Question 1 (10 points each)

A) What mass (g) of CO_2 is made when 3.0 L of a <u>stoichiometric mixture</u> of acetylene (C_2H_2) and oxygen at 50 atm, 300 K is combusted?

$2(C_2H)_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$

$1.74\ mol\left(\frac{4\ mol\ CO_2}{2\ mol\ C_2H_2}\right)\left(\frac{44g}{mol}\right) = 153$

$= \boxed{150g}$

$PV = nRT$

$n = \frac{PV}{RT} = \frac{50.3}{.0821 \cdot 300} = 6.09\ mol$

$mol\ C_2H_2 = 6.09\left(\frac{2\ mol\ C_2H_2}{7\ mol}\right) = 1.74\ mol$

B) Calculate the <u>mass of CO_2</u> produced by complete surface combustion of 0.50 L of a 5.0 M solution of propanol (C_3H_7OH) in water.

$moles = 5.0(0.5) = 2.5\ mol$

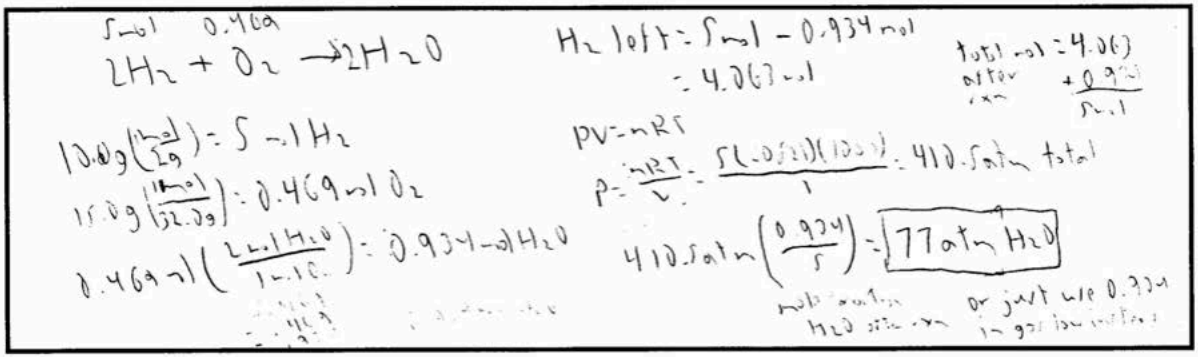
3 C's in propanol
1 C in CO_2

$C_3H_8O \rightarrow 3CO_2$

$2.5\ mol\left(\frac{3\ mol\ CO_2}{1\ mol\ C_3H_8O}\right)\left(\frac{44.09g}{mol}\right) = \boxed{330g}$

Question 2 (20 points)

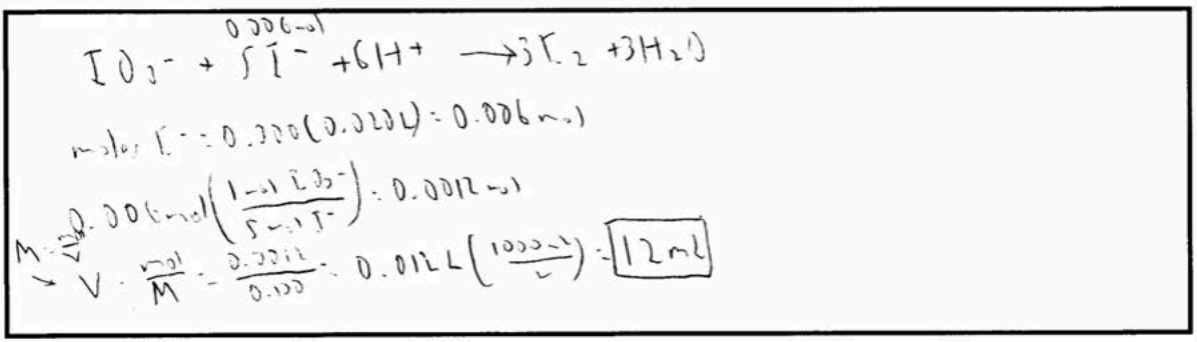
A mixture of 10.0 g of H_2 (*g*) and 15.0 g of O_2 (*g*) is combusted in a 1.0 L vessel. Calculate the partial pressure of the H_2O (*g*) produced assuming it is at 1000 K.



Question 3 (10 points each)

The Iodine Clock Reaction involves the reaction of iodate (IO_3^-) with iodide (I^-) in acidic solution (H^+) to produce iodine (I_2) and water.

A) Calculate the volume of 0.100 M IO_3^- solution that will exactly react with 20.0 mL of 0.300 M I^- solution.



B) What volume of 0.100 M sulfite (SO_3^{2-}) solution would be required to exactly react with the iodine (I_2) produced in Part A above?

The balanced reaction is: $SO_3^{2-} + I_2 + H_2O \rightarrow SO_4^{2-} + 2I^- + 2H^+$

$IO_3^- + 5I^- + 6H^+ \rightarrow 3I_2 + 3H_2O$

$0.006\ mol\ I^-$

$M\ mol\ I_2 = 0.006\left(\frac{3\ mol\ I_2}{5\ mol\ I^-}\right) = 0.0036\ mol\ I_2$

$mol\ SO_3^{2-} = 0.0036\ mol\left(\frac{1\ mol\ SO_3^{2-}}{1\ mol\ I_2}\right) = 0.0036\ mol$

$M = \frac{mol}{V}$

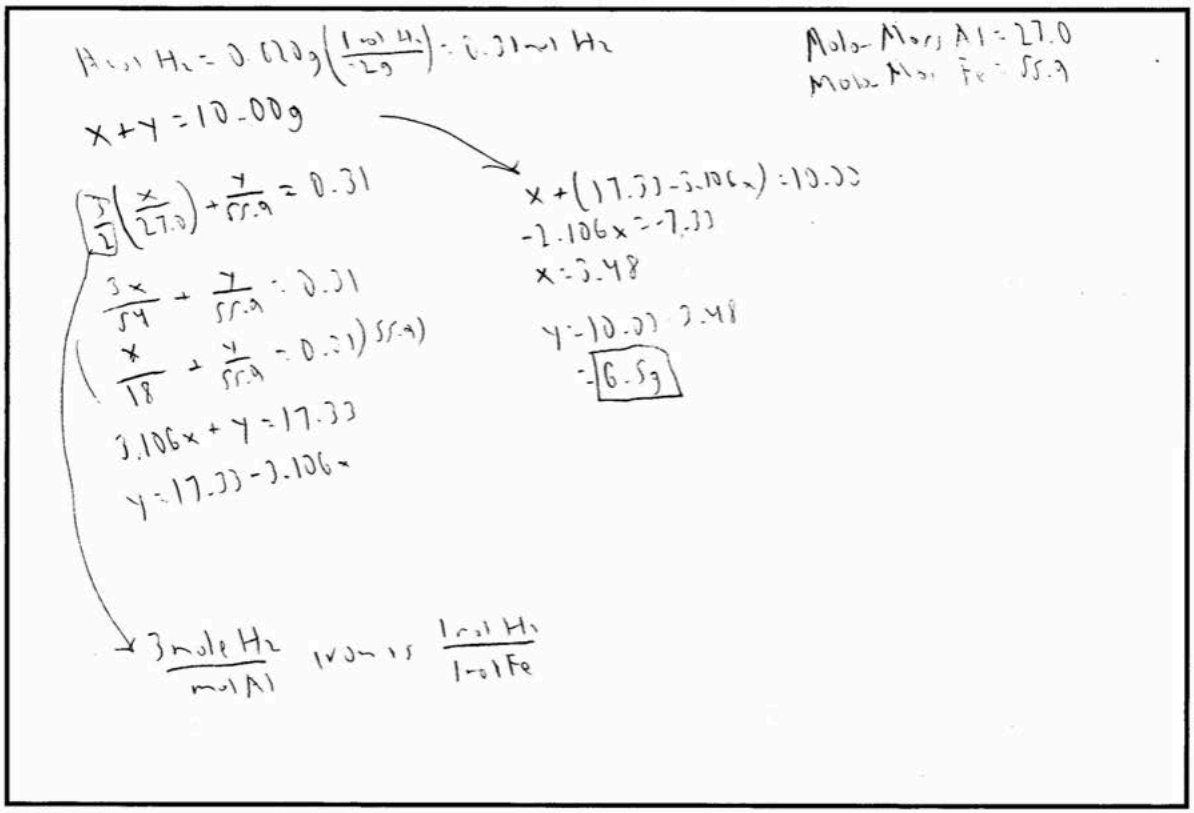
$V = \frac{mol}{M} = \frac{0.0036}{0.100} = 0.036L\left(\frac{1000\ mL}{L}\right) = \boxed{36\ mL}$

Question 4 **(20 points total)**

A) A mixture of aluminum and iron weighing 10.00 g reacts with hydrogen chloride in aqueous solution according to the parallel reactions

$$2\ Al + 6\ HCl \rightarrow 2\ AlCl_3 + 3\ H_2$$
$$Fe + 2\ HCl \rightarrow FeCl_2 + H_2$$

A 0.620 g quantity of hydrogen is evolved when the metals react completely. Calculate the mass of iron in the original mixture. **(15 points)**



B) Three trials yield the following results for the mass of H_2 produced in the above reactions:

0.738 g 0.516 g 0.815 g 0.920 g

Calculate the standard deviation of the mean for these results. **(5 points)**

$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}}$ $\bar{x} = \frac{2.989}{4} = 0.747$ $n = 4$

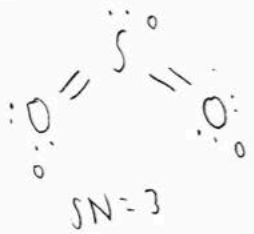
$= \sqrt{(0.738 - 0.747)^2 + (0.516 - 0.747)^2 + (0.815 - 0.747)^2 + (0.920 - 0.747)^2}$

$= \sqrt{1.0 \times 10^{-4} + 0.0534 + 0.0046 + 0.0299}$ = **0.17 g**

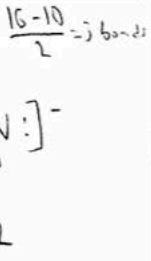
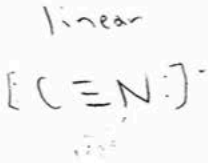
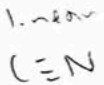
Question 5 **(10 Points each)**

For the following compounds:
A. Draw the Lewis Structure, explicitly showing the formal charges and molecular geometry
B. Indicate the Electron Pair Geometry
C. Indicate the Molecular Geometry

I. Sulfur Dioxide (SO_2)

A.	B.	C.
		

II. Cyanide (CN^-) ion

A.	B.	C.
		

TOTAL POINTS

100 / 100

QUESTION 1

1 1A **10 / 10**

✓ **+ 10 pts Correct Answer (150g of CO2)**

+ 3 pts Correct Balanced Equation (C2H2+5/2O2 -> 2 CO2 + H2O)

+ 4 pts Correct use of stoicheometric mixture (perfect mixture of C2H2 and O2 so that all reactants are reacted, 5 moles of O2 per 2 moles of C2H2)

+ 2 pts Correct Use of Ideal Gas Law (PV=nRT, should get 6.09 moles of reactant gas total)

+ 0 pts Incorrect

+ 0 pts Flag For Review

QUESTION 2

2 1B **10 / 10**

✓ **- 0 pts Correct**

- 3 pts Incorrect stoichiometry

- 3 pts Incorrect calculations

- 2 pts Incorrect sig. figs.

- 1 pts Math error

- 5 pts No calculations

- 10 pts Incorrect or blank

- 10 pts Flag for review

QUESTION 3

3 2 **20 / 20**

✓ **+ 20 pts correct answer 77atm**

+ 5 pts correct balanced eq

+ 10 pts O2 limiting

+ 5 pts mole fraction equation

+ 15 pts math error but otherwise correct

+ 0 pts incorrect

QUESTION 4

4 3A **10 / 10**

✓ **+ 10 pts Correct Answer: 12 mL of IO3-**

+ 4 pts Correct Balanced Equation

+ 2 pts Calculated Correct number of I- moles

+ 0 pts No points

- 2 pts Correct final answer, but Incorrect balanced equation

- 2 pts Incorrect Significant Figures

QUESTION 5

5 3B **10 / 10**

✓ **+ 10 pts All correct! Nice job--you should be proud of yourself! You're on your way to becoming an excellent chemist (correct answer: 36 mL)**

+ 2 pts Identified that IO$$_3^-$$ is in a 1:3 stoichiometric ratio with I$$_2$$

+ 2 pts Identified 1:1 stoichiometric ratio of I$$_2$$ and SO$$_3^{2-}$$

+ 3 pts Converted mol SO$$_3^{2-}$$ to mL sulfite solution

+ 3 pts Correct answer of 36 mL

- 0.5 pts incorrectly labeled answer

- 2 pts incorrect number of significant figures (should be 2, as per test instructions)

+ 0 pts I'm sorry to report that your answer is entirely incorrect :(

+ 0 pts CAN'T READ FLAG

QUESTION 6

6 4A **15 / 15**

✓ **+ 3 pts mol H2**

✓ **+ 3 pts mass Al/Fe**

✓ **+ 3 pts mass to mol metal**

✓ **+ 3 pts setup/math**

✓ **+ 3 pts answer**

+ 0 pts FLAG FOR REVIEW

+ 0 pts Click here to replace this description.

+ **0 pts** Click here to replace this description.

QUESTION 7

7 4B 5 / 5

✓ **- 0 pts Correctly uses**

$$s = \sqrt{\frac{\sum\limits_{i=1}^{N}(x-\bar{x})}{N-1}}$$

where $$\bar{x}$$ is the average

- 0 pts Correctly uses

$$S_m = \frac{s}{\sqrt{N}}$$

- 1.5 pts Missing Units

- 1 pts Math error\sig figs

- 2.5 pts Incorrect standard deviation formula or standard deviation of the mean

- 5 pts Incorrect/no work shown

- 5 pts flagged for review

QUESTION 8

8 5.1 A-C 10 / 10

- 2 pts Incorrect Lewis Structure

- 2 pts Incorrect Formal Charges

- 3 pts Got part a wrong and that affected B and C

- 3 pts Incorrect Electron Pair Geometry

- 3 pts Incorrect Molecular Geometry

- 1.5 pts Partial Credit for B or C

✓ **- 0 pts All correct**

- 1 pts partial credit

- 0 pts Click here to replace this description.

- 0 pts Flag for review (can't read)

QUESTION 9

9 5.2 A-C 10 / 10

- 2 pts Formal charge

- 2 pts lewis structure

- 3 pts electron pair geometry

- 3 pts molecular geometry

✓ **- 0 pts Full Credit**

- 0 pts Flag For Review