Qu 11 (cont.) COMBUSTION

(c) Mean molar mass $= \dfrac{\text{Total mass}}{\text{Total kmols}} = \dfrac{81}{a+b+c+d}$

i.e. $\dfrac{81}{0.0717 + .070 + .4757 + 2.191} = \underline{28.84 \text{ kg/kmol}}$

(d) 650°C = 923 K — we'll assume 900 K.

From Haywood Table 3 we may find molar enthalpy of each gas at 25°C & 900 K.

(MJ/kmol)

	kmols	h_m @ 900 K	h_m @ 25°C	ΔH (MJ)
CO_2	0.0717	37.41	9.37	2.010
H_2O	0.070	31.83	9.90	1.535
O_2	0.4757	27.90	8.66	9.152
N_2	2.191	26.89	8.67	39.920
				52.618 total

Average C_p given by $\Delta H_{total} = m_{total} \bar{C}_p \Delta T$

$\therefore \bar{C}_p = \dfrac{52.618 \times 10^3}{81\,(900 - 298)} = \underline{\underline{1.079}}$ kJ/kgK

(e) The fuel is @ 25°C $\therefore \Delta H_R = m_{air} C_{p_{air}} \Delta T_{air}$

$= 80 \times 1.010 \times 75 = \underline{6060 \text{ kJ}}$

Specific enthalpy $= \dfrac{\Delta H_{total}}{\dot{m}_{total}} = \dfrac{6060}{81} = \underline{\underline{74.8 \text{ kJ/kg}}}$

(f) From 1st Law for combustion :-

$\dot{Q} = (H_p - H_p^0) - (H_R - H_R^0) + \Delta H^0$

If $\dot{Q} = \phi$ & $(H_R - H_R^0) = 6060$ kJ, NB. $\Delta H^0 = -44$ MJ/kg fuel.

then $(H_p - H_p^0) = +6060 + 44000 = m(\bar{C}_p)_p \Delta T_p$

$\therefore \Delta T_p = \dfrac{50060}{81 \times 1.079} = 573$ K

Actual temp $= 25 + 573 = \underline{\underline{598\,^\circ\text{C}}}$