

Name _____

CALCULATORS ARE ALLOWED ON THIS EXAM

NOTE: To receive credit, show your work.

If you feel strapped for time, try to at least *start* each problem before going on to the next.

PLEASE DO NOT OPEN THE EXAM UNTIL INSTRUCTED TO DO SO

1 1A																	18 8A
1 H 1.008	2 He 4.003																
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	3 B 10.81	4 C 12.01	5 N 14.01	6 O 16.00	7 F 19.00	8 Ne 20.18	9 Na 22.99	10 Mg 24.31	11 Al 26.98	12 Si 28.09	13 P 30.97	14 S 32.07	15 Cl 35.45	16 Ar 39.95		
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	71 *Lu 174.97	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.03	103 †Lr (260)	104 Rf (261)	105 Db (260)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 ?	111 ?	112 ?		114 ?		116 ?		118 ?

*Lanthanide Series	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04
†Actinide Series	89 Ac 227.03	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)

Avogadro's Number: 6.02214×10^{23}

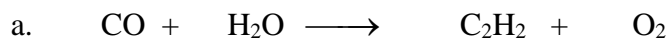
Solubility Rules	
↑ Mostly soluble ↓	<ul style="list-style-type: none">• All salts of the ammonium ion (NH_4^+), and of Group IA cations, are <i>soluble</i>.• All nitrates (NO_3^-), perchlorates (ClO_4^-), and acetates ($\text{C}_2\text{H}_3\text{O}_2^-$) are <i>soluble</i>.• All chlorides (Cl^-), bromides (Br^-), and iodides (I^-), are <i>soluble</i> EXCEPT those of silver (Ag^+), lead(II) and mercury(I) (and also mercury(II) for bromides and iodides).• All sulfates (SO_4^{2-}) are <i>soluble</i> EXCEPT Ag_2SO_4, PbSO_4, Hg_2SO_4, BaSO_4, SrSO_4, and CaSO_4. (*In particular, you may find that Ag_2SO_4 is <i>soluble</i> under conditions present in lab today! It's just not <i>as soluble as</i> many sulfate salts.)
↑ Mostly insoluble ↓	<ul style="list-style-type: none">• All carbonates (CO_3^{2-}), sulfites (SO_3^{2-}), and phosphates (PO_4^{3-}) are <i>insoluble</i> EXCEPT those of ammonium (NH_4^+) and Group IA cations (see first rule, above!)• All hydroxides (OH^-) are <i>insoluble</i> EXCEPT those of ammonium, Group IA cations, barium, and strontium. (Calcium hydroxide is slightly soluble.)• All sulfides (S^{2-}) are <i>insoluble</i> EXCEPT those of ammonium, Group IA cations, and Group IIA cations.• All oxides (O^{2-}) are <i>insoluble</i> EXCEPT those of Group IA cations, calcium, and barium; Note: ammonium oxide does not exist! Note: the soluble oxides actually react with the solvent water to form hydroxides: $\text{O}^{2-}(\text{aq}) + \text{H}_2\text{O}(\ell) \longrightarrow 2 \text{OH}^-(\text{aq})$

(5 points extra credit) Elementary Discoveries

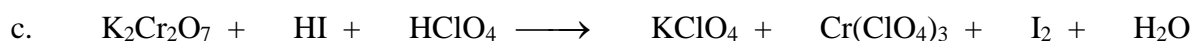
Four scientists, Cavendish, Moisson, Priestley, and Rutherford, discovered four elements, fluorine (F_2), hydrogen (H_2), nitrogen (N_2), and oxygen (O_2). Each of these elements has a different property: One is among the least reactive elements, one is the most reactive element, one is the most abundant element in the body, and one is the most abundant element in the universe. Can you determine who discovered what element and what each element's property is?

- Fluorine, which was not discovered by Cavendish, isn't the least reactive element.
- Nitrogen, which was not discovered by Priestley, isn't the most abundant element in the universe.
- The four scientists are: Priestley, Rutherford, the discoverer of fluorine, and the discoverer of the element most abundant in the universe.
- The element found to be the most abundant in the body wasn't discovered by Moisson and isn't nitrogen or hydrogen.

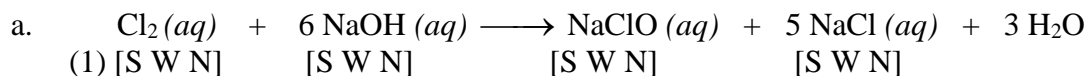
(15) 1. Balance the following chemical equations:



b. the equation for the full combustion of C_2H_6

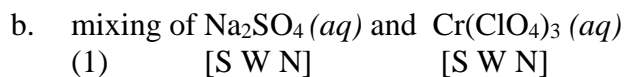


(20) 2. For each of the following, (1) label each substance involved as a *strong electrolyte (S)*, a *weak electrolyte (W)*, or a *nonelectrolyte (N)*; (2) list the principal reactant species in solution, and (3) write the balanced net ionic equation.



(2) principal *reactant* species in solution:

(3) net ionic equation:



(2) principal *reactant* species in solution:

(3) net ionic equation:

(25) 3. Calculate:

a. The number of atoms of ^{35}Cl in 10.0 g of natural abundance Cl_2 . (Natural chlorine is 75.78% ^{35}Cl and 24.22% ^{37}Cl .) [HINT: Think first. Full answer can *easily* fit in the space below.]

b. The empirical formula of a compound containing only platinum (Pt) and chlorine (Cl) if analysis indicates that it is 42.09% Cl.

c. The mass of F_2 that is needed to produce 100.0 g of IF_7 according to the equation:



d. The limiting reactant and theoretical yield in the reaction given above in part (c) if 65.0 g I_2 is reacted with 10.0 g of F_2 .

(24) 4. Explain...

a. ...the difference between a chemical *reaction* and a chemical *equation*, giving two characteristics of each.

b. ...the basic idea of how a *mass spectrometer* works, and what it is good for

c. ...what *green chemistry* means.

- (16) 5. Soon after graduation, a St. Olaf Student, Arnt I. Gud, got a \$2000-per-day job as a consultant for a company that works with a variety of metals and had messed up by accidentally mixing several gallons of them. The company needed to know how they should go about separating the metals. Testing three standard solutions of silver(I), lead(II), and iron(III), he found: (“precip” indicates *precipitate*.)

Reagents:	0.1 M HCl	0.1 M H ₂ SO ₄	0.1 M NaOH	0.1 M NH ₃	0.1 M KSCN
Metal ion solutions					
0.1 M AgNO ₃	white precip	no reaction	white precip	white precip	white precip
0.1 M Pb(NO ₃) ₂	white precip	white precip	white precip	white precip	white precip
0.1 M Fe(NO ₃) ₃	yellow solution	yellow solution	red-brown precip	red-brown precip	dark red solution

Arnt then proceeded to add one drop of one of the reagents and one drop of another to a sample of the mixture, observed a reaction, and exclaimed, “Ah, ha! I know what it is!” What did Arnt report to his client? Be sure to include and identify ALL solids and all species present in solution at the end of the procedure in the recommendation. If the final solution contains acid, indicate that it needs to be “neutralized with base”; if it contains base, indicate that it needs to be “neutralized with acid.”

I, the undersigned, as a certified Ag-Pb-Fe handler, have found the material given to me for disposal or recycling to contain the checked ions:

Ag⁺

Pb²⁺

Fe³⁺

As such, my recommended handling procedure is outlined below:

signature _____ ***date*** _____

PLEDGE: I pledge my honor that on this examination I have neither given nor received assistance not explicitly approved by the professor and that I have seen no dishonest work.

[] I intentionally did not sign the pledge. Signature _____