6pts

A-1) 0,5 $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ 1

A-2) 1

	CH_4	$2O_2$	CO_2	$2H_2O$
$t=0$	n_0^m	$2n_0^m$	0	0
t	$n_0^m - \xi_1$	$2n_0^m - 2\xi_1$	ξ_1	$2\xi_1$
$t\infty$	0	0	n_0^m	$2n_0^m$

0,5 $C_2H_6 + \frac{7}{2}O_2 \rightarrow 2CO_2 + 3H_2O$

1

	C_2H_6	$\frac{7}{2}O_2$	$2CO_2$	$3H_2O$
$t=0$	n_0^e	$\frac{7}{2}n_0^e$	0	0
t	$n_0^e - \xi_2$	$\frac{7}{2}n_0^e - \frac{7}{2}\xi_2$	$2\xi_2$	$3\xi_2$
$t\infty$	0	0	$2n_0^e$	$3n_0^e$

$t\infty$, plus de méthane et éthane

A-3) $\Rightarrow \begin{cases} \xi_1 = n_0^m \\ \xi_2 = n_0^e \end{cases}$

179,950 g de $O_2(g)$ $\Leftrightarrow$ 5,623 mole $= 2n_0^m + \frac{7}{2}n_0^e$

226,473 g de produit $\Leftrightarrow$ [crossed out]

$$\underset{(g)}{226,473} = (n_0^m + 2n_0^e)\underbrace{M_{CO_2}}_{44\ g/mol} + (2n_0^m + 3n_0^e)\underbrace{M_{H_2O}}_{18\ g/mol}$$

$$= 80n_0^m + 142\,n_0^e$$

$$= 40\left(5,623 - \frac{7}{2}n_0^e\right) + 142\,n_0^e$$

$$\Rightarrow 2n_0^e = 226,473 - 40 \times 5,623$$

1 $\Leftrightarrow \boxed{n_0^e = 0,1765 \text{ mole}} \boxed{= \xi_2}$

1 $\Rightarrow \boxed{n_0^m = 1,4526 \text{ mole}} \boxed{= \xi_1}$

A-4) 0,5 $m_{CH_4} = n_0^m \times M_{CH_4} = 1,4526 \times 16 = 23,242\ g$

0,5 $m_{C_2H_6} = n_0^e \times M_{C_2H_6} = 0,1765 \times 30 = 23,295\ g$

5pts

B) ① $\boxed{m_1 = 200g \quad T_1 = 298K}$ C $\left\{ \begin{array}{l} m_2 = 300g \\ T_2 = 353\,K \end{array} \right.$ $\longrightarrow$ $T_{ideal} = ?$ ②

$$\Delta H_1 + \Delta H_C + \Delta H_2 = 0$$

$$\Leftrightarrow Q_1 + Q_C + Q_2 = 0$$

$$\Leftrightarrow m_1 C_p^e (T_{ideal} - T_1) + \underbrace{C}_{=0}(\cancel{T_{ideal}} - T_1) + m_2 C_p^e (T_{ideal} - T_2) = 0$$ *

$$\Rightarrow T_{ideal} = \frac{\cancel{C_p^e}(m_1 T_1 + m_2 T_2)}{\cancel{C_p^e}(m_1 + m_2)}$$

$$= \frac{200 \times 298 + 300 \times 353}{200 + 300} = 331\,K$$ (1)

③ $T_{exp} = 323\,K < T_{ideal} = 331\,K$

1re méthode * $\Rightarrow C = \frac{C_p^e[-m_2(T_{exp} - T_2) - m_1(T_{exp} - T_1)]}{T_{exp} - T_1}$

$$= \frac{4185(-0{,}3 \times (323 - 353) - 0{,}2 \times (323 - 298))}{323 - 298}$$

$$= 669{,}6\ J.K^{-1}$$ (1)

2d méthode C (calorimètre) $\Leftrightarrow$ 500g H_2O $\frac{331\,K \rightarrow 323\,K}{\Delta T = 8\,K}$.

298 $\rightarrow$ 323K

$$Q_C = C \times \Delta T' = -Q_{H_2O} = m_{H_2O} C_p^{H_2O} \Delta T \,//$$

$$= C(323 - 298) = -0{,}5 \times 4185 \times (323 - 331)$$

$$\Rightarrow C = 669{,}6\ J.K^{-1}$$

(1) ② $\Delta E = m_{H_2O} C_p^{H_2O} (331 - 323) = 16740\ J.$

B-5)

$m_2 = 250\ g$
$T_2 = 373\ K$

$m_1 = 350 g$
$T_1 = 290 K$
$C = 200\ J K^{-1}$

$\longrightarrow T_f = 291,58 K$

$$-Q_1 + Q_c + Q_2 = 0$$

$$(m_1 C_p^e + C)(T_f - T_1) + m_2 C_p^{Au}(T_f - T_2) = 0$$

$$\Rightarrow C_p^{Au} = \frac{(0,350 \times 4185 + 200)(290 - 291,58)}{0,250 \times (291,58 - 373)}$$

1 $= 0,129\ J.g^{-1}.K^{-1}$

$= 129,2\ J.kg^{-1}.K^{-1}$

$\downarrow \times M_{Au}$

1 $= 25,41\ J.mol^{-1}.K^{-1}$

D) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $\boxed{3pts}$

1 D-1) $\Delta r H^o_{298K}$: Enthalpie molaire standard de réaction à 298 K. 'o' $\rightarrow$ p = p° standard.

1 D-2) Enthalpie associée à la formation de NH_3 à partir des corps simples qui le compose.

$\rightarrow \Delta f H^o_{NH_3(g), 298K}$

1 D-3) $\Delta r H^o_{298K} = 2 \Delta f H^o_{NH_3(g), 298K} - \Delta f H^o_{N_2(g), 298K} - 3 \Delta f H^o_{H_2(g), 298K}$

$\Delta f H^o_{N_2(g), 298K} = 0$; $\Delta f H^o_{H_2(g), 298K} = 0$

$\rightarrow \Delta f H^o_{NH_3(g), 298K} = -46\ kJ/mol$.

6pts

4

c) $CH_4(g) \rightleftharpoons C(s) + 2H_2(g)$

1 mole de $CH_4(g)$

$V = 50\,l$

$T = 850\,°C$

① $P = \frac{nRT}{V}$ AN $P = \frac{1 \times 8,314 \times (273,15 + 850)}{50.10^{-3}}$

$P = 186757,4$ Pa

$= 1,84$ atm

$\boxed{= 1,86 \text{ bar}}$ 1

$n_g = 1 + \xi$

$P(\xi) = (1+\xi)\frac{RT}{V}$

$= (1+\xi) P_{t=0}$

$\xi = 0 \Rightarrow P = P_{t=0}$

$\xi = 1 \Rightarrow P = 2 \times P_{t=0}$

② $CH_4(g) \longrightarrow C(s) + 2H_2(g)$

$n_0 = 1$	0	0
$n_0 - \xi$ $1 - \xi$	ξ	2ξ

$P_{t=0} = 1,86$ bar

$P_f = 3,2$ bar

$n_g^f = 1 - \xi + 2\xi = 1 + \xi$

$P_f = n_g^f \frac{RT}{V} = n_g^f \frac{P_{t=0}}{n_0} \Rightarrow n_g^f = n_0 \frac{P_f}{P_{t=0}}$

$\Rightarrow 1 + \xi = 1 \times \frac{3,2}{1,86}$

1 $\Rightarrow \xi = \frac{3,2}{1,86} - 1 = 0,7135$ mole

③ 1

$n^f_{CH_4(g)} = 1 - \xi = 0,2865$ mole

$n^f_{C(s)} = \xi = 0,7135$ mole

$n^f_{H_2(g)} = 2\xi = 1,4269$ mole

④ $P_{CH_4} = \frac{n_{CH_4}}{n_{T_g}} P_f$

$= \frac{1-\xi}{1+\xi} \times 3,2$

1 $P_{CH_4} = 0,535$ bar

1 $P_{H_2} = \frac{2\xi}{1+\xi} P_f = 2,665$ bar

⑤ $\xi_{max} = 1 \Rightarrow P_f^{max} = (1 + \xi_{max}) P_{t=0}$

$= 2 \times P_{t=0}$

1 $= 3,72$ bar