## Questão 1 $\Delta \widehat{H} \cong -78.50 \,\mathrm{kJ} \,\mathrm{mol}^{-1}$

$$\begin{split} HCl_{(g)} + NaNO_{2(s)} &\longrightarrow HNO_{2(l)} + NaCl_{(s)} \\ HCl_{(g)} + NaNO_{2(s)} &\longrightarrow HCl_{(g)} + \frac{1}{2}NO_{(g)} + \frac{1}{2}NO_{2(g)} + \frac{1}{2}Na_2O_{(s)} &\longrightarrow \frac{1}{2}NO_{(g)} + \frac{1}{2}NO_{2(g)} + \frac{1}{2}H_2O_{(l)} + NaCl_{(s)} &\longrightarrow \frac{1}{2}NO_{2(l)} + NaCl_{(s)} &\longrightarrow HNO_{2(l)} &\longrightarrow$$

## Questão 2 $\widehat{Q} \cong 1.93 \,\mathrm{MJ}\,\mathrm{s}^{-1}$

$$=\dot{\mathbf{M}}_{i}\left([\mathbf{T}]_{i}\Delta\widehat{\mathbf{H}}_{(\mathbf{T}_{l},(25\to70)^{\circ}\mathbf{C})} + [\mathbf{B}]_{i}\Delta\widehat{\mathbf{H}}_{(\mathbf{B}_{l},(25\to70)^{\circ}\mathbf{C})}\right) + \dot{\mathbf{M}}_{o1}\left([\mathbf{T}]_{o1}\left(\Delta\widehat{\mathbf{H}}_{(\mathbf{T}_{l},(70\to110.6)^{\circ}\mathbf{C})} + \Delta\widehat{\mathbf{H}}_{(\mathbf{T}_{l}\to\mathbf{T}_{g},110.6^{\circ}\mathbf{C})} + \Delta\widehat{\mathbf{H}}_{(\mathbf{T}_{g},(110.6\to70)^{\circ}\mathbf{C})}\right) + \\ + [\mathbf{B}]_{o1}\left(\Delta\widehat{\mathbf{H}}_{(\mathbf{B}_{l},(70\to80.1)^{\circ}\mathbf{C})} + \Delta\widehat{\mathbf{H}}_{(\mathbf{B}_{l}\to\mathbf{B}_{g},80.1^{\circ}\mathbf{C})} + \Delta\widehat{\mathbf{H}}_{(\mathbf{B}_{g},(80.1\to70)^{\circ}\mathbf{C})}\right)\right) = \left(100\left(0.5\left(148.8\Delta t\right)\Big|_{298}^{343} + 0.5\left(62.55\Delta t\right)\Big|_{298}^{343}\right) + \\ + 42.86\left(35\%\left((148.8\Delta t)\Big|_{343}^{383.6} + 37.47\,\mathbf{k} - (94.18\Delta t)\Big|_{343}^{383.6}\right) + 65\%\left((62.55\Delta t)\Big|_{343}^{353.1} + 30.77\,\mathbf{k} - (74.06\Delta t)\Big|_{343}^{353.1}\right)\right)\right)\,\mathbf{J}\,\mathbf{s}^{-1} \\ \cong 1.93\,\mathbf{M}\,\mathbf{J}\,\mathbf{s}^{-1}$$

(i)  $\dot{\mathrm{M}}_{o1} \cong 42.86 \,\mathrm{mol}\,\mathrm{s}^{-1}$ 

$$\begin{split} &= \dot{\mathbf{M}}_{i} - \dot{\mathbf{M}}_{o2} = [\mathbf{T}]_{o1}^{-1} \left( [\mathbf{T}]_{i} \dot{\mathbf{M}}_{i} - [\mathbf{T}]_{o2} \dot{\mathbf{M}}_{o2} \right) \implies \\ &\implies \dot{\mathbf{M}}_{o1} = \dot{\mathbf{M}}_{i} \left( 1 - \frac{[\mathbf{T}]_{o1} - [\mathbf{T}]_{i}}{[\mathbf{T}]_{o1} - [\mathbf{T}]_{o2}} \right) = \\ &= \left( 100 \left( 1 - \frac{0.3 - 0.5}{0.3 - (1 - 0.35)} \right) \right) \, \mathrm{mol} \, \mathrm{s}^{-1} \cong 42.86 \, \mathrm{mol} \, \mathrm{s}^{-1} \end{split}$$

## Questão 3

• 
$$1 = 1i1$$

• 
$$3 = 10 = 2i1$$

• 
$$5 = 2i2$$

• 
$$2 = 1i2 = 2o1$$
 •  $4 = 2o2$ 

$$4 = 202$$

%mol/mol	1i1	<u>1i2 2o1</u>	<u>10 2i1</u>	202	2i2
$\mathrm{C_2H_6}$	100	-	-	-	-
${ m O}_2$	-	100	28	28	100
$\mathrm{CO}_2$	-	-	32	32	-
${ m H_2O}$	-	-	48	48	-
Total	100	525	625	625	525
Temp (°C)	30		350	150	25

$$C_2H_{6(g)} + \frac{7}{2}O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_2O_{(g)}$$

(i)  $\widehat{\mathrm{M}}_{1i2} \cong 525 \, \% \mathrm{mol/mol}$ 

$$= [O_2]_{1i2}^{-1} \left( [C_2 H_6]_{1i1} \widehat{M}_{1i1} (7/2) * 1.5 \right) =$$

$$= (100 \%)^{-1} (100 \% * 100 \% (7/2) * 1.5) \, \text{mol/mol} \cong 525 \% \frac{\text{mol}}{\text{mol}}$$

(ii)  $\widehat{\mathrm{M}}_{2i2}\cong525\,\mathrm{\%mol/mol}$ 

$$= \widehat{M}_{2o1} \cong 525 \,\% \text{mol/mol}$$

(iii)  $\widehat{\mathrm{M}}_{1o} \cong 625 \, \% \mathrm{mol/mol}$ 

$$=\widehat{M}_{1i1}+\widehat{M}_{1i2}\cong (100+525)\,\%\mathrm{mol/mol}\cong 625\,\%\mathrm{mol/mol}$$

(iv)  $\widehat{\mathrm{M}}_{2o2} \cong 625 \, \% \mathrm{mol/mol}$ 

$$=\widehat{M}_{2i1}\cong 625\,\%\mathrm{mol/mol}$$

(v)  $[\mathbf{CO_2}]_{1o} \cong 32 \,\% \mathrm{mol/mol}$ 

$$= 2 * \left[ C_2 H_6 \right]_{1i1} \frac{\widehat{M}_{1i1}}{\widehat{M}_{1o}} = \left( 2 * 100 \% \frac{100 \%}{625 \%} \right) \text{mol/mol} \cong$$
  
\approx 32 \% mol/mol

(vi)  $[\mathbf{H_2O}]_{1o} \cong 48 \,\% \mathrm{mol/mol}$ 

$$= 3 * [C_2H_6]_{1i1} \frac{\widehat{M}_{1i1}}{\widehat{M}_{1o}} = \left(3 * 100 \% \frac{100 \%}{625 \%}\right) \text{mol/mol} \cong$$
  
\approx 48 \%mol/mol

(vii)  $[\mathbf{O_2}]_{1o} \cong 28 \,\% \text{mol/mol}$ 

$$= \widehat{M}_{1o}^{-1} \left( [O_2]_{1i2} \widehat{M}_{1i2} - [C_2 H_6]_{1i1} \widehat{M}_{1i1} (7/2) \right) \cong$$

$$\cong \left( (625\%)^{-1} \left( 100\% * 525\% - 100\% * 100\% (7/2) \right) \right) \text{mol/mol} \cong$$

$$\cong 28\% \text{mol/mol}$$

**Q3 - a)**  $t_{1i2}$ 

$$= t_{1i2} + \left(\widehat{M}_{2i2} \left[O_{2}\right]_{2i2} C_{(p,O_{2})}\right)^{-1} \left(\widehat{H}_{(2i1,O_{2},(350\rightarrow150)^{\circ}C)} + \widehat{H}_{(2i1,CO_{2},(350\rightarrow150)^{\circ}C)} + \widehat{H}_{(i1,H_{2}O,(350\rightarrow150)^{\circ}C)}\right) =$$

$$= \left(298 + (525\% * 100\% * 30.5)^{-1} \left(-625\% \left(28\% * 30.5 + 32\% * 42.2 + 48\% * 40.6\right) \Delta t \Big|_{423}^{623}\right)\right) K \cong$$

$$\cong$$

$$Q3 - b)$$
  $\hat{Q}$ 

$$\begin{split} &=\Delta\widehat{\mathbf{H}}_{\mathbf{C}_{2}\mathbf{H}_{6},(30\to350)^{\circ}\mathbf{C}}+\Delta\widehat{\mathbf{H}}_{\mathbf{O}_{2},(\mathbf{t}_{1i2}\to350)^{\circ}\mathbf{C}}+\widehat{\mathbf{M}}_{1i1}\left[\mathbf{C}_{2}\mathbf{H}_{6}\right]_{1i1}\left(-\Delta\widehat{\mathbf{H}}_{f\mathbf{C}_{2}\mathbf{H}_{6}}\right)+\widehat{\mathbf{M}}_{1o}\left(\left[\mathbf{H}_{2}\mathbf{O}\right]_{1o}\Delta\widehat{\mathbf{H}}_{f\mathbf{H}_{2}\mathbf{O}}+\left[\mathbf{C}\mathbf{O}_{2}\right]_{1o}\Delta\widehat{\mathbf{H}}_{f\mathbf{C}\mathbf{O}_{2}}\right)=\\ &=\left(100\,\%*100\,\%*49.3\,\Delta t\left|_{303}^{623}+100\,\%*525\,\%*40.6\,\Delta t\left|_{\mathbf{t}_{1i2}}^{623}+100\,\%*100\,\%*84.67\,\mathbf{k}+625\,\%\left(28*\left(-241.6\,\mathbf{k}\right)+32*\left(-393.1\,\mathbf{k}\right)\right)\right)\frac{\mathbf{J}}{\left(\frac{\mathrm{mol}}{\mathrm{mol}}\right)}\cong\\ &\simeq\end{aligned}$$