Review 1
1. How many significant figures are in the following measurements?
   a. 102.450 mm ____  b. 0.00002279 kg ____  c. 1.00003 cm ____  d. 5.00 liters ____
2. Round each of the following measurements to 4 significant figures.
   a. 12.0908 g ___________  b. 0.023104 g/ml ___________
3. A sample of an organic liquid has a density of 1.54 g/ml. What is the mass of 75 ml of the liquid?
   a. 115.5 g  b. 120 g  c. 116 g  d. 48.7 g

Review 2
Suppose the actual amount of copper in a new U.S. penny is 0.15 g. A student performs an experiment to determine this. The student grabs 7 pennies, somehow extracts the copper from each, then masses it.

a. Calculate the student's average value and determine the percent error.
b. Comment on the accuracy and the precision involved in this student's lab.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Amount of Copper</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.18 g</td>
</tr>
<tr>
<td>2</td>
<td>3.1 g</td>
</tr>
<tr>
<td>3</td>
<td>3.0 g</td>
</tr>
<tr>
<td>4</td>
<td>0.19 g</td>
</tr>
<tr>
<td>5</td>
<td>3.0 g</td>
</tr>
<tr>
<td>6</td>
<td>0.15 g</td>
</tr>
<tr>
<td>7</td>
<td>0.17 g</td>
</tr>
</tbody>
</table>

Review 3
1. Which of the following represents the best reason for keeping track of the number of significant figures in calculations in chemistry class?
   a. Values shown with too many or too few significant figures are not accurate.
   b. It represents a waste of effort and time when too many significant figures are shown.
   c. Too many significant figures represent to the reader a false sense of precision.
   d. Derived values are never as precise as the measurements that led to them.
2. A concise, factual statement accepted to be true and universal to scientists is a:
3. Which is a possible description of the sample of matter to the right?
   a) 4 N₂ and 3 H₂  b) 4 N₂ and 3 NO₂  c) 4 NO and 3 H₂O  d) 4 N₂ and 3 H₂O

Review 4
Sarah wants to know how different colors of light affect the growth of plants. She believes that plants might survive the best in white light. She buys 5 ferns of the same species, which are all approximately the same age and height. She places one in white light, one in blue light, one in green light, one in red light and one in the closet. All of the ferns are planted with Miracle-Grow and given 20 mL of water once a day for two weeks. After two weeks, Sarah observes the plants and makes measurements.

1. What kind of measurements could Sarah make to measure the growth of the plants?
2. Identify the:
   a. Hypothesis
   b. Independent Variable
   c. Dependent Variable
   d. Control Group
   e. Control Variables
3. How many atoms of each type are shown by:
   a) NH₄Cl  #N : ____ #H : ____ # Cl : ____
   b) (NH₄)₃PO₄  #N : ____ #H : ____ # P : ____ # O : ____
   c) 7 (NH₄)₂S  #N : ____ #H : ____ # S : ____
Review 5
1. What piece of glassware is used to make very accurate concentrations of aqueous chemical solutions?
2. Read the following measurements:

![Image of a graduated cylinder with measurements 6, 7, 8, and 9ml]

Review 6
Four lab groups performed the same experiment three times to determine the melting point of naphthalene (moth balls). The accepted melting point is \(79.0°C\). Indicate whether the following sets of data are precise, accurate, both or neither. (Hint: Taking an average of the data will help you determine if you were accurate or not!)

<table>
<thead>
<tr>
<th>Precise, Accurate, Both or Neither</th>
<th>Group</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1</td>
<td>76.2°C</td>
<td>79.5°C</td>
<td>81.3°C</td>
</tr>
<tr>
<td>2.</td>
<td>2</td>
<td>76.2°C</td>
<td>76.1°C</td>
<td>76.3°C</td>
</tr>
<tr>
<td>3.</td>
<td>3</td>
<td>86.4°C</td>
<td>82.8°C</td>
<td>81.2°C</td>
</tr>
<tr>
<td>4.</td>
<td>4</td>
<td>79.1°C</td>
<td>78.9°C</td>
<td>79.2°C</td>
</tr>
</tbody>
</table>

Review 7
1. The density of water at 4°C is known to be \(1.00 \text{ g/cm}^3\).
Kim experimentally found the density of water to be \(1.085 \text{ g/cm}^3\). What is her percent error?
2. Read the following measurement:

![Image of a graph with a line and a question mark]

3. Based on the related experiment & graph, identify the:
   a. Independent Variable
   b. Dependent Variable

   From the data on the graph, write a hypothesis you have about the relationship between pressure and temperature of a gas.

Review 8
Determine which is a physical property (PP), chemical property (CP), chemical change (CC), and physical change (PC):
1. Boiling Point (the temperature at which a substance boils, example = water boils at 100°C)
2. Density (measurement which explains why things sink or float)
3. Precipitate forming when 2 solutions are mixed
4. The process of boiling (liquid becoming gas)
5. Calcium + Chloride \(\rightarrow\) Calcium chloride
6. Volume (a measure of how much space an object takes up)
7. The process of sublimation (solid becoming gas)
8. The reasons why Baking Soda + Vinegar give off carbon dioxide
9. The process of condensation (gas becoming liquid)
Review 9
1. Write the word which best describes the substance. Choose from the following words:
   Element (E), Compound (C), Heterogeneous mixture (He), Homogeneous mixture (Ho)
   a. _______ Salt water   c. _______ Nails and bolts   e. _______ Air
   b. _______ Helium gas (He)   d. _______ Sand and gravel   f. _______ Carbon dioxide
2. Boron has 2 main isotopes, Boron-9 and Boron-10. Which isotope is more abundant in nature and how can you tell?
3. Fill out the following table:

<table>
<thead>
<tr>
<th>Particle</th>
<th>charge</th>
<th>mass in amu</th>
<th>location in atom</th>
<th>Discovered by?</th>
</tr>
</thead>
<tbody>
<tr>
<td>proton</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>neutron</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>electron</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Review 10
1. Ca\(^{2+}\) ion differs from a Ca\(^0\) atom in that the Ca\(^{2+}\) ion has
   a) more electrons   b) more protons   c) fewer protons   d) fewer electrons
2. All atoms of an element have the same
   a) number of neutrons   b) atomic mass   c) atomic number   d) mass number
3. A sample of element X contains 90% X-35 atoms, 8.0% X-37 atoms, and 2.0% X-38 atoms. The average mass will be closest to which value? a) 35   b) 36   c) 37   d) 38
4. What is the total number of electrons in an Mg\(^{+2}\) ion? a) 10   b) 24   c) 2   d) 12
5. Fill out the table below:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Atom or Ion?</th>
<th># protons</th>
<th># neutrons</th>
<th># electrons</th>
<th>Atomic #</th>
<th>Mass number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mg(^{2+})</td>
<td>-3 charge</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cl</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Review 11
1. Name the following:   a) CoCl\(_3\)   b) Fe\(_2\)O\(_3\)   c) PbS   c) NaC\(_2\)H\(_3\)O\(_2\)   d) P\(_2\)O\(_5\)
2. Write the formulas for the following: a) Sodium Phosphide   b) Tin (IV) Oxide   c) Aluminum sulfate
3. Which compound contains ionic bonds?   (1) CO\(_2\)   (2) NO   (3) CaO   (4) NO\(_2\)
4. Balance the following equations:
   a) \(____ \text{S}_8 + ____ \text{O}_2 \rightarrow ____ \text{SO}_3\)
   b) \(____ \text{Pb(OH)}_2 + ____ \text{HCl} \rightarrow ____ \text{H}_2\text{O} + ____ \text{PbCl}_2\)
   c) \(____ \text{FeCl}_3 + ____ \text{NaOH} \rightarrow ____ \text{Fe(OH)}_3 + ____ \text{NaCl}\)

Review 12
1. A student dissolves three different substances in water: SO\(_2\), Na\(_2\)S, and Ca\(_3\)P\(_2\). Which should describe her results with a conductivity tester?   a) only SO\(_2\) will conduct   b) only Na\(_2\)S will conduct   c) only Ca\(_3\)P\(_2\) will conduct   d) Ca\(_3\)P\(_2\) will have a greater degree of conductivity than Na\(_2\)S
2. How many moles are there in 5.96 g of magnesium acetate?
3. How many molecules of silver phosphate are there if there are 2.00 grams of silver phosphate?
4. How many moles are there in 110 grams of NaHCO\(_3\)?
5. How many grams does 1.2 moles of (NH\(_4\))\(_3\)PO\(_4\) weigh?
6. What is the total number of electrons in a Cr\(^{3+}\) ion?
Review 13
1. Draw Bohr diagrams for the following (include protons and neutrons in nucleus): a. $^{40}$Ca$^{2+}$  b. $^{32}$S$^{2-}$
2. In which compound is the ratio of metal ions to nonmetal ions 1 to 2?
   (a) calcium bromide  (b) calcium oxide  (c) calcium phosphide  (d) calcium sulfide
3. The bonds in BaO are best described as
   (a) covalent, because valence electrons are shared  (b) covalent, because valence electrons are transferred
   (c) ionic, because valence electrons are shared  (d) ionic, because valence electrons are transferred
4. How many ions are formed when one “unit” of Ca(NO$_3$)$_2$ is dissolved in water? What are the ions?
5. Which substance cannot be decomposed (broken down) by a chemical change?
   (1) Ne  (2) N$_2$O  (3) HF  (4) H$_2$O

Review 14
1. Which statement describes a chemical property that can be used to distinguish between compound A and compound B?
   (a) A is a blue solid, and B is a white solid.  (b) A has a high melting point, and B has a low melting point.
   (c) A dissolves in water, and B does not dissolve in water.  (d) A does not burn in air, and B does burn in air.
2. A 76.7-g sample of SrCl$_2$ is dissolved in 112.5 mL of solution. Calculate the molarity of this solution.
   A) 54.4 M  B) 4.30 M  C) 108.1 M  D) 2.07 M  E) none of these
3. When sodium chloride and lead(II) nitrate react in an aqueous solution, which of the following terms will be present in the balanced molecular equation?
   A) PbCl(s)  B) Pb$_2$Cl(s)  C) NaNO$_3$(aq)  D) 2NaNO$_3$(aq)  E) 2PbCl$_2$(s)

Review 15
1. Name the following: a) FeCO$_3$  b) Sn$_3$(PO$_4$)$_4$  c) N$_2$O$_5$
2. Write the formulas for the following: a) ammonium carbonate  b) gold (III) sulfate  c) diboron heptachloride
3. Which elements tend to form cations? Do they gain or lose electrons? What happens to their radius as ions?
4. What is the molecular geometry of NH$_3$?
5. Find the number of moles in 3.30 g of (NH$_4$)$_2$SO$_4$
6. How many molecules of NO$_2$ are produced when 2.0 x 10$^{20}$ molecules of N$_2$O$_4$ are decomposed according to the equation: N$_2$O$_4$(g) $\rightarrow$ 2NO$_2$(g)

The following website may be useful in reviewing for the SOL:

Review 16
1. A chemical equation is balanced when _______________.
   a. the equation shows an equal number of atoms for each element on both sides.
   b. at least one substance in each of the three physical states is present.
   c. the total number of moles of the reactants equals the moles of the products.
2. A beaker has a mass of 89.67g. When a solid is added, the beaker plus the solid have a mass of 92.25g. What is the mass of the solid?
3. A student estimated a mass to be 250g, but upon carefully measuring it, found it to be 240g. What is the percent error of the estimated mass?
4. If the volume of water in a cylinder is 8.0mL, but changes to 10.0mL when a solid is carefully lowered into it, the volume of the solid is: __________
5. Of the following, the best conductor of electricity is: a. solid salt  b. solid sugar  c. aqueous salt  d. distilled water
6. Which of the following compounds will not dissolve in water? a. KCl  b. CCl$_4$  c. CaBr$_2$  d. MgCl$_2$
7. How many moles of solute are present in 1.25 L of a 0.75M NaNO$_3$ solution?
8. The reaction H$_2$CO$_3$ $\rightarrow$ H$_2$O + CO$_2$ is an example of a reaction that is _______________.
9. How many liters of hydrogen react with 2.00 mol of nitrogen at STP in the following reaction: N$_2$ + H$_2$ $\rightarrow$ NH$_3$?
10. The percentage composition of ammonia (NH$_3$) is:
Review 17
Balance the following reactions & determine the type of reaction (synthesis/combination, decomposition, single-replacement, double-replacement, neutralization, combustion)
1. NaCl + AgNO\(_3\) → NaNO\(_3\) + AgCl
2. Ca + O\(_2\) → CaO
3. K + Al\(_2\)S\(_3\) → K\(_2\)S + Al

\[2\text{Al} + \text{Fe}_2\text{O}_3 \rightarrow \text{Al}_2\text{O}_3 + 2\text{Fe}\]
4. 20.0 grams of aluminum will react with how many grams of ferric oxide (Fe\(_2\)O\(_3\))? 
5. 10.0 moles of ferric oxide (Fe\(_2\)O\(_3\)) will produce how many moles of iron? 
6. 5.0 grams of ferric oxide (Fe\(_2\)O\(_3\)) and 10 grams of aluminum will produce how many grams of aluminum oxide?

Review 18
1. At STP, how many liters will 23.93 moles of gas occupy? 
2. Determine the total pressure of a gas mixture that contains oxygen, nitrogen, and helium if the partial pressures of the gases are P\(_{O_2}\) = 20.0 kPa, P\(_{N_2}\) = 46.7 kPa, and P\(_{He}\) = 26.7 kPa. 
3. What is the formula for lead (IV) phosphate? 
4. Convert 3.5 °C to Kelvin. 
5. What is the answer to the following problems? Round to the correct number of significant figures. 
   a. (0.0050) X (3022) = _____________ 
   b.  4.0 + 31.69 + 19.634 = _____________ 
6. If 23.1 moles of Ca is reacted, how many moles of Calcium oxide are produced? Ca + O\(_2\) → CaO

Review 19
1. Predict the products for the following reactions:
   a. Na(s) + Cl\(_2\)(g) →
   a) HgO(s) →
   b) BaCl\(_2\)(aq) + Na\(_2\)SO\(_4\)(aq) →
   c) C\(_4\)H\(_{10}\)(g) + O\(_2\)(g) →
2. Use the following information to determine the atomic mass of chlorine. Two isotopes are known: Cl\(_{35}\) and Cl\(_{37}\). The relative abundances are 75.4% and 24.6%, respectively.
3. Which statement concerning NaCl is true?
   a. NaCl has properties similar to sodium metal and chlorine gas. 
   b. NaCl is a homogeneous mixture. 
   c. NaCl is a heterogeneous mixture. 
   d. The percentage of Na in NaCl is dependent on where the sample is obtained. 
   e. NaCl is composed of ions, which are electrically charged atoms. 
4. What is the correct name for Cu\(_2\)O? 
5. What is the percent by mass of carbon in acetone, C\(_3\)H\(_6\)O? 

Review 20
1. Which of the following compounds have the same empirical formula?
   a. CO\(_2\) and SO\(_2\) 
   b. C\(_7\)H\(_{14}\) and C\(_{10}\)H\(_{20}\) 
   c. C\(_4\)H\(_{10}\) and C\(_{10}\)H\(_{4}\) 
   d. C\(_6\)H\(_{12}\) and C\(_6\)H\(_{14}\)
2. What is the empirical formula of a substance that is 53.5% C, 15.5% H, and 31.1% N by weight?
   a. C\(_3\)H\(_{6}\)N\(_2\) 
   b. C\(_4\)H\(_{14}\)N\(_2\) 
   c. C\(_3\)H\(_2\)N
   d. CH\(_2\)N\(_7\)
3. How many protons, electrons, and neutrons respectively does \(^{127}\text{I}\) have?
   a. 53, 127, 74 
   b. 74, 53, 127 
   c. 53, 74, 53 
   d. 53, 53, 74 
   e. 53, 53, 127
4. What element has the electron configuration 1s\(^2\)2s\(^2\)2p\(^6\)3s\(^3\)3p\(^2\)?
5. Which of the following elements has the smallest first ionization energy?
   a. sodium 
   b. potassium 
   c. calcium 
   d. magnesium
6. What is the element with the greatest electronegativity value?
   a. cesium 
   b. calcium 
   c. carbon 
   d. fluorine
Review 21
1. The following properties describe the element, mercury (Hg). Which one is a chemical property?
   a. Its density is 5.43 g/cm³  
   b. It is a liquid at 298 K.  
   c. It is a silvery-white metal.  
   d. Mercury(II) sulfide forms when it is exposed to sulfide ions.
2. How many significant figures should there be in the answer to the following math equation?
   \[ 23.413 \text{ g} \div (2.15 \text{ cm} \times 1.1 \text{ cm} \times 3.73 \text{ cm}) \]
3. A cube of lead has a volume of 6.61 cm³. Its mass is 75.0 grams. What is its density?
4. Glucose has a molecular weight of 180.2 g and an empirical formula CH₂O. What is its molecular formula?
   a. C₆H₁₂O₆  
   b. C₄H₈O₂  
   c. C₁₂H₂₂O₁₁  
   d. C₁₀H₁₄O₃
5. Which molecule has the most polar bond (shares the electrons least equally)? Be sure to consult the Periodic Table.
   a. IBr  
   b. HCl  
   c. N₂  
   d. HBr

Review 22
1. The chart shows the relationship between the first ionization energy and the increase in atomic number. The letter on the chart for the alkali family of elements is
   A) W.  
   B) X.  
   C) Y.  
   D) Z.
2. Which statement best describes the density of an atom’s nucleus?
   A) The nucleus occupies most of the atom’s volume but contains little of its mass.  
   B) The nucleus occupies very little of the atom’s volume and contains little of its mass.  
   C) The nucleus occupies most of the atom’s volume and contains most of its mass.  
   D) The nucleus occupies very little of the atom’s volume but contains most of its mass.

Review 23
1. What information do the experimental results on the right reveal about the nucleus of the gold atom?
   A) The nucleus contains less than half the mass of the atom.  
   B) The nucleus is small and is the densest part of the atom.  
   C) The nucleus contains small positive and negative particles.  
   D) The nucleus is large and occupies most of the atom’s space.
2. Why are enormous amounts of energy required to separate a nucleus into its component protons and neutrons even though the protons in the nucleus repel each other?
   A) The force of the protons repelling each other is small compared to the attraction of the neutrons to each other.  
   B) The electrostatic forces acting between other atoms lowers the force of repulsion of the protons.  
   C) The interactions between neutrons and electrons neutralize the repulsive forces between the protons.  
   D) The forces holding the nucleus together are much stronger than the repulsion between the protons.

Review 24
1. Which of the following correctly shows how carbon and hydrogen bond to form a compound?
   A)  
   B)  
   C)  
   D)  
2. Which substance is made up of many monomers joined together in long chains?
   A salt  
   B protein  
   C ethanol  
   D propane
3. How many atoms are in a chromium sample with a mass of 13 grams?
4. How many moles of chlorine gas are contained in \(9.02\times10^{23}\) molecules?
**Review 25**

1. Water is a polar solvent, while hexane is a nonpolar solvent. Which of the examples above illustrates a nonpolar solute in a polar solvent?
   - A NH₄Cl in water
   - B C₁₀H₈ in water
   - C C₂H₅OH in hexane
   - D CO(NH₂)₂ in hexane

2. A catalyst can speed up the rate of a given chemical reaction by
   - A increasing the equilibrium constant in favor of products.
   - B lowering the activation energy required for the reaction to occur.
   - C raising the temperature at which the reaction occurs.
   - D increasing the pressure of reactants, thus favoring products.

**Table:**

<table>
<thead>
<tr>
<th>Solute</th>
<th>Water</th>
<th>Hexane</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH₄Cl, ammonium chloride</td>
<td>Soluble</td>
<td>Insoluble</td>
</tr>
<tr>
<td>C₁₀H₈, naphthalene</td>
<td>Insoluble</td>
<td>Soluble</td>
</tr>
<tr>
<td>C₂H₅OH, ethanol</td>
<td>Soluble</td>
<td>Soluble</td>
</tr>
<tr>
<td>CO(NH₂)₂, urea</td>
<td>Soluble</td>
<td>Insoluble</td>
</tr>
</tbody>
</table>

**Review 26**

1. A student is given a cube of metal that is known to have a mass of 125.0 grams. She measures the mass of the metal three different times with the following results: 125.1 g, 124.8 g, 125.3 g. What can be said about her precision and accuracy?
2. A loaf of bread has a volume of 2270 cm³ and a mass of 454 g. What is the density of the bread?
3. Nancy put 50.2 mL of water into a graduated cylinder. After adding a solid object, the water level in the cylinder rose to 75.30 mL. The mass of the solid is 3.96 grams. What is the density of the object?

**Review 27**

1. If 26.35332 grams of Ca is reacted, how many moles of Calcium Oxide are produced?
   \[
   \text{Ca}(s) \rightarrow \text{CaO} (s)
   \]
2. Write the electron configuration for the following:
   - a. As⁺³
   - b. Ni
3. What is the proper name for each of the following?
   - a. NaCl
   - b. MgF₂
   - c. H₂O
   - d. CO₂
4. What is the formula for each of the following?
   - a. nitrogen trioxide
   - b. aluminum sulfate
   - c. ammonium phosphate
   - d. diphosphorus pentaiodide

**Review 28**

1. 90.0 g of FeCl₃ reacts with 52.0 g of H₂S. What is the limiting reactant? What is the mass of HCl produced? What mass of excess reactant remains after the reaction?
   \[
   \text{FeCl}_3 + \text{H}_2\text{S} \rightarrow \text{HCl} + \text{Fe}_2\text{S}_3
   \]
2. If 10.0 grams of Al react according to the following equation producing 6.3 g of Al₂O₃, what is the % yield?
   \[
   \text{Al} + \text{O}_2 \rightarrow \text{Al}_2\text{O}_3
   \]

**Review 29**

1. Predict the products for the following reactions:
   - a. Na(s) + Cl₂(g)
   - b. HgO(s)
   - c. BaCl₂(aq) + Na₂SO₄(aq)
   - d. C₄H₁₀(g) + O₂(g)
Review 30
1. The teacher said the volume of liquid was 500.0 mL. When measured, a student found it was 499.7 mL. What was the student’s percent error?
2. Clyde Clumsy was directed to weigh a 500 g mass on the balance. After diligently goofing off for ten minutes, he quickly weighed the object and reported 458 g.
3. Suppose a lab refrigerator holds a constant temperature of 38.0 F. A temperature sensor is tested 5 times in the refrigerator. The temperatures from the test yield are given in the table:

<table>
<thead>
<tr>
<th>Temperature (°F)</th>
<th>Accuracy</th>
<th>Precision</th>
</tr>
</thead>
<tbody>
<tr>
<td>39.4</td>
<td></td>
<td>39.4</td>
</tr>
<tr>
<td>46.3</td>
<td></td>
<td>46.3</td>
</tr>
<tr>
<td>48.2</td>
<td>28.1</td>
<td>34.5</td>
</tr>
</tbody>
</table>

Review 31
1. A sample of NH₃ gas (ammonia) fills a 63.0 liter container at 308°C and 2.6 atm. Calculate the volume of this gas at 273 K and 1.66 atm. Assume that the number of moles is constant.
2. Calculate the number of moles of O₂ that could be stored at 56°C and 19.3 atm, in a cylinder with a volume of 19.0 liters.
3. How many moles of hydrochloric acid (HCl) are in 50 mL (0.050 L) of concentrated hydrochloric acid solution that has a Molarity of 12 mol/L?
4. What is the molarity of a 500.0 ml solution that contains 4.8 moles of NaCl?

Review 32
1. Balance the following reactions:
   a. LiCl → Li⁺ + Cl⁻
   b. K + Al₂S₃ → K₂S + Al
   c. C₁₀₀H₁₀₂ + O₂ → CO₂ + H₂O
   d. H₂SO₄ + KOH → K₂SO₄ + HOH
2. A sealed flexible container with an initial volume of 1.0 L is occupied by a gas at a pressure of 150 kPa at 25°C. By changing the volume, the pressure of the gas increases to 600 kPa as the temperature is raised to 100°C. What is the new volume (in mL)?

Review 33
1. Which scientist was the first to conclude through experimentation that atoms have positive charges in their nuclei?
   a. Bohr
   b. Dalton
   c. Mosley
   d. Rutherford
2. The reaction times for three trials of an experiment are 90.3, 90.2, and 90.5 seconds. Which average time is expressed using the correct number of significant figures?
   a. 90.3
   b. 90.33
   c. 90
   d. 90.333

What is the name of the lab equipment shown on the right?
   a. Watch glass
   b. Crucible
   c. Beaker
   d. Evaporating dish

Review 34
1. Which of the following best describes why an experiment should be repeated?
   a. To organize the data
   b. To produce a variety of results
   c. To include another variable
   d. To verify the observed results
2. How should 0.000365 be expressed in proper scientific notation?
   a. 3.65 x 10⁻⁴
   b. 365
   c. 3.65
   d. 3.65 x 10⁻⁴
Review 35
1. How many significant figures will result when calculating density from these data?

<table>
<thead>
<tr>
<th>Mass (g)</th>
<th>Volume (mL)</th>
<th>Molar Mass (g/mol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>39.30</td>
<td>14.5</td>
<td>55.050</td>
</tr>
</tbody>
</table>

- a. 7
- b. 5
- c. 4
- d. 3

2. Which of these elements is found in a family with the above electron configuration?
- a. Al
- b. Sr
- c. Si
- d. Sb

Review 36
1. What is the electron configuration of scandium (Sc) in Sc(NO$_3$)$_3$?
- a. 1s$^2$2s$^2$2p$^6$3s$^2$3p$^6$4s$^2$
- b. 1s$^2$2s$^2$2p$^6$3s$^2$3p$^6$
- c. 1s$^2$2s$^2$2p$^6$3s$^2$3p$^6$4s$^2$3d$^1$
- d. 1s$^2$2s$^2$2p$^6$3s$^2$3p$^6$3d$^3$

2. Which of the following is the correct molecular shape of CH$_4$?
- a. Bent
- b. Linear
- c. Pyramidal
- d. Tetrahedral

3. What shape does the molecule BF$_3$ have?
- a. Bent
- b. Linear
- c. Tetrahedral
- d. Trigonal planar

Review 37
1. Which of these represents the empirical formula and the molecular formula, respectively, for a given organic compound?
- a. CH and C$_2$H$_2$
- b. CH and CH$_4$
- c. CH$_2$ and C$_2$H$_2$
- d. CH$_3$ and C$_3$H$_12$

2. The average kinetic energy of a sample of water molecules is —
- a. increased as the temperature is decreased
- b. increased as the temperature is increased
- c. unaffected by temperature changes
- d. always equal to zero

Review 38
1. Electronegativity differences are often helpful in determining the bond character between two atoms. A general rule states that if the electronegativity difference between two atoms is greater than 1.67, an ionic bond would most likely be formed. Using the chart above, which pair of atoms would probably form the strongest ionic bond?
- a. Al-P
- b. Na-Cl
- c. K-F
- d. Ca-O

2. A compound is composed of 58.8% C, 9.8% H, and 31.4% O, and the molar mass is 102 g/mol. What is the molecular formula for this compound?
- a. C$_2$H$_5$O$_3$
- b. C$_3$H$_3$O$_3$
- c. C$_5$H$_9$O$_2$
- d. CH$_3$O$_3$

Review 39
1. What is the molecular formula of a substance that has an empirical formula of C$_2$H$_5$ and a molecular mass of 58 g/mole?
- a. C$_2$H$_5$
- b. C$_5$H$_2$
- c. C$_6$H$_{10}$
- d. C$_6$H$_{15}$

2. Bonding between two elements of equal electronegativity would be -
- a. 100% covalent
- b. 50% ionic
- c. primarily ionic
- d. metallic in character

3. How many atoms are represented in the formula Ni(C$_2$H$_5$O$_2$)$_4$?
- a. 5
- b. 8
- c. 28
- d. 29
Review 40
1. Which formula represents a molecule with a fully saturated carbon (C) atoms?

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<tbody>
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Review 41
1. In NHO$_3$, the oxidation state of hydrogen is +1 and the oxidation state of oxygen is -2. Therefore, the oxidation state of nitrogen is --
   a. -1
   b. +3
   c. +4
   d. +5

2. Which statement describes how plastics differ from nucleic acids?
   a. Plastics are synthetic polymers, but nucleic acids are natural polymers
   b. Plastics are formed from repeated subunits, but nucleic acids are not.
   c. Plastics are formed from organic compounds, but nucleic acids are not.
   d. Plastics are polymers, but nucleic acids are monomers.

Review 42
1. Formaldehyde (H$_2$CO) reacts with oxygen to form CO$_2$ and H$_2$O. How many moles of CO$_2$ will be produced from reacting 2 moles of H$_2$CO with oxygen?
2. Calculate the volume occupied by $8.75 \times 10^{23}$ particles of an ideal gas at STP.
3. Soda water is a solution of carbon dioxide in water. The solution is composed of a -
   a. gaseous solute in a gaseous solvent
   b. liquid solute in a liquid solvent
   c. gaseous solute in a liquid solvent
   d. liquid solute in a gaseous solvent

4. Soda water is a solution of carbon dioxide in water. The solution is composed of a -
   a. gaseous solute in a gaseous solvent
   b. liquid solute in a liquid solvent
   c. gaseous solute in a liquid solvent
   d. liquid solute in a gaseous solvent

Review 43
1. Which of the following best describes sublimation?
   a. A solid melting to a liquid
   b. A solid melting to a liquid, which then evaporates
   c. The movement of gaseous particles so that they fill the space they occupy
   d. A solid forming a gas

2. Which of the following liquids would exhibit the highest vapor pressure at 25.0°C?
   a. Water, boiling point 100°C
   b. Glycerine, boiling point 290°C
   c. Ethyl alcohol, boiling point 78.3°C
   d. Ether, boiling point 34.6°C

Review 44
1. At room temperature, chlorine exists as a gas, bromine exists as a liquid, and iodine exists as a solid. The physical states of these elements indicate that melting point —
   a. decreases from top to bottom with group 17 elements
   b. is independent of periodic position
   c. increases from top to bottom within group 17 elements
   d. is constant within group 17 elements

2. The freezing point and the boiling point of water can be altered by a variety of techniques. Which of the following has little or no effect on the boiling point of water?
   a. Increasing the air pressure above the liquid
   b. Adding alcohol to the water
   c. Adding sodium chloride to the water
   d. Increasing the amount of water
Review 45
The first ionization energy for an oxygen atom is lower than the first ionization energy for a nitrogen atom. This statement is
a. Consistent with the GENERAL trend relating changes in ionization energy across a period from left to right because it is easier to take an electron from an oxygen atom than from a nitrogen atom.
b. Consistent with the GENERAL trend relating changes in ionization energy across a period from left to right because it is harder to take an electron from an oxygen atom than from a nitrogen atom.
c. Inconsistent with the GENERAL trend relating changes in ionization energy across a period from left to right due to the fact that the oxygen atom has two filled 2p orbitals and nitrogen has only one.
d. Inconsistent with the GENERAL trend relating changes in ionization energy across a period from left to right due to the fact that nitrogen has a half filled p sublevel and oxygen does not.

Review 46
The molecular geometry of CHCl₃ is ________ and the molecule is _________. (Prove your answer in the space below)

a. Bent and polar
b. Trigonal planar and non-polar
c. Trigonal pyramidal and non-polar
d. Tetrahedral and polar
e. T-shaped and non-polar

Review 47

<table>
<thead>
<tr>
<th>Boiling Point</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>140°C</td>
<td>1800°C</td>
</tr>
<tr>
<td>Melting Point</td>
<td>35°C</td>
<td>1500°C</td>
</tr>
<tr>
<td>Physical Characteristics</td>
<td>Powdery solid</td>
<td>Brittle, crystals formed</td>
</tr>
<tr>
<td>Electrical Conductivity</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

2. Using the table above, which substance, X or Y, would be classified as ionic in the solid state?
   a. X, because it is not a conductor of electricity
   b. X, because of low melting point
   c. Y, because of high melting point
   d. Y, because it is not a conductor of electricity

Review 48
Which diagram correctly shows the relationship between electronegativity and atomic number for the elements of Period 3?

(A) ![Diagram A]
(B) ![Diagram B]
(C) ![Diagram C]
(D) ![Diagram D]

Review 49
1. A compound’s empirical formula is NO₂. If the molar mass of the compound is 138 g/mol, what is the molecular formula?
2. When sodium chloride and lead (II) nitrate react in an aqueous solution, which of the following terms will be present in the balanced equation?
   a. Pb₂Cl₁
   b. NaNO₃
   c. 2NaNO₃
   d. 2PbCl₂
Review 50
1. The products of a reaction in which KCl decomposes are
   a. K + Cl
   b. no reaction occurs
   c. K + Cl₂
   d. 2K + Cl₂
2. How many grams of product Z will be formed if 12.0 g of W react with 12.0 g of X to form 8.0 g of product Y in the reaction shown? \[ W + X \rightarrow Y + Z \]

Review 51
Which of the following is the percent error of a compound if the experimental value is 105.2 g and the theoretical value is 107.5 g?
   a. 1.0 %
   b. 3.3 %
   c. 2.1 %
   d. 4.2 %

Review 52
Magnesium and nitrogen react in a combination reaction to produce magnesium nitride:
\[ 3Mg + N₂ \rightarrow Mg₃N₂ \]
In a particular experiment, a 9.27 gram sample of N₂ reacts completely. The mass of Mg consumed is
   a. 0.92 g
   b. 8.04 g
   c. 16.1 g
   d. 24.1 g

Review 53
1. A compound is 40.0 % carbon, 53.5 % oxygen, and 6.66% hydrogen. What is its empirical formula?
   a. C₄O₅H₇
   b. C₁O₂H₃
   c. C₁O₂H₂
   d. C₂O₁H₁
2. What is the empirical formula of the molecule on the right?
   a. CH
   b. C₂H₅
   c. C₁H₁₀
   d. CH₂
3. A single replacement reaction between sodium and copper (I) chloride will yield which of the following?
   a. chlorine gas and copper sodiumide
   b. sodium copper chloride
   c. sodium copperide and chlorine gas
   d. copper metal and sodium chloride
4. Why do chemical reactions occur?
   a. To produce substances that are more stable
   b. To produce less stable products
   c. To produce liquids and gases from solids
   d. Create new chemical substances
Review 54
Mercury reacts with bromine gas to produce mercury (II) bromide. What mass (in kg) of mercury (II) bromide will be produced if 15.0 mL of mercury reacts? (Mercury has a density of 13.6 g/mL)

Review 55
1. A sample of gas in a rubber tire is heated from 298 K to 345 K. During this process the volume of the tire increased from 2.31 L to 3.43 L. If the initial pressure in the tire was 123 kPa, what would the final pressure be?
   a. 1.25 kPa
   b. 63.8 kPa
   c. 78.5 kPa
   d. 95.9 kPa

2. The air in a person’s lungs consists of 0.177 mol of gas particles at 310.0 K and 1.00 atm pressure. What is the volume of the air?
   a. 0.000180 L
   b. 0.542 L
   c. 4.50 L
   d. 5560 L

3. Which of the following has the most molecules?
   a. 1.00 L of CO₂ at 50°C and 1.25 atm
   b. 1.00 L of CH₄ at 0°C and 1.00 atm
   c. 1.00 L of N₂ at 0°C and 1.00 atm
   d. 1.00 L of O₂ at 20°C and 1.00 atm