Multiple Choice:
Circle the letter of the best answer. You may refer to a periodic table and an ion chart.

1. What type of reaction is the following?
   silver + gold(III) nitrate → silver nitrate + gold
   A. synthesis
   B. neutralization
   C. single replacement
   D. double replacement

2. What type of reaction is the following?
   C₃H₈ + 5O₂ → 3CO₂ + 4H₂O
   A. single replacement
   B. combustion
   C. decomposition
   D. double replacement

3. Classify the reaction type and predict the products of the following reaction.
   HCl + Mg(OH)₂ → ?
   A. double replacement; products are MgCl₂ and H(OH)₂
   B. double replacement; products are MgCl₂ and H₂O
   C. neutralization; products are MgCl₂ and H(OH)₂
   D. neutralization; products are MgCl₂ and H₂O

4. Which of the following reactions is double replacement?
   A. Pb + 2CuCl₂ → PbCl₂ + 2Cu
   B. Na₂CO₃ + CaBr₂ → CaCO₃ + 2NaBr
   C. MgCO₃ + 2HBr → MgBr₂ + CO₂ + H₂O
   D. Mg(OH)₂ + 2HBr → MgBr₂ + 2H₂O

5. What are the products in the decomposition reaction involving aluminum oxide?
   A. Al and O
   B. Al₂O₃
   C. Al and O₂
   D. AlO

6. What is formed when HCl and NaOH solutions are combined?
   A. NaCl and H₂O
   B. NaH and ClOH
   C. NaOCl and H₂
   D. There is no reaction.
6. Which of the following household items is basic?
   A. baking soda
   B. grapes
   C. bananas
   D. water

7. What are the colours of methyl red indicator and bromothymol blue indicator in separate samples of water at pH 7?
   A. Methyl red indicator is red, and bromothymol blue indicator is yellow.
   B. Methyl red indicator is yellow, and bromothymol blue indicator is blue.
   C. Methyl red indicator is yellow, and bromothymol blue indicator is green.
   D. Methyl red indicator is orange, and bromothymol blue indicator is green.

8. Which are properties characteristic of an acid but not a base?
   A. sour, reacts with magnesium, turns litmus blue
   B. bitter, reacts with magnesium, turns litmus red
   C. slippery touch, does not react with magnesium, turns litmus blue
   D. sour, turns phenolphthalein indicator colourless, turns litmus red

9. What is the best chemical definition of a salt?
   A. a material found by evaporating sea water
   B. a material formed by the reaction of an acid with a base
   C. a material containing a metal ion and an oxide ion
   D. a material containing a metal ion and carbonate ion

10. Burning magnesium in air produces a brilliant white flame and a white powder. When the white powder is placed in water, it dissolves. What is the colour when bromothymol blue indicator is added to this solution?
    A. colourless
    B. yellow
    C. green
    D. blue

Match the Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

<table>
<thead>
<tr>
<th>Term</th>
<th>Descriptor</th>
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</thead>
<tbody>
<tr>
<td>11. synthesis</td>
<td>A. a reaction in which a compound splits into two elements</td>
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<tr>
<td>12. precipitate</td>
<td>B. the reaction involving a burning candle</td>
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<tr>
<td>13. combustion</td>
<td>C. the reaction of an acid with a base</td>
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<tr>
<td>14. surface area</td>
<td>D. a solid that forms when two ionic solutions are mixed</td>
</tr>
<tr>
<td>15. neutralization</td>
<td>E. a substance that increases reaction rate without being used up by the reaction</td>
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<tr>
<td></td>
<td>F. a reaction in which two elements combine to form a compound</td>
</tr>
</tbody>
</table>
**Match the Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.**

<table>
<thead>
<tr>
<th>Term</th>
<th>Descriptor</th>
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<tbody>
<tr>
<td>11. indigo carmine</td>
<td>A. releases OH(^-) ions in solution</td>
</tr>
<tr>
<td>13. base</td>
<td>B. releases H(^+) ions in solution</td>
</tr>
<tr>
<td>14. acid</td>
<td>C. acid-base indicator</td>
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<tr>
<td>15. concentration</td>
<td>D. a set of numbers that measure acidity levels</td>
</tr>
<tr>
<td>16. pH scale</td>
<td>E. a liquid capable of dissolving other substances</td>
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<td></td>
<td>F. turns red in acid</td>
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<td>G. a measure of the quantity of a substance dissolved in a given volume</td>
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**Short Answer Questions**

17. Identify each of the following descriptions as synthesis, decomposition, single replacement, double replacement, neutralization, or combustion.
   (a) There is only one reactant. ____________________________
   (b) One reactant is an element. The other is a compound. ____________________________
   (c) Two ionic compounds react to form two new ionic compounds. __________________

18. Which of the four factors affecting reaction rate is most important in each question below? Choose from among concentration, temperature, surface area, and catalyst.
   (a) Dust in a granary explodes when it comes in contact with a spark. __________________
   (b) Table sugar is digested in the mouth when it dissolves in saliva, which contains a digestive enzyme. __________________
   (c) A person blows on a fire to help get it burning better. _________________________

19. Complete and balance each of the following equations. Then classify each reaction type.
   (a) \[ \text{Zn} + \text{Cu(OH)}_2 \rightarrow \]
       Reaction type: ____________________________
   (b) \[ \text{C}_2\text{H}_4 + \text{O}_2 \rightarrow \]
       Reaction type: ____________________________
   (c) \[ \text{Al} + \text{S}_8 \rightarrow \]
       Reaction type: ____________________________
2. Write a balanced chemical equation to represent each reaction described below.
   (a) Aluminum metal reacts with oxygen to form aluminum oxide.

   (b) Metallic zinc combines with sulphur to form zinc sulphide.

2. Write a balanced chemical equation to represent each reaction described below.
   (a) Rubidium oxide decomposes into its elements.

   (b) Calcium chloride decomposes into its elements.

2. Write a balanced chemical equation to represent each reaction described below.
   (a) Silver reacts with gold(III) nitrate.

   (b) Copper reacts with lead(II) sulphate.

2. Write a balanced chemical equation to represent each reaction described below.
   (a) Solutions of sodium hydroxide and hydrochloric acid react.

   (b) A silver nitrate solution reacts with a sodium chloride solution.

2. Write a balanced chemical equation to represent each reaction described below.
   (a) Cand wax, C_{25}H_{52}, is burned to produce carbon dioxide and water.

   (b) Sucros C_{12}H_{22}O_{11}, is burned to produce carbon dioxide and water.
17. Determine whether the following are acids, bases, or neither. Then, predict the colour they would turn litmus paper.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Acid, Base or Neither?</th>
<th>Litmus Colour</th>
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</thead>
<tbody>
<tr>
<td>(a) H₂SO₄</td>
<td></td>
<td></td>
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<tr>
<td>(b) HCl</td>
<td></td>
<td></td>
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<tr>
<td>(c) Ca(OH)₂</td>
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</tbody>
</table>

18. Complete the following chart.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Colour at pH 4</th>
<th>Colour at pH 7</th>
<th>Colour at pH 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methyl Red</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bromthymol Blue</td>
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</tbody>
</table>

19. Complete and balance the following equations.
   (a) HBr + KOH → KBr + ____
   (b) H₂SO₄ + Al(OH)₃ → _____ + _____
   (c) The reactions in (a) and (b) are both of the same type. What is the name of this type of reaction? ______________________

**What to Do**

Classify each reaction as a synthesis (S), decomposition (D), single replacement (SR), double replacement (DR), or combustion (C) reaction. Then, balance each equation.

<table>
<thead>
<tr>
<th>Reaction</th>
<th>Classification</th>
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<tbody>
<tr>
<td>1. Li + AlCl₃ → Al + LiCl</td>
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<tr>
<td>2. NH₃ → N₂ + H₂</td>
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<td>3. K + Br₂ → KBr</td>
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<tr>
<td>4. C₁₀H₂₂ + O₂ → CO₂ + H₂O</td>
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<tr>
<td>5. NH₄OH + H₂CO₃ → H₂O + (NH₄)₂CO₃</td>
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<tr>
<td>6. H₂O → H₂ + O₂</td>
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<tr>
<td>7. Al + Cl₂ → AlCl₃</td>
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<tr>
<td>8. Zn + SnF₄ → Sn + ZnF₂</td>
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</tr>
<tr>
<td>9. Ni + HCl → NiCl₂ + H₂</td>
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<tr>
<td>10. Au(CN)₃ + Zn → Au + Zn(CN)₂</td>
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</tbody>
</table>
20. Classify each reaction as either endothermic or exothermic, and briefly explain your answer.

<table>
<thead>
<tr>
<th>Description of Chemical Reaction</th>
<th>Endothermic or Exothermic?</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A piece of paper is ignited and burns with a bright flame.</td>
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<tr>
<td>Pentaborane (a colourless liquid), $\text{B}_5\text{H}_9$, reacts violently with oxygen gas to form solid diborane, $\text{B}_2\text{O}_3$, and water, typically bursting into flame and often exploding.</td>
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<td></td>
</tr>
<tr>
<td>Pure iron metal is formed and carbon dioxide is released when iron(III) oxide ore is heated to a very high temperature in the presence of solid carbon.</td>
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<tr>
<td>Sodium hydroxide solution and hydrochloric acid solution are mixed. The temperature of the mixture increases.</td>
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<tr>
<td>Mixing ammonium thiocyanate and barium hydroxide octahydrate in a beaker causes water on the outside of the beaker to freeze.</td>
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21. A student claims that the reaction of butane gas and oxygen gas must be endothermic since a spark is needed to ignite the butane gas in a lighter. Do you agree or disagree with this claim? Explain your answer.

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________