Chemistry 121B Hanson **EXAM 2** **Oct. 14, 2016**

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 2A											13 3A	14 4A	15 5A	16 6A	17 7A	**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 3B	4 4B	5 5B	6 6B	7 7B	8	9 8B	10	11 1B	12 2B	**13 Al** 26.98	**14 Si** 28.09	**15 P** 30.97	**16 S** 32.07	**17 Cl** 35.45	**18 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** ?

*Lanth anide 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

- All salts of the ammonium ion, and of Group IA cations, are *soluble*.
- All nitrates, perchlorates, and acetates are *soluble*.
- All chlorides (Cl^-), bromides (Br^-), and iodides (I^-), are *soluble* **EXCEPT** those of silver (Ag^+), lead(II) and mercury(I) (and also mercury(II) for bromides and iodides).
- All sulfates are *soluble* **EXCEPT** Ag_2SO_4, $PbSO_4$, Hg_2SO_4, $BaSO_4$, $SrSO_4$, and $CaSO_4$.

Mostly insoluble

- All carbonates, sulfites, and phosphates are *insoluble* **EXCEPT** those of *ammonium and Group IA cations* (see first rule, above!)
- All hydroxides are *insoluble* **EXCEPT** those of *ammonium, Group IA cations*, barium, and strontium. (Calcium hydroxide is slightly soluble.)
- All sulfides are *insoluble* **EXCEPT** those of *ammonium, Group IA cations*, and Group IIA cations.
- All oxides are *insoluble* **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:

$$O^{2-}(aq) + H_2O(\ell) \longrightarrow 2\,OH^-(aq)$$

(10) 1. In each case below, name the compound or give its chemical formula, as appropriate. Each slot is for a single word or formula.

a. magnesium phosphate _____

b. _____ _____ HNO_3

c. calcium permanganate _____

d. _____ _____ $NaHCO_3$

e. _____ _____ KSCN

f. ammonium nitrite _____

g. acetic acid _____

(6) 2. Define:

a. theoretical yield

b. stoichiometry

c. net ionic equation

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(6) 3. Balance the following chemical equations:

a. ____ $Mg_3Si_2O_5(OH)_4$ + ____ CO_2 ⟶ ____ $MgCO_3$ + ____ SiO_2 + ____ H_2O

b. ____ $AsCl_3$ + ____ $NaBH_4$ ⟶ ____ AsH_3 + ____ NaCl + ____ BCl_3

(10) 4. Write balanced chemical equations for:

a. the combustion reaction of the main component in gasoline (heptane, C_7H_{16})

b. The reaction between phosphoric acid and sodium hydroxide. [If you cannot remember what phosphoric acid is, use "H_3X" for partial credit.]

(16) 5. Write the balanced net ionic equations in each case. Indicate phases for all compounds.

a. Na_2CO_3 (aq) + $BaCl_2$ (aq) ⟶ NaCl (aq) + $BaCO_3$ (s)

b. the reaction between $(NH_4)_3PO_4$ (aq) with $FeCl_3$ (aq)

c. the reaction between $Pb(NO_3)_2$ (aq) and NaCl (aq)

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(25) 6. Calculate:

a. The number of atoms of mercury in 2.5 g of Hg_2Cl_2.

b. The mass percent of potassium in KOH (FW 56.11)

c. The mass of sodium in 250 mL of a 0.15 *M* NaOH solution.

d. The volume of 0.10 *M* NaOH solution required to make 120 mL of 0.020 *M* NaOH solution by dilution.

e. The molarity of K^+ in a solution made from diluting 50 mL of 0.24 *M* K_2CO_3 solution with 150 mL of water.

(15) 7. Calculate the limiting reactant, theoretical yield of titanium, and percent yield of titanium for the following reaction, provided 3.00 kg of titanium was isolated.

	$TiCl_4$	+	4 Na	$\longrightarrow$	4 NaCl	+	Ti
mass/kg	14.5		7.00				
FW	189.68		22.99		58.44		47.88

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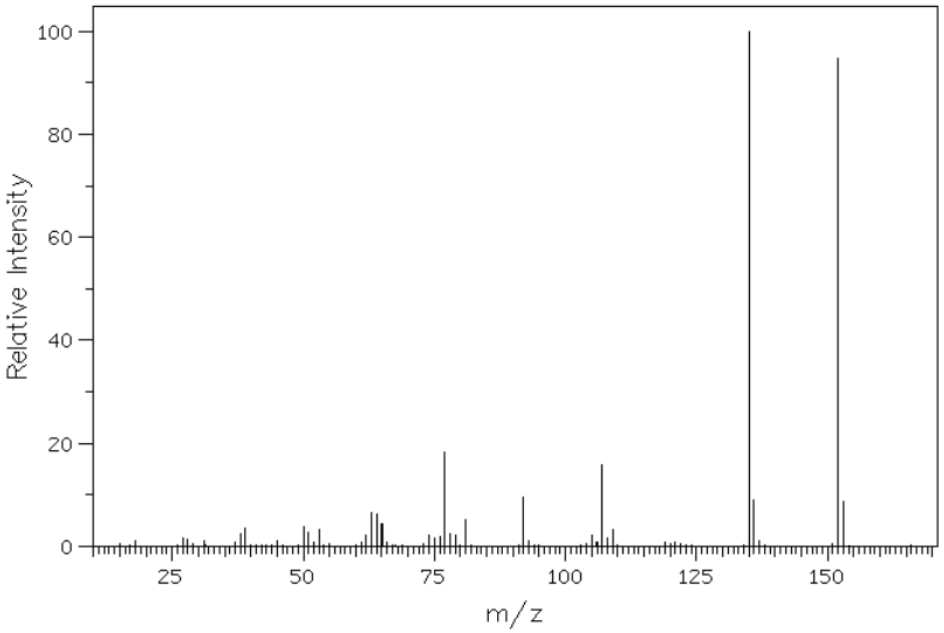
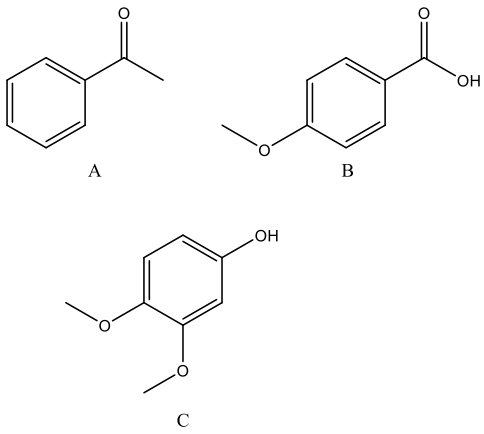
(12) 8. Shown below is a mass spectrum of a compound containing only carbon, oxygen, and hydrogen.





a) In the space below, give a brief explanation of what is going on in a mass spectrometer. [Hint – the instrument you used is called a "GC/MS." No need to discuss what a GC is, just MS.]

b) What do the vertical lines on this spectrum represent?

c) What is the likely molecular mass of this compound based on these data?

d) Which structure, A-C, is the most likely candidate for this compound? Explain your reasoning.

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_____