Key

Limiting Reagents Practice Problems

1. Heating zinc sulfide in the presence of oxygen yields the following: $\_2\_ ZnS + \_3\_ O_2 \rightarrow \_2\_ ZnO + \_2\_ SO_2$

If 1.72 mol of ZnS is heated in the presence of 3.04 mol of O_2, which reactant will be used up? (Balance the equation first.)

$1.72 mol\ ZnS \times \frac{2 mol\ ZnO}{2 mol\ ZnS} = 1.72 mol\ ZnO$ ZnS is the limiting reagent

$3.04 mol\ O_2 \times \frac{2 mol\ ZnO}{3 mol\ O_2} = 2.03 mol\ ZnO$

2. Use the folowing equation for the oxidation of aluminum in the following problems. $4Al + 3O_2 \rightarrow 2Al_2O_3$

If 3.17g of Al and 2.55g of O_2 are available, which reactant is limiting?

$3.17 g\ Al \times \frac{1 mol\ Al}{26.98 g\ Al} \times \frac{2 mol\ Al_2O_3}{4 mol\ Al} = 0.0588 mol\ Al_2O_3$

$2.55 g\ O_2 \times \frac{1 mol\ O_2}{32.00 g\ O_2} \times \frac{2 mol\ Al_2O_3}{3 mol\ O_2} = 0.0531 mol\ Al_2O_3$

O_2 is the limiting reagent

3. In the production of copper from ore containing copper(II) sulfide, the ore is first roasted to change it to the oxide according to the following equation: $2CuS + 3O_2 \rightarrow 2CuO + 2SO_2$

What mass of CuO can be formed from the reaction of 18.7g of CuS and 12.0g of O_2? Identify the limiting reagent and the excess reagent.

$18.7 g\ CuS \times \frac{1 mol\ CuS}{95.62 g\ CuS} \times \frac{2 mol\ CuO}{2 mol\ CuS} \times \frac{79.55 g\ CuO}{1 mol\ CuO} = 15.6 g\ CuO$ Mass of CuO formed

$12.0 g\ O_2 \times \frac{1 mol\ O_2}{32.00 g\ O_2} \times \frac{2 mol\ CuO}{3 mol\ O_2} \times \frac{79.55 g\ CuO}{1 mol\ CuO} = 19.9 g\ CuO$

CuS is the LR. and O_2 is the excess.

4. In the reaction $BaCO_3 + 2HNO_3 \rightarrow Ba(NO_3)_2 + CO_2 + H_2O$, what mass of barium nitrate can be formed by combining 55g $BaCO_3$ and 26g HNO_3?

$55 g\ BaCO_3 \times \frac{1 mol\ BaCO_3}{197.34 g\ BaCO_3} \times \frac{1 mol\ Ba(NO_3)_2}{1 mol\ BaCO_3} \times \frac{261.35 g\ Ba(NO_3)_2}{1 mol\ Ba(NO_3)_2} = 73 g\ Ba(NO_3)_2$

$26 g\ HNO_3 \times \frac{1 mol\ HNO_3}{63.02 g\ HNO_3} \times \frac{1 mol\ Ba(NO_3)_2}{2 mol\ HNO_3} \times \frac{261.35 g\ Ba(NO_3)_2}{1 mol\ Ba(NO_3)_2} = 54 g\ Ba(NO_3)_2$

5. Bromine replaces iodine in magnesium iodine by the following process:

$$MgI_2 + Br_2 \longrightarrow MgBr_2 + I_2$$

Which is the excess reactant when 500g of MgI_2 and 369g of Br_2 react, and what mass of the excess reagent remains?

$500.g\,MgI_2 \times \frac{1\,mol\,MgI_2}{278.11g\,MgI_2} \times \frac{1\,mol\,I_2}{1\,mol\,MgI_2} \times \frac{253.8g\,I_2}{1\,mol\,I_2} = 456g\,I_2$ MgI_2 is the limiting reagent.

$369g\,Br_2 \times \frac{1\,mol\,Br_2}{159.8g\,Br_2} \times \frac{1\,mol\,I_2}{1\,mol\,Br_2} \times \frac{253.8g\,I_2}{1\,mol\,I_2} = 586g\,Br_2$ Br_2 is the excess reagent

$456g\,I_2 \times \frac{1\,mol\,I_2}{253.8g\,I_2} \times \frac{1\,mol\,Br_2}{1\,mol\,I_2} \times \frac{159.8g\,Br_2}{1\,mol\,Br_2} = 287g\,Br_2$ used in the reaction

369g available − 287g used = **82g Br_2 left over**

6. Nickel replaces silver from silver nitrate in solution according to the following equation:

$$2AgNO_3 + Ni \longrightarrow 2Ag + Ni(NO_3)_2$$

If you have 22.9g of Ni and 112g of $AgNO_3$ available, what mass of nickel (II) nitrate can be produced? Identify the limiting reagent and the excess reagent in this problem.

$22.9g\,Ni \times \frac{1\,mol\,Ni}{58.69g\,Ni} \times \frac{1\,mol\,Ni(NO_3)_2}{1\,mol\,Ni} \times \frac{182.71g\,Ni(NO_3)_2}{1\,mol\,Ni(NO_3)_2} = 71.3g\,Ni(NO_3)_2$

$112g\,AgNO_3 \times \frac{1\,mol\,AgNO_3}{169.88g\,AgNO_3} \times \frac{1\,mol\,Ni(NO_3)_2}{2\,mol\,AgNO_3} \times \frac{182.71g\,Ni(NO_3)_2}{1\,mol\,Ni(NO_3)_2} =$ **60.2g $Ni(NO_3)_2$**

$AgNO_3$ is the limiting reagent.
Ni is the excess reagent.