Math Without a Calculator

(Use this problem set to brush up on your mathematics skills; it contains examples of all the different kinds of math you'll be doing in this course. If you're looking for an extra challenge, try doing these questions without using a calculator; the hints and tips presented herein should give you all the help you need to go calculator-free.)

Dealing with powers of ten

1. $\dfrac{2 \times 10^{89}}{(0.010)^2} =$

2. $\dfrac{(5 \times 10^{55})(4 \times 10^{23})}{(0.0010)^4(2 \times 10^5)} =$

3. $\dfrac{\left(3 \times 10^{-3}\right)^3}{5 \times 10^{10}} =$

4. $\dfrac{3 \times 10^{-5}}{5.0 \times 0.20} =$

5. $\dfrac{450 \times 10^3}{5.0 \times 10^{-3}} =$

Dealing with ln and log

If you want to try these without a calculator:

You'll have to be able to go from ln (log base e) to log (log base 10) by making use of the relationship

2.3log x ≅ ln x

You'll also need to know the log of the following simple numbers:

log 2 = 0.30 log 3 = 0.48 log 4 = 0.60 log 5 = 0.70
log 6 = 0.78 log 7 = 0.85 log 8 = 0.90 log 9 = 0.96

If you know the logs of 2, 3, and 7, you can derive the log of the other five numbers by using one of the properties of logs:

log (a x b) = log a + log b

6. $\log 2 \times 10^{-4} =$
7. $\log 5 \times 10^{-6} =$
8. $\log 2.4 =$
9. $\log 1.5 =$
10. Solve $1 \times 10^6 = e^x$ for x
11. Solve $2 \times 10^{-4} = 500e^x$ for x

There are certain constants which are commonly encountered in chemical calculations in this course. For example:

1 Faraday = 96485 coulombs $\cong$ 1 x 10^5 coulombs
R = 8.314 J/mol·K = 0.08314 L·bar/mol·K = 0.082057 L·atm/mol·K

Often the gas constant is multiplied by some temperature and we'll need to estimate that product. For example:

$$8.314 \times 298 \cong \frac{25}{3} x \ 300 \cong 2.5 \times 10^3$$

And

$$0.082057 \times 298 \cong \frac{1}{12} x \ 300 \cong 25 \ (\text{similarly, } 0.08314 \times 298 \cong 25)$$

Try these next problems without using a calculator. Estimate the result to one significant figure.

12. $0.082057 \times 1200 \cong$

13. $8.314 \times 1200 \cong$

14. $0.08314 \times 600 \cong$

15. $0.05916/3 \cong$

16. Solve $-4.5 \times 10^3 = -(5)(96485)\varepsilon°$ for $\varepsilon°$

17. $\frac{1.50 \ x \ 10^5}{8.314}\left(\frac{400-300}{400 \ x \ 300}\right) \cong$

18. Solve $\ln\left(\frac{x}{0.8}\right) = \frac{23 \ x \ 10^3}{8.314}\left(\frac{100}{400 \ x \ 300}\right)$ for x

19. Solve $1 \ x \ 10^6 = e^{\frac{x}{8.314 \ x \ 300}}$ for x

20. Solve $\ln\left(\frac{x}{1 \ x \ 10^{20}}\right) = -\frac{46000}{8.314}\left(\frac{398-298}{298 \ x \ 398}\right)$ for x

21. Solve $4.3 \times 10^{-18} = 27x^4$ for x

22. Solve $1.2 \times 10^{-17} = (1.2 \times 10^{-3})[OH^-]^2$ for $[OH^-]$