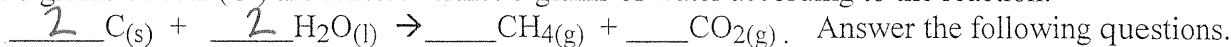


Take It To The LIMIT

Key

Text reference section pages 400 -409

1) 750 grams of coal (C) are reacted with 790 grams of water according to the reaction:



a) What is the limiting reactant?

$$750 \text{g C} \left(\frac{1 \text{ mol C}}{12.01 \text{g}} \right) \left(\frac{1 \text{ mol CH}_4}{2 \text{ mol C}} \right) \left(\frac{16.04 \text{g}}{1 \text{ mol CH}_4} \right) = 500 \text{g CH}_4$$

$$790 \text{g H}_2\text{O} \left(\frac{1 \text{ mol H}_2\text{O}}{18.02 \text{g}} \right) \left(\frac{1 \text{ mol CH}_4}{2 \text{ mol H}_2\text{O}} \right) \left(\frac{16.04 \text{g}}{1 \text{ mol CH}_4} \right) = 352 \text{g CH}_4$$

H₂O is L.R.

b) How many grams of CH₄ would be produced?

352g CH₄ (from above)

c) How many liters of CO₂ would be produced at STP?

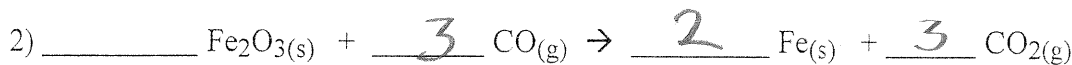
$$790 \text{g H}_2\text{O} \left(\frac{1 \text{ mol H}_2\text{O}}{18.02 \text{g}} \right) \left(\frac{1 \text{ mol CO}_2}{2 \text{ mol H}_2\text{O}} \right) \left(\frac{22.4 \text{ L CO}_2}{1 \text{ mol CO}_2} \right) = \underline{491 \text{ L CO}_2}$$

d) What is the mass of the excess reactant?

$$790 \text{g H}_2\text{O} \left(\frac{1 \text{ mol H}_2\text{O}}{18.02 \text{g}} \right) \left(\frac{1 \text{ mol C}}{1 \text{ mol H}_2\text{O}} \right) \left(\frac{12.01 \text{g}}{1 \text{ mol C}} \right) = 527 \text{g used.}$$

$$750 - 527 =$$

223g C left



If 158 grams of iron(III) oxide is mixed with 1.2 liters of carbon monoxide gas at STP, find the following:

a) The limiting reactant.

$$158 \text{g Fe}_2\text{O}_3 \left(\frac{1 \text{ mol Fe}_2\text{O}_3}{159.7 \text{g}} \right) \left(\frac{3 \text{ mol CO}_2}{1 \text{ mol Fe}_2\text{O}_3} \right) \left(\frac{22.4 \text{ L CO}_2}{1 \text{ mol CO}_2} \right) = 66.5 \text{ L CO}_2$$

CO is L.R.

$$1.2 \text{ L CO} \left(\frac{1 \text{ mol CO}}{22.4 \text{ L CO}} \right) \left(\frac{1 \text{ mol CO}_2}{1 \text{ mol CO}} \right) \left(\frac{22.4 \text{ L CO}_2}{1 \text{ mol CO}_2} \right) = 1.2 \text{ L CO}_2$$

b) The volume of CO₂ produced.

1.2 L CO₂ (from above)

c) Mass of Fe produced.

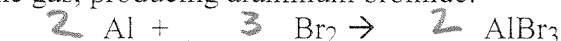
$$1.2 \text{ L CO} \left(\frac{1 \text{ mol CO}}{22.4 \text{ L CO}} \right) \left(\frac{2 \text{ mol Fe}}{3 \text{ mol CO}} \right) \left(\frac{55.85 \text{g}}{1 \text{ mol Fe}} \right) = \underline{1.99 \text{g Fe}}$$

d) Mass of the excess reactant.

$$1.2 \text{ L CO} \left(\frac{1 \text{ mol CO}}{22.4 \text{ L CO}} \right) \left(\frac{1 \text{ mol Fe}_2\text{O}_3}{3 \text{ mol CO}} \right) \left(\frac{159.7 \text{g}}{1 \text{ mol Fe}_2\text{O}_3} \right) = 2.85 \text{g Fe}_2\text{O}_3 \text{ used}$$

158 - 2.85 =
155g Fe₂O₃ left

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



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

$$6.00 \text{g Al} \left(\frac{1 \text{ mol Al}}{26.98 \text{g}} \right) \left(\frac{1 \text{ mol AlBr}_3}{1 \text{ mol Al}} \right) \left(\frac{266.68 \text{g}}{1 \text{ mol AlBr}_3} \right) = 59.3 \text{g AlBr}_3$$

Br₂ is L.R.

$$50.0 \text{g Br}_2 \left(\frac{1 \text{ mol Br}_2}{159.8 \text{g}} \right) \left(\frac{2 \text{ mol AlBr}_3}{3 \text{ mol Br}_2} \right) \left(\frac{266.68 \text{g}}{1 \text{ mol AlBr}_3} \right) = \underline{55.6 \text{g AlBr}_3}$$

4) 5.87 grams of copper(II)chloride react with 5.00 liters of hydrogen sulfide according to the following reaction at STP. $\underline{\quad}$ CuCl_2 + $\underline{\quad}$ $\text{H}_2\text{S} \rightarrow \underline{\quad}$ CuS + $\underline{2}$ HCl

answer the following questions showing all necessary work.

a) What is the limiting reactant?

$$5.87\text{g CuCl}_2 \left(\frac{1\text{mol CuCl}_2}{134.45\text{g}} \right) \left(\frac{1\text{mol CuS}}{1\text{mol CuCl}_2} \right) \left(\frac{95.61\text{g}}{1\text{mol CuS}} \right) = 4.17\text{g CuS}$$

$$5.00\text{L H}_2\text{S} \left(\frac{1\text{mol H}_2\text{S}}{22.4\text{L}} \right) \left(\frac{1\text{mol CuS}}{1\text{mol H}_2\text{S}} \right) \left(\frac{95.61\text{g}}{1\text{mol CuS}} \right) = 21.3\text{g CuS}$$

CuCl_2
is L.R.

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

4.17g CuS (from above)

c) What is the mass of the excess reactant?

$$5.00\text{L H}_2\text{S} \left(\frac{1\text{mol H}_2\text{S}}{22.4\text{L}} \right) \left(\frac{34.08\text{g}}{1\text{mol H}_2\text{S}} \right) = 7.6\text{g H}_2\text{S to start.}$$

$$5.87\text{g CuCl}_2 \left(\frac{1\text{mol CuCl}_2}{134.45\text{g CuCl}_2} \right) \left(\frac{1\text{mol H}_2\text{S}}{1\text{mol CuCl}_2} \right) \left(\frac{34.08\text{g}}{1\text{mol H}_2\text{S}} \right) = 1.49\text{g H}_2\text{S used}$$

$7.6 - 1.49 = 6.11\text{g H}_2\text{S left!}$

5) Consider the reaction $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$ Identify the limiting reactant in each of the following mixtures. (molecular masses: Al = 27.0 g/mol, O₂ = 32.0g/mol)

a) 1.0 mol Al and 1.0 mol O₂

$$\underline{\text{have}} \quad 1.0\text{mol Al} \left(\frac{3\text{mol O}_2}{4\text{mol Al}} \right) = 0.75\text{mol O}_2 \underline{\text{need}}$$

we have 1.0mol O₂ so it is in excess & Al is the L.R.

b) 75.89 grams Al and 70.9 grams O₂

$$\underline{\text{have}} \quad 75.89\text{g Al} \left(\frac{1\text{mol Al}}{27.0\text{g Al}} \right) \left(\frac{3\text{mol O}_2}{4\text{mol Al}} \right) \left(\frac{32.0\text{g O}_2}{1\text{mol O}_2} \right) = 67.46\text{g O}_2 \underline{\text{need}}$$

\Rightarrow we have 70.9g O₂ so it is in excess & Al is the L.R.