Chem 30A Spring 2016 – Laney College
Professor Scott Beaver

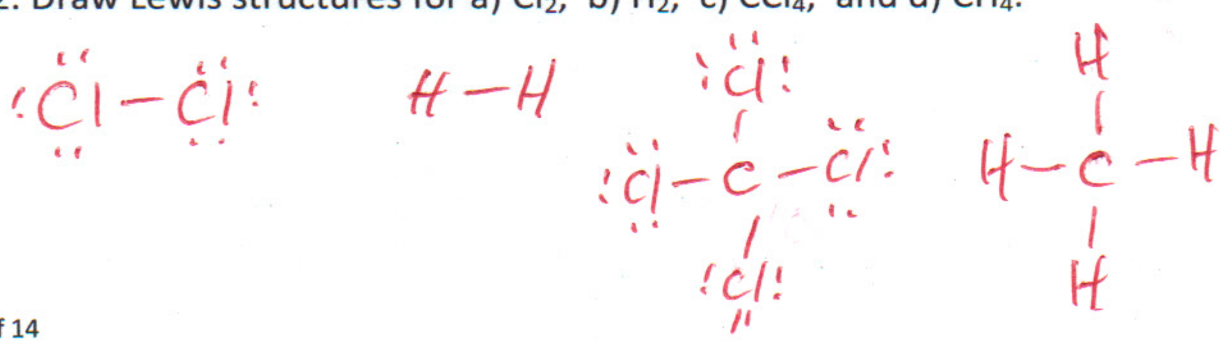
4/2/2016
Practice Exam #2

Name: Scott Beaver, PhD

[28 pt] 1. Print and complete the names/formulas in the table. Indicate as ionic (I) or covalent (C), and use the corresponding nomenclature.

Name	Ionic/covalent	Formula
dinitrogen tetroxide	C	N_2O_4
sulfur hexafluoride	C	SF_6
sulfur trioxide	C	SO_3
Zn^{2+} O^{2-} zinc oxide	I	ZnO
Ag^+ Cl^- silver chloride	I	$AgCl$
Li^+ S^{2-} lithium sulfide	I	Li_2S
K^+ N^{3-} potassium nitride	I	K_3N
carbon tetrabromide	C	CBr_4
magnesium bromide	I	$MgBr_2$
potassium bromide	I	KBr
carbon monoxide	C	CO
sulfur hexachloride	C	SCl_6
chlorine dioxide	C	ClO_2 (g)
aluminum chloride	I	$AlCl_3$

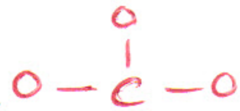
[16 pt.] 2. Draw Lewis structures for a) Cl_2, b) H_2, c) CCl_4, and d) CH_4.



Name: ____________________________

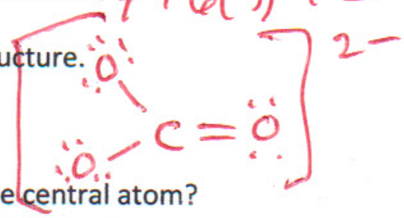
[15 pt.] **3. Consider the carbonate ion (CO_3^{2-}).**

a. Draw the skeleton structure with central atom C.



b. How many total valence electrons? $4 + 6(3) + 2 = $ 24

c. Draw one correct Lewis structure.



d. How many lone pairs on the central atom? ∅

e. How many atoms are bonded to the central atom? 3

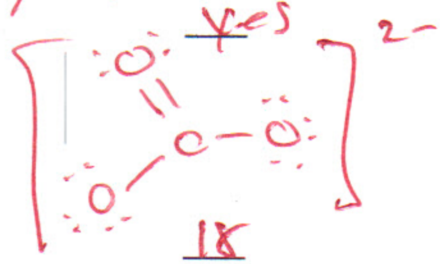
f. How many electron charge clouds are around the central atom? 3

g. What is the molecular geometry (3D shape)? trigonal planar

h. Are the bonds polar (yes/no)? $\Delta EN = 3.5 - 2.5 = 1.0$ polar bonds - yes

i. Is carbonate ion polar or non-polar? no - resonance, average symmetric non-polar

j. Are there any resonance structures? If so, draw one. yes



[15 pt.] **4. Consider sulfur dioxide (SO_2).**

a. Draw the skeleton structure with central atom S. – S – O

b. How many total valence electrons? $3(6) =$ 18

c. Draw one correct Lewis structure.

$O = S - O$

d. How many lone pairs on the central atom? 1

e. How many atoms are bonded to the central atom? 2

f. How many electron charge clouds are around the central atom? 3

g. What is the molecular geometry (3D shape)? bent - 120°

h. Are the bonds polar (yes/no)? $\Delta EN = 3.5 - 2.5 = 1.0$ polar bonds/yes

i. Is sulfur dioxide polar or non-polar? polar - bent ~~assymetric~~ /assymetric

j. Are there any resonance structures? If so, draw one.

$O - S = O$

Name: ____________________

[24 pt.] 5. Balance the following reactions.

2 C_2H_2 *(g)* + 5 O_2 *(g)* → 4 CO_2 *(g)* + 2 H_2O *(g)*

___ C_2H_4 *(g)* + 3 O_2 *(g)* → 2 CO_2 *(g)* + 2 H_2O *(g)*

2 C_2H_6 *(g)* + 7 O_2 *(g)* → 4 CO_2 *(g)* + 6 H_2O *(g)*

2 C_8H_{14} *(g)* + 23 O_2 *(g)* → 16 CO_2 *(g)* + 14 H_2O *(g)*

___ C_8H_{16} *(g)* + 12 O_2 *(g)* → 8 CO_2 *(g)* + 8 H_2O *(g)*

2 C_8H_{18} *(g)* + 25 O_2 *(g)* → 16 CO_2 *(g)* + 18 H_2O *(g)*

2 Fe *(s)* + ___ O_2 *(g)* → 2 FeO *(s)*

___ N_2 *(g)* + ___ O_2 *(g)* → 2 NO *(g)*

Name: ______________________________

[20 pt.] 6. Use the solubility guidelines to determine if any of the following are precipitation reactions. If so, complete the right side and balance the equation. If not, write "n.r." (no reaction).

a. __ KCl (aq) + __ $NaBr$ (aq) → n.r.

KBr - aq

NaCl - aq.

b. __ $BaCl_2$ (aq) + __ Na_2SO_4 (aq) → $BaSO_4(s)$ + 2NaCl(aq)

c. __ KI (aq) + __ $AgNO_3$ (aq) → $AgI(s)$ + $KNO_3(aq)$

d. __ $NaNO_3$ (aq) + __ NH_4Cl (aq) → n.r.

NaCl - aq

NH_4NO_3 - aq

e. __ $Pb(NO_3)_2$ (aq) + 2 KCl (aq) → $PbCl_2(s)$ + $2KNO_3(aq)$

Name: ______________________

[16 pt.] 7. Complete and balance the neutralization reactions. List all spectator ions for each reaction.

a. ___ HNO_3 *(aq)* + ___ KOH *(aq)* → $H_2O\ (l) + KNO_3(aq)$

Spectator ions: K^+, NO_3^-

b. ___ H_2SO_4 *(aq)* + 2 KOH *(aq)* → $2H_2O\ (l) + K_2SO_4(aq)$

Spectator ions: K^+, SO_4^{2-}

c. 2 H_3PO_4 *(aq)* + 3 $Mg(OH)_2$ *(aq)* → $6H_2O(l) + Mg_3(PO_4)_2(aq)$

Spectator ions: Mg^{2+}, PO_4^{3-}

d. 2 HCH_3COO *(aq)* + ___ $Mg(OH)_2$ *(aq)* → $2H_2O\ (l)$ $+ Mg(CH_3COO)_2\ (aq)$

Spectator ions: Mg^{2+}, CH_3COO^-

oxidized, oxidation # ↑

Name: ____________________

[6 pt.] 8. Circle the **reducing agent** in the following redox reactions:

a. $4\ \overset{0}{Fe}\ (s) + 3\ O_2\ (g) \rightarrow 2\ \overset{+3}{Fe_2}O_3\ (s)$

b. $\overset{0}{Fe}\ (s) + Cu^{2+} (aq) \rightarrow \overset{+2}{Fe^{2+}} (aq) + Cu\ (s)$

c. $2\ \overset{0}{Na}\ (s) + Cl_2\ (g) \rightarrow 2\ \overset{+1}{Na}Cl\ (s)$

[8 pt.] 9. Predict whether the following covalent bonds are polar or non-polar using electronegativity difference:

a. C—H ΔEN=0.4 n.p.
b. C—C non polar
c. C—Br ΔEN=0.3 n.p.
d. C—O ΔEN=1.0 polar
e. N—H ΔEN= 0.9, polar
f. N—C ΔEN=0.5, polar (?)
g. N—Br ΔEN=0.2, nonpolar
h. N—F ΔEN=1.0, polar

[10 pt.] 10. Give the oxidation number for <u>sulfur</u> in the following:

a. S (s) ___∅___ elemental form

b. $\overset{+4}{S}\overset{-4}{O_2}$ (g) ___+4___

c. $\overset{2(+1)}{H_2}S$ (g) ___−2___

d. SO_4^{2-} (aq) ___+6___

$S + 4(-2) = -2$
$S - 8 = -2$
$S = +6$

e. SO_3^{2-} (aq) ___+4___

$S + 3(-2) = -2$
$S - 6 = -2$
$S = +4$

Name: ______________________

11. *[10 pts, 192-E3-1]*

a. **Balance** the below equation for peroxide (H_2O_2) decomposition.

b. Calculate **how many moles of products (water and oxygen)** are produced when 6 mol of H_2O_2 decomposes.

$$\underline{2}\ H_2O_2 \rightarrow \underline{2}\ H_2O + \underline{\quad}\ O_2$$

6 mol H_2O_2 — 6 mol ? — 3 mol ?

$H_2O: \left(6\ \cancel{mol\ H_2O_2}\right)\left(\frac{2\ mol\ H_2O}{2\ \cancel{mol\ H_2O_2}}\right) = 6\ mol\ H_2O$

$O_2: \left(6\ \cancel{mol\ H_2O_2}\right)\left(\frac{1\ mol\ O_2}{2\ \cancel{mol\ H_2O_2}}\right) = 3\ mol\ O_2$

12. *[15 pts, 193-E3-2]*

For the below (<u>already balanced</u>) equation:

$$\underset{0.103\,g}{\overset{94.11\,g/mol}{3\ C_6H_5OH}} + FeCl_3 \rightarrow \underset{?}{\overset{335.15\,g/mol}{Fe(C_6H_5O)_3}} + 3\ HCl$$

a. Calculate the **theoretical yield in grams of $Fe(C_6H_5O)_3$** given 0.103 grams of phenol (C_6H_5OH) reacts with excess $FeCl_3$.

b. What is the **percent yield** if an experiment produces an actual yield of 0.118 grams of $Fe(C_6H_5O)_3$?

theoretical yield $= \left(0.103\,g\ C_6H_5OH\right)\left(\frac{mol\ C_6H_5OH}{94.11\,g\ C_6H_5OH}\right)\left(\frac{1\,mol\ Fe...}{3\,mol\ C_6H_5OH}\right)\left(\frac{335.15\,g\ Fe...}{mol\ Fe...}\right)$

$= 0.122\,g\ Fe(C_6H_5O)_3$

% yield $= \frac{actual}{theoretical} \times 100\%$

$= \frac{0.118\,g}{0.122\,g} \times 100\% = 96.5\%$

$Fe(OH)_3$ theoretical yield: 0.122 g

$Fe(OH)_3$ percent yield: 96.5%

Name: ______________________

13. *[20 pts, 131E1practice-#11]* 75.0 kg of hydrazine and 75.0 kg oxygen are reacted as below in the **unbalanced** reaction. What is the limiting reactant? What is the theoretical yield for NO_2?

$$(1)\, N_2H_4\,(l) \;+ 3\, O_2\,(g) \;\rightarrow 2\, NO_2\,(g) \;+ 2\, H_2O\,(g)$$

75.0 kg 75.0 kg

N_2H_4 yield:

$$(75{,}000\text{ g } N_2H_4)\left(\frac{\text{mol } N_2H_4}{32.04\text{ g } N_2H_4}\right)\left(\frac{2\text{ mol } NO_2}{1\text{ mol } N_2H_4}\right)\left(\frac{46.055\text{ g } NO_2}{\text{mol } NO_2}\right)$$

$= 216{,}000$ g or 216 kg NO_2

O_2 yield:

$$(75{,}000\text{ g } O_2)\left(\frac{\text{mol } O_2}{32.00\text{ g } O_2}\right)\left(\frac{2\text{ mol } NO_2}{3\text{ mol } O_2}\right)\left(\frac{46.055\text{ g } NO_2}{\text{mol } NO_2}\right)$$

$= \boxed{72{,}000 \text{ or } 72\text{ kg } NO_2}$

Limiting reactant: oxygen

NO_2 theoretical yield: 72.0 kg

Name: ______________________

[20 pt.] 14. Determine the limiting reactant when of 37 g of carbon monixide gas is reacted with 6.5 g H_2 using the balanced combustion equation below. Show your work, and write your answers below.

$$\underset{37g}{CO\,(g)} + \underset{6.5g}{2\,H_2\,(g)} \rightarrow \underset{?}{CH_3OH\,(l)}$$

a. What is the **limiting reactant**?

b. What is the **theoretical yield for CH_3OH**?

c. An experiment makes 28 g CH_3OH. What is the **percent yield?**

CO yield.

$$(37\,g\,CO)\left(\frac{mol\,CO}{28.01\,g\,CO}\right)\left(\frac{1\,mol\,CH_3OH}{1\,mol\,CO}\right)\left(\frac{32.04\,g\,CH_3OH}{mol\,CH_3OH}\right)$$

$$= 42\,g\,CH_3OH$$

H_2 yield

$$(6.5\,g\,H_2)\left(\frac{mol\,H_2}{2.016\,g\,H_2}\right)\left(\frac{1\,mol\,CH_3OH}{2\,mol\,H_2}\right)\left(\frac{32.04\,g\,CH_3OH}{mol\,CH_3OH}\right)$$

$$= 52\,g\,CH_3OH$$

$$\%\ yield = \frac{28\,g}{42\,g} \times 100\% = 67\%$$

Limiting reactant: CO

Theoretical yield: 42 g CH_3OH

Percent yield: ~~71%~~ 67%

Name: ____________________

15. **Balance** the below equation. What is the **limiting reactant** when 50.0g of propane (C_3H_8) reacts with 30.0 g oxygen? What is the **theoretical yield for CO_2**? ~~How many grams of **excess reactant** remain?~~

$$(1)\ C_3H_8 + 5\,O_2 \rightarrow 3\,CO_2 + 4\,H_2O$$

50.0g 30.0g ?

C_3H_8 yield:

$$\left(50.0\text{ g } C_3H_8\right)\left(\frac{\text{mol } C_3H_8}{44.09\text{ g } C_3H_8}\right)\left(\frac{3\text{ mol } CO_2}{1\text{ mol } C_3H_8}\right)\left(\frac{44.01\text{ g } CO_2}{\text{mol } CO_2}\right)$$

$$= 150.\text{ g } CO_2$$

O_2 yield

$$\left(30.0\text{ g } O_2\right)\left(\frac{\text{mol } O_2}{32.00\text{ g } O_2}\right)\left(\frac{3\text{ mol } CO_2}{5\text{ mol } O_2}\right)\left(\frac{44.01\text{ g } CO_2}{\text{mol } CO_2}\right)$$

$$= 24.8\text{ g } CO_2$$

Limiting reactant: O_2

CO_2 theoretical yield: 24.8g

~~Excess reactant:~~ ~~________~~

Skyline College Chem 192
Professor Scott Beaver

Exam #3
11/17/2015
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[40 pts] 3. In the below (already balanced) equation, 0.530 g of cetane ($C_{16}H_{34}$) reacts with 2.52 g of oxygen.

226.432 g/mol   32.00 g/mol   44.01 g/mol

$$2\ C_{16}H_{34} + 49\ O_2 \rightarrow 32\ CO_2 + 34\ H_2O$$

0.530 g   2.52 g   ?   ×

a. What is the **limiting reactant**?

b. What is the **theoretical yield for CO_2**?

c. How many grams of **excess reactant** remain?

CO_2 from $C_{16}H_{34}$ $= (0.530\text{ g cetane})\left(\frac{\text{mol cetane}}{226.432\text{ g cetane}}\right)\left(\frac{32\text{ mol }CO_2}{2\text{ mol cetane}}\right)\left(\frac{44.01\text{ g }CO_2}{\text{mol }CO_2}\right)$

$= 1.6482\text{ g }CO_2$ (3 s.f.)

CO_2 from O_2 $= (2.52\text{ g }O_2)\left(\frac{\text{mol }O_2}{32.00\text{ g }O_2}\right)\left(\frac{32\text{ mol }CO_2}{49\text{ mol }O_2}\right)\left(\frac{44.01\text{ g }CO_2}{\text{mol }CO_2}\right)$

$= 2.2634\text{ mol }CO_2$

O_2 needed for complete reaction of 0.530 g cetane:

$(0.530\text{ g cetane})\left(\frac{\text{mol cetane}}{226.432\text{ g cetane}}\right)\left(\frac{49\text{ mol }O_2}{2\text{ mol cetane}}\right)\left(\frac{32.00\text{ g }O_2}{\text{mol }O_2}\right)$

$= 1.835\text{ g }O_2$ required

Excess O_2 = 2.52 g − 1.835 g = 0.68 g (2 d.p.)

Limiting reactant:	cetane / $C_{16}H_{34}$
CO_2 theoretical yield:	1.65 g CO_2
grams of excess reactant:	0.68 g O_2 excess