

- (5 points) Classify each of the following with [E] for an element, [C] for a compound, [M] for a mixture. If it is a mixture, classify the mixture as homogeneous (HO) or heterogeneous (HE).

- Fruit salad (mango, pineapple, and oranges) **M. HE**; *can see distinct differences in the different components. Fruit can be separated by hand*
- Blood **M. HE**; *Blood settles on standing to form multiple layers. Can be separated with centrifuge.*
- Chocolate chip peanut butter chunk cookie **M. HE**; *can see distinct differences in the different components. chips can be separated by hand*
- Air **M. HO**; *And aren't we glad that our air is not chunky?*
- Graphite **E**; *element is an allotrope of carbon*
- Cream of tartar ($\text{KC}_4\text{H}_5\text{O}_6$) **C**; *compound, can't be physically separated.*

- (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**

$$1768.3^\circ\text{C}(1\text{K}/1^\circ\text{C}) + 273.15\text{K} = 2041.5\text{K}$$

$$\frac{-452.13^\circ\text{F} - 32^\circ\text{F} (\text{exact})}{1.8^\circ\text{F}/^\circ\text{C}} = -268.96^\circ\text{C}$$

$$-268.96^\circ\text{C} + 273.15\text{K} = 4.19\text{K}$$

- (3 points) How does the average kinetic energy of molecules compare with the average energy of attraction between molecules in solids, liquids, and gases? Use one or two complete sentences to support your answer.

50% points: faster, and lower or any answer like this

70% points: the average energy of attraction goes up with KE goes down or inversely proportional

80%-points: Solids have the lowest KE while gases have the highest KE. Solids are attractive, while gases are not.

90-100% points: Attractive forces give rise to phase. Strong attractive forces are very common in solids, and much weaker in liquids, and almost non-existent in gases. Gases, on the other hand, are highly kinetic, solids and liquids being less so. For molecules to move and be more kinetic, the system must possess more energy which weakens the ability for intermolecular forces to form.

- (1 points) Gallium melts at 302.92K and boils at 2478K . Is gallium a solid, liquid, or a gas at 325.76K . Explain your choice in one or two complete sentences

50% points: liquid

70% points: gallium is a liquid at 325.76K

80% points: Gallium is a liquid at 325.76K because it is above the melting point

90-100% points: The melting point is the temperature at which matter in the solid state becomes liquid and the boiling point is the temperature where matter in the liquid state becomes a gas.

Gallium is a liquid at 325.76K because it is above the melting point and below the boiling point.

5. (3 points) Complete the following table. Write the correct symbol with both superscript and subscript of each of the isotopes and fill in the gaps in the table. (This problem has no partial credit)

Isotopic symbol	Atomic number	Mass number	Protons	Neutrons	Electrons	Net charge
${}^{39}_{19}\text{K}$	19	39	19	20	19	0
${}^{87}_{38}\text{Sr}^{2+}$	38	87	38	49	36	2+
${}^{65}_{33}\text{As}^{3-}$	33	65	33	32	36	3-

6. (6 points) Indicate which of the following are exact numbers or inexact numbers by designating your choice with an (E) or (I):
- I The width of the Nile River
 - I The volume of a cloud
 - E The number of nickels in a dollar
 - I The temperature of the surface of the sun
 - I The number of toes on your feet.
 - Differentiate between exact and inexact with a complete sentence.

80%-points: Exact numbers are counted or are defined; inexact numbers are due to measurements

90-100% points: Exact numbers are counted values or are definitions of values. They have infinite number of significant figures and do not affect sig fig answers in a problem. Inexact numbers arise from measurement. They have finite significant figures based on the measuring device and can affect sig figs in an answer.

7. Benzoic acid, $\text{HC}_7\text{H}_5\text{O}_2$, melts at 122°C . The density in the liquid state at 130°C is $1.08\text{g}/\text{cm}^3$. The density of solid benzoic acid at 15°C is $1.266\text{g}/\text{cm}^3$.
- In which of these two states is the average distance between molecules greater?
 - If you convert a cubic centimeter of liquid benzoic acid into a solid, would the solid take up more volume or less volume than the original cubic centimeter of liquid?

The volumes are the same; the mass becomes the determining factor for part a. The mass of the solid is greater than the mass of the liquid. This means more material is packed in the volume of the solid than the volume of the liquid. The distance between molecules of the liquid must be greater than that of the solid.

The liquid has less material in it than the solid. The mass to unit volume for the liquid is smaller than the mass to volume for the solid. The mass is not going to change when the liquid sample is frozen. Lower mass means less molecules in the sample. The molecules will be closer because the density of the solid is greater than the density of the liquid. The volume will decrease as the benzene freezes. You can prove it with math! Let's say I have 1 mL of liquid benzene. The mass is 1.08g. I am going to cool this down to 15°C . the density of benzene at 15°C is $1.266\text{g}/\text{mL}$.

1.08 g benzene at 15°C	1 mL benzene at 15°C	=0.853 mL
	1.266 g benzene at 16°C	

8. (2 points) A student measuring the temperature of water mixed with salt, reported a change of -23°C . What is this temperature **change** in kelvins?

C answer: The change in kelvin will be -23°C .

B & A answers: The negative sign indicates a temperature decrease. The size of the degrees of $^{\circ}\text{C}$ and kelvin are the same. The temperature in kelvin is offset by 273.15.

$$\Delta T = T_f - T_i$$

$$T_{\text{Kf}} - T_{\text{Ki}} = [T_{\text{Cf}}(1\text{K}/1^{\circ}\text{C}) + 273.15\text{K}] - [T_{\text{Ci}}(1\text{K}/1^{\circ}\text{C}) + 273.15\text{K}]$$

9. (5 points) Indicate the number of significant figures in each of the following measured quantities: (This problem has no partial credit)
- a) 9.356 93 ms **6**
 - b) 0.000 005 010 m^2 **4**
 - c) 6, 539, 076, 000 mol **7**
 - d) 274.158 K **6**
 - e) $1.930\,076\,85 \times 10^{-6}$ dL **9**
10. (6 points) An antacid tablet weighing 0.853-g contained calcium carbonate as the active ingredient, in addition to an inert binder. When an acid solution weighing 56.519 g was added to the tablet, a solution was created and carbon dioxide gas was released, producing a fizz. If all the carbon dioxide was released in the reaction, and the resulting solution weighed 57.152 g, **how many grams of carbon dioxide were released?** [You do not need a balanced equation, gas law information, or formulas for this problem] **In terms of Dalton's law, what does this prove?**

$$56.519\text{ g} + 0.853\text{ g} = 57.372\text{ g reactant} = 57.372\text{ g product}$$

$$57.372\text{ g product} - 57.152\text{ g} = 0.22\text{ g of carbon dioxide.}$$

This illustrates the Law of Conservation of Matter (and mass). Matter (atoms) cannot be created or destroyed in a chemical process. It is merely rearranged.

11. (8 points) In the opening scenes of the movie Raiders of the Lost Ark, Indiana Jones tries to remove a gold idol from a mass sensitive booby-trapped pedestal. He replaces the idol with a bag of sand of approximately equal volume to that of the idol. ($d_{\text{Au}} = 19.32\text{g/mL}$; $d_{\text{sand}} = 1.91\text{g/mL}$) The idol has a radius of 7.50 cm. $V_{\text{sphere}} = (4/3) \pi r^3$
- What is the mass of the gold idol?
 - What is the mass of sand bag?
 - Did Indiana Jones have a reasonable chance for not activating the mass sensitive booby trap? Explain in one or two brief sentence.
 - In a later scene, Dr. Jones and an unscrupulous guide play catch with the idol. What is the mass of the idol in units of pounds? ($2.205\text{ lb} = 1\text{ kg}$)
 - Is playing catch with it a possibility for the average (couch-potato) person? (For reference: a bag of sugar weighs 5 lbs., imagine running and tossing this at the same time.)

See next page



- f) This is a couch potato!

Volume of the idol and the sandbag that Indiana Jones used:

$$V = \frac{4}{3} \pi r^3 = \frac{4}{3} \pi (7.50\text{cm})^3 = 1767.1\text{cm}^3$$

Mass of sand			Mass of gold		
1,767.1 cm ³ sand	1.91g sand	1mL sand	1,767.1 cm ³ Au	19.32 g Au	1ml Au
	1mL sand	1 cm ³		1 mL Au	1 cm ³ Au
3,375.2 g sand => 3.38 x10 ³ g sand 3.38 kg sand			34,141 g Au, => 3.41 x10 ⁴ g, 34.1 kg Au		

Indie triggered the trap because he confused volume with mass. Density is the ratio of the volume to the mass. Sand has a lower density than gold. Since the volumes were the same, the mass becomes important. For the same volume, gold delivers more mass than sand. Indie would need 10X the volume of sand to be safe from the trap, since the mass of the sand was 1/10th that of gold.

34.1 kg	2.046lb	1 sugar bag	14.0 bags of sugar
	1 kg	4 lbs	

The average couch potato (see f) can barely get out of a chair. He might fight you for the remote or 1 bag of sugar, but... okay this is 70.0 Lbs of gold. So No.

12. (3 points) Round of each of the numbers listed to the given number of significant figures and put the answers in correct scientific notation. (This problem has no partial credit)

- a) 0.000 127 7225 (3 sig fig) 1.28×10^{-4}
- b) 0.0753596 (4 sig figs) 7.536×10^{-2}
- c) 129650 (2 sig figs) 1.3×10^5

13. (6 points) In Chapter 2, we studied the basic architecture of the atom. Answer the following by identifying the true and false statements. Correct the false statements and make them true. If the statement is true, give support for the answer. Use a complete sentence for full credit. **Bwah haha they are all false. YES, I CROSSED OUT THE WRONG PART AND SUBSTITUTED THE CORRECT ANSWER TO SAVE SPACE. You were to correct the answer with complete sentences.**

- a) The nucleus of an atom contains ~~protons electrons~~ and neutrons. [T] or [F]
- b) ~~J.J. Thompson~~ **Rutherford** determined the charge to mass ratio of the electron. [T] or [F]
- c) The nucleus of an atom ~~can be~~ is positively ~~or negatively~~ charged ~~depending~~ **independent of the** ~~on~~ identity of the atom. [T] or [F]
- d) The charge of the ~~neutron~~ **electron** and the proton are equal but opposite in sign. [T] or [F]
- e) The total number of protons ~~and electrons~~ in the nucleus is equal to the number of ~~neutrons~~ **electrons** outside of the nucleus. [T] or [F]
- f) ~~Madam Curie~~ **Milikan** determine the mass and charge of the electron. [T] or [F]

14. (6 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) 1.234×10^{16} pL

1.234×10^{16} pL	10^{-12} L	{ 1.234×10^4 } this is the same as $1.234 \times 10^1 \times 10^3$ L	1kL	12.34kL
	1pL		10^3 L	

b) (1 point) 9.73×10^3 Gg

9.73×10^3 Gg	10^9 g	{ 9.73×10^{12} } this is extra credit, because I forgot about T!	1Tg	9.73 Tg
	1Gg		10^{12} g	

c) (1 point) $6.432 \times 10^6 \text{ nmol}$

$6.432 \times 10^6 \text{ nmol}$	10^{-9} mol	$\{6.432 \times 10^{-3} \text{ mol}\}$	1 mmol	6.432 mmol
	1 nmol		10^{-3} L	

d) (3 point) $7.564 \times 10^{17} \text{ pm}^3$

$7.564 \times 10^{17} \text{ pm}^3$	$(10^{-12} \text{ m})^3$	$\{7.564 \times 10^{-19} \text{ m}^3\}$ 18 is divisible by 3, giving each meter 10^{-6}	$1 \mu\text{m}^3$	$7.564 \mu\text{m}^3$
	1 pm^3		$(10^{-6} \text{ m})^3$	

15. (8 points) Give one example (atomic symbol and name) for each of the following:

- A transition element in the 4th period with an even atomic number divisible by 4. **Cr, Chromium, Ni, nickel.**
- The halogen that is a solid. **I, I₂ iodine**
- The main group (representative) element in the third period and 5th group **P, phosphorus**
- An alkali metal in the fifth period **Rb, rubidium**
- An alkaline earth metal in the third period **Mg, magnesium**
- One of the seven diatomic molecules. **H₂, N₂, O₂, F₂, Cl₂, Br₂, I₂; Hydrogen, nitrogen, oxygen, fluorine, chlorine, bromine, iodine**
- A metalloid that has similar properties to carbon **Si, silicon or Ge, germanium are acceptable.**
- The name of an allotrope of carbon [the allotropes of carbon have the same symbol]
The symbol is the same, C. The names are not. The two allotropes of carbon are diamond and graphite.

16. (5 points) Two isotopes of iridium occur in nature: isotope 1 has a mass of 190.961 amu and an abundance of 37.30% while isotope 2 has a mass of 192.963 amu and an abundance of 62.70%. Find the atomic mass of the element. **No credit for no work.**

$$190.961 \text{ amu} \times 0.3730 + 192.963 \text{ amu} \times 0.6270 = 195.216 \text{ amu}$$

17. (6 points) Perform the following calculation and report your answer with the correct significant figures and units. (This problem has no partial credit)

- (1point) $12.175 \text{ 678 023 g} + 4.320 \text{ 001 23 g} + 401.278 \text{ 771 g} + 221.826 \text{ 462 2 g}$

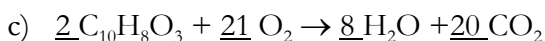
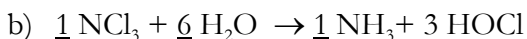
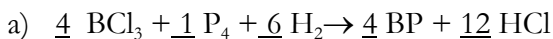
12.175 678 ~~023~~
 4.320 001 ~~23~~
 401.278 771
221.826 462 2
639.600 912 453 g

b) (4 points) $2.15693451 \times 10^{98} \text{ }^{\circ}\text{C} + 2.3142769 \times 10^{101} \text{ }^{\circ}\text{C} + 2.954681 \times 10^{102} \text{ }^{\circ}\text{C}$

$2.15693451 \times 10^{98} \text{ }^{\circ}\text{C} + 2.3142769 \times 10^3 \times 10^{98} \text{ }^{\circ}\text{C} + 2.954681 \times 10^4 \times 10^{98} \text{ }^{\circ}\text{C}$
 $2.15693451 \times 10^{98} \text{ }^{\circ}\text{C} + 2,314.2769 \times 10^{98} \text{ }^{\circ}\text{C} + 29,546.81 \times 10^{98} \text{ }^{\circ}\text{C}$
 $= 31863.54383 \times 10^{98} \text{ }^{\circ}\text{C}$, moving the decimal to sci note and rounding
 $3.186354 \times 10^{102} \text{ }^{\circ}\text{C}$,

c) (1point) $(10^{23} \times 10^{-1}) / (10^{18} \times 10^{82}) \text{ } 10^{-78}$

18. (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:**



d) Do any of these reactions represent decomposition? Explain in one or two sentences.

50% points: no

70% points: no none are decomposition

80% points: no, none are decomposition reactions. Decomposition reactions show a breakdown of the reactant.

90-100% points: none of the above are decomposition reactions. Decomposition reactions break down one (and there is only one) reactant into many product components that are smaller and more stable. Since all of the reactions have two or more reactants, none can be decompositions.

e) Do any of these reactions represent combustion? Explain in one or two sentences.

50% points: yes or c

70% points: yes, reaction C because CO_2 and H_2O are products

80%-points: yes, reaction C is a combustion because oxygen is a reactant and CO_2 and H_2O are products

90-100% points: Yes, Reaction C represents a combustion. Combustion reactions are characterized by having an organic molecule and oxygen as a reactant and CO_2 and H_2O as products. Reaction C satisfies these criteria while A and B do not.

19. (5 points) In Chapters 2 and 7, we are introduced to the periodic table and physical and chemical behavior of selected elements. Answer the following by identifying the true and false statements. Correct the false statements and make them true by writing a complete sentence, not crossing out and repairing the answer. **All of these are false**

- Non-metals** can be solid, liquid, or gas at room temperature. ~~[T]~~ or [F]
- Elements in **families or groups** show similar chemical and physical properties. [T] or [F]
- Metallic character increases **decreases** the periodic table and **increases** down a family. [T] or [F]
- Most of the elements on the periodic table are **metals** [T] or [F]
- The most stable allotrope of oxygen is **O₂**. O₃ is ozone [T] or [F]

20. (5 points) Novocain, C₁₃H₂₁N₂O₂Cl, is a local anesthetic. A sample of Novocain contains 6.000 x 10²⁵ atoms of carbon. Please show your setups for full credit.

- How many molecules of Novocain does the sample contain?

$$\frac{6.000 \times 10^{25} \text{ C}}{13 \text{ C}} \times 1 \text{ C}_{13}\text{H}_{21}\text{N}_2\text{O}_2\text{Cl} = 4.615 \times 10^{24} \text{ C}_{13}\text{H}_{21}\text{N}_2\text{O}_2\text{Cl}$$

- How many moles of Novocain does this sample contain?

$$\frac{4.615 \times 10^{24} \text{ C}_{13}\text{H}_{21}\text{N}_2\text{O}_2\text{Cl}}{6.022 \times 10^{23} \text{ C}_{13}\text{H}_{21}\text{N}_2\text{O}_2\text{Cl}} \times 1 \text{ mole C}_{13}\text{H}_{21}\text{N}_2\text{O}_2\text{Cl} = 7.664 \text{ mol C}_{13}\text{H}_{21}\text{N}_2\text{O}_2\text{Cl}$$

- What is the molar mass of Novocain? Use the following atomic masses to calculate your molar mass: Carbon: 12.010 7, nitrogen: 14.006 7, hydrogen: 1.007 94, oxygen: 15.999 4, chlorine: 35.452 7. (Your answer will be considered wrong if you do not use these masses; watch your units)

$$13 \cdot 12.0107 \text{ g C/mol C} + 2 \cdot 14.0067 \text{ g N/mol N} + 21 \cdot 1.00794 \text{ g H/mol H} + 2 \cdot 15.9994 \text{ g O/mol O} + 1 \cdot 35.4527 \text{ g Cl/mol Cl} = 272.7710 \text{ g C}_{13}\text{H}_{21}\text{N}_2\text{O}_2\text{Cl/mol C}_{13}\text{H}_{21}\text{N}_2\text{O}_2\text{Cl}$$

- What is the mass of 0.002 012 moles of Novocain?

$$\frac{0.002012 \text{ moles C}_{13}\text{H}_{21}\text{N}_2\text{O}_2\text{Cl}}{1 \text{ mole C}_{13}\text{H}_{21}\text{N}_2\text{O}_2\text{Cl}} \times 272.7701 \text{ g C}_{13}\text{H}_{21}\text{N}_2\text{O}_2\text{Cl} = 0.5488 \text{ g C}_{13}\text{H}_{21}\text{N}_2\text{O}_2\text{Cl}$$

21. (7 points) Copper can be drawn into thin wires. How many kilometers of 34gauge wire (diameter = 6.304×10^{-3} in) can be produced from the copper in 5.1256 lb of covellite, an ore that is 66.013% copper by mass. The volume of a cylinder is $\pi r^2 h$, $d_{\text{Cu}} = 8.95 \text{ g/cm}^3$.

5.126 lb ore	453.592 g-ore	66.103 g-Cu	1cm ³ Cu	= 171.728 cm ³ Cu	
	1 lb-ore	100.00 g-ore	8.95 g-Cu		
Diameter/2 = r; 6.304 X10 ⁻³ in/2 = 0.003151 in					
171.728 cm ³ Cu	•←leaving 1 cm on top	1 m ²	10 ⁻² m	1 km	= 8.53 km
π	(0.003151 m) ²	(2.54 cm) ²	1 cm	10 ³ m	