Recitation Worksheet 1

Name: | MyID:

Textbook:

Chemistry & Chemical Reactivity
by John C. Kotz, Paul M. Treichel, John R. Townsend, David Treichel
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Instructions:

- This recitation worksheet covers CHEM 1211 Review and will be graded.
- Please enter your first and last name as it appears on the eLC roster (do not use a nickname that is not reflected in eLC).
- Your UGA myID is a combination of letters and numbers (example: Dr. Abdelrahman's MyID is ema88805). **Do not use your 81x number**.
- Your completed worksheet has to be submitted to **Gradescope**. You have multiple options for submission:
  - You may use an app to annotate the worksheet by placing your answers in the answer boxes and showing your work when appropriate. Afterward, submit the worksheet to Gradescope. You will not need to upload anything to eLC.
  - You may print out the worksheet, write your answers in the answer boxes, and show your work on it when appropriate. Afterward, convert the worksheet to a PDF and submit to Gradescope. You will not need to upload anything to eLC.
  - If you do not have access to a printer, you may type your answers directly into the worksheet PDF and then submit it to Gradescope. Write your work on separate sheets of paper, convert them to a PDF, and upload to the appropriate dropbox on eLC.
  - There is a Gradescope app available for both iOS and Android devices that allows you to scan and submit your printed work, or you can submit your fillable PDF directly.
- The following criteria **must** be met to be eligible for full credit:
  - You must make sure the pages are in the correct order and have the same layout as the original worksheet when submitting to Gradescope regardless of your submission type.
  - Answers must be written in the corresponding answer boxes.
  - You must show your work when appropriate.
- This worksheet is due no later than **12:00 PM (noon), Monday, August 26th.**
- A periodic table and formula sheet are attached to the end of this worksheet. Please keep these attached to your worksheet in the correct order when submitting to Gradescope.

Part I: CHEM 1211 Review

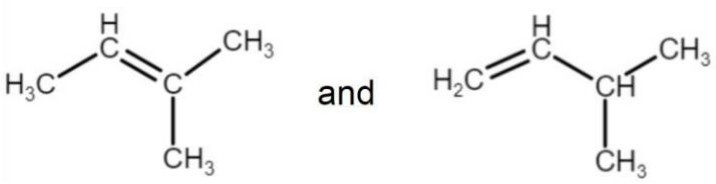
1. In a user's manual accompanying an American-made car, a typical pressure gauge performance of car tires is 32 lb/in^2. What is the pressure in kg/m^2? (1 lb. = 453.59 g and 1 in. = 2.54 cm).

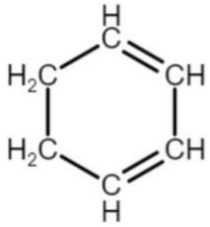
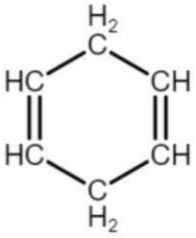
   | | kg/m^2

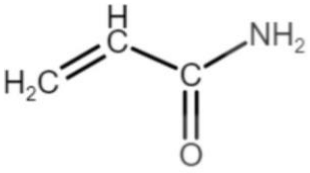
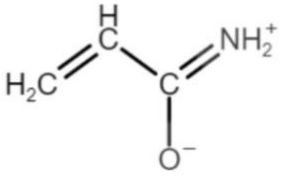
2. Blood alcohol content (BAC) is sometimes reported in weight-volume percent and, when it is, a BAC of 0.10% corresponds to 0.10 g of ethyl alcohol per 100 mL of blood. In many jurisdictions, a person is considered legally intoxicated if his or her BAC is 0.10%. Suppose that a 68 kg person has a total blood volume of 5.4 L and breaks down ethyl alcohol at a rate of 10.0 grams per hour. How many 145 mL glasses of wine, consumed over three hours, will produce a BAC of 0.10% in this 68 kg person? Assume the wine has a density of 1.01 g/mL and 11.5% ethyl alcohol by mass (11.5 g ethyl alcohol/100 g wine).

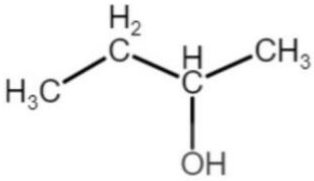
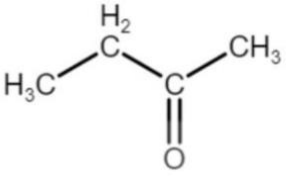
[ ] glasses of wine

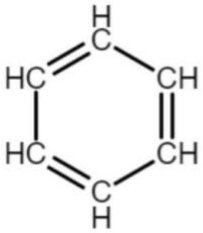
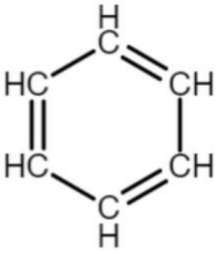
3. Students have proposed resonance structures for different chemical species. Which set(s) represent resonance structures? Select all that apply. Insert letters without spaces in the answer box, example **ABCD**.

A.  and

B.  and 

C.  and 

D.  and 

E.  and 

4. Which of these molecules are polar? Select all that apply. Insert letters without spaces in the answer box, example **ABCD**.

A. $AsCl_5$

B. OF_2

C. $SOCl_2$

D. BrF_4^+

E. CH_2Cl_2

F. IF_4^-

5. What is the hybridization of the **central atom** in each of the ions or molecules below?

A. ClF^+

B. H_2CO

C. SCl_4

D. NO^-

E. IF_6^+

6. Dimethylolpropionic acid (shown below) is used in the preparation of water-soluble resins to make high gloss coatings with excellent flexibility and toughness. What is the hybridization of each of the carbon atoms labeled below?

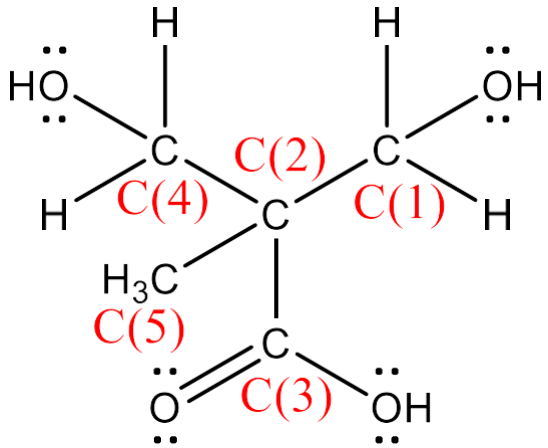
A. C(1) ☐

B. C(2) ☐

C. C(3) ☐

D. C(4) ☐

E. C(5) ☐



7. What is the **total ionic equation** for the reaction between copper(II) nitrate and sodium phosphate?

☐

A. $3\ Cu(NO_3)_2(aq) + 2\ Na_3PO_4(aq) \longrightarrow 6\ NaNO_3(aq) + Cu_3(PO_4)_2(s)$
B. $Cu^{2+}(aq) + NO_3^-(aq) + Na^+(aq) + PO_4^{3-}(aq) \longrightarrow Na^+(aq) + NO_3^-(aq) + PO_4^{3-}$
C. $3\ Cu^{2+}(aq) + 6\ NO_3^-(aq) + 6\ Na^+(aq) + 2\ PO_4^{3-}(aq) \longrightarrow 6\ Na^+(aq) + 6\ NO_3^-(aq) + Cu_3(PO_4)_2(s)$
D. $3\ Cu^{2+}(aq) + 6\ NO_3^-(aq) + 6\ Na^+(aq) + 2\ PO_4^{3-}(aq) \longrightarrow 6\ Na^+(aq) + 6\ NO_3^-(aq) + 3\ Cu^{2+}(aq) + 2\ PO_4^{3-}(aq)$
E. $3\ Cu^{2+}(aq) + 2\ PO_4^{3-}(aq) \longrightarrow Cu_3(PO_4)_2(s)$
F. No reaction occurs

8. What is the **net ionic equation** for the reaction between HNO_3 and $Ba(OH)_2$?

☐

A. $2\ HNO_3(aq) + Ba(OH)_2(aq) \longrightarrow Ba(NO_3)_2(aq) + 2\ H_2O(l)$
B. $2\ H^+(aq) + 2\ NO_3^-(aq) + Ba^{2+}(aq) + 2\ OH^-(aq) \longrightarrow Ba^{2+}(aq) + 2\ NO_3^-(aq) + 2\ H_2O(l)$
C. $H^+(aq) + OH^-(aq) \longrightarrow H_2O(l)$
D. No reaction occurs

9. Which of these compounds are soluble in water? Select all that apply. Insert letters without spaces in the answer box, example **ABCD**.

A. $BaSO_4$
B. CH_3COONH_4
C. $NaClO_4$
D. $CaCO_3$
E. $FeBr_3$
F. AgI
G. $ZnCl_2$
H. $Pb(NO_3)_2$

10. Classify the compounds below as an acid, base, or salt. Insert acid, base, or salt in the boxes below.

A. $HClO_4$
B. C_6H_5COOH
C. RbOH
D. $CaCl_2$
E. NaBr
F. $Mg(OH)_2$
G. K_2SO_4
H. NH_3

11. How many milliliters of 0.650 M K_2CrO_4 are needed to precipitate all the silver in 415 mL of 0.186 M $AgNO_3$ as $Ag_2CrO_4(s)$?

$$2\ AgNO_3(aq) + K_2CrO_4(aq) \longrightarrow Ag_2CrO_4(s) + 2\ KNO_3(aq)$$

[ ] mL

12. Phosphorous trichloride, PCl_3, is a commercially important compound used in the manufacturing of pesticides, gasoline additives, and a few other products. Liquid PCl_3 is made by the direct combination of phosphorous and chlorine as shown in the **unbalanced** equation below.

$$P_4(s) + Cl_2(g) \rightarrow PCl_3(l)$$

A. What is the maximum mass of PCl_3 produced from 125 g of P_4 and 323 g of Cl_2?

[ ] g

B. What is the limiting reactant and what mass of the excess reactant remains?

[ ]

i. Cl_2 is the limiting reactant and 30.9 g of P_4 remain
ii. P_4 is the limiting reactant and 137 g of Cl_2 remain
iii. Cl_2 is the limiting reactant and 93.9 g of P_4 remain
iv. P_4 is the limiting reactant and 198 g of Cl_2 remain
v. P_4 is the limiting reactant and 30.9 g of Cl_2 remain

13. Using Hess's law, determine $\Delta H°$ for the reaction below:

$$C_2H_4(g) + Cl_2(g) \longrightarrow C_2H_4Cl_2(l)$$

Given that,

$4\ HCl(g) + O_2(g) \longrightarrow 2\ Cl_2(g) + 2\ H_2O(l)$ $\Delta H° = -202.4$ kJ/mol

$2\ HCl(g) + C_2H_4(g) + ½\ O_2(g) \longrightarrow C_2H_4Cl_2(l) + H_2O(l)$ $\Delta H° = -318.7$ kJ/mol

[ ] kJ/mol

<u>Part II: CHEM 1212 Syllabus and Assignments</u>

You may find the answers in the instructions of this document and in the course syllabus. Please read both of those before submitting:

1. Where should this recitation worksheet be submitted?

[ ]

A. eLC
B. By email to the instructor
C. The worksheet must go to Gradescope. If the work is not written on the worksheet, then upload the work to eLC.

2. What time are recitation worksheets due?

A. At the end of recitation
B. By the next lecture period
C. Saturday at 12:00 pm (noon) of the recitation week

3. What day and time are the exams? Choose the two that correctly pair (example: AB).

A. Monday
B. Tuesday
C. Wednesday
D. Thursday
E. During the lecture period
F. 7:00 pm
G. 5:30 pm

4. What assignments are due every week on WebAssign?

A. Exams
B. In-Class Activities
C. Recitations
D. Weekly Quizzes
E. Suggested exercises and practice quizzes

Formula Sheet

Length
1 kilometer = 0.62137 mile
1 inch = 2.54 centimeters (exactly)
1 Ångstrom = 1×10^{-10} meter

Energy
1 joule = 1 kg·m^2/s^2
1 calorie = 4.184 joules
1 Calorie = 1 kilocalorie = 1000 calories
1 L·atm = 101.325 joules

Pressure
1 pascal = 1 N/m^3 = 1 kg/m·s^2
1 atmosphere = 101.325 kilopascals = 760 mm Hg = 760 torr = 14.70 lb/in^2
1 bar = 1×10^5 Pa (exactly)

Temperature
0 K = −273.15°C
K = °C + 273.15
°C = (5/9)(°F − 32)

Mass
1 kg = 2.205 lbs

Volume
1 mL = 1 cm^3 = 1 cc

Constants
c = 2.998×10^8 m/sec
h = 6.626×10^{-34} J·sec^{-1}
R = 0.08206 L·atm/mol·K = 8.314 J/mol·K
Specific heat of water = 4.184 J/g·K
Mass of an electron: 9.109 x 10^{-31} kg
Mass of a proton: 1.673 x 10^{-27} kg
RH = 2.18 x 10^{-18} J
Specific heat of water = 4.184 J/g·K
STP = 273.15 K and 1 atm
Avogadro's number: 6.022×10^{23}

Equations
d (density) = m/V
$P_1V_1=P_2V_2$
$V_1/T_1=V_2/T_2$
$P_1V_1/n_1T_1=P_2V_2/n_2T_2$
PV=nRT
$(P + a(n^2/V^2))\cdot(V - nb) = nRT$
molar mass (M) = mRT/PV
density (d) = MP/RT
$x_A = n_A/n_{tot} = P_A/P_{tot} = V_A/V_{tot}$
$P_{tot} = P_A + P_B + \ldots$
$n_{tot} = n_A + n_B + \ldots$

$$\mu_{rms} = \sqrt{\frac{3RT}{M}}$$

$$\frac{Rate\ of\ effusion\ A}{Rate\ of\ effusion\ B} = \sqrt{\frac{MW_B}{MW_A}}$$

$Q = C \times \Delta T = c_{specific} \times m \times \Delta T$
$Q = n \times \Delta H\ (kJ/mol) = m \times \Delta H\ (kJ/g)$
$w = -P\Delta V$
$\Delta E = q + w$
$\Delta H° = \Sigma n\Delta Hf°(products) - \Sigma n\Delta Hf°(reactants)$
$\Delta H° = \Sigma n\Delta H°(bonds\ broken) - \Sigma n\Delta H°(bonds\ formed)$
$E=h\nu$
$c=\lambda\nu$
$\lambda = h/m\nu$

$$\Delta E = -2.18 \times 10^{-18} J(\frac{1}{n_f^2} - \frac{1}{n_i^2})$$

$$\ln\left(\frac{P_2}{P_1}\right) = \frac{\Delta H_{vap}}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$C_g = kP_g$
$P_{solution}=P_{solvent}\ X_{solvent}$
$P_{solution}=\sum P_j=\sum P_j X_j$
$\Delta T_b = K_b m i$
$\Delta T_f = K_f m i$
$\pi = MRTi$

Thermodynamic and Electrochemistry

$S = k_b \times \ln(W)$
$k_b = 1.381 \times 10^{-23}\ J/K$
$\Delta S = q_{rev}/T$
$\Delta S_{surr} = q_{surr}/T = -q_{rev}/T$
$\Delta S_{univ} = \Delta S_{sys} + \Delta S_{surr}$
$\Delta S°_{rxn} = \Sigma \nu S°_{products} - \Sigma \nu S°_{reactants}$
$\Delta H°_{rxn} = \Sigma \nu H°_{products} - \Sigma \nu H°_{reactants}$
$\Delta G°_{rxn} = \Sigma \nu G°_{products} - \Sigma \nu G°_{reactants}$
$\Delta G = \Delta H - T\Delta S$
$\Delta G = \Delta G° + RT \cdot \ln Q$
$R=8.314\ J/mol.K$
$\Delta G° = -RT \cdot \ln K$
$\Delta G= -nFE_{cell}$
$F = 96485\ J/(V \cdot mol\ e^-)$
$E°_{cell} = RT/nF\ \ln K$
$E°_{cell} = (0.0257/n)\ \ln K = (0.0592/n)\ \log K$
$E_{cell} = E°_{cell} - (RT/nF)\ \ln Q$
$E_{cell} =E°_{cell} - (0.0257/n)\ \ln Q$
Electrolysis: $Q\ (total\ charge) = I \times t = n \times F$

Integrated Rate Laws & half-life

$$\ln\frac{[A]}{[A]_0} = -kt$$

$$\frac{1}{[A]} = kt + \frac{1}{[A]_0}$$

$$[A] = -kt + [A]_0$$

$$t_{1/2} = \frac{[A]_0}{2k}$$

$$t_{1/2} = \frac{\ln 2}{k} = \frac{0.693}{k}$$

$$t_{1/2} = \frac{1}{k[A]_0}$$

$$ln\frac{k_2}{k_1} = -\frac{\mathrm{E_a}}{\mathrm{R}}(\frac{1}{\mathrm{T_2}} - \frac{1}{\mathrm{T_1}})$$

Equilibrium and Acid / Base

$K_P = K_c \times (RT)^{\Delta n}$

$pH = -\log[H_3O^+]$

$K_w = 1.0 \times 10^{-14}$ at 25 °C

$K_w = [H_3O^+] \times [OH^-]$

$K_w = K_a \times K_b$

$pK_a = -\log[K_a]$

Buffer: $pH = pK_a + \log\frac{[A^-]}{[HA]}$

$$ln\frac{K_2}{K_1} = \frac{\Delta H^\circ_{rxn}}{R}(\frac{1}{T_1} - \frac{1}{T_2})$$

Periodic Table of the Elements