De verbrandingswarmte van formaldehyde $H_2CO_{(g)}$ en mierenzuur $HCOOH_{(vl)}$ bedragen resp. −563 kJ/mol en −270 kJ/mol. Bereken $\Delta_r H^o$ voor:

$H_2C{=}O_{(g)} + ½\ O_{2(g)} \rightleftharpoons HCOOH_{(vl)}$

Oplossing

$$\Delta_r H^o = \left(\Delta_f H^o_{HCOOH_{(vl)}}\right) - \left(\Delta_f H^o_{H_2C=O_{(g)}} + \frac{1}{2}\Delta_f H^o_{O_{2(g)}}\right)$$

$$\Delta_r H^o = \left(\Delta_f H^o_{HCOOH_{(vl)}}\right) - \left(\Delta_f H^o_{H_2C=O_{(g)}}\right)$$

Verbranding van formaldehyde:

$$H_2C{=}O_{(g)} + O_{2(g)} \longrightarrow CO_{2(g)} + H_2O_{(vl)}$$

$$\Delta_r H^o = \left(\Delta_f H^o_{CO_{2(g)}} + \Delta_f H^o_{H_2O_{(vl)}}\right) - \left(\Delta_f H^o_{H_2C=O_{(g)}} + \Delta_f H^o_{O_{2(g)}}\right) = -563\ \frac{kJ}{mol}$$

$$\Rightarrow \Delta_f H^o_{H_2C=O_{(g)}} = \left(\Delta_f H^o_{CO_{2(g)}} + \Delta_f H^o_{H_2O_{(vl)}}\right) + 563\ \frac{kJ}{mol}$$

Verbranding van mierenzuur:

$$HCOOH_{(vl)} + ½\ O_{2(g)} \longrightarrow CO_{2(g)} + H_2O_{(vl)}$$

$$\Delta_r H^o = \left(\Delta_f H^o_{CO_{2(g)}} + \Delta_f H^o_{H_2O_{(vl)}}\right) - \left(\Delta_f H^o_{HCOOH_{(vl)}} + \frac{1}{2}\Delta_f H^o_{O_{2(g)}}\right) = -270\ \frac{kJ}{mol}$$

$$\Rightarrow \Delta_f H^o_{HCOOH_{(vl)}} = \left(\Delta_f H^o_{CO_{2(g)}} + \Delta_f H^o_{H_2O_{(vl)}}\right) + 270\ \frac{kJ}{mol}$$

Daaruit volgt dat:

$$\Delta_r H^o = \left(\Delta_f H^o_{HCOOH_{(vl)}}\right) - \left(\Delta_f H^o_{H_2C=O_{(g)}}\right)$$

$$\Delta_r H^o = \left[\left(\Delta_f H^o_{CO_{2(g)}} + \Delta_f H^o_{H_2O_{(vl)}}\right) + 270\ \frac{kJ}{mol}\right] - \left[\left(\Delta_f H^o_{CO_{2(g)}} + \Delta_f H^o_{H_2O_{(vl)}}\right) + 563\ \frac{kJ}{mol}\right]$$

$$\Delta_r H^o = 270\ \frac{kJ}{mol} - 563\ \frac{kJ}{mol}$$

$$\mathbf{\Delta_r H^o = -293\ \frac{kJ}{mol}}$$