

$$G = U - TS + PV$$

$$dG = dU - dTS - Tds + pdU + ~~dVdT~~$$

$$\text{IF } dT = 0 \quad dp = 0$$

$$dG = dU - Tds + pdU = Q + W - Tds + pdV$$

SINCE

~~$$Q = Tds$$~~

$$Q \leq Tds \quad Q - Tds \leq 0$$

$$dG = Q - Tds + W + pdV$$

$$\leq 0 + W + pdV$$

$$dG \leq W + pdV$$

$$W = -pdV + W_{OTHER} \quad] \quad \text{ELEMENTARY!}$$

$$dG \leq W_{OTHER}$$

$$H = U + PV$$

$$dH = dU + Vdp + pdV$$

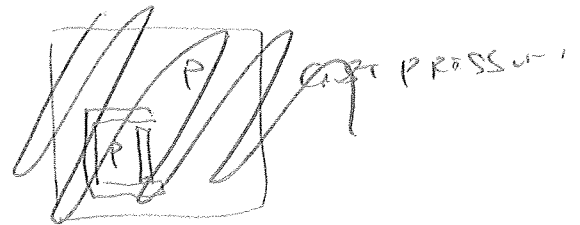
$$dH = Q + W + Vdp + pdV \Rightarrow$$

IF $dp = 0$

$$dH = Q + W + pdV$$

$$W = -pdV + W_{OTHER}$$

$$dH = \underline{Q} + W_{OTHER}$$



100

EXAMPLE



~~163 J/K~~

$$\begin{aligned} \Delta H &= 0 + 0 - (-285.83) = 285.83 \text{ kJ} \\ &= \text{Q} + \text{WORKER} \end{aligned}$$

$$S_{\text{H}_2\text{O}} = 70 \text{ J/K} \quad S_{\text{H}_2} = 131 \text{ J/K} \quad S_{\text{O}_2} = 205 \text{ J/K}$$

$$Tds = 298\text{K} \left(131 + \frac{205}{2} - 70 \right)$$

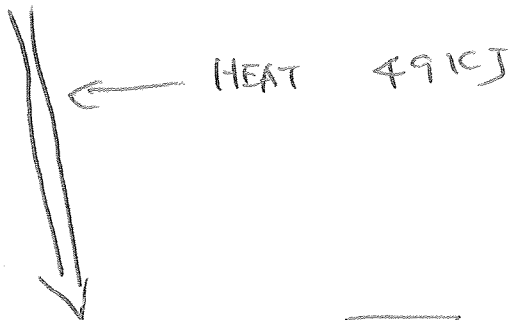
$$Tds = 298\text{K} (163 \text{ J/K}) = 49 \text{ kJ}$$

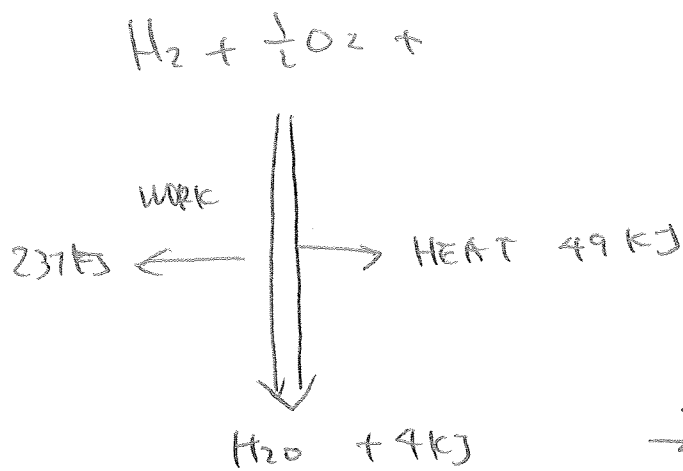
$$dG = dH - Tds \quad \text{687} = 286 \text{ kJ} - 298\text{K}(163 \text{ J/K})$$

$$dG = 237 \text{ kJ}$$

H₂O

237 kJ
→
ELECTRICAL





$$\frac{237}{286} = 83\% \text{ EFFICIENT}$$

↓

FUEL CELL



$$0 \quad -217 \quad + 0 \quad + -795 \times 2 \quad -813 \times 2 \quad + 2 \times 237$$

$$\Delta G = -813 \times 2 - 2 \times 237 + 795 \times 2 + 217$$

$$= -393 \text{ kJ/mol} \quad \text{WORK OUT}$$

$$\Delta H = -316 \text{ kJ/mol}$$

WHERE IS EXTRA 77 kJ COMING FROM