1. (30)a. Rewrite the following list in order of increasing wavelength.

\[
gamma < \text{UV} < \text{vis} < \text{IR}
\]

b. How many electrons and neutrons, respectively, are in \( ^{8} \text{Kr} \)

a) 36, 56
d) 36, 92
b) 56, 36
c) 92, 36
e) 56, 92
d) 36, 92
e) 56, 92
c. What is the maximum number of electrons in an atom that can be described with the quantum numbers \( n=3, l=2, m=2 \)

1 orbital \( \ell = 2e^-
\)
d. Underline the compound with the shortest C-O bond and circle the compound with the longest C-O bond.

Draw Lewis structures!

e. If 2 mol \( \text{H}_2 \) and 1 mol \( \text{O}_2 \) react to form \( \text{H}_2\text{O} \) and 9 g \( \text{H}_2\text{O} \) is produced, what is the percent yield?

a) 100%
b) 25%
c) 50%
d) Not enough information is given.

e. 2 mol \( \text{H}_2\text{O} \) \( \rightarrow \) \( 2 \text{H}_2\text{O} \)

e. 2 mol \( \text{H}_2\text{O} = 36 \text{g} \)

e. \( 36 \text{g} \times \frac{100}{18} = 20 \%
\)
f. Rewrite the following list in order of increasing ionization energy.

\[
\text{Rb} < \text{Cl} < \text{Ca} < \text{K} \]

e. \( \text{Rb} < \text{K} < \text{Ca} < \text{Cl} \)

g. Give the number of unpaired electrons in the ground state electron configuration of \( \text{Cr} \):

\( 4s^23d^5 \)

e. \( 4s^23d^5 \)

h. Rewrite the following list in order of increasing atomic radius.

\[
\text{Rb} < \text{Cl} < \text{Ca} < \text{K} \]

e. \( \text{Cl} < \text{Ca} < \text{K} < \text{Rb} \)

i. What element has the following valence electron configuration in an excited state?

\( 4s^13d^1 \)

e. \( 4s^13d^1 \)

j. Circle the sample that contains the greatest number of hydrogen atoms.

\( 1 \text{ mol H}_2\text{O} \)

e. \( 1 \text{ mol H}_2\text{O} \)

\( 5 \text{ g H}_3\text{PO}_4 \)

e. \( 5 \text{ g H}_3\text{PO}_4 \)

\( 0.5 \text{ mol H}_3\text{PO}_4 \)

e. \( 0.5 \text{ mol H}_3\text{PO}_4 \)

\( 5 \text{ g H}_2\text{O} \)

e. \( 5 \text{ g H}_2\text{O} \)

2. (6) Provide names or formulas for the following compounds: \( \text{SO}_2 \) \( \text{sulfur dioxide} \)

\( \text{SrCl}_2 \)

e. \( \text{SrCl}_2 \)

\( \text{Fe}(\text{PO}_4)_3 \) \( \text{iron(III) phosphate} \)

e. \( \text{Fe}(\text{PO}_4)_3 \)
4. (12) 25 mL of 1.0 M potassium chloride and 75 mL of 0.80 M barium chloride are mixed. The solution is then heated to evaporate water until the total volume of the solution is 50 mL. What is the molarity of chloride ions in the final solution?

\[
\text{Initial concentration of } \text{Cl}^- = 0.025 \times \frac{\text{mol KCl}}{\text{L}} = 0.075 \times \frac{\text{mol BaCl}_2}{\text{L}} = 0.145 \text{ mol Cl}^- \\
\text{Initial concentration of } \text{Cl}^- = \frac{14.5 \text{ mol Cl}^-}{0.050 \text{ L}} = 2.9 \text{ M Cl}^-
\]

5. (12) Fat stored in a camel's hump is a source of water as well as energy. Assuming that metabolism is essentially an internal combustion reaction and that the fat in the hump is pure triolein (C_{57}H_{100}O_6), calculate how many molecules of water would be produced by metabolizing 1.3 kg of fat.

\[
1000 \text{ g} \times \frac{1 \text{ mol \( C_{57}H_{100}O_6 \)}}{908 \text{ g}} \times \frac{6 \times 10^{20} \text{ molecules}}{2 \text{ mol}} = 3.7 \times 10^{20} \text{ molecules H}_2\text{O}
\]

6. (13) Draw two resonance contributors for NOCl (O is the central atom) that have all octets filled. Circle the most favorable.

\[
\begin{array}{c}
\text{\( N \rightarrow O \rightarrow Cl \)} \quad \leftrightarrow \quad \text{\( N \rightarrow O \rightarrow Cl \)} \quad \leftrightarrow \quad \text{\( N \rightarrow O = Cl \)} \quad \leftrightarrow \quad \text{\( N \rightarrow O \rightarrow Cl \)}
\end{array}
\]

\( \text{\(-1\)} \)
4. (12) 25 mL of 1.0 M potassium chloride and 75 mL of 0.80 M barium chloride are mixed. The solution is then heated to evaporate water until the total volume of the solution is 50 mL. What is the molarity of chloride ions in the final solution?

\[
\text{mol Cl}^- = \frac{0.025 \times 1 \text{ mol KCl}}{1 \text{ mol KCl}} + \frac{0.075 \times 0.8 \text{ mol BaCl}_2}{1 \text{ mol BaCl}_2} = 0.145 \text{ mol Cl}^- \\
\text{mol Cl}^- = \frac{0.145 \text{ mol Cl}^-}{0.050 \text{ L}} = 2.9 \text{ M Cl}^-
\]

5. (12) Fat stored in a camel’s hump is a source of water as well as energy. Assuming that metabolism is essentially an internal combustion reaction and that the fat in the hump is pure tristearin (C_{57}H_{110}O_{6}), calculate how many molecules of water would be produced by metabolizing 1.0 kg of fat.

\[
\text{mol H}_2\text{O} = \frac{3 \times \frac{1000 \text{ g}}{890 \text{ g}} \times \frac{1 \text{ mol C}_{57}H_{110}O_{6}}{2 \text{ mol C}_{57}H_{110}O_{6}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}}}{3} = 3.7 \times 10^{25} \text{ molecules H}_2\text{O}
\]

6. (13) Draw two resonance contributors for NOCl (O is the central atom) that have all octets filled. Circle the most favorable.

\[
\text{NOCl} : \text{N} \equiv \text{O} - \text{Cl} \quad \leftrightarrow \quad \text{NO}\equiv\text{O} - \text{Cl} \quad \leftrightarrow \quad \text{N} \equiv \text{O} = \text{Cl}:
\]

\[\text{circle most favorable.}\]

\[\begin{array}{c}
\text{N} \\
-1
\end{array} \quad \begin{array}{c}
\text{O} \\
+1
\end{array} \quad \begin{array}{c}
\text{Cl} \\
-1
\end{array}
\]
7. (11) What wavelength of light would promote an electron from the ground state to n=4 in a helium +1 ion?

\[ \Delta E \approx \frac{2.178 \times 10^{-15}}{4} \left( \frac{z^2}{n^2} - \frac{z^2}{n'^2} \right) = 8.17 \times 10^{-19} \]

\[ \Delta E = h \nu = \frac{h c}{n} \]

\[ \nu = \frac{h c}{\Delta E} = \frac{6.626 \times 10^{-34} \cdot 3 \times 10^{8}}{5.17 \times 10^{-19}} \]

\[ \nu \approx 2.43 \times 10^{15} \text{ m}^{-1} \]

8. (12) A mixture of hydrogen and nitrogen gases react in a closed container to form ammonia (NH₃). The reaction ceases before either reactant was totally consumed. At this point the flask contains 2.0 mol nitrogen gas, 2.0 mol hydrogen gas and 2.0 mol ammonia gas. How many grams of nitrogen and hydrogen were present in the flask before any reaction took place?

\[ \begin{align*}
3 \text{H}_2 + \text{N}_2 & \rightarrow 2 \text{NH}_3 \\
\text{Init.} & \quad \text{amt.} \\
& = 3 \text{ mol} + 2 \text{ mol} = 5 \text{ mol} \text{H}_2 \\
& \text{Init.} & \quad \text{amt.} \\
& = 1 \text{ mol} + 2 \text{ mol} = 3 \text{ mol} \text{N}_2
\end{align*} \]

\[ \text{Init.} \quad \text{amt.} = 3 \text{ mol} \text{H}_2 + 1 \text{ mol} \text{N}_2 = 4 \text{ mol} \]

9. (12) A compound that is 31.9% K and 28.9% Cl by mass decomposes when heated to give oxygen gas and a compound that is 52.4% K and 47.6% Cl by mass. Write a balanced equation for this reaction. You must show all reasoning for credit.

Assume 100 g:

\[ \begin{align*}
31.9 \text{g K} & \rightarrow 3 \text{mol K} \\
28.9 \text{g Cl} & \rightarrow 1.5 \text{mol Cl}
\end{align*} \]

K, Cl, \rightarrow KCl

Assume 100 g:

\[ \begin{align*}
52.4 \text{g K} & \rightarrow 1.3 \text{mol K} \\
47.6 \text{g Cl} & \rightarrow 0.55 \text{mol Cl}
\end{align*} \]

\[ \begin{align*}
2 \text{ KCl} & \rightarrow 2 \text{ K} + 3 \text{O}_2
\end{align*} \]