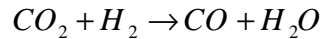
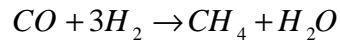


### Example 7 (Problem 8.23 - Page 530)

In an adiabatic catalytic reactor, the following gaseous phase reactions take place:



The feed to the reactor enters at 400 °C and consists of 5 mol of H<sub>2</sub> to 1 mol CO<sub>2</sub>. 90% conversion of CO<sub>2</sub> takes place and the products leave the reactor at 400 °C.

- (1) Calculate the % molar composition of the exit stream.
- (2) Calculate the % molar composition of the exit stream if the products leave at 600 °C.

#### EZ-SOLVE PROGRAM

```
// M=CH4 ; CM=CO ; CD=CO2 ; H=H2 ; W=H2O
CD1 = 100
0.9 = (CD1-CD2)/CD1
T1 = 400
T2 = 400 //change to 600 to answer (2)
TR = 25

HFM=-17890*4.18 //J/MOL
HFCM=-26420*4.18
HFCD=-94050*4.18
HFW=-57800*4.18
H1/CD1=5

//MATERIAL BALANCES
CD2 = CD1 - R2
CM2 = R2 - R1
M2 = R1
H2 = H1 - 3*R1 - R2
W2 = R1 + R2
//ENERGY BALANCE

//ENTHALPY IN
HINCD = CD1*(ENTHALPY(3,T1,TR)+HFCD)
HINH = H1*ENTHALPY(4,T1,TR)
HIN = HINCD + HINH

//ENTHALPY OUT
HOUTM = M2*(ENTHALPY(1,T2,TR)+HFM)
HOUTCM = CM2*(ENTHALPY(2,T2,TR)+HFCM)
HOUTCD = CD2*(ENTHALPY(3,T2,TR)+HFCD)
HOUTH = H2*ENTHALPY(4,T2,TR)
HOUTW = W2*(ENTHALPY(5,T2,TR)+HFW)
HOUT=HOUTM+HOUTCM+HOUTCD+HOUTH+HOUTW
Q=0
Q=HOUT - HIN
```

## USER DEFINED FUNCTION

FUNCTION ENTHALPY(I,T,TR)

IF (I=1) THEN //CH4

A=3.57\*10<sup>1</sup>

B=1.66\*10<sup>-1</sup>

C=7.99\*10<sup>-5</sup>

D=-1.965\*10<sup>-7</sup>

E=8.383\*10<sup>-11</sup>

ELSE

IF (I=2) THEN //CO

A=2.9\*10<sup>1</sup>

B=2.49\*10<sup>-3</sup>

C=-1.864\*10<sup>-5</sup>

D=4.7989\*10<sup>-8</sup>

E=-2.873\*10<sup>-11</sup>

ELSE

IF (I=3) THEN //CO2

A=1.902\*10<sup>1</sup>

B=7.9629\*10<sup>-2</sup>

C=-7.371\*10<sup>-5</sup>

D=3.746\*10<sup>-8</sup>

E=-8.133\*10<sup>-12</sup>

ELSE

IF (I=4) THEN //H2

A=1.7638\*10<sup>1</sup>

B=6.7\*10<sup>-2</sup>

C=-1.3148\*10<sup>-4</sup>

D=1.0588\*10<sup>-7</sup>

E=-2.918\*10<sup>-11</sup>

ELSE

IF (I=5) THEN //H2O

A=3.404\*10<sup>1</sup>

B=-9.6506\*10<sup>-3</sup>

C=3.2998\*10<sup>-5</sup>

D=-2.0447\*10<sup>-8</sup>

E=4.3023\*10<sup>-12</sup>

ENDIF

ENDIF

ENDIF

ENDIF

ENDIF

ENTHALPY=A\*(T-TR)+B/2\*(T<sup>2</sup>-TR<sup>2</sup>)+C/3\*(T<sup>3</sup>-TR<sup>3</sup>)+D/4\*(T<sup>4</sup>-TR<sup>4</sup>)+E/5\*(T<sup>5</sup>-TR<sup>5</sup>)

RETURN ENTHALPY

END

**Results**

<b>CD2</b>	<b>CM2</b>	<b>H2</b>	<b>M2</b>	<b>W2</b>	<b>CD1</b>	<b>H1</b>
<b>10.00</b>	<b>71.38</b>	<b>354.14</b>	<b>18.62</b>	<b>108.62</b>	<b>100.00</b>	<b>500.00</b>
<b>R1</b>	<b>R2</b>					
<b>18.62</b>	<b>90.00</b>					
<b>HIN</b>	<b>HINCD</b>	<b>HINH</b>				
<b>-33216500</b>	<b>-38100000</b>	<b>4883480</b>				
<b>HOUT</b>	<b>HOUTCD</b>	<b>HOUTCM</b>	<b>HOUTH</b>	<b>HOUTM</b>	<b>HOUTW</b>	
<b>-33216500</b>	<b>-3810000</b>	<b>-7103070</b>	<b>3458850</b>	<b>-885341</b>	<b>-24877000</b>	
		<b>CD2</b>	<b>CM2</b>	<b>H2</b>	<b>M2</b>	<b>W2</b>
<b>(1) 400 C</b>		<b>1.78%</b>	<b>12.68%</b>	<b>62.93%</b>	<b>3.31%</b>	<b>19.30%</b>
<b>(2) 600 C</b>		<b>1.91%</b>	<b>9.95%</b>	<b>56.56%</b>	<b>7.21%</b>	<b>24.37%</b>