1. (3 points) Indicate the number of significant figures in each of the following measured quantities: (**This problem has no partial credit**)

    a. 1,302,400 km   **5 significant figures**

    b. 0.000 826 9 mAmp   **4 significant figures**

    c. 3024000.0 cd   **8 significant figures**

2. (3 points) Round of each of the numbers listed to the given number of significant figures and present the answer in the correct scientific notation. (**There is no partial credit on this problem)**

    a. 2,600,961 (5 sig figs)   **2.601 0 x 10^6**

    b. 1,295.71 (4 sig figs)   **1.296 x 10^3**

    c. 0.001 265 982 (5 sig figs)   **1.266 0 x 10^{-3}**

3. (5 points) Platinum, one of the noble metals, has a melting point of 1768.3°C, while nitrogen has a boiling point of -452.13°F. What are these temperatures in Kelvin? **Show your work for full credit**

1768.3°C(1K/1°C) + 273.15K= 2041.5K

$$\frac{-452.13°F - 32°F\ (exact)}{1.8\ °F/°C} = -268.9\overline{6}°F$$

—268.9$\underline{6}$1°C + 273.15K= 4.19K

4. (6 points) Indicate which of the following statements represent exact (E) or inexact (I) numbers:
    a. **Inexact measurement** The width of the Nile River
    b. **Inexact measurement** The volume of a cloud
    c. **Exact counted value or by definition** The number of nickels in a dollar
    d. **Exact counted value or by definition** The number of sheets of paper in a ream (package) of paper.

_____

Differentiate between exact and inexact numbers with a complete sentence.

_____

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Numbers obtained by measurement are inexact because the number represents uncertainty in the measurement process. Exact numbers have defined values and have no uncertainty. Exact numbers are most often values that arise from counting or are by definition.

5. (4 points) These values are not written in the most appropriate metric prefix. Re Write them please. **Show the math and reasoning you used to support your answer.**

   a. (1 point) $1.23 \times 10^{7} \times 10^{-18}$m

Combine exponents Find closest prefix/exponent value.
$1.23 \times 10^{7} \times 10^{-18}$m $= 1.23 \times 10^{-11}$m.

1.23×10^{-11}m.	10^{-1}m	10^{+1}m	1 pm	= 12.3 pm
			10^{-12}m	

   b. (3 points) 123,456 nm^{2}

Expand units, convert to appropriate exponents, combine exponents. Find the exponent/prefix that is closest to the total exponent divided by the power of the unit.
123,456 nm x nm

$1.234\ 56 \times 10^{6}$x nm x nm	10^{-9} m x 10^{-9} m	= $1.234\ 56 \times 10^{-12}$x m x m

$1.234\ 56 \times 10^{-6}$ m x 10^{-6} m	1μm x 1μm	= 0.123 456 μm^{2}
	10^{-9} m x 10^{-9} m	

6. (4 points) A certain substance is cooled so that its temperature falls (changes) by 35°C. How many K (degrees Kelvin) does the temperature fall? Pick the appropriate answer and explain your answer. (**No explanation, no credit)**
   a. 308K
   b. –259 K
   c. **–35 K the change is negative ($\Delta T = T_f - T_i$) If $T_i > T_f$ the value of the difference is negative. But the absolute value is the same. So I accepted either answer. But why? Since the size of the °C and K are the same, but off-set by 273.15 (°C or K-look at the formula! -273.15°C and 273.15K) so the change in K is the same as the change in °C.**
   d. **35K**
   e. 95 K

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7. (3 points) Predict the ionic formula formed from the following pairs of elements. DO NOT NAME THE COMPOUND! (**There is no partial credit on this problem**)

   a. Sr and S **SrS because Sr is in group 2A (all 2+) and S is group 6A (nonmetals 2–)**

   b. K and N **K₃N because K is in group 1A (all 1+) and N is group5A (nonmetals 3–)**

   c. Mg and I **MgI₂ because Mg is in group 2A (all 2+) and I is group 7A (nonmetals 1–)**

8. (**6 points**) Complete the following table (**if the #Z, #p⁺, charge, #e⁻ were appropriate, you got points**

Isotopic symbol	Atomic number	Mass number	Protons	Neutrons	Electrons	Net charge
$^{59}_{27}Co^{3+}$	27	59	27	32	24	3+
$^{121}_{51}Sb$	51	121	51	70	51	0
$^{46}_{15}P^{3-}$	15	46	15	31	18	3–

9. (8 points) Which of the following is a chemical property of morphine and which is a physical property of morphine? Use [C] for chemical and [P] for physical.

   a. P____The solubility is 60 mg morphine sulfate in 100 mL of water at a temperature of 20°C.

   b. C____ Morphine binds directly to the central nervous system to decrease the feeling of pain and is metabolized through the liver.

   c. P____It melts at 255 °C.

   d. P____It is a white crystalline solid in pure form at room temperature.

   e. P____It has a molecular mass of 285.34 amu

   f. C____Morphine yields carbon dioxide and water vapor when burned.

   How did you distinguish between a physical property and a chemical property?

   Physical changes and properties help chemists identify matter without 'changing' the overall composition or appearance of the matter.

   Chemical changes and properties are indicative of how matter changes. There are characteristic changes that matter undergoes in a chemical transformation that chemists can use to predict reaction behavior.

10. (6 points) Perform the following calculation and report your answer with the correct significant figures and units. **(Show your work for partial credit)**
    a. (1 point) 2.171 012 1 g + 4.320 1 g + 401.278 77 g + 21.826 g

```
  2.171 012 1 g
  4.320 1 g
401.278 77 g
 21.826 g
429.595 882 1 g        429.596 g
```

    b. (3 points) $2.156\ 934\ 51 \times 10^{86}$ °C + $2.314\ 276\ 9 \times 10^{88}$ °C + $2.954\ 681\ 211 \times 10^{90}$ °C

change all the exponents to 10^{86}; move decimals to reflect proper columns; do operation; sci note

$2.156\ 934\ 51 \times 10^{86}$ °C	$2.156\ 934\ 51 \times 10^{86}$ °C	$2.156\ 934\ 51$
$2.314\ 276\ 9 \times 10^{88}$ °C	$2.314\ 276\ 9 \times 10^{2} \times 10^{86}$ °C	$231.427\ 69$
$2.954\ 681\ 211 \times 10^{90}$ °C	$2.954\ 681\ 211 \times 10^{4} \times 10^{86}$ °C	$29{,}546.812\ 11$
		$29{,}780.396\ 734\ 51$
$29{,}780.396\ 76 \times 10^{86}$	$29{,}780.396\ 76 \times 10^{4} \times 10^{86}$	**$2.978\ 039\ 673 \times 10^{90}$ °C**

    a. (2 points) $[10^{123} \times 10^{-16}] / [10^{-18} \times 10^{82}]$ **exponential math**

Here is how the exponents work out
Top $123 + (-16) = 107$
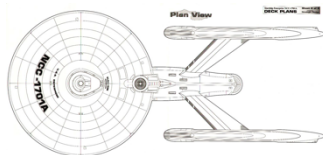Bottom $-18 + 82 = 64$
$107 - 64 = 43$
10^{43}

11. **(5 points)** Science fiction often uses nautical analogies to describe space travel. In the words of Captain Picard, "It's continuing mission: to explore strange new worlds, to seek out new life and new civilizations, to boldly go where no one has gone before.

If the starship *U.S.S. Enterprise* is traveling to this new world at Warp Factor 2.56, what is its speed in yd/s?
(Warp factor 1.709 = 5 times the speed of light; speed of light is 2.998×10^{8} m/s; 1 knot is **exactly** 0.562 6 yd/s, 1 meter = 1.093 613 3 yd)

2.56 warp factor	5 x speed of light	2.998×10^{8} m	1.093 613 3 yd	= 2.4556×10^{9} yd/s
	1.709 warp factor	1s	1 m	

Final answer: **2.46×10^{9} yd/s**
It was a trick!! You don't need knots. WATCH YOUR UNITS!

12. **(4 points)** Recently surfaced is " The Periodic Table of Rejected Elements," constructed by Gerber and Schwartz, noted table-ologists. There is something wrong with the name, the symbol or both. As a hint, they have included the atomic number, which is the only thing correct in this periodic table. Please correct the errors by writing **<u>BOTH</u>** the name and symbol. **SPELLING COUNTS!**

Architectural elements:

32	Cafetorium (Ct)	**Ge, Germanium**
51	Auditorium (Ad)	**Sb, Antimony**
80	Gymnasium (Gy)	**Hg, Mercury**
48	Sanatorium (Sa)	**Cd, Cadmium**

13. (5 points) Classify each of the following as an element [E], a compound [C], or a mixture [M]
    a. E   Graphite
    b. M   Blood
    c. C   Butane gas ($CH_3CH_2CH_2CH_3$)
    d. M   air
    e. C $K_2C_2O_4$

14. (6 points) As we learned in Chapters 1, 10, & 11, intermolecular forces are the forces that keep matter in the most stable phase (or state) at room temperature. Answer the following as True (T) or False (F) about solids, liquids, gases, and intermolecular forces. Correct the wrong answer by crossing out the part that makes it false and giving the word(s) that make it true. **Your answer must be legible and understandable. If you think I will not understand your answer, re-write the statement with the correction in the space provided (This is a good thing to do!)**

    a) [T/F] In solids, the intermolecular forces are strong enough to resist molecular motion. **this is true! That is why they are solid.**

    b) [T/F] The three types of intermolecular forces that exist between neutral molecules are: dispersion forces, hydrogen bonding, ~~and ion-dipole forces.~~ **Ions are charged and are not molecules. The three forces are dispersion, hydrogen bond, and dipole-dipole**

    c) [T/F] Gases expand spontaneously to fill its container, flow readily, and are virtually ~~incompressible.~~ **The first two are correct; gases expand to fill containers and flow readily. Gases are compressible.**

    d) [T/F] The phase (or state) of a substance is the balance between the kinetic energies of the particles and intermolecular forces between them. **Increasing the KE of matter changes the phase from solid to liquid and so on.**

    e) [T/F] Gases have the ~~strongest~~ dispersion forces between particles. **Gases have the weakest interaction. This leads to the characteristic properties of gases.**

    f) [T/F] Water molecules experience dispersion forces, dipole-dipole interactions, and ~~ion-dipole~~ bonds. **Water has strong hydrogen bonds.**

15. (5 points) Two isotopes of thallium occur in nature: isotope 1 has a mass of 204.974 amu and an abundance of 70.525% while isotope 2 has a mass of 202.972 3 amu and an abundance of 29.475%. Find the atomic mass of the element. For full credit, you must show your work.

204.974 amu x 0. 705 25 + 202.972 3 amu x 0. 294 75 = 144.557 9 amu + 59.826 08 = 204.384 amu

It should make sense that the atomic weight is closer to the mass of the most abundant isotope.

16. (5 points) In Chapter 2, we studied the basic architecture of the atom. Answer the following by identifying the true and false statements. Correct the wrong answer by crossing out the part that makes it false and giving the word(s) that make it true. **Your answer must be legible and understandable. If you think I will not understand your answer, re-write the statement with the correction in the space provided (This is a good thing to do!)**

    a. The nucleus of an atom contains ~~electrons~~ and protons. [T] [F]

 The nucleus of an atom contains NEUTRONS and protons.

    b. Millikan determined the charge to mass ratio of the electron. [T] **[F]**

    THOMPSON determined the charge to mass ratio of the electron

    c. The nucleus of an atom ~~can be positively or negatively charged depending on identity of the atom.~~ [T] **[F]**

The nucleus of an atom IS ALWAYS POSITIVE INDEPENDENT OF THE IDENTITY OF THE ATOM

    d. The charge of the ~~neutron~~ and the electron are equal but opposite in sign. [T**] [F]**

The charge of the PROTON and the electron are equal but opposite in sign.

    e. The number of ~~neutrons~~ in the nucleus is equal to the number of electrons outside of the nucleus. [T] **[F]**

The number of PROTONS in the nucleus is equal to the number of electrons outside of the nucleus.

17. (7 points) Give one example (atomic symbol and name) for each of the following (**SPELLING COUNTS!]**:

   a) A transition element, which is noble metal besides platinum; **Cu, copper; Ag, silver; Au, gold**

   b) A reactive, green-yellow gas; the halogen gas that is denser than air. **Two of the halogens are gases, fluorine (yellowish, but lighter than air) and chlorine (Yellow-green and much denser than air). Cl, chlorine**

   c) The main group (representative) element in the fourth period and 5th group **As, arsenic**

   d) An alkali metal in the sixth period **Cs, cesium**

   e) An alkaline earth metal in the fifth period, **Sr, strontium**

   f) A liquid diatomic, **the diatomic elements are hydrogen, nitrogen, fluorine, chlorine (all gases), bromine, and iodine (respectively, a liquid and a solid) Br, Br$_2$ bromine.**

   g) The noble gas whose Z is 54>Z>18 **element 18 is argon, element 54 is xenon, the noble gas in-between is Kr, superman some planet, Krypton.**

18. (5 points) In Chapter 2 and 7, we are introduced to the periodic table. Answer the following by identifying the true and false statements. Correct the wrong answer by crossing out the part that makes it false and giving the word(s) that make it true. **Your answer must be legible and understandable. If you think I will not understand your answer, re-write the statement with the correction in the space provided (This is a good thing to do!)**

   a. [T] [F] The density of an element ~~decreases~~ down a family. **FALSE: The density of an element INCREASES down a family because the mass of the atom increases with increasing proton number. The volume is staying constant in density, so…**

   b. [T] [F] Elements can be classified as either ~~metalloids~~ or metals. **FALSE; I would accept metals and nonmetals or metals, non metals, and metalloids.**

   c. [T] [F] The elements above the staircase are ductile, malleable, lustrous solids (for the most part) that are good conductors of heat. **FALSE: these are the properties of metals which are found below the stair case.**

   d. [T] [F] Aluminum is a metalloid. **FALSE: Aluminum is a metal. It is below the staircase and has more metal than non-metal properties.**

   e. [T] [F] The elements of group 4A show an interesting change in properties moving down the group, in that the elements become less metallic. **FALSE: metallic character increases down a family.**

19. **(6 points)** You can dissolve an aluminum soft drink can in an aqueous base such as KOH. You place 2.05g Al in a beaker with 4.12 mL of water, and 4.26 g KOH and allow the reaction to occur. You make 10.20 g of $KAl(OH)_4$ (and some mass of hydrogen gas). The gas is cooled to a pressure of 1.00 atm and a temperature of 0.0°C. Assume the density of water is 1.00g/mL

The density of hydrogen gas at this temperature and pressure is 0.0899 g/L. What is the volume of hydrogen gas produced? [You do not need a balanced equation, gas law information, or formulas for this problem]
2.05g Al + 4.12 g of water + 4.26 g KOH = 10.43 g of reactant = 10.43 g of product.
10.43 g product —10.20 g of $KAl(OH)_4$ = 0.23g of hydrogen
0.23 g Hydrogen ÷ 0.0899 g Hydrogen/L =2.558 L, **2.6 L H_2 gas made**

In terms of Dalton's law, what does this prove?
This process proves that the Law of Conservation of Mass is obeyed in a chemical process. This means the mass of the products of a chemical reaction must equal the mass of the reactants before the reaction

1. (6 points) Balance the following equations, for this question, if the coefficient is 1[one], put that in the line as well. You will lose points if you leave the lines blank:


   a.   ___4__BCl_3 +__1___P_4 +___6__H_2 → ___4__BP + ___12__HCl

   b.   ___2_$C_9H_8O_3$ + __19__O_2 → __8__H_2O + __18__CO_2

   c.   ___1_NCl_3 + _3__H_2O →_1___NH_3+__3__HOCl

   d.   __1__$CaCO_3$ + __2__HCl → __1__$CaCl_2$ + __1__H_2O + __1__CO_2
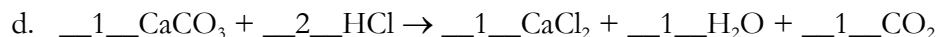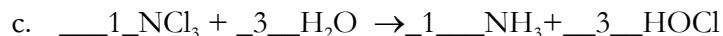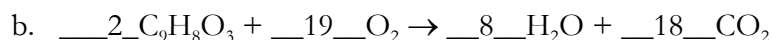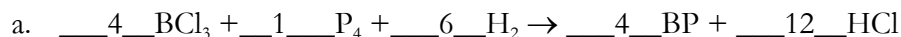
   e.   Which of the reactions above represents a combustion? Explain your choice in one or two sentences. (2 points)

A combustion reaction occurs between an organic compound and oxygen producing carbon dioxide and water. The only reaction that follows these criteria is b. it might seem that d is a combustion. Although water and carbon dioxide are produced, the reactants are not organic or oxygen.

2. **(7pt)** Answers the questions below:

30 | 20 (graduated cylinder)

a. (1 point) What is the volume contained in the graduated cylinder in mL?
25.8 mL ± 0.1mL

A   B   C   D
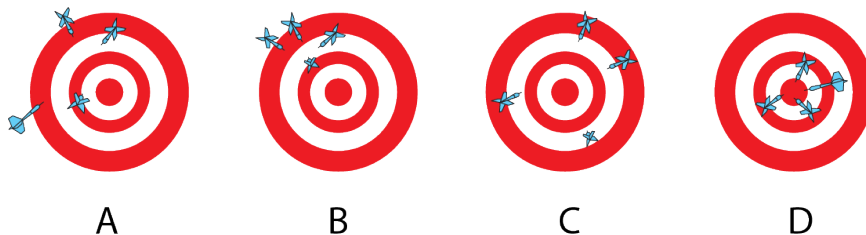
b.   (4 point) Burt (A), Ernie (B), Kermit (C), and Gonzo (D) enter a dart contest. The prize is an all-expense paid trip to Sesame Street. The winner will be the dart player who is the most accurate **and** precise.
This problem is about precision vs accuracy. Values that are precise are closely grouped. Precision can indicate good technique. Accuracy is a measure of the grouped values to an accepted value.
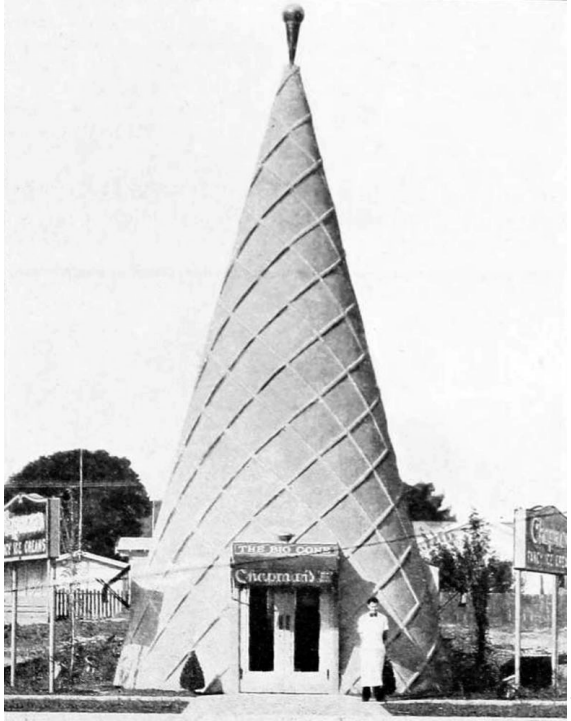
i.   Is Ernie (B) more accurate than Gonzo (D? Explain your choice in one or two sentences.

Gonzo is more accurate than Ernie. The goal of the game is to hit the bulls eye. Ernie has good grouping, a measure of precision, but poor accuracy.

ii.   Is Burt (A) more precise than Ernie (B)? Explain your choice in one or two sentences. **Burt is less precise than Ernie because his grouping is very poor. The darts are spread out.**

iii.   Who should win the trip to Sesame Street? Why? **Gonzo should win the trip. He is both precise and accurate. His darts are close together and are near the bull's eyes. I hope he takes Ernie with him.**

3. (10 points) The building pictured below is a perfect cone (ice cream cone, that is!). The volume of a cone is represented by the formula: $V = \frac{\pi r^2 h}{3}$, where h is the height of the building (or cone). Find the radius of the base of the building, if the height of the building is 0.000 0131 997 Mm. and the volume is 0.04370 **da**m^3 (1**da**m [**deca**meter] $=10^1$m, same idea as the cm and cm^3)

[1]

$$r = \sqrt{\frac{3V}{\pi h}}$$

4.370×10^{-2} **da**m x dam x dam	10^1 m x 10^1 m x 10^1 m	$= 4.37\,0 \times 10^1$ m x m x m
	dam x dam x dam	

1.319 971 0^{-5} Mm	10^6m	$= 13.199\,710$ m
	1Mm	

$$r = \sqrt{\frac{3 x 4.370 x 10^1 m^3}{\pi\ 13.199\ 710\ m}}$$

r = 1.778m

[1] https://i0.wp.com/www.martinturnbull.com/wp-content/uploads/2011/07/LAChapmansBigCone.jpg