

INSTRUCTIONS/SUGGESTIONS.
READ THIS CAREFULLY!

YOU MAY OMIT ANY TWO OF THE 15 POINT QUESTIONS AND
ANY TWO OF THE 6 POINT QUESTIONS.

INDICATE ON THE NEXT PAGE WHICH 4 QUESTIONS ARE NOT TO BE
GRADED BY WRITING DNG (DO NOT GRADE) NEXT TO THE
PROBLEM NUMBER.

NO PARTIAL CREDIT on any question except where indicated
by the statement SHOW WORK. When work is
requested, set up equations (with numbers
substituted in appropriate units) in space provided, but do the
calculations on scrap sheet.

IF QUESTION STATES "SHOW WORK" AND YOU GUESS CORRECTLY WITHOUT
SHOWING WORK - YOU GET 1/2 CREDIT.

CHECK FRONT BLACKBOARD FOR CORRECTIONS/CHANGES.

IF ANY QUESTION IS NOT CLEAR - ASK ERIC OR ME ABOUT IT!

CONSTANTS AND CONVERSION FACTORS ARE ON THE PAGE
FOLLOWING THE LAST PROBLEM. PLEASE LOOK THERE!
LAST THREE PAGES ARE FOR SCRAP WORK.
FEEL FREE TO TEAR THESE PAGES OFF.

REMOVE THIS PAGE PRIOR TO STARTING EXAM.

CHEMISTRY F14O3
PROFESSOR J. MORROW

FIRST EXAM

10/11/99

PRINT NAME, LAST: _____

FIRST: _____

I.D.# : _____

MAXIMUM POINT VALUE IS IN PARENTHESES

- | | | |
|---------------|---------------|---------------|
| 1. _____ (6) | 9. _____ (6) | 17. _____ (6) |
| 2. _____ (15) | 10. _____ (6) | 18. _____ (6) |
| 3. _____ (15) | 11. _____ (6) | 19. _____ (6) |
| 4. _____ (15) | 12. _____ (6) | 20. _____ (6) |
| 5. _____ (15) | 13. _____ (6) | 21. _____ (6) |
| 6. _____ (15) | 14. _____ (6) | 22. _____ (6) |
| 7. _____ (15) | 15. _____ (6) | 23. _____ (6) |
| 8. _____ (15) | 16. _____ (6) | 24. _____ (6) |

COLUMN TOTALS (MAXIMUM):

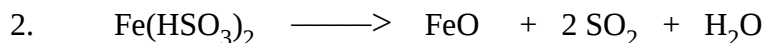
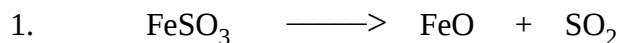
_____ (81) _____ (48) _____ (48)

EXAM TOTAL (165 pts) _____

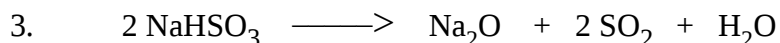
OUT OF 100

USE THE FOLLOWING INFORMATION FOR PROBLEMS 1 AND 2

Given the following 3 reactions:



and



You are given a mixture of iron(II)sulfite (FeSO_3), iron(II)hydrogensulfite ($\text{Fe}(\text{HSO}_3)_2$) and sodium hydrogensulfite (NaHSO_3). When heated this mixture completely reacts as shown above, forming 57.60 g of $\text{SO}_{2(g)}$, 5.40 g of H_2O , and 0.100 mol Na_2O .

Molar masses: FeSO_3 (135.9), $\text{Fe}(\text{HSO}_3)_2$ (217.9), NaHSO_3 (104.0), SO_2 (64.0), FeO (71.9), H_2O (18.0), Na_2O (62.0)

1) Calculate the number of moles of H_2O and of SO_2 formed. (6 pts)

ANSWER IS (H_2O): _____

ANSWER IS (SO_2): _____

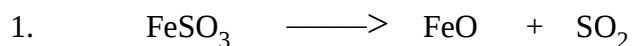
2) Calculate the number of moles of FeSO_3 , $\text{Fe}(\text{HSO}_3)_2$, and NaHSO_3 present initially. SHOW WORK (OR REASONING) (15 pts - 5 pts each part)

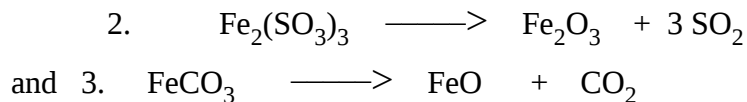
$\underline{n}_{\text{NaHSO}_3}$ IS: _____

$\underline{n}_{\text{Fe}(\text{HSO}_3)_2}$ IS: _____

$\underline{n}_{\text{FeSO}_3}$ IS: _____

3) Given the following 3 reactions:





Starting with 3 moles total of FeSO_3 , FeCO_3 , and $\text{Fe}_2(\text{SO}_3)_3$,
 1.5 moles of CO_2 and 2.5 moles of FeO are obtained.

Calculate the starting number of moles of $\text{Fe}_2(\text{SO}_3)_3$ and the total number
 of moles of SO_2 produced. SHOW WORK (OR REASONING) (15 pts)

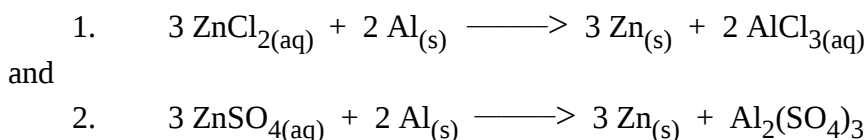
moles of $\text{Fe}_2(\text{SO}_3)_3$: _____

moles of SO_2 : _____

USE THE FOLLOWING INFORMATION FOR PROBLEMS 4 AND 5

A mixture of ZnCl_2 and ZnSO_4 weighing 8.513 g was dissolved in
 water. The mixture was allowed to react with solid aluminum and the
 following two reactions occurred. The total weight of solid zinc
 produced was 3.707 g.

(molar masses: Zn (65.38 g), Al (26.98 g), ZnCl_2 (136.28), ZnSO_4 (161.38))



4) Calculate the weight of ZnCl_2 present in the original mixture.

SHOW WORK

ANSWER IS: _____

5) Calculate the total weight of aluminum used. THE ANSWER FOR THIS
 PART IS NOT DEPENDENT UPON YOUR ANSWER FOR QUESTION 4. SHOW WORK

ANSWER IS: _____

- 6) A 0.20 mol sample of a hydrocarbon, C_xH_y reacts with 1.3 mol of O_2 gas, to yield 1.6 mol TOTAL of CO_2 and H_2O . The molecular formula of C_xH_y is;

a) C_4H_2 b) C_4H_4 c) C_4H_6 d) C_4H_{10} e) C_5H_4
 f) C_5H_6 g) C_5H_8 h) C_5H_{10} i) C_5H_{12}

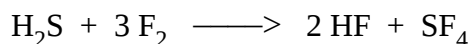
ANSWER IS: _____

- 7) A compound has the formula $C_xH_yO_zCl_w$. 7.80 g of this compound is burned producing 0.200 mol of CO_2 , 2.27 g of H_2O , and ultimately 0.100 mol of $AgCl$. What is the empirical formula of this compound?
 HINT: First obtain the weights of hydrogen and oxygen in the original compound. ATOMIC WEIGHTS: H (1.00), C (12.00), O (16.00), Cl (35.50) SHOW WORK

a) $C_2H_3O_2Cl_2$ b) $C_4H_5OCl_2$ c) $C_4H_6O_2Cl$ d) $C_6H_8O_2Cl_4$ e) $C_4H_5O_2Cl_2$

ANSWER IS: _____

- 8) The following gaseous reaction occurs in a vessel of 50.0 L volume at 300 K.



Initially, three moles of H_2S and six moles of F_2 are mixed in this vessel. The reaction then occurs until the reactant in limiting

quantity is totally consumed. (15 pts - 5 pts each part)

Molar masses: H_2S (34.0), F_2 (38.0), HF (20.0), SF_4 (108.0)

a) Which reactant is limiting? ANSWER IS: _____

b) How many moles of the reactant in excess remain, when the reaction is complete?

ANSWER IS: _____

c) What is the mole ratio of HF to SF_4 produced, $\frac{n_{\text{HF}}}{n_{\text{SF}_4}}$?

ANSWER IS: $\frac{n_{\text{HF}}}{n_{\text{SF}_4}} =$

9) The spatial appearance of the SF_4^{2-} ion is,
(GROUP NUMBERS: S (6) ; F (7))

- a) tetrahedral
- b) seesaw
- c) square planar
- d) pyramidal

ANSWER IS: _____

10) The mass in grams of a single molecule of C_3H_6 is....

(at. wt: C = 12.0 , H = 1.0)

- a) 7×10^{23}
- b) 7×10^{-21}
- c) 7×10^{-22}
- d) 7×10^{-23}
- e) 42

ANSWER IS: _____

11) Element X reacts with oxygen to form a pure sample of X_2O_3 . In an experiment it is found that 1.0000g of X produces 1.1596 g of X_2O_3 . Using the known atomic weight of oxygen, 16.000 g/mol, calculate the atomic weight of X.

- a) 20.70 b) 66.85 c) 100.2 d) 150.4 e) 168.9

ANSWER IS: _____

12) Complete the following table (isotopic symbols are hypothetical)

Symbol	Atomic Number	# of neutrons	mass number	# of electrons
${}_{12}^X\text{M}^{2+}$	_____	13	_____	_____
${}_{15}^{31}\text{A}^{3-}$	15	_____	_____	_____

13) Give the conjugate acid of NHOH^- .

ANSWER IS: _____

14) Give the hydrated form of the anhydrous acid Br_2O_3 .

ANSWER IS: _____

15) give the formula for the anhydrous form of H_2SeO_3 .

ANSWER IS: _____

16) Beaker A contains 0.100 L of an 0.20 M KOH solution; beaker B contains 0.100 L of an 0.10 M H_2SO_4 solution. The contents of both beakers are thoroughly mixed together in a sufficiently large third beaker. The resulting solution is; (HINT: BALANCE EQUATION(S) CAREFULLY)

- | | |
|--------------------------------------|---|
| a) 0.05 M in K_2SO_4 | b) 0.05 M in both KHSO_4 and KOH |
| c) 0.10 M in K_2SO_4 | d) 0.10 M in both KHSO_4 and KOH |
| e) 0.10 M in KHSO_4 | f) 0.10 M in KOH |

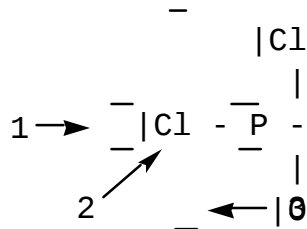
ANSWER IS: _____

17) Draw a Lewis structure for C_3H_4 . If possible satisfy the octet rule and covalency.

18) Write the oxidation number above the symbol of each atom that changes oxidation state in the course of reaction.



- 19) Give the formal charge of each indicated atom in the following molecule.

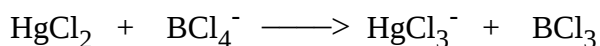


atom 1 =

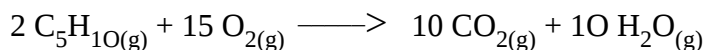
atom 2 =

atom 3 =

- 20) Indicate which reactant species is the Lewis acid and which is the Lewis base in the following reaction.



- 21) Given the reaction:



How many liters of CO_2 were recovered by burning 16 L of C_5H_{10} ?
(P and T constant) if the percent yield was 75 %.

- a) 55 L b) 60 L c) 70 L d) 75 L e) 80 L

ANSWER IS: _____

- 22) GIVEN: ZrCl_2 is zirconium(II)chloride; ZrCl_4 is; NaVO_3 is sodium vanadate. For the following: where there is a formula, give it's name; where there is a name, give it's formula. (1 point each.)

i) $\text{Zr}(\text{SO}_4)_2$:

ii) SF_6

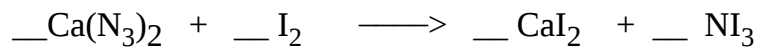
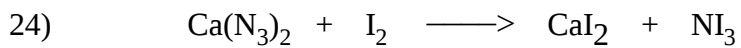
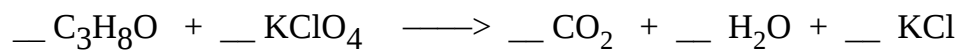
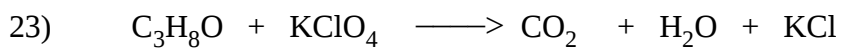
iii) zirconium(II) vanadate :

iv) CrBr_3 :

v) ferric phosphate :

vi) aluminum chromate

BALANCE THE FOLLOWING EQUATIONS BY INSERTING INTEGERS IN THE SPACES PRECEDING THE FORMULAS.



SCRAP WORK PAGE

SCRAP WORK PAGE

SCRAP WORK PAGE