Prerequisite Knowledge Test

Part A Multiple Choice

1. An approximately 1 M aqueous HCl solution can best be prepared by adding:
   A) 100 mL of 10 M aqueous HCl to 10 mL of Water
   B) 100 mL of 10 M aqueous HCl to 990 mL of Water
   C) 10 mL of 10 M aqueous HCl to 100 mL of Water
   D) 90 mL of 10 M aqueous HCl to 10 mL of Water
   E) 10 mL of 10 M aqueous HCl to 90 mL of Water

2. Hydrogen cyanide, HCN, is a poisonous gas that is also important in industrial chemical synthesis. It is produced from methane, ammonia and oxygen according to
$2\ CH_4(g) + 2\ NH_3(g) + 3\ O_2(g) \rightarrow 2\ HCN(g) + 6\ H_2O(g)$
What mass of oxygen (in kg) is required to produce 200 kg of hydrogen cyanide?
   A) 149
   B) 423
   C) 257
   D) 317
   E) 355

3. What is the chemical formula of sodium carbonate?
   A) $NaCO_3$
   B) $NaClO_3$
   C) $Na(CO_3)_2$
   D) Na_2CO_3
   E) Na_2CO_2

4.What is the empirical formula of the compound formed by gallium and oxygen?
   A) GaO_3
   B) Ga_2O
   C) Ga_3O_2
   D) GaO
   E) Ga_2O_3

5.Balance the reaction (unbalanced as written),
$OCl^-(aq) + H_2CO(aq) \rightarrow Cl^-(aq) + HCOO^-(aq)$
under basic conditions. If 1 mol of H_2CO is consumed, how much $OH^-(aq)$ is consumed/produced?
   A) 1 mol of $OH^-(aq)$ is consumed
   B) 3 mol of $OH^-(aq)$ is produced
   C) 1 mol of $OH^-(aq)$ is produced
   D) 2 mol of $OH^-(aq)$ is produced
   E) 2 mol of $OH^-(aq)$ is consumed

6. Which one of the following atoms has two unpaired electrons in its ground state electronic configuration?

A) B
B) He
C) N
D) C
E) Be

7. Which one of the following choices lists the species in order of increasing size?

A) $I^- < I < Br$
B) $F^- < F < Cl$
C) $F^- < Cl^- < Cl$
D) $Cl^+ < Cl^- < Cl$
E) $F < F^- < Cl^-$

8. The cation $^{33}S^+$ contains

A) 17 neutrons, 16 protons, 17 electrons
B) 33 neutrons, 17 protons, 16 electrons
C) 16 neutrons, 16 protons, 15 electrons
D) 17 neutrons, 17 protons, 16 electrons
E) 17 neutrons, 16 protons, 15 electrons

9. What mass (in g) of CaO(s) is produced when 6.80 g of calcium metal reacts with 2.00 L of oxygen at 298 K and 1.00 atm pressure?

A) 6.89
B) 9.17
C) 10.1
D) 9.87
E) 8.14

10. For the following pure substances, identify the one incorrect chemical name from among the following:

A) Li2CO3, lithium carbonate
B) Fe2O3, iron(III) oxide
C) HF, hydrogen fluoride
D) Ca(H2PO4)2, calcium dihydrogen phosphate

Part B Application Question

1. Calculate the number of moles of silver present in $1.505 * 10^{23}$ atoms of Ag.

2. For 415.68g of $Ca(OH)_2$, determine the follow
   a) The moles of $Ca(OH)_2$
   b) Determine the moles of oxygen atoms from a)

3. A student conducted an experiment for which the theoretical yield of the product was 1.7g. Upon completion, the student reported an actual yield of 1.2g.
   a) Determine the percentage yield
   b) Is the student's actual yield possible? Justify your answer, including an explanation of how this result may have been obtain within 1-3 lines

4. A new employee is asked to make Al(OH)3 using the following balanced reaction: $Al_2S_3 + 6H_2O \Rightarrow 2Al(OH)_3 + 3H_2S$. The employee decides to use 270.2g of Al_2S_3 and 151.2g of H_2O.
   a) Demine the limiting reactant
   b) Determine the mass of excess reactant that will be left over
   c) In 1-2 sentence, explain why the employee's supervisor was NOT pleased with this work and how the employee can improve their work next time?