1. Write and balance a chemical equation to represent the reaction between aqueous solutions of a salt made from the most common monatomic ion of calcium and the nitrate ion and the salt that forms from the ammonium ion and the phosphate ion. Be sure to include phases for each reactant and product. Identify the spectator ions in this reaction.

2. A 5.0g sample of an unknown hydrocarbon (contains only C and H) is composed of 4.13g C and 0.870g of H. The 5.0g sample contains 0.0860 moles of the compound. How many grams of O₂ are required to completely react with the hydrocarbon if the products are CO₂ and H₂O? You may assume 100% yield for the reaction.

3. What mass of Na₂CO₃ is required to produce 150mL of a solution that is 0.500M in sodium ions?

4. How many photons with wavelength equal to 465nm are required to produce 15J of energy?

5. Which statement is true regarding effective nuclear charge, Zₑffective? Correct each false statement or explain why it is false.
   A) Zₑffective is greater than the atomic number, Z, for any given atom with more than one electron.
   B) The value of Zₑffective is closer to the value of the atomic number, Z, when the ratio of core electrons to valence electrons is greater.
   C) The number of protons, core electrons, and valence electrons in an atom all play a role in determining the magnitude of Zₑffective.
   D) The value of Zₑffective decreases progressing from left to right across a period because the number of valence electrons increases.
   E) The value of Zₑffective for Br is closer to its atomic number, Z, than the value of Zₑffective for Cl is to its atomic number.

6. The Lyman series refers to transitions of photons of light correlating to electrons in hydrogen atoms. All of the spectral lines in the Lyman series end at n = 1. The four lowest energy lines have wavelengths at 91.2nm, 97.2nm, 102.6nm, and 121.6nm. Draw and label these emission lines on the graph provided.
7. Which statement best describes the pi bonding in ethyne?

\[ H - C \equiv C - H \]

A) There are two pi bonds created through the overlap of unhybridized 2p atomic orbitals on each C atom.
B) There are two pi bonds created through overlap of sp hybrid orbitals on each C atom.
C) There is one pi bond created through overlap of a 2p hybridized atomic orbital on each C atom.
D) There is one pi bond created through overlap of sp unhybridized atomic orbitals on each C atom.
E) There are two pi bonds created through overlap of an sp hybrid orbital on each C atom and a 1s unhybridized atomic orbital on each H atom.

8. The combustion of one gallon of gasoline produces \(3.3 \times 10^4\) kJ of heat. Considering the thermochemical equation below, how many grams of ethanol, \(C_2H_5OH\), are required to produce the same amount of heat as the combustion of one gallon of gasoline? Assume 100% yield and an excess of \(O_2(g)\). Molar masses: ethanol = 48.08 g/mol; \(O_2 = 32.00 \text{ g/mol}\); \(CO_2 = 44.01 \text{ g/mol}\); \(H_2O = 18.02 \text{ g/mol}\)

\[ C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l) + 1368kJ \]


10. Which statement is true for a solution made of a nonvolatile (does not evaporate readily) solute dissolved in a liquid solvent?

A) The freezing point of the solution is higher than that of the pure solvent.
B) The boiling point of the solution is lower than that of the pure solvent.
C) The vapor pressure of the solution is lower than that of the pure solvent.
D) The freezing point of the pure solvent is lower than that of the solution.
E) The freezing point, vapor pressure, and boiling point of the solution are the same as those for the pure solvent.
1. \[3\text{Ca(NO}_3\text{)}_2(aq) + 2(\text{NH}_4\text{)}_3\text{PO}_4(aq) \rightarrow 6\text{NH}_4\text{NO}_3(aq) + \text{Ca}_3(\text{PO}_4)_2(s)\]
   Spectator Ions = \(\text{NH}_4^+(aq)\) and \(\text{NO}_3^-(aq)\)

2. \[2\text{C}_4\text{H}_{10} + 13\text{O}_2 \rightarrow 8\text{CO}_2 + 10\text{H}_2\text{O}\]
   17.9g \(\text{O}_2\)

3. 3.97g

4. \(3.5 \times 10^{19}\) photons

5. A) **Corrected:** \(Z_{\text{eff}}\) is less than the atomic number, \(Z\), for any given atom with more than one electron.
   B) **Corrected:** The value of \(Z_{\text{eff}}\) is closer to the value of the atomic number, \(Z\), when the ratio of core electrons to valence electrons is smaller.
   C) **Correct**
   D) **Corrected:** The value of \(Z_{\text{eff}}\) increases progressing from left to right across a period because the number of valence electrons increases.
   E) **Corrected:** The value of \(Z_{\text{eff}}\) for Cl is closer to its atomic number, \(Z\), than the value of \(Z_{\text{eff}}\) for Br is to its atomic number.

6.

7. A) There are two pi bonds created through the overlap of unhybridized \(2p\) atomic orbitals on each C atom.

8. 1200g
9. Vapor pressure is the pressure a gas exerts on the surface of the liquid from which it evaporated.

10. C) The vapor pressure of the solution is lower than that of the pure solvent.