AP Chemistry – Chapter 4: Chemical Equations and Stoichiometry Supplemental Worksheet Key

1. a. .24g PbS/239.27g/mol = .001mol
multiply by 4mol H_2O_2/1mol PbS = .004mol H_2O_2 = .137g H_2O_2
b. 0.072g H_2O/18.015g/mol = .004mol
multiply by 1mol $PbSO_4$/4mol H_2O = .001mol $PbSO_4$
multiply by 303.268g/mol = .303g $PbSO_4$

2. a. 12.0g H_2/2.0158g/mol = 5.95mol H_2 exists
74.5g CO/28.010g/mol = 2.66mol CO
x 2mol H_2/1mol CO = 5.32mol H_2 required
H_2 in excess
b. CO limits (see calculation above)
c. 5.95mol - 5.32mol = .63mol x 2.0158g/mol = 1.27g H_2 leftover
d. 2.66mol CH_3OH x 32.042g/mol = 85.23g

3. Theoretical = 1.00mol $ZnCl_2$ x 136.29g/mol 136.29g
% yield = 115g/136.29g = 84.4%

4. 1.760g CO_2/44.01g/mol = .04mol CO_2 = .04 mol of C in hydrocarbon
.900g H_2O/18.16g/mol = .05mol H_2O = .10mol H
$C_{(.04/.04)}H_{(.10/.04)} = CH_{2.5} = C_2H_5$

5. 0.657g CO_2/44.01g/mol = .015mol CO_2 = .015mol C = .015 mol $CaCO_3$
.015mol(100.09g/mol) = 1.50g $CaCO_3$
1.50g/1.605g = 93.46% mass percentage

6. Mass of C = 0.561(.273) = .153g mass% C = .153/0.255 = 60.1%
Mass of H = 0.306(.112) = .0343g mass% H = .0343/0.255 = 13.4%
Mass of O = .255 - .153 - .0343 = .0677 = .068g mass% O = .068/0.255 = 26.5%

mol C = .153/12.01 = .0127 mol H = .0343/1.008 = .0340
mol O = .068 / 15.9994 = .0043
$C_{.0127/.0043}H_{.0340/.0043}O_{.0043/.0043}$ = **C_3H_8O**

7. $PCl_5 + 4H_2O \rightarrow H_3PO_4 + 5HCl$
$6CaO + P_4O_{10} \rightarrow 2Ca_3(PO_4)_2$
$3Ba(NO_3)_2 + Al_2(SO_4)_3 \rightarrow 3BaSO_4 + 2Al(NO_3)_3$
$2NaHCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O + 2CO_2$
$2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$

8. mol C = 47.99/12.01 = 4.00
mol H = 9.40/1.008 = 9.33
mol O = 42.62/15.9994 = 2.66
$C_{4.00/2.66}H_{9.33/2.66}O_{2.66/2.66} = C_{1.5}H_{3.5}O = C_3H_7O_2$
Empirical mass = 75.09g/mol which is ½ the molecular mass, therefore the molecular formula is $C_6H_{14}O_4$ and the chemical equation is:
$2C_6H_{14}O_4 + 15O_2 \rightarrow 12CO_2 + 14H_2O$

9. a) 20mol Fe_2O_3 (2mol Fe / 1mol Fe_2O_3) = 40mol Fe
b) 24mol Fe (3mol H_2 / 2mol Fe) = 36mol H_2
c) 90mol H2O (1mol Fe_2O_3 / 3mol H_2O)(159.69g Fe / 1mol Fe) = 4790.7g = 4800g Fe

10. $PCl_5 + 4H_2O \rightarrow H_3PO_4 + 5HCl$
a) 0.360mol PCl_5 (4mol H_2O / 1mol PCl_5) = 1.44mol H_2O required. Since there are 2.88mol of water available, the PCl_5 limits the reaction and is the limiting reagent.
b) The theoretical yield must be based on the limiting reagent since that is what you will run out of first. Therefore:
0.360mol PCl_5 (1mol H_3PO_4 / 1mol PCl_5) = 0.360mol H_3PO_4
0.360mol PCl_5 (5mol HCl / 1mol PCl_5) = 1.80mol HCl

11. a) 25.00g $AlCl_3$ (1mol $AlCl_3$ / 133.34g)(3mol H_2SO_4 / 2mol $AlCl_3$)(98.08g H_2SO_4/ 1mol)
= 27.58g H_2SO_4
b) 25.00g $AlCl_3$ (1mol $AlCl_3$ / 133.34g)(1mol $Al_2(SO_4)_3$ / 2mol $AlCl_3$)(342.15g $Al_2(SO_4)_3$ / 1mol)
= 32.07g $Al_2(SO_4)_3$ = theoretical yield
% yield = (28.36g / 32.07g) x 100% = 88.43%