ASSESSMENT	**Chapter 8 Test**	**BLM 8.4.1**

Multiple-Choice Questions

Circle the letter for the choice that best completes the statement or answers the question.

1. The diagram of a burette shown below shows the initial and final readings (in mL) during titration. What volume of acid was delivered from this burette?
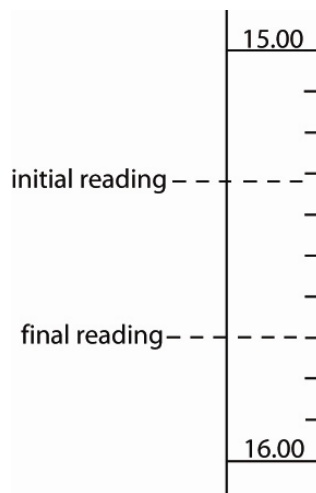
    a) 15.32 mL
    b) 0.38 mL
    c) 0.68 mL
    d) 1.70 mL

The pH range over which some indicators change colour is shown below in Table 8.1. Use this information for questions 2 and 3

Table 8.1   pH Range and Colour Change of Indicators

| Indicator	pH Range	Colour Change
Methyl red	4.8–6.0	red–yellow
Bromothymol blue	6.0–7.6	yellow–green–blue
Phenol red	6.6–8.0	yellow–red
Phenolphthalein	8.2–10.0	colourless–pink

2. In a titration, an acid is the titrant that is in a burette. The titration goes past the equivalence point and the indicator colour is red. Referring only to the indicators listed in the table, what indicator was used?
    a) phenolphthalein
    b) methyl red
    c) phenol red
    d) bromothymol blue

3. A titration is to be carried out with the equivalence point coming at pH = 7.5. Referring only the indicators listed in the table, which one would be the best choice for this titration?
   a) methyl red
   b) bromothymol blue
   c) phenol red
   d) phenolphthalein

4. A 15.0 mL sample of an acid is to be titrated with a base. The equivalence point comes at pH = 6.6 but the indicator that is used changes colour at pH = 9.9. Which statement describes the error that will occur?
   a) Too much base will be used.
   b) The titration will go past the equivalence point.
   c) Too little base will be used.
   d) Answers (a) and (b) are correct.

5. In the reaction below, the concentration of A is 0.2 mol/L, and the concentration of B is 0.1 mol/L. For what combination of reactants will neither be a limiting reagent?

$$A + 2B \rightarrow C$$

   a) 10 mL of A + 10 mL of B
   b) 10 mL of A + 20 mL of B
   c) 20 mL of A + 10 mL of B
   d) 10 mL of A + 40 mL of B

6. A 20.0 mL sample of 0.080 mol/L sodium hydroxide is titrated with hydrochloric acid. The initial burette reading of the acid is 11.64 mL. If the concentration of the HCl is 0.06 mol/L, what is the final burette reading at the equivalence point?
   a) 38.31 mL
   b) 26.67 mL
   c) 15.03 mL
   d) 11.64 mL

7. 300 kL of sulfur dioxide and 100 kL of oxygen react in the presence of a catalyst to form sulfur trioxide. All gases are measured at 100 $^\circ$C and 100 kPa pressure. What volume of sulfur trioxide is produced?

$$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$$
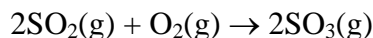
   a) 200 kL
   b) 300 kL
   c) 100 kL
   d) 400 kL

8. The following data were obtained in an experiment to precipitate barium sulfate.

$$Na_2SO_4(aq) + Ba(NO_3)_2(aq) \rightarrow 2NaNO_3(aq) + BaSO_4(s)$$
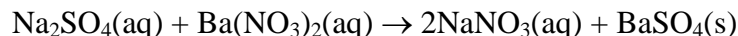
   The precipitate was recovered by filtration.
   Mass of filter paper = 1.56 g
   Mass of filter paper + precipitate = 13.78 g
   The predicted mass of precipitate for this reaction is 14.09 g.

   What is the percentage yield in this experiment?
   a) 97.78%
   b) 89.37%
   c) 86.73%
   d) 90.93%

9. 25.0 mL of 0.600 mol/L KOH is pipetted into a beaker. 4 drops of bromothymol blue indicator
   are added. After the addition of 30.0 mL of 0.400 mol/L HCl, what will be the colour of the
   indicator?
   a) pink
   b) green
   c) yellow
   d) blue

10. A strip of magnesium metal having a mass of 0.86 g is burned in a bottle of oxygen.

$$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$$
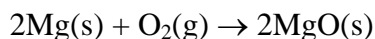
   Based on this mass of magnesium, the expected yield of magnesium oxide is 1.43 g. The mass of
   magnesium oxide produced is 1.00 g. What is one conclusion that could account for this result?
   a) The magnesium was not 100% pure.
   b) Mechanical losses occurred during transfer of the product.
   c) Oxygen was a limiting reagent.
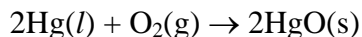   d) Any of the above answers account for this result.

Numerical Response Questions

For each numerical response question, record the answer in the following response box.
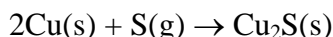
| **11.** |
| **12.** |
| **13**. |
| **14.** |
| **15.** |

ASSESSMENT

Chapter 8 Test

11. What mass of mercury(II) oxide, HgO(s), is predicted to be produced when 2.000 mol of oxygen gas and 1.000 mol of mercury are allowed to react?

$$2Hg(l) + O_2(g) \rightarrow 2HgO(s)$$

12. When 12.71 g of copper react with 8.000 g of sulfur, 14.72 g of copper(I) sulfide is produced. What is the percentage yield in this reaction?

$$2Cu(s) + S(g) \rightarrow Cu_2S(s)$$

13. Aluminium hydroxide, $Al(OH)_3$(s) can be precipitated when aqueous solutions of aluminium sulfate, $Al_2(SO_4)_3$(aq), and sodium hydroxide, NaOH(aq), react as shown in the equation:

$$Al_2(SO_4)_3(aq) + 6NaOH(aq) \rightarrow 3Na_2SO_4(aq) + 2Al(OH)_3(s)$$
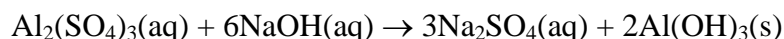
Predict how many moles of $Al(OH)_3$(s) can be produced when 0.060 mol of NaOH(aq) react with 0.030 mole of $Al_2(SO_4)_3$(aq).

14. What mass of the reagent in excess will remain after the reaction in which 0.3604 g of H_2O(l) react with 0.8000 g of O_2(g)?

$$2H_2O(l) + O_2(g) \rightarrow 2H_2O_2(l)$$
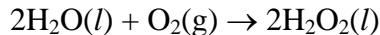
15. In the reaction between 0.060 mol of aluminium metal and iron(III) oxide, 2.234 g of iron is produced. How many mol of iron(III) oxide reacted?

$$2Al(l) + Fe_2O_3(s) \rightarrow 2Fe(l) + Al_2O_3(s)$$
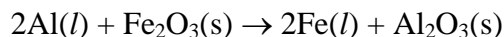
Written Response Questions

Answer each question in the space provided. Use complete sentences and diagrams when necessary.

16. A double-replacement reaction is used in a precipitation experiment. The precipitate formed is recovered by filtration. The precipitate is washed, dried, and weighed to find the experimental yield. The percentage yield is then calculated.

    Poor laboratory technique can lead to experimental error. Indicate if the technique described will increase or decrease the calculated percentage yield. Explain your reasoning.
    a) The precipitate is rinsed with tap water, dried, and weighed.

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    b) A stirring rod is used to agitate the solution containing the precipitate while filtering. The stirring rod is not rinsed into the funnel at the end of this procedure.

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17. Muriatic acid (hydrochloric acid) is used in some toilet bowl cleaners. An experiment was designed to compare the concentration of acid in different products. Answer the following questions concerning the procedure that would be followed to titrate samples of cleaner.
   a) Sodium hydroxide is selected as the titrant. Why is this a good choice?

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    b) What is meant by a standard solution of sodium hydroxide?

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ASSESSMENT	**Chapter 8 Test**	BLM 8.4.1

The burette is rinsed out with distilled (or de-ionized) water and then rinsed with the standard solution of sodium hydroxide before filling with the standard NaOH(aq) solution. Why is the burette rinsed with sodium hydroxide solution?

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    c) Sketch the titration curve for this titration. Label each axis and the equivalence point.

18. Chrome yellow is the common name given to lead(II) chromate, a pigment used in some paints. Calculate the predicted yield of this pigment that can be prepared by mixing 375 mL of 0.200 mol/L lead nitrate with 450 mL of 0.175 mol/L potassium chromate.
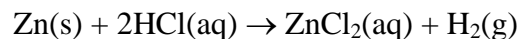
$$Pb(NO_3)_2(aq) + K_2CrO_4(aq) \rightarrow 2KNO_3(aq) + PbCrO_4(s)$$

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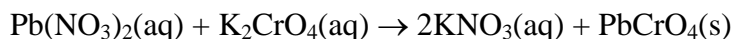
19. A sample of impure zinc is added to dilute hydrochloric acid, HCl(aq), and the hydrogen gas produced is collected at 25.0 ^{o}C and 103.5 kPa.

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$
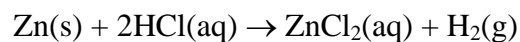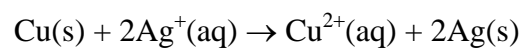
a) What volume of hydrogen gas, $H_2(g)$, is expected to be produced when 15.00 g of zinc that is 90.0% pure is added to 120.0 mL of 4.00 mol/L hydrochloric acid?

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

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b) If 4.88 L of $H_2(g)$ is actually collected, what is the percentage yield in this reaction?

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20. Silver can be recovered from waste solutions by a reaction with copper metal.

$$Cu(s) + 2Ag^+(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$$

When 1.00 kg of copper react, 3.12 kg of silver is recovered. What is the percentage yield in this reaction?