

SOLUTION

NAME: _____

This is an open book quiz. You may use a 4-function calculator. An unsigned honors pledge will result in a zero.

1. What is the exit temperature for a reactor that burns carbon in 100% theoretical oxygen where the inlets are at SRS and the heat transfer rate from the reactor to the surroundings is 300,000 kJ per kmole of fuel flowing?

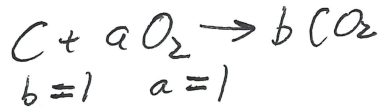
GIVEN: C as fuel; 100% theo. O₂; $\dot{Q}/\dot{n}_F = -300,000 \frac{\text{kJ}}{\text{kmole}}$

FIND: T_e = ?

ASSUME: Usual combustion assumptions; S.S.

ANALYSIS:

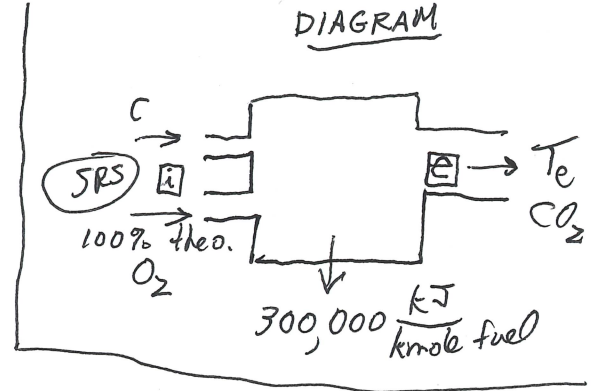
Stoichiometry



C.O.E.

$$\frac{dE}{dt} = \dot{Q} - \dot{W} + \sum_i \dot{n}_i \bar{h}_i - \sum_e \dot{n}_e \bar{h}_e$$

$$\sum_e \dot{n}_e \bar{h}_e = \sum_i \dot{n}_i \bar{h}_i + \dot{Q} \Rightarrow [\dot{n}_{CO_2} \bar{h}_{CO_2}]_e = [\dot{n}_C \bar{h}_C + \dot{n}_{O_2} \bar{h}_{O_2}]_i + \dot{Q}$$



$$[\bar{h}_{CO_2}]_e = [\bar{h}_C + \bar{h}_{O_2}]_{SRS} + \dot{Q}/\dot{n}_F$$

so, $\Delta \bar{h} = 0$ for these two terms

$$[\bar{h}_{f_{CO_2}}^\circ + \bar{h}(T_e) - \bar{h}(298K)]_{CO_2} = \bar{h}_{f_C}^\circ + \bar{h}_{f_{O_2}}^\circ + \dot{Q}/\dot{n}_F$$

$$\bar{h}_{CO_2}(T_e) = \bar{h}_{CO_2}(298K) - \bar{h}_{f_{CO_2}}^\circ + \dot{Q}/\dot{n}_F$$

$$\bar{h}_{CO_2}(T_e) = 9364 \frac{\text{kJ}}{\text{kmole}} - (-393,520 \frac{\text{kJ}}{\text{kmole}}) + (-300,000 \frac{\text{kJ}}{\text{kmole}})$$

$$\bar{h}_{CO_2}(T_e) = 102,884 \frac{\text{kJ}}{\text{kmole}} \rightarrow \text{Interpolating for } T_e$$

T(K)	\bar{h} (kJ/kmole)
2000	100,804
T _e	102,884
2050	103,835

$$T_e = 2034 K \leftarrow \text{ANS.}$$

I HAVE NEITHER PROVIDED OR RECEIVED HELP DURING THIS QUIZ.

SIGNATURE