Key

Take It To The LIMIT

Text reference section pages 400 -409

1) 750 grams of coal (C) are reacted with790 grams of water according to the reaction:

2 $C_{(s)}$ + 2 $H_2O_{(l)}$ → ____ $CH_{4(g)}$ + ____ $CO_{2(g)}$. Answer the following questions.

a) What is the limiting reactant?

$750g\,C\left(\frac{1mol\,C}{12.01g}\right)\left(\frac{1mol\,CH_4}{2mol\,C}\right)\left(\frac{16.04g}{1mol\,CH_4}\right) = 500g\,CH_4$

$790g\,H_2O\left(\frac{1mol\,H_2O}{18.02g}\right)\left(\frac{1mol\,CH_4}{2mol\,H_2O}\right)\left(\frac{16.04g}{1mol\,CH_4}\right) = 352g\,CH_4$

H_2O is L.R.

b) How many grams of CH_4 would be produced?

352g CH_4 (from above)

c) How many liters of CO_2 would be produced at STP?

$790g\,H_2O\left(\frac{1mol\,H_2O}{18.02g}\right)\left(\frac{1mol\,CO_2}{2mol\,H_2O}\right)\left(\frac{22.4L\,CO_2}{1mol\,CO_2}\right) = 491L\,CO_2$

d) What is the mass of the excess reactant?

$790g\,H_2O\left(\frac{1mol\,H_2O}{18.02g}\right)\left(\frac{1mol\,C}{1mol\,H_2O}\right)\left(\frac{12.01g}{1mol\,C}\right) = 527g$ used.

750 − 527 =

223g C left

2) ____ $Fe_2O_{3(s)}$ + 3 $CO_{(g)}$ → 2 $Fe_{(s)}$ + 3 $CO_{2(g)}$

If 158grams of iron(III) oxide is mixed with11.2 liters of carbon monoxide gas at STP, find the following:

a) The limiting reactant.

$158g\,Fe_2O_3\left(\frac{1mol\,Fe_2O_3}{159.7g}\right)\left(\frac{3mol\,CO_2}{1mol\,Fe_2O_3}\right)\left(\frac{22.4L\,CO_2}{1mol\,CO_2}\right) = 66.5L\,CO_2$

$1.2L\,CO\left(\frac{1mol\,CO}{22.4L\,CO}\right)\left(\frac{1mol\,CO_2}{1mol\,CO}\right)\left(\frac{22.4L\,CO_2}{1mol\,CO_2}\right) = 1.2L\,CO_2$

CO is L.R.

b) The volume of CO_2 produced.

1.2L CO_2 (from above)

c) Mass of Fe produced.

$1.2L\,CO\left(\frac{1mol\,CO}{22.4L\,CO}\right)\left(\frac{2mol\,Fe}{3mol\,CO}\right)\left(\frac{55.85g}{1mol\,Fe}\right) = 1.99g\,Fe$

d) Mass of the excess reactant.

$1.2L\,CO\left(\frac{1mol\,CO}{22.4L\,CO}\right)\left(\frac{1mol\,Fe_2O_3}{3mol\,CO}\right)\left(\frac{159.7g}{1mol\,Fe_2O_3}\right) = 2.85g\,Fe_2O_3$ used

158 − 2.85 =

155g Fe_2O_3 left

3) Aluminum burns in bromine gas, producing aluminum bromide:

2 Al + 3 Br_2 → 2 $AlBr_3$

What mass of aluminum bromide would be produced if 6.00 grams of aluminum was reacted with 50.0 grams of bromine gas?

$6.00g\,Al\left(\frac{1mol\,Al}{26.98g}\right)\left(\frac{1mol\,AlBr_3}{1mol\,Al}\right)\left(\frac{266.68g}{1mol\,AlBr_3}\right) = 59.3g\,AlBr_3$

Br_2 is L.R.

$50.0g\,Br_2\left(\frac{1mol\,Br_2}{159.8g}\right)\left(\frac{2mol\,AlBr_3}{3mol\,Br_2}\right)\left(\frac{266.68g}{1mol\,AlBr_3}\right) = 55.6g\,AlBr_3$

4) 5.87 grams of copper(II)chloride react with 5.00 liters of hydrogen sulfide according to the following reaction at STP. ____ $CuCl_2$ + ____H_2S →_____CuS + __2__HCl
answer the following questions showing all necessary work.

a) What is the limiting reactant?

$5.87\,g\,CuCl_2 \left(\frac{1\,mol\,CuCl_2}{134.45\,g}\right)\left(\frac{1\,mol\,CuS}{1\,mol\,CuCl_2}\right)\left(\frac{95.61\,g}{1\,mol\,CuS}\right) = 4.17\,g\,CuS$

$5.00\,L\,H_2S \left(\frac{1\,mol\,H_2S}{22.4\,L}\right)\left(\frac{1\,mol\,CuS}{1\,mol\,H_2S}\right)\left(\frac{95.61\,g}{1\,mol\,CuS}\right) = 21.3\,g\,CuS$

$CuCl_2$ is L.R.

b) How many grams of copper(II)sulfide are produced in the reaction at STP?

4.17 g CuS (from above)

c) What is the mass of the excess reactant?

$5.00\,L\,H_2S \left(\frac{1\,mol\,H_2S}{22.4\,L}\right)\left(\frac{34.08\,g}{1\,mol\,H_2S}\right) = 7.6\,g\,H_2S$ to start.

$5.87\,g\,CuCl_2 \left(\frac{1\,mol\,CuCl_2}{134.45\,g\,CuCl_2}\right)\left(\frac{1\,mol\,H_2S}{1\,mol\,CuCl_2}\right)\left(\frac{34.08\,g}{1\,mol\,H_2S}\right) = 1.49\,g\,H_2S$ used

$7.6 - 1.49 =$ 6.11 g H_2S left

5) Consider the reaction $4Al + 3O_2 \rightarrow 2Al_2O_3$ Identify the limiting reactant in each of the following mixtures. (molecular masses: Al = 27.0 g/mol, O_2 = 32.0g/mol)

a) 1.0 mol Al and 1.0 mol O_2

$1.0\,mol\,Al \left(\frac{3\,mol\,O_2}{4\,mol\,Al}\right) = 0.75\,mol\,O_2$

have / need

⇒ we have 1.0 mol O_2 so it is in excess & Al is the L.R.

b) 75.89 grams Al and 70.9 grams O_2

$75.89\,g\,Al \left(\frac{1\,mol\,Al}{27.0\,g\,Al}\right)\left(\frac{3\,mol\,O_2}{4\,mol\,Al}\right)\left(\frac{32.0\,g\,O_2}{1\,mol\,O_2}\right) = 67.46\,g\,O_2$

have / need

⇒ we have 70.9 g O_2 so it is in excess & Al is the L.R.