

# Chem 1141 Fall 2012 Exam 2A

Name: KEY

Please write your full name, and which exam version (2A) you have on the scantron sheet.

**Multiple Choice. [3 points each.] Record your answers to the multiple choice questions on the scantron sheet.**

Q1. What is the mass of a single atom of Carbon-12?

- a) 12.01 u      **b) 12 u (exactly)**      c) 12.01 g  
d) 12 g (exactly)      e)  $6.022 \times 10^{-23}$  g

*By definition!*

Q2. How many moles of Li are in a 4.0-g sample?

- a) 28      **b) 0.58**      c) 1.7      d) 0.29      e) 6.9

$$\frac{4.0 \text{ g Li}}{6.94 \text{ g Li}} \times 1 \text{ mol Li} = 0.58 \text{ mol Li}$$

Q3. What is the name of the instrument that can "weigh" individual atoms and molecules by converting them into ions, and measuring their deflection as they move through a magnetic field?

- a) Analytical Balance      b) Nuclear Magnetic Spectrometer      **c) Mass Spectrometer**  
d) Gas-Chromatograph      e) Magnetron

$$\%C = \frac{72.06}{180.2} \times 100 = 39.99\%$$

Q4. Calculate the percent by mass of carbon in the compound  $C_6H_{12}O_6$ .

- a) 25%      b) 33%      **c) 40%**      d) 50%      e) 72%

$$\begin{aligned} 6 \times C &= 6 \times 12.01 = 72.06 \\ 12 \times H &= 12 \times 1.01 = 12.1 \\ 6 \times O &= 6 \times 16.00 = 96.00 \\ \hline &180.2 \end{aligned}$$

Q5. 3.0 mol of  $N_2$  reacts with 4.0 mol of  $H_2$  according to the balanced chemical equation:  $N_2 + 3H_2 \rightarrow 2NH_3$

The limiting reagent is:

- a)  $N_2$       **b)  $H_2$**       c)  $NH_3$       d) There is no limiting reagent

$$\text{XS} \rightarrow \frac{3.0 \text{ mol } N_2}{1 \text{ mol } N_2} = 3.0 \text{ mol } N_2$$

Q6. An example of a weak electrolyte is:

- a)  $C_6H_{12}O_6$       **b)  $NH_3$**       c) HCl      d) NaOH      e) KCl

*non-electrolyte*

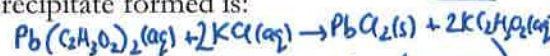
*strong electrolytes*

*weak base*

$$\text{LR} \rightarrow \frac{4.0 \text{ mol } H_2}{3 \text{ mol } H_2} = 1.3 \text{ mol } H_2$$

Q7. Aqueous lead(II) acetate is mixed with aqueous potassium chloride. The precipitate formed is:

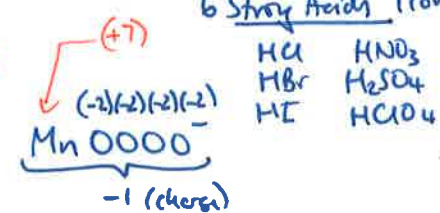
- a) PbCl      **b)  $PbCl_2$**       c)  $KC_2H_3O_2$       d) PbK      e)  $PbK_2$



Q8. Which of the following compounds is NOT a strong acid:

- a) HCl      b)  $H_2SO_4$       c)  $HClO_4$       d)  $HNO_3$       **e) HF**

*6 Strong Acids (common)*



Q9. The oxidation number of Mn in the  $MnO_4^-$  ion is:

- a) +3      b) +4      **c) +7**      d) +8      e) -8

Q10. How many moles of  $H_2SO_4$  are there in a 54.0 g sample?

- a) 0.551**      b) 98.1      c) 1.82      d) 1.59      e) 0.130

$$\begin{aligned} 2 \times H &= 2 \times 1.01 \\ 1 \times S &= 32.07 \\ 4 \times O &= 4 \times 16.00 \\ \hline &98.09 \end{aligned}$$

$$\frac{54.0 \text{ g } H_2SO_4}{98.09 \text{ g } H_2SO_4} \times 1 \text{ mol } H_2SO_4 = 0.551 \text{ mol } H_2SO_4$$

## Short Response.

Show all work to receive credit. You must use the factor-label (conversion-factor) method for all conversions. Be sure to show all units and write your answers using the correct number of significant figures or decimal places.

Q11. [10 pts.] Calculate the empirical formula of a compound that contains 64.26% C, 7.21% H, and 28.54% O by mass. If the molar mass of this compound is 168.2 g, then what is its molecular formula?

Assume 100g sample

$$\frac{64.26\text{g C}}{12.01\text{g C}} = 5.351\text{ mol C}$$

$$\frac{7.21\text{g H}}{1.01\text{g H}} = 7.14\text{ mol H}$$

$$\frac{28.54\text{g O}}{16.00\text{g O}} = 1.784\text{ mol O}$$

$$\frac{5.351\text{ mol C} : 7.14\text{ mol H} : 1.784\text{ mol O}}{1.784\text{ mol}}$$

$$\Rightarrow 3.000\text{ C} : 4.00\text{ H} : 1.000\text{ O}$$

$$\Rightarrow \boxed{\text{C}_3\text{H}_4\text{O}} \text{ empirical formula!}$$

$$\text{molar mass of } \text{C}_3\text{H}_4\text{O} \text{ is } 56.07\text{g}$$

$$\Rightarrow \text{molecular formula is } \frac{168.2\text{g}}{56.07\text{g}} = 3 \times \text{larger!}$$

$$\text{so, } \boxed{\text{C}_9\text{H}_{12}\text{O}_3} \text{ molecular formula.}$$

Q12. [15 pts.] 38.4 g of  $\text{C}_2\text{H}_6$  undergoes a combustion reaction with 41.0 g of  $\text{O}_2$ , and forms 31.4 g of  $\text{CO}_2$ . Calculate the percent yield of this reaction.

Hint: Start by writing out a balanced chemical equation.

combustion = burning!



$$\begin{array}{l} \text{C}_2\text{H}_6 \\ 2 \times \text{C} = 2 \times 12.01 \\ 6 \times \text{H} = 6 \times 1.01 \\ \hline 30.08 \end{array}$$

$$\begin{array}{l} \text{O}_2 \\ 2 \times \text{O} = 2 \times 16.00 = \underline{32.00} \end{array}$$

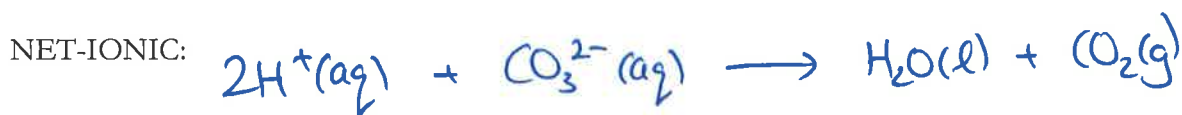
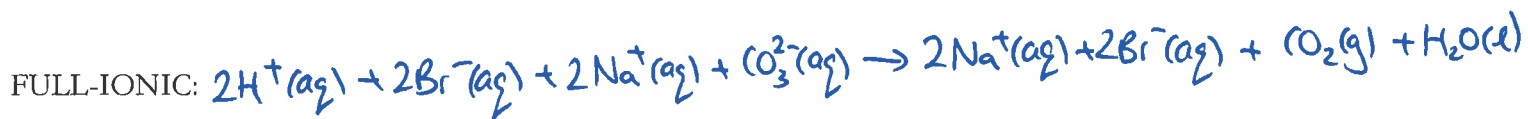
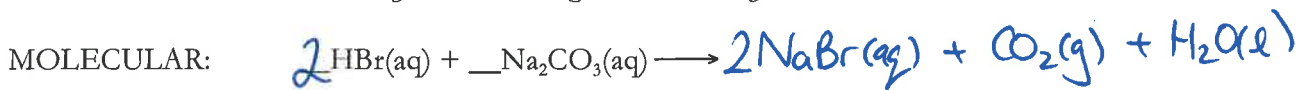
$$\begin{array}{l} \text{CO}_2 \\ 1 \times \text{C} = 12.01 \\ 2 \times \text{O} = \underline{32.00} \\ \hline 44.01 \end{array}$$

$$\begin{array}{l} \text{XS} \\ \downarrow \\ \frac{38.4\text{g C}_2\text{H}_6}{30.08\text{g C}_2\text{H}_6} \times \frac{1\text{ mol C}_2\text{H}_6}{2\text{ mol C}_2\text{H}_6} \times \frac{4\text{ mol CO}_2}{1\text{ mol CO}_2} \times \frac{44.01\text{g CO}_2}{1\text{ mol CO}_2} = 112\text{g CO}_2 \end{array}$$

$$\begin{array}{l} \text{LR} \\ \uparrow \\ \frac{41.0\text{g O}_2}{32.00\text{g O}_2} \times \frac{1\text{ mol O}_2}{7\text{ mol O}_2} \times \frac{4\text{ mol CO}_2}{1\text{ mol CO}_2} \times \frac{44.01\text{g CO}_2}{1\text{ mol CO}_2} = 32.2\text{g CO}_2 \end{array} \quad \begin{array}{l} \text{**} \\ \text{Theoretical} \\ \text{Yield.} \end{array}$$

$$\Rightarrow \% \text{ yield} = \frac{\text{Actual}}{\text{Theoretical}} \times 100 = \frac{31.4\text{g}}{32.2\text{g}} \times 100 = 97.5\%$$

Q13. [10 pts.] Write out the balanced molecular, full-ionic, and net-ionic equations for the following reaction:  
*Be sure to include all state symbols and charges where necessary.*



Q14. [6 pts.] Write formulas for the following polyatomic ions:

- |                |                                      |
|----------------|--------------------------------------|
| a) sulfite     | <u><math>\text{SO}_3^{2-}</math></u> |
| b) nitrite     | <u><math>\text{NO}_2^-</math></u>    |
| c) bicarbonate | <u><math>\text{HCO}_3^-</math></u>   |
| d) ammonium    | <u><math>\text{NH}_4^+</math></u>    |
| e) cyanide     | <u><math>\text{CN}^-</math></u>      |
| f) nitrate     | <u><math>\text{NO}_3^-</math></u>    |

Q15. [6 pts.] How many protons, neutrons, and electrons are there in the common **ion** of calcium-38?



$20\text{p}^+$

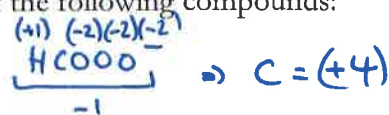
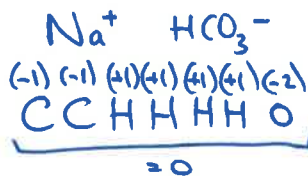
$18\text{e}^-$  (2 less since  $2+$  charge!)

$18\text{n}^0$  ( $A=38=\#p^+ + \#n^0$   
 $Z=20=\#p^+$ )

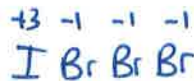
Q16. [5 pts.] Calculate the oxidation number of the underlined atom in each of the following compounds:



+4



-1



Br = higher halogen  
 = -1



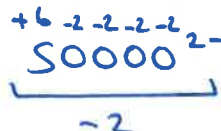
+3



-1



+6



Q17. [12 pts.] A 5.00 mL sample of H<sub>2</sub>SO<sub>4</sub>(aq) required 13.4 g of KOH to completely neutralize it. Calculate the molar concentration of the H<sub>2</sub>SO<sub>4</sub>.



[H<sub>2</sub>SO<sub>4</sub>] =  $\frac{\# \text{mol H}_2\text{SO}_4}{\# \text{L H}_2\text{SO}_4}$  ← ?

0.00500 L  
 (5.00 mL)

$\frac{13.4 \text{ g KOH}}{56.11 \text{ g KOH}} \times \frac{1 \text{ mol KOH}}{2 \text{ mol KOH}} \times \frac{1 \text{ mol H}_2\text{SO}_4}{1 \text{ mol H}_2\text{SO}_4} = 0.119 \text{ mol H}_2\text{SO}_4$

⇒ [H<sub>2</sub>SO<sub>4</sub>] =  $\frac{0.119 \text{ mol}}{0.00500 \text{ L}} = 23.8 \text{ M}$

Q18. [6 pts.] Give one example of an intensive property, and one example of an extensive property.

INTENSIVE:

density

EXTENSIVE:

mass

BONUS Question. [3 pts.]

Do you prefer me to use the over-head projector, or to write on the white-board? WHY?

?

# Chem 1141

## Fall 2012

### Exam 2B

Name: KEV

Please write your full name, and which exam version (2B) you have on the scantron sheet.

**Multiple Choice. [3 points each.] Record your answers to the multiple choice questions on the scantron sheet.**

Q1. An example of a weak electrolyte is:

- a)  $C_6H_{12}O_6$    b)  $NH_3$    c) HCl   d) NaOH   e) KCl

Q2. Aqueous lead(II) acetate is mixed with aqueous potassium chloride. The precipitate formed is:

- a) PbCl   b)  $PbCl_2$    c)  $KC_2H_3O_2$    d) PbK   e)  $PbK_2$

Q3. Which of the following compounds is NOT a strong acid:

- a) HCl   b)  $H_2SO_4$    c)  $HClO_4$    d)  $HNO_3$    e) HF

Q4. The oxidation number of Mn in the  $MnO_4^-$  ion is:

- a) +3   b) +4   c) +7   d) +8   e) -8

Q5. How many moles of  $H_2SO_4$  are there in a 54.0 g sample?

- a) 0.551   b) 98.1   c) 1.82   d) 1.59   e) 0.130

Q6. What is the mass of a single atom of Carbon-12?

- a) 12.01 u   b) 12 u (exactly)   c) 12.01 g  
d) 12 g (exactly)   e)  $6.022 \times 10^{-23}$  g

Q7. How many moles of Li are in a 4.0-g sample?

- a) 28   b) 0.58   c) 1.7   d) 0.29   e) 6.9

Q8. What is the name of the instrument that can "weigh" individual atoms and molecules by converting them into ions, and measuring their deflection as they move through a magnetic field?

- a) Analytical Balance   b) Nuclear Magnetic Spectrometer   c) Mass Spectrometer  
d) Gas-Chromatograph   e) Magnetron

Q9. Calculate the percent by mass of carbon in the compound  $C_6H_{12}O_6$ .

- a) 25%   b) 33%   c) 40%   d) 50%   e) 72%

Q10. 3.0 mol of  $N_2$  reacts with 4.0 mol of  $H_2$  according to the balanced chemical equation:  $N_2 + 3H_2 \longrightarrow 2NH_3$

The limiting reagent is:

- a)  $N_2$    b)  $H_2$    c)  $NH_3$    d) There is no limiting reagent

See Exam 2A  
for explanations

### Short Response.

Show all work to receive credit. You must use the factor-label (conversion-factor) method for all conversions. Be sure to show all units and write your answers using the correct number of significant figures or decimal places.

Q11. [10 pts.] Write out the balanced molecular, full-ionic, and net-ionic equations for the following reaction:  
Be sure to include all state symbols and charges where necessary.

MOLECULAR:  $\text{HBr(aq)} + \text{Na}_2\text{CO}_3\text{(aq)} \longrightarrow$

FULL-IONIC:

See Exam 2A, Q13

NET-IONIC:

Q12. [6 pts.] Write formulas for the following polyatomic ions:

- a) sulfite
- b) nitrite
- c) bicarbonate
- d) ammonium
- e) cyanide
- f) nitrate

See Exam 2A, Q14

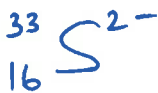
Q13. [6 pts.] Give one example of an intensive property, and one example of an extensive property.

INTENSIVE:

EXTENSIVE:

See Exam 2A, Q18

Q14. [6 pts.] How many protons, neutrons, and electrons are there in the common ion of sulfur-33?



16p<sup>+</sup>

18e<sup>-</sup>

17n<sup>0</sup>

(2 more e<sup>-</sup> since 2- ion)

(A = 33 = #p<sup>+</sup> + #n<sup>0</sup>, Z = 16 = #p<sup>+</sup>)

Q15. [10 pts.] Calculate the empirical formula of a compound that contains 64.26% C, 7.21% H, and 28.54% O by mass. If the molar mass of this compound is 168.2 g, then what is its molecular formula?

See Exam 2A, Q11.

Q16. [15 pts.] 32.1 g of  $C_2H_6$  undergoes a combustion reaction with 42.0 g of  $O_2$ , and forms 31.4 g of  $CO_2$ . Calculate the percent yield of this reaction.

*Hint: Start by writing out a balanced chemical equation.*

See Exam 2A, Q12 for general approach!

Q17. [5 pts.] Calculate the oxidation number of the underlined atom in each of the following compounds:



See exam 2A, Q16

Q18. [12 pts.] A 5.00 mL sample of H<sub>2</sub>SO<sub>4</sub>(aq) required 13.4 g of NaOH to completely neutralize it. Calculate the molar concentration of the H<sub>2</sub>SO<sub>4</sub>.

See exam 2A, Q17 for general approach.

**BONUS Question.** [3 pts.]

Do you prefer me to use the over-head projector, or to write on the white-board? WHY?

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