Show your work for complete (and partial) credit. Report your answers to the correct number of significant figures, and use units where appropriate. \(N_A=6.022\times10^{23}\)

1. What is the Law of Definite Proportions (Constant Composition)? State it.

2. How does Dalton's Atomic Theory explain the Law of Definite Proportions?

3. Mixtures can be separated into simpler components by a physical process. Separations take advantage of a difference in a physical property of the components of the mixture. A separation of a mixture of salt dissolved in water by boiling off the water to leave the salt takes advantage of a difference in ________________. (a physical property)

4. Convert .015000mg to g

5. Convert \(1.87 \times 10^5\)mg to kg

6. Convert \(1.75\text{cm}^3\) to mL (L=dm\(^3\), dm=10\(^{-1}\)m)

7. How many cubic centimeters is \(103\text{in}^3\)?

8. Which of the following values equal 0.01cm? Check all that apply. Disregard SF.
   ___ 1mm     ___ \(10^{-4}\)m     ___ 10mm    ___ 100\(\mu\)m    ___ 0.1mm

9. Fill in the 4 empty boxes in the following table.

<table>
<thead>
<tr>
<th>Isotope symbol</th>
<th># protons</th>
<th># neutrons</th>
<th># electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>(^{37})Cl</td>
<td>11</td>
<td>12</td>
<td>11</td>
</tr>
</tbody>
</table>
10. Why did Rutherford propose the nuclear model of the atom? Rutherford performed the gold foil experiment, in which α particles were scattered.

11. Why is the average mass of a naturally-occurring carbon atom, 12.011amu, so close to the mass of a $^{12}\text{C}$ atom, which is 12.000amu exactly?

12. Most of an atom's mass is in the ____________, which contains the subatomic particles ___________ and ___________. Most of an atom's volume is the region occupied by ____________ (subatomic particle).

13. What is the mass of 1.3 moles of barium (element # 56)

14. How many sodium atoms are in 35g of sodium?

15. What is the mass of one (average) calcium atom in amu?

16. What is the mass of one (average) calcium atom in grams?

6 points extra credit: answer only one of the following two questions.  
A) What information is obtained from a mass spectrometer?  
B) Carbon and oxygen form two different compounds, A and B. The composition of samples of A and B were determined and are listed in the following table. Show that the data for these two compounds are consistent with the law of multiple proportions.

<table>
<thead>
<tr>
<th></th>
<th>Compound A</th>
<th>Compound B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass of sample analyzed</td>
<td>14.0g</td>
<td>5.5g</td>
</tr>
<tr>
<td>Mass of carbon in sample</td>
<td>6.0g</td>
<td>1.5g</td>
</tr>
<tr>
<td>Mass of oxygen in sample</td>
<td>8.0g</td>
<td>4.0g</td>
</tr>
</tbody>
</table>