

**Problem 1** (5 Points). Use the log rules to find exact answers. Then (if needed) use your calculator to give an answer approximate to 3 decimal places.

a)  $\frac{\log_{\frac{1}{3}} 9}{\log_{\frac{1}{3}} 9}$  Use  $\log_a M = \frac{\log_b M}{\log_b a}$   $a=9$   $b=\frac{1}{3}$   $M=3$

$$\frac{\log_{\frac{1}{3}} 3}{\log_{\frac{1}{3}} 9} = \log_9 3 = \log_9 9^{\frac{1}{2}} = \frac{1}{2} \log_9 9$$

b)  $\log_2 5$

$$\log_2 5 = \frac{\ln 5}{\ln 2} \approx \frac{1.609438}{.693147} \approx 2.322$$

c)  $\log e \approx .434$

**Problem 2** (10 points). Solve for  $x$  in the following problems. Give exact answers here do not use a calculator.

a) (5 points)  $4^x - 2^{x+3} = -12$

$$4^x - 2^{x+3} + 12 = 0$$

$$(2^x)^2 - 8 \cdot 2^x + 12 = 0$$

$$u = 2^x$$

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

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

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

$$u=2$$

$$2^x = 2$$

$$x=1$$

$$u=6$$

$$2^x = 6$$

$$x = \log_2 6$$

$$x=1 \text{ or } x = \log_2 6$$

b) (5 points)  $\pi^{1-4x} = \left(\frac{4}{5}\right)^{x+2}$

$$\ln \pi^{1-4x} = \ln \left(\frac{4}{5}\right)^{x+2}$$

Using  $\log_a M^r = r \log_a M$

$$(1-4x) \ln \pi = (x+2) \ln \left(\frac{4}{5}\right)$$

$$\ln \pi - 4x \ln \pi = x \ln \frac{4}{5} + 2 \ln \frac{4}{5}$$

$$\ln \pi - 2 \ln \frac{4}{5} = x \ln \frac{4}{5} + 4x \ln \pi$$

$$\ln \pi - 2 \ln \frac{4}{5} = x \left( \ln \frac{4}{5} + 4 \ln \pi \right)$$

$$\rightarrow x = \frac{\ln \pi - 2 \ln \frac{4}{5}}{\ln \frac{4}{5} + 4 \ln \pi}$$