The problems in this review are designed to help prepare you for your upcoming exam. Questions pertain to material covered in the course and are intended to reflect the topics likely to appear in the exam. Keep in mind that this worksheet was created by CARE tutors, and while it is thorough, it is not comprehensive.

In addition to exam review sessions, CARE also hosts regularly scheduled tutoring hours.

Tutors are available to answer questions, review problems, and help you feel prepared for your exam during these times:

Session 1: Sept 19, 4-6pm John, Jesse, and Ryan
Session 2: Sept 20, 8-10pm John, Jesse, and Sofia

Can’t make it to a session? Here’s our schedule by course:

https://care.engineering.illinois.edu/tutoring-resources/tutoring-schedule-by-course/

Solutions will be available on our website after the last review session that we host, as well as posted in the zoom chat 30 minutes prior to the end of the session.

Step-by-step login for exam review session:

1. Log into Queue @ Illinois
2. Click “New Question”
3. Add your NetID and Name
4. Press “Add to Queue”
5. Join the zoom link in the staff message

Please do not log into the zoom call without adding yourself to the queue

Good luck with your exam!
**Naming:**
Memorize polyatomic ions

1. Ionic does not have prefixes, covalent does
2. -ate = -ic
   -ite = -us
3. Don’t use mono if its the first part of the name

Write the corresponding name/chemical formula for the following compounds:

1. \( \text{H}_2\text{SO}_4 \)

2. \( \text{Ca}_3\text{P}_2 \)

3. Ammonium Chlorate

4. Copper (II) Acetate

5. Tetraphosphorus Hexoxide
**Lewis Structures:**

1. Add the valence electrons from each element to find the total number of valence electrons
2. Draw bonds between connected atoms
3. Add electron pairs around the atoms to satisfy the octet rule (or duet rule for hydrogen)
4. Make sure the electron count and formal charges are satisfied

   Note: Pay attention to exceptions to the octet rule

1. Draw the corresponding Lewis structures for the following compounds:
   I. HCN  
   II. CO$_2$  
   III. AsF$_5$

2. Which of the following statements regarding the Lewis structure below are FALSE?

   ![Lewis Structure](image)

   A) An sp$^2$ hybrid orbital from C-1 overlaps with an sp hybrid orbital from C-2 to form the sigma bond between C-1 and C-2.
   B) This molecule has three $\pi$ bonds.
   C) Two of the atoms in this compound are sp$^3$ hybridized.
   D) The $\pi$ bonds between C-2 and C-3 are formed from overlap of sp hybrid orbitals.
   E) There are 10 sigma bonds in this molecule.
Orbitals/Electron Configuration:

1. Know Cr and Cu exceptions
2. For ions, 3d electron leaves before 4s electron
3. For shorthand notation, state at closest noble gas
4. Paramagnetic (unpaired electron) vs. dimagnetic (all electrons are in couples)

Write the electron configuration for the following elements in shorthand notation:

1. O

2. Pb

3. K

4. Ce

5. Rn

6. Cu

7. Mn
Periodic Trends:

- **Electronegativity**: The ability to hold onto electrons (negative charge). Increases up and right.

- **Ionization energy**: follows the same trend as electronegativity. The amount of energy needed to remove the weakest electron

- **Atomic Radius**: increases down and left

1. Rank from smallest to largest atomic radii: (Li, O, Lu, Rf, He)

   ____<____<____<____<____

2. Which has a higher ionization energy, Boron or Beryllium?

   __________________________________________

3. Rank from most to least ionization energy: (P, As, Te, O)

   ____>____>____>____
**Balanced Equations**
Remember: Keep polyatomic ions together. Make sure coefficients are reduced, whole numbers.

Balance the following equation

\[
\underline{\text{C}}_{8}\text{H}_{18} + \underline{\text{O}}_{2} \rightarrow \underline{\text{CO}}_{2} + \underline{\text{H}}_{2}\text{O}
\]

**Electron Configuration and Ground State:**
Circle the following elements that have 2 unpaired electrons in ground state.

Cu\(^+\)  \hspace{1cm} \text{Ni}^{2+} \hspace{1cm} \text{Zn}^{2+} \hspace{1cm} \text{Cr}^{2+} \hspace{1cm} \text{Ti}^{2+}

**Bond Length:**
1. Double bonds will be shorter than single bonds because the higher electron sharing of the pi bonds will pull them closer. Triple bonds will be the shortest of all.
2. Ionic bonds are shorter than covalent bonds. Covalent bonds share electrons, but ionic bonds fully give up electrons

Which bond has the shortest bond length and give an explanation as to why?

A) Single
B) Double Bond
C) Triple Bond
Chemical Changes/Polarity/Solubility:
Chemical change → Formula change
Physical change → State change

How many of the following processes are examples of a chemical change?

(I) \( \text{H}_2\text{O} (l) \rightarrow \text{H}_2\text{O} (g) \)

(II) \( \text{I}_2 (s) \rightarrow \text{I}_2 (g) \)

(III) \( \text{CH}_4 (g) + 2\text{O}_2 (g) \rightarrow \text{CO}_2 (g) + 2\text{H}_2\text{O} (l) \)

(IV) \( \text{C}_6\text{H}_{12}\text{O}_6(s) \rightarrow \text{C}_6\text{H}_{12}\text{O}_6(aq) \)

(V) \( 2\text{H}_2\text{O}_2(aq) \rightarrow 2\text{H}_2\text{O}(l) + \text{O}_2(g) \)

A) 1  B) 2  C) 3  D) 4  E) 5
Electromagnetic Radiation:

- Going from a lower to higher energy level = endothermic (needs energy to get to higher level)
- Going from higher to lower energy level = exothermic (releases energy when going to lower state)
- Shorter wavelength or higher frequency = higher energy (E = hf)

1. For a hydrogen atom, how many of the following three electronic transitions are exothermic? Circle them.

   A) n = 6 to n = 1  
   B) n = 2 to n = 3  
   C) n = 3 to n = 5

2. When an electron in a 2p orbital of a lithium atom makes a transition to the 2s orbital, a photon of wavelength 670.8 nm is emitted. Calculate the energy difference between the 2p and 2s orbitals in lithium.

3. Calculate the change in energy for the n = 4 to the n = 2 transition in hydrogen.

4. Does a visible light (λ = 400 - 700 nm) photon have enough energy to excite a H electron from n=1 energy to n = 6 energy state?
Shape/Geometry of Compounds:

1. How many of the following compounds have a square planar shape?
   
   A) KrF$_2$
   B) PCl$_5$
   C) XeF$_4$
   D) TeF$_4$
   E) ICl$_3$

2. Which of the following compounds will be least soluble in water? Hint: Water is a polar solvent and “like dissolves like”
   
   A) KrF$_2$
   B) PF$_3$
   C) IF$_5$
   D) COS
   E) SO$_2$