Задача №1

$\mathrm{CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl}$
$\mathrm{CH_4 + 2\,O_2 \longrightarrow CO_2 + 2\,H_2O_{(liq)}}$
$\mathrm{CH_3Cl + \frac{3}{2}\,O_2 \longrightarrow CO_2 + H_2O_{(liq.)} + HCl}$
$\mathrm{H_2 + \frac{1}{2}\,O_2 \longrightarrow H_2\,O_{(liq.)}}$
$\mathrm{\frac{1}{2}\,H_2 + \frac{1}{2}\,Cl_2 \longrightarrow HCl}$

$\Delta_r H^\circ_{298}$
$\Delta_r H^\circ_2 = -890.35$ *кДж/моль*
$\Delta_r H^\circ_3 = -686.20$ *кДж/моль*
$\Delta_r H^\circ_4 = -285.85$ *кДж/моль*
$\Delta_r H^\circ_5 = -92.30$ *кДж/моль*

$$\Delta_r H^\circ_{298} = \Delta_r H^\circ_1 - \Delta_r H^\circ_2 + 2\Delta_r H^\circ_4 - \Delta_r H^\circ_3 = -102.9 \text{ кДж/моль}$$
$$\Delta_r H^\circ_{298} = \Delta_f H^\circ_{298}(\mathrm{CH_3Cl}) + \Delta_f H^\circ_{298}(\mathrm{HCl}) - \Delta_f H^\circ_{298}(\mathrm{CH_4}) = -99.45 \text{ кДж/моль}$$

Задача №2

$\mathrm{C_2H_4 + H_2 \longrightarrow C_2H_6}$
$\mathrm{C_2H_6 + \frac{7}{2}\,O_2 \longrightarrow 2\,CO_2 + 3\,H_2O}$
$\mathrm{C + O_2 \longrightarrow CO_2}$
$\mathrm{H_2 + \frac{1}{2}\,O_2 \longrightarrow H_2\,O}$

$\Delta_r H^\circ_1 = -136.96$ *кДж/моль*
$\Delta_r H^\circ_2 = -1559.88$ *кДж/моль*
$\Delta_r H^\circ_3 = -393.51$ *кДж/моль*
$\Delta_r H^\circ_4 = -285.84$ *кДж/моль*

$$\Delta_f H^\circ_{298}(\mathrm{C_2H_4}) = -\Delta_r H^\circ_1 - \Delta_r H^\circ_2 + 2\Delta_r H^\circ_3 + 3\Delta_r H^\circ_4 = -55.37 \text{ кДж/моль}$$
$$\Delta_c H^\circ_{298}(\mathrm{C_2H_4}) = \Delta_r H^\circ_1 + \Delta_r H^\circ_2 - \Delta_r H^\circ_4 = -1411 \text{ кДж/моль}$$

Задача №3

$\mathrm{C_2H_4 + H_2 \longrightarrow C_2H_6}$ $\Delta_r H^\circ_{298}$

$\Delta_f H^\circ_{298}(\mathrm{C_2H_6}) = -84.67$ *кДж/моль*
$\Delta_f H^\circ_{298}(\mathrm{C_2H_4}) = 52.28$ *кДж/моль*

$$\Delta_r H^\circ_{298} = \Delta_f H^\circ_{298}(\mathrm{C_2H_6}) - \Delta_f H^\circ_{298}(\mathrm{C_2H_4}) = -136.95 \text{ кДж/моль}$$

$\Delta_c H^\circ_{298}(\mathrm{C_2H_6}) = -1559.88$ *кДж/моль*
$\Delta_c H^\circ_{298}(\mathrm{C_2H_4}) = -1410.97$ *кДж/моль*
$\Delta_c H^\circ_{298}(\mathrm{H_2}) = -285.84$ *кДж/моль*

$$\Delta_r H^\circ = \Delta_c H^\circ_{298}(\mathrm{C_2H_4}) - \Delta_c H^\circ_{298}(\mathrm{H_2}) + \Delta_c H^\circ_{298}(\mathrm{C_2H_6}) = -136.93 \text{ кДж/моль}$$

1 Задача №4

Вещество	C_p, 298	C_p, 400	$\Delta_f H^\circ_{298}$	$\Delta_f H^\circ_{349}$
CH_4	35.70	40.63	-74.85	-72.90
CH_3F	37.48	44.18	-246.9	-244.82
HF	29.14	29.15	-273.30	-271.81
F_2	31.30	32.99	0	1.64

$CH_4 + F_2 \longrightarrow CH_3F + HF$ $\Delta_r H^\circ_{349}$

$$\Delta_f H^\circ_{349} = \Delta_f H^\circ_{298} + \int_{298}^{349} c_p(T)dT \approx \Delta_f H^\circ_{298} + (c_p^{349} + c_p^{298}) \cdot \frac{\Delta T}{2}$$

$$\Delta_r H^\circ_{349} = \Delta_f H^\circ_{349}(CH_3F) + \Delta_f H^\circ_{349}(HF) - \Delta_f H^\circ_{349}(CH_4) - \Delta_f H^\circ_{349}(F_2) = -445.37 \text{ кДж/моль}$$

2 Задача №5

$$\Delta_f H^\circ_T(HCl) = \Delta_f H^\circ_{298} + \int_{298}^{T} c_p(T')dT' = -92310 + 25.53 \cdot T'\Big|_{298}^{T} + 2.30 \cdot 10^{-3} \cdot (T')^2\Big|_{298}^{T} - 1.09 \cdot 10^5 (T')^{-1}\Big|_{298}^{T}$$

$$\Delta_f H^\circ_T(O_2) = \Delta_f H^\circ_{298} + \int_{298}^{T} c_p(T')dT' = 37.03 \cdot T'\Big|_{298}^{T} + 0.33 \cdot 10^{-3}(T')^2\Big|_{298}^{T} + 2.85 \cdot 10^5 (T')^{-1}\Big|_{298}^{T}$$

$$\Delta_f H^\circ_T(Cl_2) = \Delta_f H^\circ_{298} + \int_{298}^{T} c_p(T')dT' = 31.46 \cdot T'\Big|_{298}^{T} + 1.69 \cdot 10^{-3}(T')^2\Big|_{298}^{T} + 3.77 \cdot 10^5 (T')^{-1}\Big|_{298}^{T}$$

$$\Delta_f H^\circ_T(H_2O) = \Delta_f H^\circ_{298} + \int_{298}^{T} c_p(T')dT' = -241810 + 30.00 \cdot T'\Big|_{298}^{T} + 5.35 \cdot 10^{-3}(T')^2\Big|_{298}^{T} - 0.33 \cdot 10^5 (T')^{-1}\Big|_{298}^{T}$$

$$\Delta_r H^\circ_T = -114.38+$$