REVIEW QUESTIONS
Test 1

1. Consider the reaction shown below:

$$CaCO_3\,(s) + 2\,HCl\,(aq) \rightarrow CaCl_2\,(aq) + CO_2\,(g) + H_2O\,(l)$$

   a) How many mL of 0.55M HCl are needed to react with 3.7 g of $CaCO_3$?

   b) After the reaction has gone to completion, what volume of CO_2 gas can be collected at 25.0°C and barometric pressure of 755 mmHg? (Vapor pressure of water at 25.0°C is 23.8 mmHg)

2. What is the concentration of chloride ions in a solution that contains 0.375 g of aluminum chloride in 15.0 mL of solution?

3. A mixture of 7.00 g of CO and 10.0 g of SO_2 is placed in a 250-mL flask at a particular temperature. If the total pressure of the mixture is 755 mmHg, what are the partial pressures of each gas in the mixture?

4. An ideal gas with a density of 3.00 g/L has a pressure of 675 mmHg at 25 °C. Determine the molar mass of this gas.

5. Identify the oxidizing and reducing agents in each of the following reactions:

   a) $2\ NiS + 3\ O_2 \rightarrow 2\ NiO + 2\ SO_2$

   oxidizing agent:_____ reducing agent:_____

   b) $3\ H_2S + 2\ HNO_3 \rightarrow 3\ S + 2\ NO + 4\ H_2O$

   oxidizing agent:_____ reducing agent:_____

   c) $2\ Au + 2\ BrF_3 + 2\ KF \rightarrow 2\ KAuF_4 + Br_2$

   oxidizing agent:_____ reducing agent:_____

6. Balance the two half-reactions shown below and combine to find the overall equation for the reaction:

$$P_4 + H_2O \rightarrow H_2PO_4^- + H^+$$

$$NO_3^- + H^+ \rightarrow NO + H_2O$$

7. Tellerium, a group 6 element, forms the oxoanions TeO_4^{2-} and TeO_3^{2-}. What are the likely names for these anions? Which other group 6 oxoanions are these similar to?

8. How many mL of 2.0M $NaHCO_3$ must be used to completely neutralize 55 mL of 3.0M H_2SO_4 spilled from a battery?

9. To find the mass percent of limestone ($CaCO_3$) in a soil sample, a geochemist titrates 1.586 g of the soil with 43.56 mL of 0.2516M HCl. What is the mass percent of $CaCO_3$ in the soil?

10. An unknown gas effuses 1.73 times faster than Kr. What is the molar mass of this gas?

11. What is the temperature of CO_2 gas if the root-mean-square velocity of the molecules is 750 m/s?

12. A solution is prepared by dissolving 10.8 g of ammonium sulfate in enough water to make 100.0 mL of stock solution. A 10.00 mL sample of this stock solution is added to 50.00 mL of water. Determine the concentration of ammonium and sulfate ions in the final solution.

13. Calculate the sodium ion concentration when 70.0 mL of 3.0 M sodium carbonate is added to 30.0 mL of 1.0 M sodium bicarbonate.

14. A 100.0-mL sample of 0.200 M aqueous KOH is mixed with 100.0 mL of 0.200 M of aqueous $Mg(NO_3)_2$.
    a) What is the mass of the precipitate produced after the reaction is complete?

    b) Calculate the concentration of each ion remaining in solution after precipitation is complete.

15. Consider a 1.0-L sample of neon gas at STP. Will the average kinetic energy, average velocity, and frequency of collisions of gas molecules with the walls of the container increase, decrease or remain the same under each of the following conditions:

    a) The temperature is increased to 100°C.

    b) The volume is decreased to 0.5 L

    c) The temperature is decreased to –50°C.

    d) The number of moles of neon is doubled.

16. Calculate the average kinetic energy and root mean square velocity of $CH_4(g)$ molecules at 546 K.

17. A glass vessel contains 28 g of nitrogen gas. Assuming ideal behavior, which of the processes listed below would double the pressure exerted on the walls of the vessel? Give a brief explanation for your choices.

    a) Adding 28 g of oxygen gas.
    b) Raising the temperature of the container from –73°C to 127°C.
    c) Adding enough mercury to fill one-half of the container.
    d) Adding 32 g of oxygen gas.
    e) Raising the temperature of the container from 30°C to 60°C.

18. A 30.03-g sample compound containing C, H and O undergoes combustion analysis and yields 43.5 g of CO_2 and 23.5 g of water. What is the empirical formula of the compound?

ANSWERS

1a) 130 mL (2 sig figs)

1b) 0.94 L

2) 0.563 M

3) P_{CO} = 465 mmHg P_{SO2} = 290 mmHg

4) 82.6 g/mol

5a) Oxidizing agent = O_2 Reducing agent = NiS

5b) Oxidizing agent = HNO_3 Reducing agent = H_2S

5a) Oxidizing agent = BrF_3 Reducing agent = Au

6) $3\ P_4 + 8\ H_2O + 8\ H^+ + 20\ NO_3^- \rightarrow 12\ H_2PO_4^- + 20\ NO$

7) No answer provided

8) 170 mL (2 sig figs)

9) 34.58%

10) 28.0 g/mol

11) 992 K

12) $[NH_4^+]$ = 0.272 M $[SO_4^{2-}]$ = 0.136 M

13) $[Na^+]$ = 4.5 M

14 a) 0.583 g
b) $[Mg^{2+}]$ = 0.050 M $[K^+]$ = 0.100 M $[NO_3^-]$ = 0.200 M

15) No answers provided.

16) $KE_{avg} = 1.13 \times 10^{-20}$ J/molecule u_{rms} = 921 m/s

17) No answers provided.

18) $C_3H_8O_3$