Warm Up

a) $(\frac{1}{2})^x = 3$

$\log_{10}(\frac{1}{2})^x = \log_{10}3$

$\frac{x\log_{10}(\frac{1}{2})}{\log_{10}(1/2)} = \frac{\log_{10}3}{\log_{10}(\frac{1}{2})}$

$x = -1.58$

b) $\frac{6(2)^{x+3}}{6} = \frac{30}{6}$

$2^{x+3} = 5$

$\log_{10}2^{x+3} = \log_{10}5$

$\frac{(x+3)\log_{10}2}{\log_{10}2} = \frac{\log_{10}5}{\log_{10}2}$

$x+3 = \left(\frac{\log_{10}5}{\log_{10}2}\right) - 3$

$x = \left(\frac{\log_{10}5}{\log_{10}2}\right) - 3$

$= -0.67$

c)

$$4^{x+2} - 2^{+2} = 10^{+2}$$

$$4^{x+2} = 12$$

$$\log 4^{x+2} = \log 12$$

$$\frac{(x+2)\log 4}{\log 4} = \frac{\log 12}{\log 4}$$

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

$$x = \left(\frac{\log 12}{\log 4}\right) - 2$$

$$= -0.208$$

From Yesterday

$$3\left(2^{x-4}\right) = 360$$

$$\frac{3\left(2^{x-4}\right)}{3} = \frac{360}{3}$$

$$2^{x-4} = 120$$

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

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

$$x-4 = \frac{\log 120}{\log 2}$$

$$x = \left(\frac{\log 120}{\log 2}\right) + 4$$

$$x = 10.9$$

$$10^{x+5} - \overset{+8}{8} = \overset{+8}{60}$$

$$10^{x+5} = 68$$

$$\log_{10} 10^{x+5} = \log_{10} 68$$

$$(x+5)\log_{10} 10 = \log_{10} 68$$

$$x+5(1) = \log_{10} 68$$

$$x = (\log_{10} 68) - 5$$

$$x = -3.16$$

From Yesterday

1.71
3
-1.5

$$\frac{4000}{\cancel{2+7^{2x}}} \cdot \cancel{(2+7^{2x})} = 5 \cdot (2+7^{2x})$$

$$\frac{4000}{5} = \frac{5(2+7^{2x})}{5}$$

$$800 = 2+7^{2x}$$
$$-2 \qquad -2$$

$$798 = 7^{2x}$$

$$\log 798 = \log 7^{2x}$$

$$\frac{\log 798}{\log 7} = \frac{2x(\log 7)}{\log 7}$$

$$2x = \left(\frac{\log 798}{\log 7}\right)$$

$$\overline{}\, 2$$

$$x = 1.71$$

This process leads to a very useful formula...

Have you ever thought...

"b raised to what power will give me some number N?"

ie. $\log_b N = x$ or $b^x = N$

Solve the equation: $b^x = N$

Could we have taken the logarithm of each side to any base we had chosen?

This leads to the change of base formula:

$$\log_b N = \frac{\log_a N}{\log_a b}$$

$$= \frac{\log_7 N}{\log_7 b}$$

Evaluate each of the following:

$\log_5 45$

$= \frac{\log_{10} 45}{\log_{10} 5}$

$= 2.36$

$\log_3 7$

$= \frac{\log_{10} 7}{\log_{10} 3}$

$= 1.77$

Examples...

(1) $\log_9 75$ (2) $3(4)^{x-1} = 24$ (3) $6^{3x} = 2^{2x-3}$

$$\frac{\log_{10} 75}{\log_{10} 9} \qquad \frac{\ln 75}{\ln 9}$$

$$= 1.96$$

Example: $$\frac{2^{4x}}{5^{2x+5}} = 7^{x-1}$$

$$\log_{10}\left(\frac{2^{4x}}{5^{2x+5}}\right) = \log 7^{x-1}$$

$$\log 2^{4x} - \log 5^{2x+5} = \log 7^{x-1}$$

$$(4x)\log 2 - (2x+5)\log 5 = (x-1)\log 7$$

$$(4\log 2)x - (2\log 5)x - 5\log 5 = (\log 7)x - \log 7$$

$$(4\log 2)x - (2\log 5)x - (\log 7)x = -\log 7 + 5\log 5$$

$$\frac{x\left[(4\log 2) - (2\log 5) - (\log 7)\right]}{\left[(4\log 2) - (2\log 5) - (\log 7)\right]} = \frac{-\log 7 + 5\log 5}{''}$$

$$x = -1.550$$