Unit 2: AP Quiz Free Response Practice [2003 Form B #2, modified, 6 points]

1. Solid iron (III) oxide can be reduced with gaseous carbon monoxide, producing solid iron and carbon dioxide gas.

   a. In an experiment, a student combines a 16.2 L sample of CO(g) at 1.50 atm and 200.°C with 15.39 g of Fe_2O_3(s).

      i. What is the balanced chemical equation for this reaction? [2 points]

$$1\ Fe_2O_{3(s)} + 3\ CO_{(g)} \rightarrow 2\ Fe_{(s)} + 3\ CO_{2(g)}$$

      ii. How many moles of CO(g) are available for the reaction? [1 point]

$$n = \frac{PV}{RT} = \frac{(1.50\ atm)(16.2\ L)}{\left(0.08206\ \frac{L \cdot atm}{mol \cdot K}\right)(200. + 273)} = 0.626\ mol\ CO$$

      iii. What is the limiting reactant for the reaction? Justify your answer with calculations. [2 points]

$$15.39\ g\ Fe_2O_3 \times \frac{1\ mol}{159.7\ g} = 0.09637\ mol \times \frac{1\ mol_{rxn}}{1\ mol\ Fe_2O_3} = 0.09637\ mol_{rxn}$$

$$0.626\ mol\ CO \times \frac{1\ mol_{rxn}}{3\ mol\ CO} = 0.209\ mol_{rxn}$$

Smaller!

$\Rightarrow$ Fe_2O_3 is limiting

      iv. How many moles of Fe(s) are formed in the reaction? [1 point]

$$0.09637\ mol\ Fe_2O_3 \times \frac{2\ mol\ Fe}{1\ mol\ Fe_2O_3} = 0.1927\ mol\ Fe$$