

October 12, 2017

Do not open the exam until you are told to do so.

Cell phones and other electronic devices must be turned off and stowed out of sight (your sight and mine). Calculator policy is in effect. Infractions will cost you points!

ALL outside paper must be stowed out of sight. You have a responsibility to keep your gaze confined to your own desk. Unauthorized materials will result in your exam being removed and a score of 0 assigned.

If you reach a point where you need more scratch paper than the space available, ask a proctor. Since partial credit is based on showing your work, be sure to write your name on your scratch paper, turn it in, and note on the exam answer sheet if you have work elsewhere that you want considered.

You have a responsibility to keep your gaze confined to your own desk. Wandering eyes may result in your being asked to move, or may result in your exam being removed and a score of 0 assigned.

- **Please clearly and legibly write your name at the top of every page of your test. Your score will not be recorded and your exam will not be returned if this is not done.**

All answers should be rounded to the appropriate precision (correct significant figures.)

Atomic weights are provided in the Periodic Table. These values must be used.

Be certain your answers are clear. If an answer is not clear, it will probably be considered wrong.

Use your time effectively.

When authorized to open your exam, you may carefully remove this cover sheet. When you are finished with your exam, please turn in **the two answer sheets**. Make sure your name is clearly written on every page. (Problem numbers may not appear exactly in order in your exam. As long as you have the right number of pages as announced by the Proctors, don't be concerned about it.)

Note: point values should be considered approximate. Values may be adjusted slightly (+/- 1 point) in scoring.

Time is up at 12:15!!

THE PERIODIC TABLE

1	2															13	14	15	16	17	18		
1	2															2							10
1 H 1.008															2 He 4.003							10 Ne 20.18	
2	3	4											5	6	7	8	9	10					
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						
3	11	12	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18					
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95						
4	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36					
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	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 65.38	31 Ga 69.72	32 Ge 72.63	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80						
5	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54					
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.96	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3						
6	55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86					
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)						
7	87	88	89	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118					
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (267)	105 Db (268)	106 Sg (271)	107 Bh (270)	108 Hs (270)	109 Mt (278)	110 Ds (281)	111 Rg (282)	112 Cn (285)	113 Nh (286)	114 Fl (289)	115 Mc (289)	116 Lv (293)	117 Ts (294)	118 Og (294)						

58	59	60	61	62	63	64	65	66	67	68	69	70	71
58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.1	71 Lu 175.0
90	91	92	93	94	95	96	97	98	99	100	101	102	103
90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np (237)	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)	103 Lr (262)

Atomic weights based on IUPAC 2009, 2007 (publ 2011, 2009).

Potentially useful information:

$$6.022 \times 10^{23}$$

Solubility trends:

- Group 1 (1A) compounds, ammonium compounds, and acids are soluble.
- All nitrates, acetates, chlorates, and perchlorates are soluble.
- Silver, lead, mercury(I) and copper(I) compounds are INSOLUBLE.
- Chlorides, bromides, and iodides are soluble.
- Sulfates are soluble except calcium sulfate and barium sulfate.
- Compounds with anions of 2- or 3- charge are INSOLUBLE.
- Hydroxides are INSOLUBLE except calcium hydroxide and barium hydroxide.

Scored grade (instructor use only!) _____

1 Write **balanced net ionic** equations, with appropriate phase labels, for the following reactions. In each case, you may use as much scratch space as you need, but write your final answer **legibly** in the box. *(If you may want your scratch work considered for partial credit, make sure it's preserved somewhere on the exam pages you turn in.)*

a. [10 pts] **Acetic acid reacts with sodium hydrogen carbonate.**

(remember to balance reaction, write as net, and include phase labels)

b. [10] **Aqueous barium chloride reacts with sulfuric acid.**

(remember to balance reaction, write as net, and include phase labels)

c. [6] **Pure magnesium chlorate dissociates in water.**

(remember to balance reaction, write as net, and include phase labels)

2 [2 each] Identify each of the following as:

A a strong acid

B a weak acid

C neutral

D a weak base

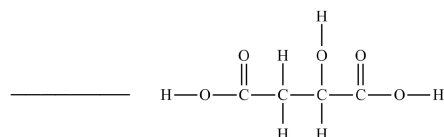
E a strong base

_____ ammonia

_____ sodium chloride

_____ potassium acetate

_____ perchloric acid



_____ K_2O

3 [1 each] Assign oxidation numbers for each of the identified elements.

H in H_2 _____

H in CH_4 _____

H in NaH _____

O in H_2O_2 _____

Cr in $\text{Fe}_2(\text{CrO}_3)_3$ _____

4 [2 pts each] **Clearly** indicate whether each statement is TRUE or FALSE. If we can't tell which you mean, it's wrong.

_____ H_2 is an acid.

_____ Carbon dioxide dissolves in water to form an acidic solution.

_____ Ionic compounds are always soluble in water at room temperature.

_____ In a reaction, the reactant present in the smaller molar amount is the limiting reactant.

_____ All precipitates are insoluble compounds and all insoluble compounds are precipitable.

_____ Ionic compounds are soluble in water when hydration is strong enough to overcome the ionic bonds.

_____ In water, the oxygen atoms carry a charge of -2 .

_____ HCl is an ionic compound, which dissociates completely in aqueous solution.

_____ Substances that dissolve in water also dissociate, so the terms "dissolve" and "dissociate" are interchangeable in aqueous chemistry;

5 [2 pts each] Fill in the blanks. (In some cases there could be more than one acceptable answer; pick **one**. Any chemical species you choose must be consistent with normal laboratory conditions on earth.)

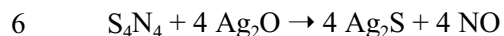
_____ A diprotic acid.

_____ A strong base.

_____ A chemical substance containing an atom with oxidation number = 0.

_____ A nonbasic anion.

_____ A soluble compound of the perrhenate ion, ReO_4^- .



The reaction is conducted beginning with 50.63 g S_4N_4 and 137.22 g Ag_2O .

(a) [2] How many moles of S_4N_4 are present at the start of the reaction? (Show work, include unit(s), round appropriately)

Answer: _____

(b) [6 pts] What mass of NO is formed from the complete reaction? (Show work, include unit(s), round appropriately)

Answer: _____

(c) [4 pts] Which reactant is left over, and what mass of that reactant remains after the reaction is complete? (Show work, include unit(s), round appropriately)

Answer: _____

(d) [2] If the experimenter captures 17.04 g of NO at the end of the experiment, what is the percent yield? (Show work, include unit(s), round appropriately)

Answer: _____

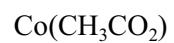
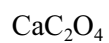
(e) [1 each] Provide appropriate **phase labels** for each of these substances. (Assume pure substances under normal laboratory conditions.)

Ag_2O _____ Ag_2S _____ NO _____

(f) [2 each] Provide a correct systematic name for each of these substances.

S_4N_4 _____ Ag_2S _____

7 [5] Circle the formulas that represent **insoluble** ionic compounds.



8 [3] In the space provided, sketch the molecular-level interaction between a calcium ion and a water molecule. Represent relevant charges accurately.

