KEY

# Stoichiometry Review

Name - ________________

1.) Solve for the number of grams of oxygen needed to burn $1.06\ moles$ of methane, $CH_4$, to produce carbon dioxide and water. $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$

Answer - $1.06\ mol\ CH_4 \times \frac{2\ mol\ O_2}{1\ mol\ CH_4} \times \frac{32.00\ g\ O_2}{1\ mol\ O_2} = 67.8\ g\ O_2$

2.) A camping Lantern uses the reaction of calcium carbide, $CaC_2$, and water to produce acetylene gas, $C_2H_2$, and calcium hydroxide. How many grams of water are required to produce $1.55\ moles$ of acetylene gas? $CaC_2 + 2\ H_2O \rightarrow C_2H_2 + Ca(OH)_2$

Answer - $1.55\ mol\ C_2H_2 \times \frac{2\ mol\ H_2O}{1\ mol\ C_2H_2} \times \frac{18.02\ g\ H_2O}{1\ mol\ H_2O} = 55.862\ g$ $55.9\ g\ H_2O$

3.) When $7.52\ g$ of lead (II) carbonate are reacted with $27.5\ ml$ of $3.00\ M$ nitric acid, what mass of lead (II) nitrate will be formed? $PbCO_3 + 2\ HNO_3 \rightarrow Pb(NO_3)_2 + H_2CO_3$

Answer - $0.0275\ L\ HNO_3 \times \frac{3.00\ mol\ HNO_3}{1\ L\ HNO_3} \times \frac{1\ mol\ Pb(NO_3)_2}{2\ mol\ HNO_3} \times \frac{331.2\ g\ Pb(NO_3)_2}{1\ mol\ Pb(NO_3)_2} = 13.662\ g\ Pb(NO_3)_2$

$9.32\ g\ Pb(NO_3)_2$ Limiting → $7.52\ g\ PbCO_3 \times \frac{1\ mol\ PbCO_3}{267.2\ g\ PbCO_3} \times \frac{1\ mol\ Pb(NO_3)_2}{1\ mol\ PbCO_3} \times \frac{331.4\ g\ Pb(NO_3)_2}{1\ mol\ Pb(NO_3)_2} = 9.321\ g\ Pb(NO_3)_2$

4a.) For the reaction of zinc metal and hydrochloric acid, how many moles of hydrochloric acid are needed to completely react with $12.35\ g$ of zinc? $Zn + 2\ HCl \rightarrow ZnCl_2 + H_2$

Answer - $12.35\ g\ Zn \times \frac{1\ mol\ Zn}{65.39\ g\ Zn} \times \frac{2\ mol\ HCl}{1\ mol\ Zn} = 0.3777\ mol\ HCl$

b.) What volume of $3.00\ M$ hydrochloric acid is required to react with $12.35\ g$ of zinc?

Answer - $12.35\ g\ Zn \times \frac{1\ mol\ Zn}{65.39\ g\ Zn} \times \frac{2\ mol\ HCl}{1\ mol\ Zn} \times \frac{1\ L\ HCl}{3.00\ mol\ HCl} = 0.126\ L\ HCl$

c.) How many moles of hydrogen are produced when $12.35\ g$ of zinc are reacted with the correct amount of hydrochloric acid? Answer - $12.35\ g\ Zn \times \frac{1\ mol\ Zn}{65.39\ g\ Zn} \times \frac{1\ mol\ H_2}{1\ mol\ Zn} = 0.1889\ mol\ H_2$

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5a.) If $10.45\ g$ of aluminium is reacted with $66.55\ g$ of copper (II) sulphate, which reactant is in excess?

$2\ Al + 3\ CuSO_4 \rightarrow Al_2(SO_4)_3 + 3\ Cu$

Answer - $$10.45\ g\ Al \times \frac{1\ mol\ Al}{26.98\ g\ Al} \times \frac{3\ mol\ Cu}{2\ mol\ Al} \times \frac{63.55\ g\ Cu}{1\ mol\ Cu} = 36.9217\ g\ Cu$$

Al Excess → $$66.55\ g\ CuSO_4 \times \frac{1\ mol\ CuSO_4}{159.61\ g\ CuSO_4} \times \frac{3\ mol\ Cu}{3\ mol\ CuSO_4} \times \frac{63.55\ g\ Cu}{1\ mol\ Cu} = 26.4974\ g\ Cu$$

b.) Calculate the mass of the excess reactant.

After many years of marital bliss, tension enters the Kent household.

Answer - $$66.55\ g\ CuSO_4 \times \frac{1\ mol\ CuSO_4}{159.61\ g\ CuSO_4} \times \frac{2\ mol\ Al}{3\ mol\ CuSO_4} \times \frac{26.98\ g\ Al}{1\ mol\ Al} = 7.4996\ g\ Al$$

$10.45\ g - 7.4996\ g = 2.9503\ g$ $\qquad$ $2.95\ g\ Al$

c.) Calculate the mass of each product.

Answer – Cu = $26.4908\ g$

$$66.55\ g\ CuSO_4 \times \frac{1\ mol\ CuSO_4}{159.65\ g\ CuSO_4} \times \frac{1\ mol\ Al_2SO_4}{3\ mol\ CuSO_4} \times \frac{342.14\ g\ Al_2(SO_4)_3}{1\ mol\ Al_2SO_4} = 47.54\ g\ Al_2(SO_4)_3$$

6.) If $111.7\ g$ of iron (II) and $212.7\ g$ of chlorine gas completely react, how many grams of product are formed? $\qquad$ $Fe + Cl_2 \rightarrow FeCl_2$

Answer - $$111.7\ g\ Fe \times \frac{1\ mol\ Fe}{55.85\ g\ Fe} \times \frac{1\ mol\ FeCl_2}{1\ mol\ Fe} \times \frac{126.75\ g\ FeCl_2}{1\ mol\ FeCl_2} = 253.5\ g\ FeCl_2$$

$$212.7\ g\ Cl_2 \times \frac{1\ mol\ Cl_2}{70.90\ g\ Cl_2} \times \frac{1\ mol\ FeCl_2}{1\ mol\ Cl_2} \times \frac{126.75\ g\ FeCl_2}{1\ mol\ FeCl_2} = 380.3\ g\ FeCl_2$$

Lower amount is correct amount . . . . so $253.5\ FeCl_2$

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7.) If you mix $15.50\ g$ of lead (II) nitrate and $3.81\ g$ of sodium chloride, what mass of each product is produced? $Pb(NO_3)_2 + 2\ NaCl \rightarrow 2\ NaNO_3 + PbCl_2$

Answer - $15.50\ g\ Pb(NO_3)_2 \times \frac{1\ mol\ Pb(NO_3)_2}{331.2\ g\ Pb(NO_3)_2} \times \frac{2\ mol\ NaNO_3}{1\ mol\ Pb(NO_3)_2} \times \frac{85.00\ g\ NaNO_3}{1\ mol\ NaNO_3} = 7.995\ g\ NaNO_3$

Limiting → $3.81\ g\ NaCl \times \frac{1\ mol\ NaCl}{58.44\ g\ NaCl} \times \frac{2\ mol\ NaNO_3}{2\ mol\ NaCl} \times \frac{85.00\ g\ NaNO_3}{1\ mol\ NaNO_3} = 5.542\ g\ NaNO_3$ $5.54\ g\ NaNO_3$

$3.81\ g\ NaCl \times \frac{1\ mol\ NaCl}{58.44\ g\ NaCl} \times \frac{1\ mol\ PbCl_2}{2\ mol\ NaCl} \times \frac{85.00\ g\ PbCl_2}{1\ mol\ PbCl_2} = 9.065\ g\ PbCl_2$ $9.07\ g\ PbCl_2$

8.) $2.0\ L$ of $0.60\ M$ $FeCl_3$ solution are mixed with $1.0\ L$ of $0.90\ M$ $BaCl_2$ solution. No reaction occurs. What is the concentration of each compound in the final solution?

Answer - $FeCl_3$ → $C_{dil} = \frac{C_{conc} \times V_{conc}}{V_{dil}}$ $C_{dil} = \frac{(0.60)(2.0)}{(2.0+1.0)}$ $C_{dil} = 0.40\ M\ FeCl_3$

$BaCl_2$ → $C_{dil} = \frac{C_{conc} \times V_{conc}}{V_{dil}}$ $C_{dil} = \frac{(0.90)(1.0)}{(2.0+1.0)}$ $C_{dil} = 0.30\ M\ BaCl_2$