Practice Test Questions 6
Metals of Groups 1 and 2

1. Fill in each blank with the word or short phrase that best completes the sentence.
For elements and compounds, write both the name and symbol. e.g. lithium (Li)

(a) One typical property of a metal is _____.

(b) The only element in Group 1 that is not a metal is _____.

(c) The alkaline earth metal in the 2nd period is _____.

(d) The colour observed when a potassium salt is heated in a Bunsen burner flame is _____.

(e) The alkaline earth metal that makes covalent bonds with chlorine is _____.

(f) The alkaline earth metal that reacts most vigorously with water is _____.
For this question only, you may provide just the symbol.

(g) The alkali metal that produces salts giving yellow flame tests is _____.

(h) The gas produced when potassium is added to water is _____.

(i) The alkali metal cation with the largest enthalpy of hydration is _____.

(j) Sodium metal is produced through the electrolysis of sodium chloride in what state of matter? _____

2. Write a balanced chemical equation for each of the following reactions.
If no reaction occurs, write "NO REACTION" instead.
Include states of matter.

(a) Cesium (Cs) is added to chlorine gas and the reaction warmed to initiate reaction.

(b) Sodium is added to pure water.

(c) Barium oxide (BaO) is added to strong aqueous acid.

(d) Calcium reacts with oxygen.

(e) Calcium is added to aqueous HCl.

(f) Lithium is heated with nitrogen gas.

(g) Bromine is poured into a flask containing calcium.

(h) Sodium pieces are dropped into a jar with liquid bromine.

(i) Calcium pieces are dropped into water.

(j) Calcium oxide reacts with water.

(k) Potassium metal reacts with fluorine gas.

(l) Lithium metal is exposed to oxygen gas.

(m) Calcium is heated with nitrogen gas.

(n) Hydrogen gas is prepared *via any method discussed in either lab or lecture of CHEM 1000.*

3.

(a) Write a balanced chemical equation for the industrial production of sodium metal. *Include all states of matter.*

(b) Write a balanced chemical equation for the industrial production of sodium hydroxide. *Include all states of matter.*

(c) These two industrial processes are based on the same method for making an otherwise unfavourable reaction occur. What is this method?

(d) Despite the fact that the two processes have reagents in common and employ the same method, they lead to different products. Why?

4. It is not possible to perform electrolysis on solid sodium chloride. It is, however, possible to perform electrolysis on sodium chloride that has been either melted **or** dissolved in water. In either case, it is necessary to keep the products of the reaction separate.

(a) Why is it not possible to perform electrolysis on solid sodium chloride?

(b) i. Write a balanced chemical equation describing the electrolysis of sodium chloride that has been melted. *Include all states of matter.*

ii. What would happen if the products of this reaction were not kept separate? Be specific.

(c) i. Write a balanced chemical equation describing the electrolysis of sodium chloride that has been dissolved in water. *Include all states of matter.*

ii. What would happen if the products of this reaction were not kept separate? Be specific.

5. A diagonal relationship links lithium with magnesium.

(a) Given an example of a property that lithium shares with magnesium (but not with sodium or other alkali metals).

(b) Explain why lithium has more properties in common with magnesium than sodium.

6. Atoms in metals are arranged in lattices.

(a) Use a diagram to show what is meant by the term “closest packed” as it relates to metal lattices.

(b) Two common types of lattice are the hexagonal closest packed lattice and the cubic closest packed lattice. Briefly explain the difference between these two types of lattice. You may find it helpful to draw diagrams.

7. Give an example of a chemical property of beryllium which makes it different from the other group 2 metals.

8.

(a) The bonding in $BeCl_2$ is different from the bonding in $MgCl_2$ or $CaCl_2$. What is different about $BeCl_2$ and why is this the case?

(b) This is not the only case of beryllium behaving differently from the other alkaline earth metals. Outside of Group 2, what element has the most similar chemical properties to beryllium? This is an example of what kind of relationship?

9. You are given two unlabeled test tubes. You are told that one contains a sodium chloride solution, and the other a lithium nitrate solution, and are asked to tell which is which. How can this be done?

Make sure you clarify how you'll know which solution is which.

10. The labels on the jars of alkaline earth metals have been obscured, and it's Dan's job to determine which metal is which. He carefully weighs out 100 mg of one metal and, behind a blast shield, adds it to a bottle containing 1 L of 1 M HCl(aq). He uses a balloon to collect the gas produced, finding that this reaction produces 62 mL of gas at 1.00 bar and 25 °C.

(a) Name the gas produced by this reaction.

(b) Write a balanced chemical equation for the reaction that Dan performed.

Use M as a stand-in for the unknown metal.

(c) Identify the alkaline earth metal that Dan used.

(d) Suggest a safer method of determining which alkaline earth metal was in the container.

Remember that your method must be safe regardless of which metal it turns out to be.

11. A 4.0 L bottle of bleach contains 4.5% NaOCl (4.5 g NaOCl per 100 mL bleach).

The bleach is prepared from sodium hydroxide and chlorine gas:

$$\_\_\_\,NaOH(aq) + \_\_\_\,Cl_2(g) \rightarrow \_\_\_\,NaOCl(aq) + \_\_\_\,NaCl(aq) + \_\_\_\,H_2O(l)$$

(a) Balance the reaction equation above.

(b) Calculate the concentration of NaOCl in the bottle of bleach.

Report your answer in mol/L.

(c) Calculate the minimum mass of NaOH required to make 4.0 L of bleach.

12. The electrolysis of aqueous sodium chloride solution, the chlor-alkali process, is the main industrial source of sodium hydroxide.

(a) Write a balanced reaction for this process. Include all states of matter.

(b) The U.S. produces approximately 6 million tonnes of sodium hydroxide by the chlor-alkali process every year. What mass of sodium chloride is used in the U.S. on an annual basis in this process? Express your answer in million tonnes.

1 tonne = 1000 kg