Answer on Question #81831, Chemistry / Organic Chemistry

To process certain metal ores, reactions with carbon can sometimes generate the pure metal at high temperatures.

Consider the reaction of zinc oxide with carbon:

$ZnO + C \rightarrow Zn + CO$; ΔH = 240 kJ/mol of rxn

How much heat needs to be absorbed by the system (in kJ) to react 3121 g of ZnO with 351 g of C until the reaction is completed?

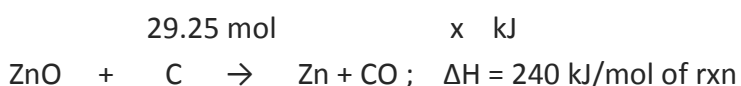**Solution**

Find limiting reactant:

$ZnO + C \rightarrow Zn + CO$; ΔH = 240 kJ/mol of rxn

n=m/M

$n(ZnO) = \frac{3121 \, g}{81\frac{g}{mol}} = 38.53 \, mol$

$n(C) = \frac{351 \, g}{12\frac{g}{mol}} = 29.25 \, mol$

According to equation mole ratio n(ZnO):n(C)=1:1, then n(ZnO) should be equal to n(C), but we can see that n(ZnO)>n(C), 38.53 mol > 29.25 mol. So, C is a limiting reactant.

Find heat that needs to be absorbed by the system (in kJ) to react 3121 g of ZnO with 351 g of C until the reaction is completed by solving the proportion

$$\begin{array}{ccccc} & 29.25 \text{ mol} & & \text{x} & \text{kJ} \\ ZnO & + & C & \rightarrow & Zn + CO ; \quad \Delta H = 240 \text{ kJ/mol of rxn} \end{array}$$

$$\frac{29.25 \, mol}{1 \, mole} = \frac{x \, kJ}{240 \, kJ}$$
$$x = 7020 \, kJ$$

Answer: 7020 kJ