

1. Calculate the percent composition of oxygen in the following compound. (4pts)



$$\text{Ba} = 137 \text{ g/mol}$$

$$\text{Cr} = 52 \text{ g/mol}$$

$$\text{O} = \frac{16 \text{ g/mol} \times 14 = 64 \text{ g/mol}}{253 \text{ g/mol}}$$

$$\% \text{O} = \frac{64}{253} \times 100 = 25\% \text{O}$$

2. Fill in the missing information in the following table: (12 pts)

Symbol	Protons	Neutrons	Electrons	Charge
$^{88}\text{Sr}^{2+}$	38	50	36	+2
$^{32}\text{P}^{3-}$	15	17	18	-3
^{131}I	53	78	54	-1
$^{59}\text{Co}^{n+}$	27	32	24	+3

3. Name the following compounds: (8 pts)



Type (II)

Copper(II) Nitrate



Type (I)

Lithium Fluoride



Type (III)

dinitrogen tetraoxide



Type (I)

Ammonium Chlorate

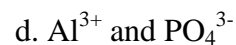
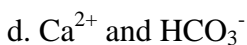
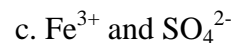
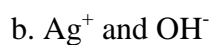
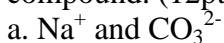
4. An element has four naturally occurring isotopes with the following masses and abundances:

Isotopic Mass (amu)	Fractional Abundance
49.946	0.0435
51.940	0.8379
52.941	0.0950
53.939	0.0236

What is the atomic weight of this element? (6pts)

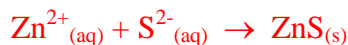
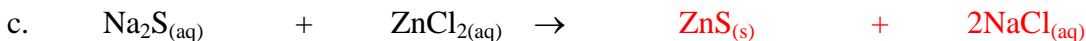
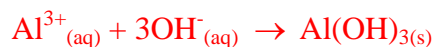
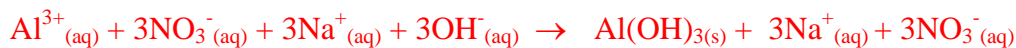
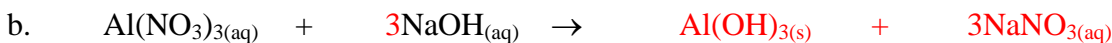
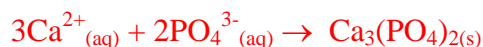
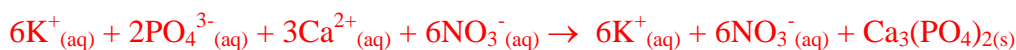
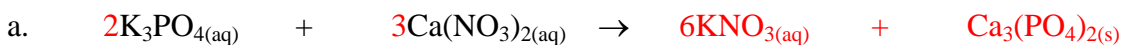
$$\text{Atomic Weight} = 49.946(0.0435) + 51.940(0.8379) + 52.941(0.095) + 53.939(0.0236) = 51.996 \text{ Amu}$$

5. For each of the following pairs of ions, write the formula of the corresponding compound. (12pts)

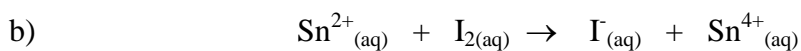
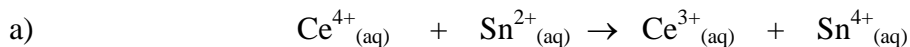


Soluble	Except	Insoluble	Except
$\text{Na}^+, \text{K}^+, \text{Li}^+, \text{NH}_4^+$	None	CO_3^{2-}	Group 1A, NH_4^+
NO_3^-	None	PO_4^{3-}	Group 1A, NH_4^+
$\text{Cl}^-, \text{Br}^-, \text{I}^-$	$\text{Ag}^+, \text{Pb}^{2+}, \text{Hg}_2^{2+}$	S^{2-}	Group 1A, NH_4^+
SO_4^{2-}	$\text{Ca}^{2+}, \text{Ag}^+, \text{Pb}^{2+}, \text{Ba}^{2+}$	OH^-	Group 1A, $\text{Ca}^{2+}, \text{Ba}^{2+}$

6. Write the balance molecular equation, complete ionic equation, and net ionic equation for each of the following aqueous reactions including phase labels. If no reaction occurs (*no precipitate*), just write NR after the arrow: (18 pts)



7. Balance the following Redox reactions using the half-reaction method and clearly label the oxidation and reduction steps. (10 pts)



8. One of the most commonly used white pigments in paint is a compound of titanium and oxygen that contains 59.9% Ti by mass and has a molecular mass of 80 g/mol. Determine the empirical formula and molecular formula of this compound. (10 pts)

Assume a 100 g sample:

$$59.9 \text{ g Ti} \times \frac{\text{mol}}{48 \text{ g}} = 1.25 \text{ mol} \div 1.25 \text{ mol} = 1$$

$$100\% - 59.9\% = 40.1\% \text{ O}$$

$$40.1 \text{ g O} \times \frac{\text{mol}}{16 \text{ g}} = 2.51 \text{ mol} \div 1.25 \text{ mol} = 2$$

Empirical Formula

TiO₂

Empirical Mass = 80 g/mol

$$\frac{\text{Molecular mass}}{\text{Empirical Mass}} = \frac{80}{80} = 1$$

Molecular Formula

TiO₂

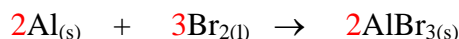
9. Combustion of a 1.00 g sample of an organic compound containing only carbon, hydrogen, and oxygen produces 2.360 g of CO₂ and 0.640 g of H₂O. Calculate the % composition for C, H, and O. (10 pts)

$$2.360 \text{ g CO}_2 \times \frac{\text{mol}}{44 \text{ g}} \times \frac{1 \text{ mol C}}{1 \text{ mol CO}_2} \times \frac{12 \text{ g}}{\text{mol}} = 0.644 \text{ g C or } \mathbf{64.4\% C}$$

$$0.640 \text{ g H}_2\text{O} \times \frac{\text{mol}}{18 \text{ g}} \times \frac{2 \text{ mol H}}{1 \text{ mol H}_2\text{O}} \times \frac{1 \text{ g}}{\text{mol}} = 0.071 \text{ g H or } \mathbf{7.1\% H}$$

$$100\% - (64.4\% + 7.1\%) = \mathbf{28.5\% O}$$

10. Aluminum burns in bromine, producing aluminum bromide:



When 10.0g of aluminum was reacted with an excess of bromine, 79.8 g of aluminum bromide was isolated. Calculate the theoretical yield and the percent yield of this reaction. (10pts)

$$10.0 \text{ g Al} \times \frac{\text{mol}}{27 \text{ g}} \times \frac{2 \text{ mol AlBr}_3}{2 \text{ mol Al}} \times \frac{267 \text{ g}}{\text{mol}} = 98.9 \text{ g AlBr}_3$$

Theoretical Yield

$$\% \text{ Yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100 = \frac{79.8}{98.9} \times 100 = \mathbf{80.7\%}$$

11. Extra Credit. Hydrogen has two stable isotopes, ¹H and ²H, and sulfur has four stable isotopes, ³²S, ³³S, ³⁴S, and ³⁶S. How many peaks would you observe in the mass spectrum of the positive ion of hydrogen sulfide, H₂S⁺? Assume no decomposition of the ion into smaller fragments. (5 pts) **4 isotopes of sulfur**

<u>H combinations</u>	<u>Possible Masses</u>	
¹ H ¹ H	34 35 36 __ 38	
² H ² H	36 37 38 __ 40	7 peaks
¹ H ² H	35 36 37 __ 39	
	1 2 3 4 5 6 7	