
Arthur & Polly Mays Conservatory Of The Arts

Dear Honors Chemistry Student,

This packet is prepared to provide entering students of Honors Chemistry with practice to be familiar with the following skills and content before the start of the school year. The summer assignment consists of:

Part I: Videos

Part II: Basic Math Skills

- A. Rounding
- B. Number Line
- C. Scientific Notation
- D. Clear Presentation of Work
- E. Multiplying Fractions using the calculator
- F. Scientific Notation on the Calculator
- G. Areas of Rectangles and Volumes of Rectangular Blocks
- H. Exponents
- I. Proportion - Cross Multiplication
- J. Simple Algebra Problems
- K. Literal Equations in Algebra
- L. Complex Fractions
- M. Metric System

Part I: Videos

Go to Bozeman Science website at <http://www.bozemanscience.com/chemistry/>

Watch the following videos

- Unit 1: Introduction – Factor-Label Method
- Unit 1: Introduction – Scientific Method
- Unit 1: Introduction – Significant Digits
- Unit 2: Matter & Atomic Theory – History of the Atom
- Unit 2: Matter & Atomic Theory – Matter
- Unit 2: Matter & Atomic Theory – Properties of Matter

Create a timeline for the development of the current model of the atom, the quantum mechanical model.

Part II: Basic Math Skills

A. Rounding

If the next digit is 5 or higher, then round up; if the digit is less than 5, then round down. Round only once, do not round twice.

Examples:

If you want to round to whole number, then

- a) $24.45 = 24$
- b) $23.67 = 24$
- c) $1.443 = 1$

If you want to round to 1 decimal place, then

- a) $24.45 = 24.5$
- b) $23.67 = 23.7$
- c) $1.443 = 1.4$

Round the following numbers to 2 decimal places:

(i) 58.3382 _____

(iii) 729.5005 _____

(ii) 2.5546 _____

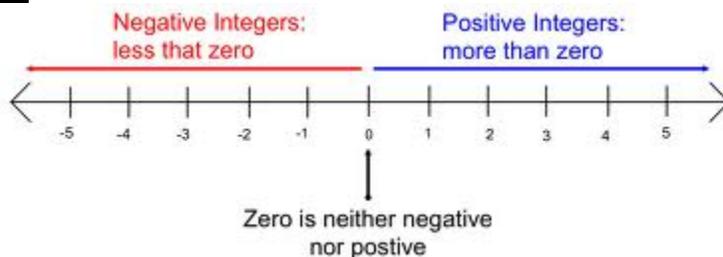
(iv) 4.8898 _____

Round the following numbers to whole numbers:

(v) 729.5005 _____

(vi) 2.5546 _____

B. The Number Line



If “<” sign means “less than” and “>” sign means “greater than”,
then $-3 < -2 < -1 < 0 < 1 < 2 < 3$ and $3 > 2 > 1 > 0 > -1 > -2 > -3$

Which symbol, < or >, correctly compares the given numbers?

(i) -6 _____ -13

(iii) 4 _____ -4

(ii) -24 _____ -16

(iv) $-4 + 3$ _____ 1

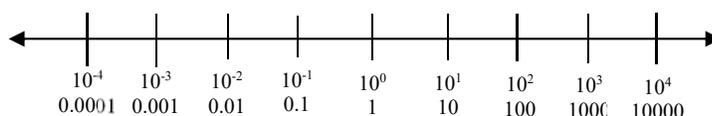
C. Scientific Notation

When you have a number that is very large or very small, you can express that number in scientific notation. In scientific notation, a number is rewritten as the product of two numbers: a coefficient and 10 raised to a power, as shown below.

$$c \times 10^e$$

where c is the coefficient and satisfies the following: $1 \leq c < 10$ and e is a whole integer.

The larger a number is, the larger the power of 10 needed to represent it. Positive exponents of 10 result in numbers greater than 1 (large numbers). The smaller a number is, the smaller the power of 10 is needed to represent it. Negative exponents of 10 result in numbers less than 1 (decimals).



Examples:

- The number 60,200 is equivalent to $6.02 \times 10,000$; therefore, it can be written in scientific notation as 6.02×10^4 .
Written mathematically: $60,200 = 6.02 \times 10,000 = 6.02 \times 10^4$
- The number 0.0072 is equivalent to 7.2×0.001 ; therefore, it can be written in scientific notation as 7.2×10^{-3} .
Written mathematically: $0.0072 = 7.2 \times 0.001 = 7.2 \times 10^{-3}$

Previously, you may have learned before to determine what power of 10 is used in scientific notation is to count how many places the decimal is moved. Even if you are familiar with that method, learn the concept explained above.

Write out the following numbers currently shown in scientific notation.

(i) 4.2×10^{-2} _____

(ii) 6.2×10^5 _____

Circle the greater number in each pair below:

(i) 7×10^2 or 7×10^6

(iii) 4×10^{-5} or 4×10^{-8}

(ii) 1×10^3 or 1×10^{-3}

(iv) 6×10^{-8} or 2×10^{-4}

D. Clear Presentation of Work

Since written communication is important, you must present mathematical work clearly. Work horizontally (as if you write a phrase or a sentence), and work downwards. Make sure that you have proper equal signs, if needed. Use parenthesis instead of “x” to indicate multiplication.

Example:

$$(2.5)(4.6)(6.7) \\ = 77.05$$

This means 2.5 multiply 4.6 multiply 6.7
(We will talk about significant figures later.)

Example:

$$5V=20 \\ V = 4$$

Example: Write formula or equation.
Substitute correct values.
Solve for the unknown

$$PV=nRT, \text{ if } P=3.40, V=2.55, R=0.0821, \text{ and } T=298$$
$$(3.40)(2.55)=n(0.0821)(298)$$
$$n = 0.354$$

Solve the following problems. Show your work.

(i) If $PV = nRT$ and $P = 1.2$, $V = 3.4$, $n = 5.6$, $R = 8.31$, calculate T .

(ii) If $M_1V_1 = M_2V_2$ and $M_1 = 6.2$, $M_2 = 1.3$, and $V_2 = 200$, calculate V_1 .

(iii) If you want to multiply 13 by 24 and then divide by 2, set up the expression in one step and then evaluate.

- (iv) Add 50 to 273, then multiply by 4, then divide by 2.3. Set up the expression in one step and then evaluate.

E. Multiplying fractions using the calculator

The parentheses are often used to indicate multiplication. Get into the habit of using parentheses instead of “x” to indicate multiplication.

Example:

$(2.5)(4.6)(6.7)$ means 2.5 is multiplied by 4.6, which is then multiplied by 6.7

Hint: For a fraction, multiply the value above the fraction line and divide the value below the fraction line.

Example:

$$\left(\frac{1.2}{2.3}\right)\left(\frac{3.4}{4.5}\right)\left(\frac{5.6}{6.7}\right)$$
$$= 0.33$$

- a) A suggestion is to solve the problem above by looking at one pair of parentheses at a time. So on your calculator, press:

$$1.2 \div 2.3 \times 3.4 \div 4.5 \times 5.6 \div 6.7$$

- b) It is also correct to multiply all the numbers above the fraction line first, then divide by all the numbers below the fraction line; so on your calculator, press:

$$1.2 \times 3.4 \times 5.6 \div 2.3 \div 4.5 \div 6.7$$

- c) Or, press:

$$1.2 \times 3.4 \times 5.6 \div (2.3 \times 4.5 \times 6.7)$$

The method (a) above is recommended in science since the fraction can be very large with numbers, symbols, and/or words, and the many fractions may occupy more than one line, so working with one fraction at a time will be less confusing. For example,

$$(35.6 \text{ g NH}_3) \left(\frac{1 \text{ mol NH}_3}{17.0 \text{ g NH}_3} \right) \left(\frac{3 \text{ mol H}_2\text{O}}{4 \text{ mol NH}_3} \right) \left(\frac{18.0 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} \right)$$
$$= 28.3 \text{ g H}_2\text{O} \quad \{\text{Note that some units have cancelled out.}\}$$

For the above problem, on your calculator, work with one fraction at a time, so press:

$$35.6 \times 1 \div 17.0 \times 3 \div 4 \times 18.0 \div 1$$

Of course, you don't have to worry about multiplying or dividing by 1, so you can press:

$$35.6 \div 17.0 \times 3 \div 4 \times 18.0$$

Use Method (a) above and your calculator to evaluate the following expressions.

(i) $\left(\frac{8.09}{3.44} \right) \left(\frac{3.23}{4.50} \right) \left(\frac{8.55}{6.73} \right)$

(ii) $\left(\frac{70.2}{3.11} \right) \left(\frac{5.90}{4.23} \right) \left(\frac{2.35}{4.43} \right) \left(\frac{4.25}{6.77} \right) \left(\frac{10.23}{3.76} \right)$

F. Scientific Notation on the Calculator

Another common chemistry calculation involves using numbers in scientific notation. To put a number in scientific notation into your calculator, there are two options:

a) 6.02×10^{23} can be put into your calculator as $(6.02 \times 10 \wedge 23)$

b) 6.02×10^{23} can be put into your calculator as $6.02 \text{ E } 23$

You can use either one of the above methods. To enter “E” on your calculator, you may have an “EE” key or “EXP” key. If not, consult your scientific calculator’s user guide. “E” is equivalent to “x10^” and by using it instead of “x10^” in your calculations, you eliminate having to worry about having parenthesis around numbers in scientific notation used in calculations.

Here is an example that involves both multiplying many fractions as well as using numbers in scientific notation:

$$\left(\frac{29.2\text{g H}_2\text{O}}{1}\right)\left(\frac{1\text{ mol H}_2\text{O}}{18\text{g H}_2\text{O}}\right)\left(\frac{1\text{ mol O}_2}{2\text{ mol H}_2\text{O}}\right)\left(\frac{6.02 \times 10^{23}\text{ molecules O}_2}{1\text{ mol O}_2}\right)$$
$$= 4.88 \times 10^{23}\text{ molecules O}_2$$

In your calculator, you would enter this as:

$$(29.2 \div 18 \div 2 * 6.02 \text{ E } 23) = 4.88 \text{ E } 23 \text{ (which is } 4.88 \times 10^{23}\text{)}$$

When dividing by scientific notation numbers, use parentheses, or treat each part of the notation separately.

Example:

To calculate $\frac{4.25}{3.42 \times 10^6}$ using your calculator, you can enter one of the three methods shown below:

1) $4.25 \div 3.42\text{E}6$

or

2) $4.25 \div (3.42 \times 10^6)$

or

3) $4.25 \div 3.42 \div 10^6$ Use the \div sign for anything below the fraction bar.

Use one of the methods above to calculate the following, without having to show intermediate work:

$$(i) \quad \frac{(2.96 \times 10^5) (4.3 \times 10^2)}{(8.58 \times 10^3)}$$

$$(ii) \quad \frac{(6.67 \times 10^{-11}) (423) (570)}{(6.40 \times 10^{-6})^2}$$

G. Areas of rectangles and volumes of rectangular blocks

Area of rectangle = length x width = lw

Area of volume of a rectangular box = length x width x height = lwh

Note that the units multiply also.

Example:

If length = 5.02 cm and width = 2.34 cm,

Then area = (5.02 cm)(2.34 cm)
= 11.7 2cm²

If length = 5.02 cm, width = 2.34 cm, and height = 1.23 cm,

Then volume = (5.02 cm)(2.34 cm)(1.23 cm)
= 14.4 3cm³

- (i) If the length of a rectangle measures 35.6 cm and the width measures 2.30 cm, what is the area? (Don't forget to write the unit.) Show work (setup) clearly.

- (ii) A box measures 12.5 cm in length, 8.67 cm in width, and 3.30 cm in height. What is the volume? Show work (setup) clearly.

H. Exponents

- a) The value of any power expression with exponent zero is equal to 1, i.e., $a^0 = 1$.

Example: $10^0 = 1$, $11^0 = 1$, $23^0 = 1$, etc.

- b) To multiply two powers having the same base, add the exponents, i.e., $(a^m)(a^n) = a^{m+n}$

Example: $(3^2)(3^5) = 3^7$

- c) To divide one power by another having the same base, subtract the exponents,

i.e., $\frac{a^m}{a^n} = a^{m-n}$

Example: $\frac{3^8}{3^2} = 3^6$ $\frac{3^8}{3^{-2}} = 3^{10}$

- d) To evaluate the power a power, multiply the exponents, i.e., $(a^m)^n = a^{mn}$

Example: $(3^2)^5 = 3^{10}$

Evaluate the following expressions:

(i) $(5^3)(5^{10})$

(ii) $(-5a^4)^3$

$$(iii) \frac{6^{24}}{6^3}$$

$$(iv) \frac{10^{-23}}{10^{-11}}$$

$$(v) \frac{10^{23}}{10^{-2}}$$

$$(vi) \left(\frac{5^{13}}{5^{-22}}\right)\left(\frac{5^{-4}}{5^6}\right)$$

I. Proportion - Cross multiplication & cross division

$$D = \frac{M}{V}$$

If $D = 3.42 \text{ g/mL}$ and $V = 12.2 \text{ mL}$, then upon substitution,

$$3.42 = \frac{M}{12.2} \quad \text{which is the same as} \quad \frac{3.42}{1} = \frac{M}{12.2}$$

$$M = 41.7 \text{ g}$$

The idea is to isolate the unknown on one side and everything else on the other side of the equal sign. Cross multiply 3.42 and 12.2. This is the same as multiplying 12.2 on both sides and then canceling.

$$3.42 = \frac{M}{12.2}$$

$$M = 41.7 \text{ g}$$

Example:

If $D = 3.42 \text{ g/mL}$ and $M = 45.6 \text{ g}$, then upon substitution,

$$3.42 = \frac{45.6}{V}$$

$$V = 13.3\text{g}$$

Solve.

(i) If $M = \frac{n}{V}$ and $M = 2.1$ and $V = 3.8$, calculate n .

(ii) If $M = \frac{n}{V}$ and $M = 2.1$ and $n = 5.5$, calculate V .

J. Simple Algebra problems

Students should not show any more intermediate steps, just envision putting the unknown, n , on one side and everything else on the other side using cross-multiplying or cross-dividing.

Example:

$PV=nRT$ If $P=3.40$, $V=2.55$, $R=0.0821$, and $T=298$, then write

$$(3.40)(2.55) = n(0.0821)(298)$$

$$n = 0.354$$

Press $3.40 \times 2.55 \div 0.0821 \div 298$ on your calculator, or $3.40 \times 2.55 \div (0.0821 \times 298)$.

Find the answer to the problems.

(i) Multiply the following numbers: 2.03, 5.78, 9.00

(ii) Solve for x if $7.8x = 209$

K. Literal equations in Algebra

Express one variable in terms of other variables, without numbers.

Example:

For the expression, $PV = nRT$

a) express P in terms of the other variables: $P = \frac{nRT}{V}$

b) express T in terms of the other variables: $T = \frac{PV}{nR}$

c) express n in terms of the other variables: $n = \frac{PV}{RT}$

If $M_1V_1 = M_2V_2$, express

(i) V_2 in terms of the other variables.

(ii) M_1 in terms of the other variables.

If $M = \frac{n}{V}$, express

(i) n in terms of the other variables

(ii) V in terms of the other variables

L. Complex fractions

The fraction bar is a division line. Since $\frac{A}{B}$ means $A \div B$,

$$\frac{\frac{C}{D}}{\frac{E}{F}} = \frac{C}{D} \div \frac{E}{F} = \frac{C}{D} \times \frac{F}{E}$$

Do the same for units.

Evaluate the following expressions

$$(i) \quad \frac{\frac{8.566}{2.35}}{\frac{15.90}{9.33}}$$

$$(ii) \quad \frac{\frac{5.89}{1.64}}{\frac{31.47}{2.78}}$$

M. Metric System

Learn the common unit conversions:

$$1 \text{ kg} = 1000 \text{ g}$$

$$1 \text{ g} = 10 \text{ dg}$$

$$1 \text{ g} = 100 \text{ cg}$$

$$1 \text{ g} = 1000 \text{ mg}$$

$$1 \text{ g} = 1,000,000 = 1 \mu\text{g} \text{ [a million]}$$

$$1 \text{ g} = 1,000,000,000 = \text{ng} \text{ [a billion]}$$

$$1 \text{ km} = 1000 \text{ m}$$

$$1 \text{ m} = 10 \text{ dm}$$

$$1 \text{ m} = 100 \text{ cm}$$

$$1 \text{ m} = 1000 \text{ mm}$$

$$1 \text{ m} = 1,000,000 = 1 \mu\text{m} \text{ [a million]}$$

$$1 \text{ m} = 1,000,000,000 = 1 \text{ nm} \text{ [a billion]}$$

Convert the following:

$$(i) \quad 22.1 \text{ kg} = \underline{\hspace{2cm}} \text{ mg}$$

(ii) 23. 1 km = _____ m

(iii) 24. 1 g = _____ mg

(iv) 25. 23 m = _____ cm

(v) 26. 15.3 g = _____ cg

(vi) 27. 0.25 m = _____ m

STUDENTS ALSO NEED TO
MEMORIZE THE PERIODIC TABLE