Answers

Diagnostic Test
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.
(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)
(6) work with logarithms to the base 10 (logs) and natural logarithms
(7) solve a quadratic equation.

In this excercise, you can work in groups, but make sure that everyone in your group can handle all the calculations when finished. For more help, visit the math review on our homepage.

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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}

2. (a) $(6.4 \times 10^{-3}) + (3.96 \times 10^{-2}) =$ 4.60×10^{-2}

$$\begin{array}{r} 0.0064 \\ +0.0396 \\ \hline 0.0460 \end{array}$$

(b) $(1.0369 \times 10^4) - (9.14 \times 10^2) =$ 9.455×10^3

$$\begin{array}{r} 10369 \\ -\ 914 \\ \hline 9455 \end{array}$$

(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}

To do this in your calculator, remember $10^5 \equiv 1 \times 10^5$

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.) $4x + 3 = 10$, $4x = 7$, $\therefore x = \frac{7}{4} = 1.75$

(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 0.20 L to milliliters.

$?\,mL = 0.20\,L \times \frac{1000\,mL}{1\,L} = 200\,mL$ (2 sig figs) or $2.0 \times 10^2\,mL$

These are exact conversions so # significant figures is infinite.

(b) How many minutes are in 1.00 year?

not exact

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

logs are exponents!

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) $\log x = 4.00$ $x = 1.0 \times 10^4$

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

-6.75
10 = x

(e) $\ln 2.3 \times 10^5 =$ 12.35 $(e^{12.35} = 2.3 \times 10^5)$

(f) $\ln 7.1 \times 10^{-14} =$ −30.28

(g) $\ln x = 5.00$ $x = 150$ (2 sig figs) $(e^{5.00} = x)$

Note on sig. figs + logs + lns — the decimal part of the log (mantissa) has same number of digits as no. of sig. figs in original number.

7. Solve for x (there will be 2 answers): $x^2 - 3.13x - 0.737 = 0$

Recall the quadratic equation: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ for $ax^2 + bx + c = 0$

Use quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{+3.13 \pm \sqrt{(-3.13)^2 - 4(1)(-0.737)}}{2(1)}$$

$$= \frac{3.13 \pm \sqrt{9.80 + 2.95}}{2}$$

$$= \frac{3.13 \pm 3.57}{2}$$

$$= 3.35 \text{ or } -0.22$$

Note - in a chemistry problem one value will make sense & the other won't, so only one value has chemical meaning.