 7$

$\ln e^{-2x} = \ln 7$

$$\frac{-2x}{2} = \frac{1.946}{2}$$

$x = .973$

19. $\ln(x+2) = 1$

log on only one side so change forms

$e^1 = (x+2)$

$$\begin{aligned} 2.72 &= x + 2 \\ -2 \quad & \quad\;\; -2 \end{aligned}$$

$.72 = x$

20. $\underbrace{\ln 4x + \ln x}_{\text{combine}} = 9$

$$\ln(4x \cdot x) = 9$$

$$\ln(4x^2) = 9 \quad \text{change form}$$

$$e^9 = 4x^2$$

$$\frac{8103.084}{4} = \frac{4x^2}{4}$$

$$\pm\sqrt{2025.771} = \sqrt{x^2}$$

$$\cancel{\pm}45.009 = x$$

if I plug in -45.009 it makes the inside of both logs become negative so I throw it out. $x = 45.009$

21. $A = a(1-r)^t$

$a = 250$

$r = .25$

$t = 3$

$A = 250(1-.25)^3$

$A = \$105.47$

$A = a(1+r)^t$

$a = 45600$

$t = 10$

$A = 64800$

$r = \text{find}$

$$\frac{64800}{45600} = \frac{45600(1+r)^{10}}{45600}$$

type this in as: $\sqrt[10]{1.421} = \sqrt[10]{(1+r)^{10}}$

10 → math → $\sqrt[x]{\ }$ → 1.421 → enter

or

1.421 ^ (1/10) → enter

$$1.036 = 1 + r$$
$$-1 \qquad -1$$
$$.036 = r$$

$r = 3.6\%$

23. $A = a(1+r)^t$

$a = 25$

$r = .0325$

$t = 15$

$A = \text{find}$

$A = 25(1+.0325)^{15}$

$A = \$40.39$

24. $A = a(1+r)^t$

$a = 25$

$r = .0325$

$A = 50$ (double 25)

$t =$ find

$$\frac{50}{25} = \frac{25(1+.0325)^t}{25}$$

$$2 = (1.0325)^t$$

$$\log 2 = \log 1.0325^t$$

$$\frac{.301}{.0139} = \frac{t \cdot (.0139)}{.0139}$$

21.65 years $= t$