Gas Stoichiometry

Chem Worksheet 14-5

Name _____

Use your knowledge of *Stoichiometry* and the *Ideal Gas Law* to solve the following problems. The chemical equations given are all balanced.

1. What volume of O_2 is produced when 28.5 g of hydrogen peroxide (H_2O_2) decomposes to form water and oxygen at 150°C and 2.0 atm?

   $2H_2O_2\ (aq) \rightarrow 2H_2O\ (l) + O_2\ (g)$

2. This reaction uses 18.2 g of copper (I) sulfide (Cu_2S). What volume of sulfur dioxide gas would be collected at 237°C and 10.7 atm?

   $2Cu_2S\ (s) + 3O_2\ (g) \rightarrow 2Cu_2O\ (s) + 2SO_2\ (g)$

3. When 62.7-g nitrogen and excess oxygen react they generate nitrogen dioxide. If the NO_2 is collected at 625 K and 0.724 atm, what volume will it occupy?

   $N_2\ (g) + 2O_2\ (g) \rightarrow 2NO_2\ (g)$

4. What volume of hydrogen gas is evolved from a reaction between 0.52 g of Na and water? The gas is collected at 20.°C and 745 mmHg.

   $2Na\ (s) + 2H_2O\ (1) \rightarrow 2NaOH\ (aq) + H_2\ (g)$

5. At what pressure is the nitrogen gas sample that is collected when 48.4 g of NaN_3 decomposes? The temperature of the gas is 25°C and the volume is 18.4 L.

   $2NaN_3\ (s) \rightarrow 2Na\ (s) + 3N_2\ (g)$

6. When 2.4-g zinc is added to hydrochloric acid, 450 mL of hydrogen gas forms at a temperature of 32°C. What is the pressure of the gas?

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

7. The following reaction forms 6.41 L of oxygen at a temperature of 18.7°C and a pressure of 731 torr, what mass of $KClO_3$ must have decomposed?

   $2KClO_3\ (s) \rightarrow 2KCl\ (s) + 3O_2\ (g)$

8. What mass of $CaSO_3$ must have been present initially to produce 14.5 L of SO_2 gas at a temperature of 12.5°C and a pressure of 1.10 atm?

   $CaSO_3\ (s) \rightarrow CaO\ (s) + SO_2\ (g)$

DATE:

TOPIC:

28.5g ?vol

1) $2H_2O_2 \rightarrow 2H_2O + O_2$

$28.5g\ H_2O_2 \left|\frac{1mol\ H_2O_2}{34.02g}\right. = .838mol\ H_2O_2 \left|\frac{1mol\ O_2}{2mol\ H_2O_2}\right. = .419mol\ O_2$

$PV = nRT \quad (2.0atm)V = (.419mol)(.0821)(423K)$

$V = 7.28L\ O_2$

18.2g ?vol

2) $2\ Cu_2S + 3O_2(g) \rightarrow 2Cu_2O + 2SO_2(g)$

$18.2g\ Cu_2S \left|\frac{1mol\ Cu_2S}{159.17g}\right. = .114mol\ Cu_2S \left|\frac{2mol\ SO_2}{2mol\ Cu_2S}\right. = .114mol\ SO_2$

$PV = nRT \quad (10.7atm)V = (.114mol)(.0821)(510K)$

$V = .446L\ SO_2$

62.7g ?vol

3) $N_2 + 2O_2 \rightarrow 2NO_2$

$62.7g\ N_2 \left|\frac{1mol\ N_2}{28.02g}\right. = 2.24mol\ N_2 \left|\frac{2mol\ NO_2}{1mol\ N_2}\right. = 4.48mol\ NO_2$

$PV = nRT \quad (.724atm)V = (4.48mol)(.0821)(625K)$

$V = 318L\ NO_2$

.52g ?vol

4) $2Na + 2H_2O \rightarrow 2NaOH + H_2$

$.52g\ Na \left|\frac{1mol\ Na}{22.99g}\right. = .0226mol\ Na \left|\frac{1mol\ H_2}{2mol\ Na}\right. = .0113mol\ H_2$

$PV = nRT \quad \left(745mm \left|\frac{.980atm}{760mm}\right.\right)(V) = (.0113mol)(.0821)(293K)$

$V = .277L$

DATE:

TOPIC:

48.4g ? Press

5) $2NaN_3 \rightarrow 2Na + 3N_2$

$48.4\,g\,NaN_3 \left|\frac{1\,mol\,NaN_3}{65.02\,g}\right. = .744\,mol\,NaN_3 \left|\frac{3\,mol\,N_2}{2\,mol\,NaN_3}\right. = 1.12\,mol\,N_2$

$PV = nRT \quad P(18.4L) = (1.12mol)(.0821)(298K)$

$P = 1.49atm$

2.4g ? Press

6) $Zn + 2HCl \rightarrow ZnCl_2 + H_2$

$2.4\,g\,Zn \left|\frac{1\,mol\,Zn}{65.39\,g}\right. = .0367\,mol\,Zn \left|\frac{1\,mol\,H_2}{1\,mol\,Zn}\right. = .0367\,mol\,H_2$

$PV = nRT \quad P(.450L) = (.0367mol)(.0821)(305K)$

$P = 2.04atm$

? mass 6.41L

7) $2KClO_3 \rightarrow 2KCl + 3O_2$

$PV = nRT \quad (731torr \left|\frac{1atm}{760torr}\right.)(6.41L) = n(.0821)(305K)$

$.962atm$

$(O_2) .246\,mol = n$

$.246\,mol\,O_2 \left|\frac{2\,mol\,KClO_3}{3\,mol\,O_2}\right. = .164\,mol\,KClO_3 \left|\frac{122.55\,g}{1\,mol\,KClO_3}\right. = \boxed{20.1\,g\,KClO_3}$

? g 14.5L

8) $CaSO_3 \rightarrow CaO + SO_2$

$PV = nRT \quad (1.10atm)(14.5L) = n(.0821)(286K)$

$(SO_2) .679\,mol = n$

$.679\,mol\,SO_2 \left|\frac{1\,mol\,CaSO_3}{1\,mol\,SO_2}\right. = .679\,mol\,CaSO_3 \left|\frac{120.15\,g}{1\,mol\,CaSO_3}\right. = \boxed{81.6\,g\,CaSO_3}$