1. Give short answer to seven of the following

(a) Write the following numbers in scientific notation to four significant figures.

\[
\begin{align*}
0.890478 & = 8.90 \times 10^{-1} \\
123.256 & = 1.233 \times 10^2 \\
5.000 \times 10^{-4} & = 5.00 \times 10^{-4} \\
123.256 & = 1.233 \times 10^2 \\
0.0005000 & = 5.00 \times 10^{-4}
\end{align*}
\]

(b) What are the three states of matter?

solid liquid gas

(c) Briefly explain how Dalton's Atomic theory explains the law of conservation of matter.

Chemical reactions are the rearrangement of atoms to form new substances. No atoms are lost, so the mass is the same before and after.

(d) A silver nugget floats in mercury. A gold nugget sinks in mercury. How do the densities of silver and gold compare to mercury?

silver less than mercury / gold greater than mercury

floats

density = mass / volume

(e) What are the three particles and the charges on these particles that make up all atoms?

protons, neutrons, and electrons

(f) Briefly explain the role of experiments in the scientific method.

Experiments test hypotheses and theories to see if they are valid.

(g) Table salt (uniodized) is a compound. Pepper is a mixture. Explain the difference.

Table salt has a fixed composition, all table salt has the same ratio of elements.

Pepper

(h) A sample of frozen alcohol is melted, distilled, and then burned in a lamp. Identify these processes as physical or chemical change.

Melt - physical, these do not change
Distillation - physical, the alcohol, but merely change its form
Burning - chemical, the alcohol is converted to new substances
2. Convert the following measurements
   (a) A standard U.S. postage stamp is 2.50 long and 2.10 cm wide. What is the area of this postage stamp in in²? (1 in = 2.54 cm)
   \[
   \text{Convert cm} \rightarrow \text{in} \rightarrow A = l \times w
   \]
   \[
   2.50 \, \text{cm} \times 2.54 \, \text{cm} = 6.35 \, \text{in} \times 0.827 \, \text{in}
   \]
   \[
   = 5.214 \, \text{in}^2
   \]
   \[
   \frac{2.50 \, \text{cm}}{2.54 \, \text{cm}} = 0.984 \, \text{in}
   \]
   \[
   \frac{2.10 \, \text{cm}}{2.54 \, \text{cm}} = 0.827 \, \text{in}
   \]

   (b) The distance from Montclair to the Delaware Water Gap is 58.3 mi. What is this distance in km? (1 mile = 1.609 km)
   \[
   58.3 \, \text{mi} \times \frac{1.609 \, \text{km}}{1 \, \text{mi}} = 93.8 \, \text{km}
   \]

   (c) Soda is commonly sold in bottles measured in liters. How many fl oz are in a 3.0 L of soda? (1 fl oz = 29.57 mL)
   \[
   \frac{1 \, \text{L}}{3 \, \text{L}} \rightarrow \text{mL} \rightarrow \text{fl oz}.
   \]
   \[
   3.0 \, \text{L} \times \frac{1000 \, \text{mL}}{4 \, \text{L}} = 3000 \, \text{mL}
   \]
   \[
   3000 \, \text{mL} \times \frac{1 \, \text{fl oz}}{29.57 \, \text{mL}} = 101.6 \, \text{fl oz}
   \]

3. A 10.00 g sample of nitrogen has a volume of 7660 mL. What is the density of nitrogen in g/L? (Watch the units carefully)
   \[
   m(\text{g}) \rightarrow \text{mol}
   \]
   \[
   \text{V mL} \rightarrow V(\text{L}) \times \frac{1 \, \text{L}}{1000 \, \text{mL}} = 7.660 \, \text{L}
   \]
   \[
   D = \frac{m}{V} = \frac{10.00 \, \text{g}}{7.660 \, \text{L}} = 1.305 \, \text{g/L}
   \]
4. Write the electron configuration of the following atoms or ions.
   (You may use the noble gas short cut i.e. [NG]x where NG = a noble gas, x = subshell)
   
   (a) O: \(1s^2 2s^2 2p^4\) or \([\text{He}]2s^2 2p^4\)
   (b) Ne: \(1s^2 2s^2 2p^6\) or \([\text{Ne}]\)
   (c) K: \(1s^2 2s^2 2p^6 3s^2 3p^6 4s^1\) or \([\text{Ar}]4s^1\)
   (d) C: \(1s^2 2s^2 2p^2\) or \([\text{He}]2s^2 2p^2\)
   (e) Ni: \(1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^8\) or \([\text{Ar}]4s^2 3d^8\)
   (f) S: \(1s^2 2s^2 2p^6 3s^2 3p^4\) or \([\text{Ne}]3s^2 3p^4\)

5. The specific heat of tin is 0.0543 cal/(g °C). How much heat in kcal must be added to 454 g of tin to raise the temperature from 25.0°C to the melting point which is 231.9 °C?
   \[
   \text{Heat} = \text{mass} \times \text{Specific Heat} \times (T_{\text{final}} - T_{\text{init}})
   \]
   \[
   = 454 \text{ g} \times \left(0.0543 \frac{\text{cal}}{\text{g} \cdot \text{°C}}\right) (231.9 - 25.0 \text{ °C})
   \]
   \[
   = (454 \text{ g}) \left(0.0543 \frac{\text{cal}}{\text{g} \cdot \text{°C}}\right) (206.9 \text{ °C})
   \]
   \[
   = 5.10 \times 10^3 \text{ cal}
   \]
   
   6. Write the correct atomic symbol for the following atoms in this format: \(^{\text{A}}_{\text{Z}}\)C
   (a) An atom with 10 protons and 10 neutrons \(\overset{20}{10}\text{Ne}\)
   (b) An atom with 4 protons and and mass number (A) of 9 \(\overset{9}{4}\text{Be}\)
   (c) The isotope of the atom in (b) with 6 neutrons \(\overset{16}{4}\text{Be}\)
   (d) An atom of atomic number 12 with mass number of 25 \(\overset{25}{12}\text{Mg}\)
7. Answer these questions with the help of the periodic table.

(a) Which of the following elements are metals?
He, Ti, U, Cl, C, W __Tl, U, W__

(b) How many elements are in period 3? __8__

(c) Which halogen is in the same period as potassium? __Br__

(d) What is the name of the elements in group 8A? __noble gases__

(e) Group the following elements into sets that you would predict to have similar chemical properties: K, S, Br, Cl, I, At
   __Li, K__, __C, Si__, __O, S, Se__

(f) Name the following elements from their symbols
   __Ne__ paneo, __S__ulfur, __Na__ sodium, __Au__ gold, __H__ hydrogen

8. Magnesium occurs with three isotopic forms: $^{24}\text{Mg}$ (78.99% abundance), $^{25}\text{Mg}$ (10.00% abundance) and $^{26}\text{Mg}$ (11.01% abundance). What would the atomic weight of magnesium be according to this data? (Show your calculations)

\[
\text{Ave atomic mass} = \frac{\text{mass of isotope A (fraction A)} + \text{mass of isotope B (fraction B)} + \ldots}{1}
\]

\[
= \text{mass}^{24}\text{Mg (frac. 78.99\%)} + \text{mass}^{25}\text{Mg (frac. 10.00\%)} + \text{mass}^{26}\text{Mg (frac. 11.01\%)}
\]

\[
= 24.00 \text{amu} (0.7899) + 25.00 \text{amu} (0.1000) + 26.00 \text{amu} (0.1101)
\]

\[
= 18.96 + 2.500 + 2.863 \text{ amu}
\]

\[
= 24.32 \text{ g/mol}
\]

limits to 2 to right of decimal