Review—Chem Honors
Chapter 2: Matter and Measurement

Name Answer Key
Period________ Date__________

Test Statistics and format:

- Test will be a combination of short answer, problem solving and short explanation questions.
- Test should be a total of 60-70 points.
- Study all concepts covered in notes, worksheets, and labs (Candle, and Density Lab)
- My suggestion is to PRACTICE problems and practice answering questions. Don't just READ!!!

Topics:

- units: base vs. derived
- scientific notation *(with and without a calculator)*
- accuracy vs. precision
- percent error (*equation on reference sheet*)
- significant digits *(counting # of sig figs and properly rounding answers to proper # of sig figs)*
- density: concept and problem solving *(rearranging equation, plugging in numbers, writing units)*
- dimensional analysis (factor label) conversions *(using method properly to convert any type of units)*
- metric unit conversions: use factor label method to convert metric units

Practice questions:

1) **Scientific notation--** Do not use a calculator to do this question.

Express the following quantities in scientific notation:

a) 7770 g 7.77×10^{3} g
b) 0.0125 cm 1.25×10^{-2} cm
c) 250,000 L 2.5×10^{5} L

Express each # as either a whole number or a decimal:

d) 5.05×10^{2} s 505 s
e) 2.0054×10^{-3} m 0.0020054 m
f) 8.1×10^{5} J 810 000 J

2) Determine the number of significant digits in each of these numbers.

a) 0.000345 g 3
b) 500.00 km 5
c) 220 paperclips ∞
d) 30,050 L 4
e) 1000 yrs/millennium ∞
f) 0.0076080 mg 5

3) Make the following calculations. You must be able to do these questions **WITHOUT** a calculator. Show initial calculations before converting to valid scientific notation, with the correct significant digits and units

a) $(3.0 \times 10^{3}\ \text{mm})(6.00 \times 10^{-5}\ \text{mm}) = \boxed{18 \times 10^{-2}\ \text{mm}^2 \rightarrow 1.8 \times 10^{-1}\ \text{mm}^2}$

b) $\dfrac{144.0\times10^{2}\ \text{km}}{12.0\times10^{7}\ \text{s}} = \boxed{12.0\times10^{-5}\ \text{km/s} \rightarrow 1.20\times10^{-4}\ \text{km/s}}$

4) Perform the following calculations, expressing your answers with the appropriate number of **significant digits** and **correct units**. *You may write answers in scientific or regular notation.* You may use a calculator.

a) $\dfrac{0.0050\ \text{g}}{2.03\ \text{mL}} = \boxed{2.5\times10^{-3}\ \text{g/mL}}$ (2 SF)

b) $(19.1\ \text{m})(8.010\ \text{m})(4{,}023\ \text{m}) = \boxed{6.15\times10^{5}\ \text{m}^3 \text{ or } 615{,}000\ \text{m}^3}$ (3 SF)

c) $\dfrac{7.87\ \text{m} + 2.3\ \text{m}}{65.7\ \text{s}} = \dfrac{10.2\ \text{m}}{65.7\ \text{s}} = \boxed{0.155\ \text{m/s}}$ (0.1 place in addition, 3 SF in division)

5) Why is it important to write calculated answers with the proper number of significant digits?
Because it indicates the precision to which we know the result.

6) Which has a greater density: 1 g of water or 10 g of water? The densities are the same (both water!)
7) Which has a greater density: 1g of lead or 10 g of water? Lead is always more dense than water.
8) What would you rather have: a centigram of gold or a kilogram of gold? A kilogram of gold
9) Which has more volume: 1 mL of water or 1 cm^3 of alcohol? Same volume because 1 mL = 1 cm^3
10) What is the **volume** of a 20.1 g sample of glycerol if the density of this liquid is 1.26 g/ml?

$$D = \frac{M}{V} \text{ rearranges to } V = \frac{M}{D} = \frac{20.1 \text{ g}}{1.26 \text{ g/mL}} = \underbrace{15.952}_{3\,SF} \text{ mL} = \boxed{16.0 \text{ mL}}$$

11) When a sample of a metal alloy that has a mass of 9.65 g is placed into a graduated cylinder containing water, the volume reading in the cylinder increases from 16.0 mL to 19.5 mL. What is the density of the alloy sample in grams per cubic centimeter?

$$V = 19.5 \text{ mL} - 16.0 \text{ mL} = 3.5 \text{ mL (tenths place)}$$

$$D = \frac{M}{V} = \frac{9.65 \text{ g}}{3.5 \text{ mL}} = 2.757 \text{ g/cm}^3 = \boxed{2.8 \text{ g/cm}^3} \text{ (2 SF)}$$

12) If the accepted value for the density in the previous question is 2.701 g/cm^3, what is the % error?

$$\% \text{ Error} = \frac{\left|2.8 \text{ g/cm}^3 - 2.701 \text{ g/cm}^3\right|}{2.701 \text{ g/cm}^3} \times 100 = \frac{0.1 \text{ g/cm}^3}{2.701 \text{ g/cm}^3} \times 100\% = 3.665\% = \boxed{4\%}$$

Precision: tenths place (0.1) in subtraction, 1 SF in division

13) Make the following unit conversions using dimensional analysis. All numbers should have units. Write answers with proper number of **significant figures.**

a) 3.5 mg is how many g?

$$? \text{ g} = 3.5 \text{ mg} \times \frac{1\times10^{-3} \text{ g}}{1 \text{ mg}} = \boxed{0.0035 \text{ g or } 3.5\times10^{-3} \text{ g}}$$

2 SF

b) The radius of a sodium atom is 1.86×10^{-10} m. What is the radius expressed in picometers (pm)?

$$? \text{ pm} = 1.86\times10^{-10} \text{ m} \times \frac{1 \text{ pm}}{1\times10^{-12} \text{ m}} = \boxed{186 \text{ pm}} \text{ (3 SF)}$$

c) Convert 498.82 kW to MW (W is the symbol for watts, a unit of power).

$$? \text{ MW} = 498.82 \text{ kW} \times \frac{1\times10^3 \text{ W}}{1 \text{ kW}} \times \frac{1 \text{ MW}}{1\times10^6 \text{ W}} = \boxed{0.49882 \text{ MW}} \text{ (5 SF)}$$

d) How many μg/mL is 22.4 kg/L?

$$? \frac{\mu g}{mL} = \frac{22.4 \text{ kg}}{1 \text{ L}} \times \frac{1\times10^3 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ } \mu g}{1\times10^{-6} \text{ g}} \times \frac{1\times10^{-3} \text{ L}}{1 \text{ mL}} = \boxed{2.24\times10^7 \text{ } \mu g/mL} \text{ (3 SF)}$$

e) How much does 2.55 pounds of caviar cost in Russian rubles?

1 pound = 16.0 ounces **1 gram = 0.353 ounces** **1 gram = 2000 rubles**

$$? \text{ rubles} = 2.55 \text{ lbs} \times \frac{16.0 \text{ oz}}{1 \text{ lbs}} \times \frac{1 \text{ g}}{0.353 \text{ oz}} \times \frac{2000 \text{ rubles}}{1 \text{ g}} = 231{,}161.5 \text{ rubles} = \boxed{231{,}000 \text{ rubles} = 2.31\times10^5 \text{ rubles}}$$

3 SF (assume 1 g = 2000 rubles is defined)

f) A creature moves at a speed of 5.0 furlongs/hr. Determine the speed of the creature in m/s.

1 furlong = 201 m

$$? \text{ m/s} = \frac{5.0 \text{ furlongs}}{1 \text{ hr}} \times \frac{201 \text{ m}}{1 \text{ furlong}} \times \frac{1 \text{ hr}}{60 \text{ mins}} \times \frac{1 \text{ min}}{60 \text{ sec}} = 0.2792 \text{ m/s} = \boxed{0.28 \text{ m/s}} \text{ (2 SF)}$$

g) A car uses 0.050 cm^3 of oil for each kilometer it is driven. How much oil, in liters, is consumed if the car is driven 2.0×10^3 km? **1 mL = 1 cm^3**

$$? \text{ L} = \underbrace{2.0\times10^3 \text{ km}\times\frac{0.050 \text{ cm}^3}{1 \text{ km}}}_{1.0\times10^2 \text{ cm}^3}\times\frac{1 \text{ mL}}{1 \text{ cm}^3}\times\frac{1 \text{ L}}{1000 \text{ mL}} = \boxed{0.10 \text{ L}}$$

h) The standard pressure of the atmosphere is 14.7 lbs/in^2. *(This means that the atmosphere typically pushes down with a force of 14.7 pounds per square inch of surface area.)* Convert this standard pressure of the atmosphere into units of kg/cm^2. **1 inch = 2.54 cm; 1 lb = 453.6 g**

$$? \text{ lbs/cm}^2 = \underbrace{\frac{14.7 \text{ lbs}}{\text{in}^2}\times\underbrace{\left(\frac{1 \text{ in}}{2.54 \text{ cm}}\right)^2}_{=1 \text{ in}^2/6.4516 \text{ cm}^2}}_{2.2785 \text{ lbs/cm}^2}\times\underbrace{\frac{453.6 \text{ g}}{1 \text{ lb}}}_{1033.5 \text{ g/cm}^2}\times\frac{1 \text{ kg}}{1\times10^3 \text{ g}} = 1.0335 \text{ kg/cm}^2 = \boxed{1.03 \text{ kg/cm}^2} \text{ (3 SF)}$$

i) Traveling at 30.0 m/s, how many hours will it take to drive 345 km to Washington, DC?

$$? \text{ hr} = \underbrace{345 \text{ km}\times\frac{1\times10^3 \text{ m}}{1 \text{ km}}\times\frac{1 \text{ s}}{30.0 \text{ m}}}_{11{,}500 \text{ s}}\times\underbrace{\frac{1 \text{ min}}{60 \text{ s}}\times\frac{1 \text{ hr}}{60 \text{ min}}}_{=1 \text{ hr}/3600 \text{ s}} = 3.1944 \text{ hr} = \boxed{3.19 \text{ hr}} \text{ (3 SF)}$$

For these last few questions, you do not need to use dimensional analysis (though it often is helpful), but you must show all work and every number must have units. If a formula is used, you must rearrange the formula as needed before plugging in numbers.

14) The average density of living matter on Earth's land areas is 0.100 g/cm^2. What mass of living matter in kilograms would occupy an area of 0.125 ha?
(1 ha = 10,000 m^2)

$$? \text{ kg} = \underbrace{\underbrace{0.125 \text{ ha}\times\frac{10{,}000 \text{ m}^2}{1 \text{ ha}}}_{1{,}250 \text{ m}^2}\times\underbrace{\left(\frac{1 \text{ cm}}{1\times10^{-2} \text{ m}}\right)^2}_{1\times10^4 \text{ cm}=1 \text{ m}^2}}_{1.25\times10^7 \text{ cm}^2}\times\underbrace{\frac{0.100 \text{ g}}{1 \text{ cm}^2}}_{1.25\times10^6 \text{ g}}\times\frac{1 \text{ kg}}{1000 \text{ g}} = \boxed{1250 \text{ kg} = 1.25\times10^3 \text{kg}} \text{ (3 SF)}$$

15) A rectangular piece of a metal has a mass of 6.58 g. The metal piece is 0.560 mm thick, 36.5 mm long and 30.1 mm wide. What is the density of the metal in grams/cm^3?

$$\text{Volume} = l\times w\times h = (0.560 \text{ mm})(36.5 \text{ mm})(30.1 \text{ mm}) = 615.244 \text{ mm}^3$$

$$D = \frac{M}{V} = \underbrace{\frac{6.58 \text{ g}}{615.244 \text{ mm}^3}}_{0.010695 \text{ g/mm}^3}\times\underbrace{\left(\frac{10 \text{ mm}}{1 \text{ cm}}\right)^3}_{1 \text{ cm}^3=1000 \text{ mm}^3} = 10.695 \text{ g/cm}^3 = \boxed{10.7 \text{ g/cm}^3}$$

All starting numbers 3 SF

16) What volume of magnesium in cm^3 would have the same mass as 1.82 L of platinum?
Density of magnesium = 1.74 g/cm^3 **Density of platinum = 21.45 g/cm^3**

$$1.82 \text{ L}\times\frac{1000 \text{ mL}}{1 \text{ L}} = 1820 \text{ mL};\ D = \frac{M}{V};\ M = D\cdot V;\ \text{Mass}_{Pt} = (21.45 \text{ g/cm}^3)(1820 \text{ mL}) = 39039 \text{ g Pt}$$

Now to find the volume of magnesium with that same mass:

$$D = \frac{M}{V};\ V = \frac{M}{D} = \frac{39039 \text{ g}}{1.74 \text{ g/cm}^3} = \boxed{22{,}400 \text{ cm}^3}$$

Note: I kept a few extra sig figs in the mass and rounded correctly at the end.