Multiple choice (3 points each).

1. What was the major result from Milikan’s oil drop experiment?
   (a) the structure of the atom
   (b) The mass of the proton
   (c) The mass of the neutron
   (d) The mass of the electron
   (e) The charge of the electron
   (f) d and e
   (g) a, b and c.

2. What was the major discovery of Rutherford’s gold foil experiment?
   (a) The mass of the electron
   (b) The nature of light
   (c) The nucleus
   (d) the charge of the electron
   (e) The mass of the electron.
   (f) The mass of the proton
   (g) d, e and f
   (h) a and d
   (i) c and e

3. Which group corresponds to the alkaline earth metals?
   (a) 1  (b) 2  (c) 3  (d) 4  (e) 5  (f) 6  (g) 7

4. Which of the following are strong acids?
   (a) HC₂H₃O₂  (b) Perchloric acid  (c) Sodium hydroxide  (d) sodium carbonate
   (e) Ammonia  (f) hydrofluoric acid  (g) a, d, f
   (h) d, f.

5. Which of the following are strong bases?
   (a) Potassium hydroxide  (b) Aluminum hydroxide  (c) Ammonia
   (d) Sodium bicarbonate  (e) Sodium acetate  (f) HCl
   (g) a, f  (h) a, b
Use the answers below to answer the next set of questions.

(a) NaC₂H₃O₂
(b) NaClO
(c) NaClO₂
(d) NaClO₃
(e) NaClO₄
(f) NaClO₅
(g) Na₂CO₃
(h) Na₂SO₄
(i) NaNO₂
(j) NaHSO₃

Give the correct formula for the following:

6. Sodium perchlorate
7. Sodium carbonate
8. Sodium bisulfite
9. Sodium sulfate
10. Sodium nitrite
11. Sodium acetate
12. Sodium chlorite
13. Sodium chlorate
14. Which of the above is NOT one of the common ionic compounds you know?

15. An element cannot ______________
   a. be part of a homogeneous mixture
   b. be part of a heterogeneous mixture
   c. be separated into other substances by chemical means
   d. interact with other elements to form compounds
   e. be a pure substance.

16. Of the objects below, which is the most dense?
   a. an object with a volume of 2.5 L and a mass of 12.5 kg
   b. an object with a volume 139 mL and a mass of 93 g.
   c. an object with a volume 0.00212 m³ and a mass of 4.33x10⁴ mg
   d. an object with a volume of 3.91x10⁻²⁴ nm³ and a mass of 7.93x10⁻³ g
   e. an object with a volume of 13 dm³ and a mass of 1.29x10⁵ kg

17. Which reside in the nucleus of atoms?
   (a) Protons       (b) Electrons        (c) Neutrons        (d) Molecules
   (e) Ions         (f) None of the above (g) a, b and c        (h) a and c
   (i) a, b, c and d
18. Which pair of atoms is a pair of isotopes of the same element?
   (a) $^{14}_{6}X$ $^{14}_{7}X$
   (b) $^{19}_{10}X$ $^{19}_{9}X$
   (c) $^{17}_{6}X$ $^{17}_{8}X$
   (d) $^{14}_{6}X$ $^{12}_{6}X$
   (e) $^{14}_{6}X$ $^{14}_{7}X$
   (f) $^{20}_{10}X$ $^{21}_{11}X$
   (g) a, c, d, e

19. Which of the following are nonmetals
   a. Sodium    b. Oxygen    c. Chlorine    d. Tin
   e. Magnesium  f. Sulfur     g. a, b, c and f   h. a, c and f
   i. b, c and f

20. (10 points) Naturally occurring magnesium has the following isotopic abundances:

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Abundance</th>
<th>Atomic mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>78.99%</td>
<td>23.98504</td>
</tr>
<tr>
<td>2</td>
<td>10.0%</td>
<td>24.98584</td>
</tr>
<tr>
<td>3</td>
<td>11.01%</td>
<td>25.98259</td>
</tr>
</tbody>
</table>

   a. What is the atomic mass of magnesium?

   b. Draw the symbol for each of the Mg isotopes (like in problem 18).

21. (10 points) If a car burning (by a standard combustion reaction) pure octane (C$_{8}$H$_{18}$, density = 0.70 g/mL), gets 18 miles/gallon and travels 225 miles, how many kilograms of CO$_{2}$ will it produce?
22. (13 points) The fizz produced by alka selzer is due to the reaction of sodium bicarbonate with citric acid:

\[
3\text{NaHCO}_3(\text{aq}) + \text{H}_3\text{C}_6\text{H}_5\text{O}_7(\text{aq}) \rightarrow 3\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\text{l}) + \text{Na}_3\text{C}_6\text{H}_5\text{O}_7(\text{aq})
\]

How much carbon dioxide is produced if 32.0 grams of sodium bicarbonate and 50.0 grams of citric acid are reacted together?

23. (10 points) Determine the empirical formula of the compound with the composition: 55.2% K, 14.6% P and 30.2% O.

24. EXTRA CREDIT (8 points) Magnesium carbonate (an insoluble solid) reacts with nitric acid to produce three products.

(a) Write the balanced chemical equation for the reaction.

(b) Write the ionic equation for the reaction.

(c) Write the net ionic equation for the reaction.