MENTAL MATH PRACTICE:
Speed things up ~~and get ready for no calculator~~!
(You get a calculator now, but still good to find ways to speed things up since it is a timed exam!)

This work will not be collected as part of the summer assignment. It is highly recommended that you do some “mental math” practice for two reasons. First, you do not get a calculator on the Multiple Choice portion of the AP Chemistry exam! Yikes! Trust me…if I made the rules this would be the first thing I changed - ha! Second, many students waste a lot of time on exams both in class and on the AP Exam because they do not utilize common sense and number sense to help them answer questions faster. Sometimes there may be questions that look like horribly long algebra problems to solve, but if you looked at the answer choices you would realize that only one answer makes any possible sense! Sometimes you could round numbers to easier values and do the math in your head faster than you could on your calculator. So start practicing now!

**Adding, Subtracting, Multiplying, Dividing**

*Example:* Round to easier numbers! That will be close enough to one of the answer choices that you will be
 able to recognize which answer to choose! 58 x 88 → 60 x 90 = 5,400

 **a.**  95 **b.** 84 **c.** 6⟌516  **d.** 9⟌2187

 x 16 x 73

*Example:* Work with parts of a calculation that are easier first! In the next example you can see that
 the person chose to simplify parts of the equation in a stepwise manner until they were
 down to simple numbers left over. It is key that you are GOOD at your multiplication facts!
 Old fashioned multiplication and long division can help a ton!

 8 x 15 x 3 =  ~~8~~  x 15 x 3 =  ~~8~~ x 15 x ~~3~~  = 15 = 5

 72  ~~72~~  9  ~~72~~   ~~9~~  3 3

*Practice:*

 **e.**  48 x 6 x 11 =

 4 x 18

  **f.** 28 x 60 =

 12 x 7 x 2

**Fractions**

Fractions describe a part (numerator) of the total (denominator). As the numerator gets bigger, your final answer gets larger. As the denominator gets bigger, your final answer gets smaller. I always like to think of a pizza and slices per person. Three slices divided by one person 3/1 = 3 sounds good to me. One slice divided by 3 people 1/3 = 0.33 isn’t that great.

Here are the fractions that are most helpful to remember. MEMORIZE THEM!

$\frac{1}{2}=0.5$ $\frac{1}{4}=0.25$ $\frac{3}{4}=0.75$

$\frac{1}{5}=0.2$ $\frac{2}{5}=0.4$ $\frac{3}{5}=0.6$ $\frac{4}{5}=0.8$

$\frac{1}{3}=0.33...$ $\frac{2}{3}=0.66...$

*Practice:*

 **a.**  $\frac{1}{2}=$ **b.** $\frac{1}{3}=$ **c.** $\frac{1}{4}=$ **d.** $\frac{1}{5}=$

 **e.** $\frac{2}{3}=$ **f.** $\frac{3}{4}=$ **g.** $\frac{1}{8}= $ **h.** $\frac{3}{2}=$

*Example:* Converting decimals into fractions and then multiplying can help a lot.

 0.75 x 0.5 → $\frac{3}{4}x \frac{1}{2}=\frac{1}{8} = 0.375 $

*Example:* Splitting fractions you don’t know the decimal equivalent of into fractions you do know, and
 then adding the decimals can be helpful also.

 $\frac{2}{5} = \frac{1}{5}+\frac{1}{5}= 0.2+0.2 = 0.4$

*Practice:*

 **a.** $\frac{2}{25}=$ **b.** $\frac{3}{25}=$ **c.** $\frac{5}{25}=$ **d.** $\frac{9}{25}=$ **e.** $\frac{12}{25}=$

*Example:* It is often easier to deal with problems if you can remember to factor out and/or distribute.

 $\frac{1}{8}x\frac{1}{5}=\frac{1}{40}=\frac{1}{4}x\frac{1}{10}=0.25 x \frac{1}{10}=0.025$

*Example:* Sometimes it is easier to solve problems by converting to scientific notation. When dividing
 exponents, subtract the exponents. When multiplying exponents, add the exponents.

 am x an = am + n am / an = am - n (am)n = am x n (ab)m = ambm

 a0 =1 a-n = $\frac{1}{a^{n}}$

$\frac{0.0060}{2400}= \frac{6 x 10^{-3}^{}}{24 x 10^{2}^{}}= 0.25 x 10^{-5}= 2.5 x 10^{-6} $

*Practice:*

 **a.** $\frac{100 x 0.10}{0.001 x 0.010}=$ **b.** $\frac{1}{1000 x 0.010}=$

 **c.** $\frac{10 x 0.0010}{10,000 x 0.010}=$ **d.** $\frac{0.10 x 0.010}{1000 x 100,000}=$

*Example:* To simplify fractions composed of fixed decimal numbers, the decimals on the top and bottom can
 be moved the same number of places - to get an easy division problem or a fraction with a familiar
 decimal equivalent.

 $\frac{0.440}{0.020}$ → move decimal two places to the right, for both numerator and denominator.

 $=\frac{44.0}{2.0}=22$

*Practice:*

 **a.** $\frac{0.025}{0.075}=$ **b.** $\frac{5.6}{0.70}=$

 **c.** What mass of NaOH is needed to make 250mL of a 0.5 M solution?

 **d.** What mass of CuSO4·5H2O is needed to make 100mL of a 0.2 M solution?

 **e.** What mass of glucose is needed to prepare 125mL of a 0.8 M solution?

**Square Roots and Logs**

*Example:* Remember that instead of taking a square root or cube root, you can raise the number to the
 corresponding fraction instead. This can sometimes be easier/faster than finding and using the
 official buttons in your calculator.

 x2 = 34 → x = $\sqrt{34}$ OR x = (34)½ → x = 5.83

 x3 = 82 → x = $\sqrt[3]{82}$ OR x = (82)⅓ → x = 4.34

x2 = 2.5 x 10-9 x2 = 25 x 10-10 x = 2.5 x 10-10 OR x = (2.5 x 10-10)1/2

Know how to use your calculator to perform logarithmic functions (log), inverse of logarithmic functions 10x, natural logarithmic functions (ln), and the inverse of natural logarithmic functions ex.

Basic logs should be memorized.

Logs of anything less than 1 = negative log 1 = 0

Logs of anything greater than 1 = positive log 10 = 1

Estimating pH values can be very helpful. It can be a quick way to rule out some answer choices!
The trick is to take the absolute value of the exponent and subtract 10% of the coefficient (the number that comes before the x 10x part). The answer will be approximately 0.1 - 0.2 “off” from the real answer.

 pH = -log (c x 10x)

 Estimated pH = x - 10%(c)

 If calculating a pH from [H+] your answer will be about 0.1 - 0.2 HIGHER than the real answer.
 If calculating a pH from [OH-] your answer will be about 0.1 - 0.2 LOWER than the real answer.

*Example:*

 pH = -log(5.6 x 10-6) → 6 - 0.56 = 5.44 → real answer is 5.25, pretty close! *(estimate was higher)*

 [OH-] = 7.1 x 10-9 pOH = -log(7.1 x 10-9) → 9 - 0.71 = 8.29 → pH = 14 - 5.71 *(estimate was lower)*
 real answer is 5.85, pretty close!

**Practice Quiz on the next page!**

**Practice Quiz!**

Do not use a calculator!

**1.** Convert to 0.XXX

 **a.** 32 / 36 = **b.**  $\frac{10 x 15}{12 x 50}=$ **c.** $\frac{6}{25}=$ *hint:* $\frac{1}{25}=0.04$

**2.** Answer as a 10x

 **a.**  $\frac{100 x 0.10}{0.010}=$ **b.**  $\frac{1}{10^{-8} x 0.10}=$

**3.** Write the final answer in scientific notation with two digits in the significand (coefficient).

 **a.** (0.0060 x 109)(0.070) = **b.**  $\frac{16}{400 x 10^{9}}=$

 **c.**  $\frac{ 10^{5}}{2.0 x 10^{-7}}=$ **d.**  $\frac{0.20}{0.009}=$

 **e.**  $\frac{48 x 10^{-5}}{120 x 10^{-3}}=$

**4.** Estimate the pH using the trick mentioned in this document. Identify if the estimate should be higher or lower than the
 actual pH

 **a.** [H+] = 2.3 x 10-8 **b.** [OH-] = 6.3 x 10-4

**Answer Key**1a. 0.888

1b. 0.20

1c. 0.240

2a. 103

2b. 109

3a. 4.2 x 105

3b. 4.0 x 10-11

3c. 5.0 x 1011

3d. 2.2 x 101

3e. 4.0 x 10-3

4a. 7.77, estimate = higher (real = 7.64)

4b. 10.63, estimate = lower (real = 10.80)