Short answer:

1. What are the products of a neutralization reaction called?
   
   Salt and water

2. When an acid reacts with a metal, what is one of the usual products called?

   Salt or hydrogen

3. Why do all acid solutions contain OH?  
   
   Solutions contain water, water ionizes to produce H^+ and OH^-.

4. What is the major component of a solution called?

   Solvent

5. A solution is an example of a (an) (Circle a letter)
   
   a. pure substance
   b. element
   c. compound
   d. homogeneous mixture
   e. heterogeneous mixture

6. Which type of energy is associated with motion? (Circle a letter)
   
   a. chemical
   b. electrical
   c. potential
   d. kinetic
   e. none of the above

7. An atom containing 7 protons, 8 neutrons, and 7 electrons (Circle a letter)
   
   a. is charge-neutral
   b. is an ion
   c. is an oxygen atom
   d. cannot exist
   e. none of the above

8. Which type of chemical reaction always has oxygen as one of its reactants?

   Combustion

9. (True or False) Electrons circle the nucleus much like planets orbit the sun?

   False

10. A substance that acts as an acid or a base is called what?

    Amphoteric

11. What is the purpose of an indicator?

    To indicate by color a pH range.
12. (True or False) A weak acid is mostly unionized (i.e. produces few ions)

13. What is the purpose of a buffer in our blood? **To keep pH constant around 7.42 by consuming acids or bases**

14. Which statement about supersaturated solutions below is always true? (Circle a letter)
   a. A supersaturated solution will crystalize if one crystal of solute is added to it.
   b. A supersaturated solution has a smaller density compared to a saturated one.
   c. A supersaturated solution contains more solute than an unsaturated solution.
   d. A supersaturated solution contains more water than an unsaturated solution.

15. When water boils, the bubbles that rise from the bottom contain what substance? **H₂O(g) water vapor**

For the following questions
Use the information contained On the figure to the right.

16. Which substance, **Hg** or **H₂O** has the strongest adhesive forces?

17. Which substance, **Hg** or **H₂O** has the larger viscosity?

18. Using the terms, cohesive and adhesive, explain why mercury is convex and water is concave in the figure above.
   The cohesive forces of mercury are stronger causing mercury to attract to mercury and not the glass, thus pulling Hg up the sides of the tube.
Problems

1. A 17.0 mL aliquot of HCl solution is required to neutralize 45.0 mL of 0.235 M Ca(OH)\(_2\) solution.
   a. Write and balance the neutralization equation.
      \[ 2 \text{HCl} + \text{Ca(OH)}_2 \rightarrow \text{CaCl}_2 + 2\text{H}_2\text{O} \]
   b. What is the original molarity of the HCl solution?
      \[
      \frac{0.235 \text{ mole Ca(OH)}_2}{17.0 \text{ mL}} \rightarrow \frac{2 \text{ mole HCl}}{45.0 \text{ mL}} \rightarrow \frac{1.24 \text{ M HCl}}{0.235 \text{ mole Ca(OH)}_2}
      \]
   c. What is the original pH of the HCl solution?
      \[
      \text{pH} = -\log 1.24 \\
      \text{pH} = -0.093
      \]

2. The phosphorous-to-hydrogen mass ratio is 10.2 for a compound. Calculate the empirical formula.
   \[
   \frac{10.29 \text{ g P}}{80.97 \text{ g P}} = 0.12794 \\
   \frac{1.008 \text{ g H}}{1.008 \text{ g H}} = 1.000 \\
   \frac{0.3294}{0.3294} = 1.000 \\
   \]

3. Label the acid, base, conjugate acid, and conjugate base in the following reactions:
   a. \( \text{NaNH}_2 + \text{HOH} \rightleftharpoons \text{NH}_3 + \text{OH}^- \)
      \[ \text{A} \quad \text{B} \quad \text{C}_A \quad \text{C}_B \]
   b. \( \text{HCl} + \text{HOH} \rightleftharpoons \text{H}_3\text{O}^+ + \text{OH}^- + \text{Cl}^- \)
      \[ \text{A} \quad \text{B} \quad \text{C}_A \quad \text{C}_B \]
4. How many grams of lead are contained in a 405 ml sample of a 12.3M solution of Pb(NO₃)₂?

\[
\frac{12.3 \text{ mole Pb(NO}_3\text{)}_2}{10^3 \text{ mole}} \times \frac{207.2 \text{ g Pb}}{1 \text{ mole}} = 1030 \text{ g Pb}
\]

5. Find the [OH⁻], pOH, and pH of a solution when [H⁺] = 7.22 \times 10^{-4}.

\[
[\text{OH}^-] = \frac{10^{-14}}{7.22 \times 10^{-4}} = 1.39 \times 10^{-11} \text{ M OH}^-
\]

\[
\text{pOH} = 10.859
\]

\[
\text{pH} = 14 - 10.859 = 3.141
\]

6. Find the [OH⁻] and [H⁺] if the pOH is 4.00.

\[
[\text{OH}^-] = 1.0 \times 10^{-4}
\]

\[
[\text{H}^+] = 1.0 \times 10^{-10}
\]

7. Find the molarity when 15.0 ml of water is added to 15.0 ml of 4.00 M HCl.

\[
C_{\text{HCl}} = C_2 V_2
\]

\[
(15.0)(4.00) = 30.0 C_2
\]

\[
C_2 = \frac{(15.0)(4.00)}{30.0} = 2.00 \text{ M HCl}
\]

8. How many grams of NaCl must be added to 72.0 g H₂O to make a 35.0% (w/w) solution of NaCl?

\[
\frac{35.0 \text{ g NaCl}}{65.0 \text{ g H}_2\text{O}} = 53.8 \text{ g NaCl}
\]
9. How many significant figures do the following contain?

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>a.</td>
<td>44.0</td>
<td>3</td>
</tr>
<tr>
<td>b.</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>c.</td>
<td>1.04404</td>
<td>6</td>
</tr>
<tr>
<td>d.</td>
<td>1.00</td>
<td>3</td>
</tr>
<tr>
<td>e.</td>
<td>0.01200</td>
<td>4</td>
</tr>
<tr>
<td>f.</td>
<td>0.0909</td>
<td>3</td>
</tr>
<tr>
<td>g.</td>
<td>0.01</td>
<td>1</td>
</tr>
<tr>
<td>h.</td>
<td>6.022 \times 10^{23}</td>
<td>4</td>
</tr>
</tbody>
</table>

10. Mercury has a density of 13.6 g/ml. Find the volume of 78.2 Kg of mercury.

\[
\frac{m_0}{\text{kg}} \times 10^3 \, \text{g} \times 78.2 \, \text{kg} = \frac{5750 \, \text{mm}^3}{5.75 \, \Omega}
\]

11. A 2.35 g metal ball bearing is placed in boiling water at 100°C for 25 minutes. The ball bearing is then placed into a beaker containing 75.0 mL of water at 25.0°C. The ball bearing raises the temperature of the water to 28.0°C. Calculate the specific heat of the ball bearing using the specific heat of the water as 4.184 J/g°C.

\[
\frac{4.184 \, \text{J}}{\text{g}} \times 75.0 \, \text{g} \times 3.0^\circ \Delta \times 2.35 \, \text{g} \times 72.0^\circ \Delta = 5.56 \, \text{J/g°C}
\]

12. Find the temperature in °C of a tire originally at 25°C and 32.0 PSI, after a trip when the pressure increased to 42 PSI.

\[
\frac{32.0 \, \text{PSI}}{298} = \frac{42 \, \text{PSI}}{T'} \rightarrow T' = \frac{(42 \times 298)}{32}
\]

\[
T' = 391 \, \text{K}
\]
13. Oxygen gas is produced by the decomposition of potassium chlorate, KClO₃.

\[ 2 \text{ KClO}_3 \rightarrow 2 \text{KCl} + 3 \text{O}_2 \]

If 1.44 grams of KClO₃ is completely decomposed by this reaction, liters of oxygen gas if formed at 25.0°C and 777 torr?

\[
\begin{array}{c|c|c}
\text{mass KClO}_3 & \text{mole KClO}_3 & \text{mole O}_2 \\
1.44 \text{ g} & 122.55 \text{ g/mol} & 2 \times 32.00 \text{ g/mol} \\
0.0117 \text{ mole} & & 0.247 \text{ mole} \\
\end{array}
\]

\[ 0.247 \text{ mole} \times 0.422 \text{ L/mole} = 0.102 \text{ L} \]

14. Thionyl chloride, SOCl₂, is used as a chlorinating agent in organic chemistry. Draw its Lewis structure, give its molecular shape, bond angles and polarity. Be sure to include formal charges if necessary.

Trigonal pyramid

\[ \text{P} = 8(4-0) + 2(6) - 2(4-1) - 2e = 0 \]

15. Find the %\((w/v)\) of 12.0 M HCl.

\[
\frac{12.0 \text{ mole HCl}}{10^3 \text{ mol}} \times 36.45 \text{ g/mole HCl} \times 10^2 = 43.71\% \text{ w/v}
\]

16. Convert 13.4 ft³ into m³.

\[
\begin{array}{c|c|c|c}
13.4 \text{ ft}^3 & 1 \text{ ft}^3 & 1 \text{ ft} & 1 \text{ m}^3 \\
\hline
1 \text{ ft}^3 & 1 \text{ m}^3 & 1 \text{ ft} & 1 \text{ m} \\
\end{array}
\]

\[ 13.4 \text{ ft}^3 = 0.379 \text{ m}^3 \]

17. A 25.00 ml aliquot of 0.500 M HCl is combined with 33.00 ml of 0.400 M sample of Ca(OH)₂.

\[ 2 \text{HCl} + \text{Ca(OH)}_2 \rightarrow \text{CaCl}_2 + 2 \text{H}_2\text{O} \]

a. Find the mass of the calcium chloride formed.

\[
\begin{array}{c|c|c|c|c}
0.500 \text{ mole HCl} & 0.35 \text{ mole} & \text{mole CaCl}_2 & 110.08 \text{ g/mol CaCl}_2 \\
0.500 \text{ mole Ca(OH)}_2 & 0.50 \text{ mole} & \text{mole CaCl}_2 & 110.08 \text{ g/mol CaCl}_2 \\
0.400 \text{ mole HCl} & 0.33 \text{ mole} & \text{mole CaCl}_2 & 110.08 \text{ g/mol CaCl}_2 \\
0.400 \text{ mole Ca(OH)}_2 & 0.33 \text{ mole} & \text{mole CaCl}_2 & 110.08 \text{ g/mol CaCl}_2 \\
\end{array}
\]

\[ 0.694 \text{ g CaCl}_2 \]

b. Find the volume of the excess reactant.

\[
\begin{array}{c|c|c|c|c}
0.694 \text{ mole CaCl}_2 & 110.08 \text{ g/mol CaCl}_2 & 10 \text{ mole Ca(OH)}_2 & 0.400 \text{ mole HCl} & \text{used} \\
33.0 \text{ ml} & 15.63 \text{ ml excess HCl} \\
\end{array}
\]

\[ 12.4 \text{ ml excess HCl} \]
18. Nomenclature and Formulas

I. NAME THE FOLLOWING:

a. CO
  Carbon monoxide
b. CuSO₃
  Copper(II) sulfite
c. Fe₃S₂
  Iron(II) sulfide
d. KClO
  Potassium hypochlorite
e. CrO₃
  Chromium(VI) oxide

II. WRITE FORMULAS FOR THE FOLLOWING

a. Barium hydroxide
   $\text{Ba(OH)_2}$
b. Ammonium carbonate
   $(\text{NH}_4)_2\text{CO}_3$
c. Iodine monochloride
   $\text{ICl}$
d. Chloric acid
   $\text{HClO}_3$
e. Hydrosulfuric acid
   $\text{H}_2\text{S}_2\text{(aq)}$

19. Write and balance the formula, ionic, and net ionic equations when $\text{Na}_2\text{CrO}_4\text{(aq)}$ combines with $\text{Fe(NO}_3\text{)_3\text{(aq)}}$. Solubility rules are on the Periodic Chart.

$$3\text{Na}_2\text{CrO}_4\text{(aq)} + 2\text{Fe(NO}_3\text{)_3\text{(aq)}} \rightarrow \text{Fe}_2\text{(CrO}_4\text{)}_3\text{(s)} + 3\text{Na}_2\text{NO}_3\text{(aq)}$$

20. Consider the unbalanced equation and answer the questions below.

$$\text{HClO}_4 + \text{NaBr} \rightarrow \text{HClO}_3 + \text{Br}_2$$

a. Give the oxidation states for Cl and Br on both sides of the equation.
   $\text{Cl} = 7 + \frac{1}{2} 5^+$
   $\text{Br} = 1 - \frac{1}{2} 0$

b. List each reactant as oxidized or reduced.
   $\text{NaBr}$ oxidized
   $\text{HClO}_4$ reduced

c. Identify the oxidizing and reducing agents.
   $\text{R.A.} = \text{NaBr}$
   $\text{O.A.} = \text{Br}_2\text{HClO}_4$