Answers!

Diagnostic Test - Chem 101
Mathematical Computations in General Chemistry

This diagnostic test is designed to help you assess your computing abilities as well as your skills in using your scientific calculator. Since computations are an important part of the study of chemistry, it is important that you can **WITH** the correct number of significant figures:

(1) put scientific notation correctly into your cheapie scientific calculator - it's best to practice on one you will use for the exams. **Remember: use the ee or exp button when working in scientific notation on your calculator. In new calculators, this button has been replaced by a button marked x10. Don't use multiply button and the 10` button.**
(2) do calculations using numbers in scientific notation.
(3) manipulate exponents (to check your calculations on your calculator)
(4) do straightforward algebraic manipulations
(5) do unit conversions using dimensional analysis (also called the factor-label method)

For more help, visit the math review at http://www.chem.tamu.edu/class/fyp/mathrev/mathrev.html.

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Use the correct number of significant figures in all calculations!

1. Change these numbers into scientific notation.

   (a) 2,430,000 2.43×10^6

   (b) 0.00072 7.2×10^{-4}

   (b) $\begin{array}{r} 10369 \quad 5 \text{ sig figs} \\ - \underline{914} \quad 3 \text{ sig figs} \\ 9455 \quad 4 \text{ sig figs} \end{array}$

2. (a) $(6.4 \times 10^{-3}) + (3.96 \times 10^{-2}) =$

   (a) $\begin{array}{r} 0.0064 \\ + \underline{0.0396} \\ 0.0460 \end{array}$ (3 sig figs)

   Hint: (a) and (b) are tricky. Determine longhand.

   (b) $(1.0369 \times 10^4) - (9.14 \times 10^2) =$

   (c) $(6.02 \times 10^{23})(2.9 \times 10^{-3}) =$ 1.7×10^{21}

   (d) $(3.5 \times 10^4)^5 =$ 5.3×10^{22}

   (e) $\sqrt{4.53 \times 10^6} =$ 2.13×10^3

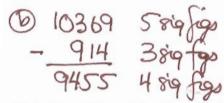   (f) $\sqrt[5]{4.53 \times 10^{-36}} =$ 8.54×10^{-8}

3. (a) $10^3 \times 10^2 =$ 10^5

   (b) $10^2 / 10^5 =$ 10^{-3}

   (c) $10^4 / 10^{-6} =$ 10^{10}

   (d) $(10^3)^5 =$ 10^{15}

   (e) $\sqrt[3]{10^{-6}} = (10^{-6})^{1/3} =$ 10^{-2}

   Note that 10^3 is essentially the same thing as 1×10^3.

   So don't put 10×10^3 into your calculator.

4. (a) $x - 3 = 7$ $x = 10$

(b) $\frac{3}{x} = 7$ (to 2 sig. fig) $3 = 7x$
$x = 3/7 = 0.43$

(c) $\frac{4x + 3}{2} = 5$ (to 3 sig. fig.) $4x + 3 = 10$ $\therefore x = \frac{7}{4} = 1.75$
$4x = 7$

(d) $\frac{3x + 5}{4} = \frac{x - 7}{3}$ (to 3 sig. fig.) $3(3x + 5) = 4(x - 7)$
$9x + 15 = 4x - 28$
$5x = -43$
$x = \frac{-43}{5} = -8.60$

5. (a) Convert 3.0 milliliters (mL) to units of liters. Which numbers are exact and which are inexact (measured) values?

$? \text{ L} = 3.0 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} = 0.0030 \text{ L}$ (2 sig fig)

↑ inexact

↑ exact — both 1 L and 1000 mL has ∞ number of sig. figs.

(b) How many minutes are in 1.00 year? Which numbers are exact and which are inexact (measured) values?

$? \text{ min} = 1.00 \text{ yr} \times \frac{365 \text{ d}}{1 \text{ hr}} \times \frac{24 \text{ hr}}{1 \text{ d}} \times \frac{60 \text{ min}}{1 \text{ hr}} = 5.26 \times 10^5 \text{ min}$ (3 sig fig)

not exact (remember leap year)

exact

6. (a) $\log 1.5 \times 10^3 = 3.18$ $(10^{3.18} = 1.5 \times 10^3)$

(b) $\log 8.0 \times 10^{-6} = -5.10$

(c) $\log x = 4.00$ $x = 1.0 \times 10^4$ $(10^{4.00} = x)$

(d) $-\log x = 6.75$ $x = 1.8 \times 10^{-7}$
$(10^{-6.75} = x)$

(logs are exponents!)

Note on significant figures and logs: the decimal part of the log, called the mantissa, has the same number of digits as the number of sig. figs in the original number.