# AP CHEMISTRY

## TOPIC 1: CHEMICAL FOUNDATIONS, PART A

Day 2:

- Scientific Method:
- Precision and Accuracy:
- Temperature:
- Unit of Measurement:
- Significant Figures:
- Density:
- Uncertainty in Measurement:
- Dimensional Analysis (factor-label):
- Classification of Matter:

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1) Which of the following statements (hypotheses) could be tested as quantitative measurements? Explain
   a) Plainfield is better than Mooresville.

***This is not a quantitative measurement. There are no numbers and units (statistics) to prove otherwise. Also, this is a question that could be argued on many levels.***

   b) Tums consumes 35 times its weight in excess stomach acid.

***This is a quantitative measurement. "35 times its weight" is a number with a unit (just not defined)***

   c) The sample of gold is 99.85% pure.

***This is a quantitative measurement. 99.85% of the sample is gold, the other 0.15% (other "stuff")***

2) A student performed an analysis of a sample for its copper content and got the following results:

35.23% 35.19% 35.22% 35.21%

The actual amount of the copper in the sample is 33.22%. What conclusion can you draw about the accuracy and precision of these results? Explain.

***Answer:***

***The student's methods of measuring are "very good". The student's results could easily be duplicated if someone else (whose methods were good as well) tried to obtain the same data. This is an example of precision. All of the "mass values" allow for the student to obtain similar percentages (very close to each other). Even though the actual percent was incorrect by approximately 2%, the student was NOT to blame – blame it on the calibration of the equipment.***

3) Distinguish between physical changes and chemical changes. Give one example of each kind of change.

***Answer:***

***Physical changes involve a loss or gain of energy. The substance's properties (boiling point, etc.) DO NOT change if the substance changes from a liquid to a solid – no new substance is formed. In a chemical change, the properties ALWAYS change and a new substance is formed.***

4) How many significant figures are in each of the following (place your answer to the right of the number)

| | | | | | |
|---|---|---|---|---|---|
| 12 | ***2*** | 4.003 x $10^{12}$ | ***4*** | 2020 | ***3*** |
| 1000750 | ***6*** | 3.14 | ***3*** | 9.8130 x $10^{0}$ | ***5*** |
| 20000. | ***5*** | 10000 | ***1*** | 0.000003000 | ***4*** |
| .000000456 | ***3*** | 220.000000100 | ***12*** | 1,000,000,000 | ***1*** |

5) Use exponential notation (scientific notation) to the express the number 630 to:

a) one significant digit ***600 or 6 x $10^{2}$***

b) two significant digits ***630 or 6.3 x $10^{2}$***

c) three significant digits ***630. or 6.30 x $10^{2}$***

d) four significant digits ***630.0 or 6.300 x $10^{2}$***

e) five significant digits ***630.00 or 6.3000 x $10^{2}$***

6) Perform the following mathematical operations, and express each result to the correct number of significant figures:

a) $\frac{0.220 \times 0.0531 \times 466}{5.01} =$ ***calculator = 1.08658922*** ***correct = 1.09***

b) ( 6.02 x $10^{23}$ ) x 3.022 = ***calculator = 1.819244 x $10^{24}$*** ***correct = 1.82 x $10^{24}$***

c) 34.76 + 8.6 + 2349.023 = ***calculator = 2392.383*** ***correct = 2392.4***

d) $\frac{4567.02}{67.2 + 4.2000} =$ ***calculator = 63.96386555*** ***correct = 64.0***

7) How many milligrams are in 7 nanograms? (show all work)

***Answer:***

$$\frac{7\ ng}{}\times\frac{1\ mg}{10^{6}\ ng}\ =\ 7\times10^{-6}\ mg \quad \textbf{\textit{( 1 sig fig )}}$$

8) How many how many milliliters are in 73 cubic meters? (show all work)

***Answer:***

$$\frac{73\ m^{3}}{}\times\frac{(10^{2}\ cm)^{3}}{(1\ m)^{3}}\times\frac{1\ mL}{1\ cm^{3}}\ =\ 7.3\times10^{7}\ mL \quad \textbf{\textit{( 2 sig fig )}}$$

9) The circumference of the earth is 25,000 miles at the equator. What is the circumference in kilometers? (show all work)

***Answer:***

$$\frac{25000\ miles}{}\times\frac{5280\ ft}{1\ mile}\times\frac{12\ inches}{1\ ft}\times\frac{2.54\ cm}{1\ inch}\times\frac{1\ km}{10^{5}\ cm}\ =\ 4.0\times10^{4}\ km \quad \textbf{\textit{( 2 sig fig )}}$$

10. A person has a body temperature of 38.5 $^{0}$C, how many Kelvins is this equal to?

***Answer:***

38.5 + 273 = 311.5 K

11. A star has an estimated mass of 3.5 x $10^{36}$ kilograms. Assuming it to be a sphere of average radius 6.5 x $10^{5}$ kilometers, calculate the average density of the star in units of grams per cubic centimeter. (show all work)

***Answer:*** ***Density = mass / volume***

***Volume =*** $\frac{4}{3}\pi r^{3}\ =\ \frac{4}{3}(\pi)(6.5\times10^{5}\ km)^{3}\ =\ 1.15\times10^{18}\ km^{3}$

***Convert:*** $\frac{1.15\times10^{18}\ km^{3}}{}\times\frac{(10^{5}cm)^{3}}{(1\ km)^{3}}\ =\ 1.15\times10^{33}cm^{3}$ ***and*** $\frac{3.5\times10^{36}\ kg}{}\times\frac{10^{3}\ g}{1\ kg}\ =\ 3.5\times10^{39}\ g$

***Density =*** $\frac{3.5\times10^{39}g}{1.15\times10^{33}\_cm^{3}}=3.0\times10^{6}\frac{g}{cm^{3}}$

12. The density of gold is 19.7 g/cm$^3$. If a 2.50 kilogram rectangular block of gold has two dimensions of 3.7 cm x 6.5 cm, calculate the third dimension of the block.

***Known: Density = 19.7 g/cm$^3$, Mass = 2.50 kg of gold,***

***Problem: Calculate volume to get the third dimension***

***Volume = mass / density***

$$\textbf{\textit{Volume}} = \frac{2.50\times10^3\ g}{19.7\ \frac{g}{cm^3}} = 127\ cm^3$$

$$\textbf{\textit{Third dimension}} = \frac{127\ cm^3}{(3.7\ cm)(6.5\ cm)} = 5.3\ cm$$

13. Classify the following as chemical changes ( CC ) or physical changes ( PC ):

a) Moth balls gradually vaporize in a closet.

***(PC) Physical, when something goes through a deposition (changes from a solid to a gas), that is a physical change. The vapors you smell are "moth balls"***

b) Hydrofluoric acid attacks glass, and was used to etch the "chicken-hawk" (oriole) on the glass at the student services office.

***(CC) Chemical, the hydrofluoric acid "burns" or etches its way into the glass (silicon) and changes the glass chemically.***

c) A French chef making a sauce with brandy is able to burn off the alcohol from the brandy, leaving the brandy flavoring.

***(CC) Chemical, anytime you remove one "part" of a substance and leave another part behind is chemical***

d) Chemistry majors (in college) sometimes get holes in the cotton jeans they wear to lab because of acid spills.

***(CC) Chemical, the acid "dissolves" the cotton fibers, which forms the holes.***