

ANSWER TO "TRY YOURSELF" PROBLEM FROM STUDY SECTION 7.4

Try Yourself 7.4 a

The reaction $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g})$ contributes to air pollution whenever a fuel is burned in air at high temperature. At 1500 K, $K = 1.0 \times 10^{-5}$. Suppose a sample of air has $[\text{N}_2] = 0.80 \text{ M}$ and $[\text{O}_2] = 0.20 \text{ M}$ before any reaction occurs. Calculate the equilibrium concentrations of reactants and products at 1500 K.

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$$\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g}) \quad K_c = 1.0 \times 10^{-5}$$

$$[\text{N}_2]_i = 0.80 \text{ M} \quad [\text{O}_2]_i = 0.20 \text{ M}$$

$$[\text{N}_2]_E = ?$$

$$[\text{O}_2]_E = ?$$

$$[\text{NO}]_E = ?$$

I	$\text{N}_2(\text{g})$	$\text{O}_2(\text{g})$	$2\text{NO}(\text{g})$
	0.80	0.20	0
C	$-x$	$-x$	$+2x$
E	$0.8-x$	$0.2-x$	$2x$

$$K_c = \frac{[\text{NO}]^2}{[\text{N}_2][\text{O}_2]} = \frac{(2x)^2}{(0.8-x)(0.2-x)}$$
~~$$K_c = \frac{4x^2}{x^2 - x + 0.16}$$~~

$$K_c = \frac{(2x)^2}{(0.8)(0.2)}$$

$$= \frac{4x^2}{0.16}$$

$$0.16(1.0 \times 10^{-5}) = 4x^2$$

$$x^2 = 4 \times 10^{-7}$$

$$x = \sqrt{4 \times 10^{-7}}$$

$$x = 6.32 \times 10^{-4}$$

$$[\text{N}_2]_E = 0.8 - x = 0.8 - 6.32 \times 10^{-4} = \underline{0.799 \text{ M}}$$

$$[\text{O}_2]_E = 0.2 - x = 0.2 - 6.3 \times 10^{-4} = \underline{0.199 \text{ M}}$$

$$[\text{NO}]_E = 2x = 2(6.3 \times 10^{-4}) = \underline{1.26 \times 10^{-3} \text{ M}}$$