(4)

85% methane
10% ethane
5% nitrogen

basis: 1 mole total

a)

(1) $CH_{4(g)} + O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$

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

$\Delta H^\circ_{c,1} = [(-393,509\ J/mol) + 2(-241,818\ J/mol)] - [-74,520\ J/mol]$

$\Delta H^\circ_{c,1} = -802625\ J/mol$

$\Delta H^\circ_{c,2} = [2(-393,509\ J/mol) + 3(-241,814\ J/mol)] - [-83820\ J/mol]$

$\Delta H^\circ_{c,2} = -1428652$

$\Delta H^\circ_{c,total} = -802625\ J/mol - 1428652\ J/mol$

$= -2231277\ J/mol$

$$\boxed{\Delta H^\circ_{c,total} = -2231.3\ kJ/mol}$$

b)