

$$\#19.a) \log_{15}(3-x) + \log_{15}(1-x) = 1$$

$$\log_{15}(3-x)(1-x) = 1$$

$$15^1 = 3 - 4x + x^2$$

$$0 = x^2 - 4x - 12$$

$$0 = (x-6)(x+2)$$

$$x = \cancel{6} \text{ or } x = -2$$

$$b) \log_9(x^2 - 2x - 15) = 1$$

$$9^1 = x^2 - 2x - 15$$

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

$$0 = \cancel{(x-12)(x+2)}$$

$$0 = \cancel{(x-12 \text{ or } x=-2)} \\ (x-6)(x+4)$$

$$x = 6 \text{ or } x = \cancel{-4}$$

$$c) 2\log_3 x - \log_3(2x+3) = 0$$

$$\log_3\left(\frac{x^2}{2x+3}\right) = 0$$

$$3^0 = \frac{x^2}{2x+3}$$

$$2x+3 = x^2$$

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

$$0 = (x-3)(x+1)$$

$$x = 3 \text{ or } x = \cancel{-1}$$

$$d) 4^1 = x^2 - 3x$$

$$0 = x^2 - 3x - 4$$

$$0 = (x-4)(x+1)$$

$$x = 4 \text{ or } x = -1$$

$$f) \log_3(\log_3 125) = 1$$

$$3^1 = \log_3 125$$

$$x^3 = 125$$

$$x = 125^{1/3}$$

$$x = 5$$

$$e) \log_4(\log_3 x) = 0$$

$$4^0 = \log_3 x$$

$$1 = \log_3 x$$

$$3^1 = x$$

(g.)

$$6^{\log x} = \frac{1}{36}$$

$$6^{\log x} = 6^{-2}$$

$$\log x = -2$$

$$10^{-2} = x$$

$$x = \frac{1}{100}$$

(h)

$$\log_x 8 = \frac{3}{4}$$

$$x^{3/4} = 8$$

$$x = 8^{4/3}$$

$$x = 16$$

#20

i) $\log(x^2 + 12) = \log 8x$

$$x^2 + 12 = 8x$$

$$x^2 - 8x + 12 = 0$$

$$(x-6)(x-2) = 0$$

$$x = 6 \text{ or } x = 2$$

$$\#20. \quad -5 = \log_c \frac{1}{32}$$

$$c^{-5} = \frac{1}{32}$$

$$c^{-5(-1/5)} = \left(\frac{1}{32}\right)^{-1/5}$$

$$\boxed{c = 2}$$

$$(K, 256) \rightarrow \text{inverse} \\ (256, K)$$

$$K = \log_2 256$$

$$2^K = 256$$

$$2^K = 2^8$$

$$K = 8$$

$$\#21 \quad 20 = 50 \left(\frac{1}{2}\right)^{x/25}$$

$$\frac{2}{5} = \left(\frac{1}{2}\right)^{x/25}$$

$$\log\left(\frac{2}{5}\right) = \frac{x}{25} \log\left(\frac{1}{2}\right)$$

$$\frac{x}{25} = \frac{\log\left(\frac{2}{5}\right)}{\log\left(\frac{1}{2}\right)}$$

$$x = 25 \frac{\log\left(\frac{2}{5}\right)}{\log\left(\frac{1}{2}\right)}$$

$$x \approx 33$$

$$\#22. \quad 34000(0.25)^{x/6} = 18000(0.5)^{x/4}$$

$$\log [\quad] = \log [\quad]$$

$$\log 34000 + \frac{x}{6} \log 0.25 = \log 18000 + \frac{x}{4} \log 0.5$$

$$\frac{x}{6} \log 0.25 - \frac{x}{4} \log 0.5 = \log 18000 - \log 34000$$

$$x \left[\frac{1}{6} \log 0.25 - \frac{1}{4} \log 0.5 \right] = \log 18000 - \log 34000$$

$$x = \frac{\log 18000 - \log 34000}{\frac{1}{6} \log 0.25 - \frac{1}{4} \log 0.5}$$

$$x = \frac{-0.27621}{-0.02509}$$

$$\approx \underline{\underline{11 \text{ years}}}$$