7Answer on Question #59483, Chemistry / General Chemistry

Calculate the standard free energy change, DrGq, for the reaction:
$H_{2(g)} + I_{2(s)} \rightarrow 2\ HI_{(g)}$ at 25 C.

$$T = 273 + 25^0C = 298K$$

Data:
$H_{2(g)}$, $\Delta H^0{}_{298} = 0.00\ kJ \cdot mol^{-1}$, $S^0{}_{298} = +130.6\ J \cdot mol^{-1} \cdot K^{-1}$
$I_{2(s)}$, $\Delta H^0{}_{298} = 0.00\ kJ \cdot mol^{-1}$, $S^0{}_{298} = +116.12\ J \cdot mol^{-1} \cdot K^{-1}$
$HI_{(g)}$, $\Delta H^0{}_{298} = +26\ kJ \cdot mol^{-1}$, $S^0{}_{298} = +206\ J \cdot mol^{-1} \cdot K^{-1}$

$$\Delta G = \Delta H - T \cdot \Delta S$$

$$\Delta G^0_{298} = \Delta H^0_{298} - 298K \cdot \Delta S^0_{298}$$

$$H^0_{298} = 2 \cdot \Delta H^0_{298}(HI_{(g)}) - \Delta H^0_{298}(H_{2(g)}) - \Delta H^0_{298}(I_{2(g)})$$

$$\Delta H^0_{298} = 2 \cdot 26\ kJ \cdot mol^{-1} - 0.00\ kJ \cdot mol^{-1} - 0.00\ kJ \cdot mol^{-1}$$

$$= 52kJ \cdot mol^{-1}$$

$$\Delta S^0_{298} = 2 \cdot S^0_{298}(HI_{(g)}) - S^0_{298}(H_{2(g)}) - S^0_{298}(I_{2(g)})$$

$$\Delta S^0_{298} = 2 \cdot 206\ J \cdot mol^{-1} \cdot K^{-1} - 130.6\ J \cdot mol^{-1} \cdot K^{-1} - 116.12\ J \cdot mol^{-1} \cdot K^{-1} = 165.26\ J \cdot mol^{-1} \cdot K^{-1}$$

$$\Delta G^0_{298} = 52 \cdot 10^3 J \cdot mol^{-1} - 298K \cdot 165.26\ J \cdot mol^{-1} \cdot K^{-1} = 2752.52J$$