

## 15-4 Calculating Enthalpy change

Hess's Law - states that we can determine the total amount of energy required to run a reaction that is made up of other rxns by adding each of the  $\Delta H_{\text{rxns}}$  of . . .

\* to keep things easy, scientists use  $\Delta H$  @ standard states - meaning @ 1 Atm pressure & 298 K (25°C).

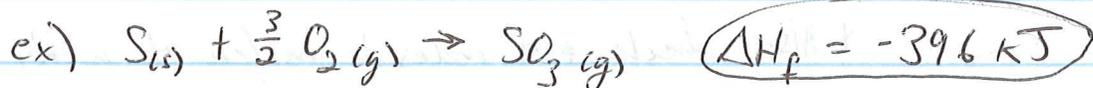
- can find standard states @ room temp on periodic table

ex) Iron = solid & Bromine = liquid

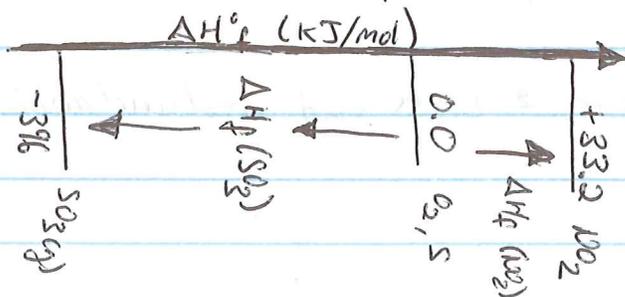
$\Delta H_f^\circ$  = Standard Enthalpy of Formation = the  $\Delta H$  of a compound in stand. state that forms its elements in their standard states.

\* Remember: A compound = Element A + Element B . . .

see fig  
15.15

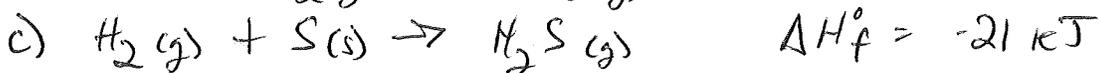
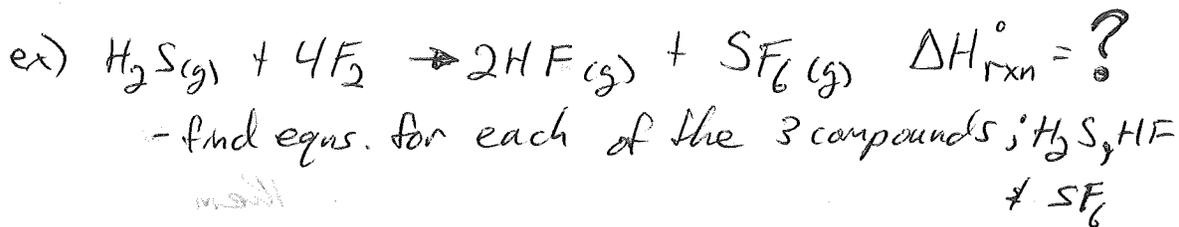


The  $\Delta H_f$  of elements in their standard states are 0.0 kJ to form 1 mole of compound - they can be exothermic ( $-\Delta H_f$ ) or endothermic ( $+\Delta H_f$ )

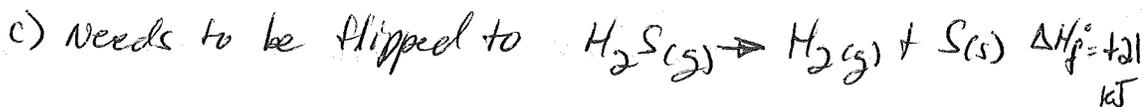


2

We can use the  $\Delta H_f^\circ$  to calculate  $\Delta H_{rxn}$

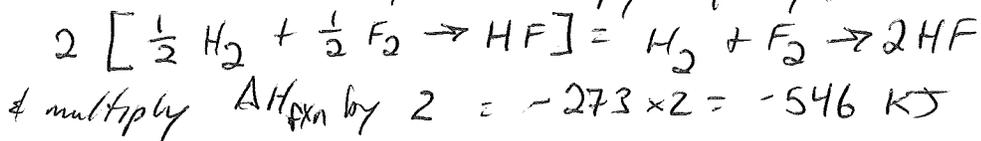


- check each eqn a  $\rightarrow$  c to determine if the  
 have prods. & reactants on correct side in original  
 eqn. if NOT, flip the eqn & reverse sign of  $\Delta H_f^\circ$



\* Also - check # of moles to make it work

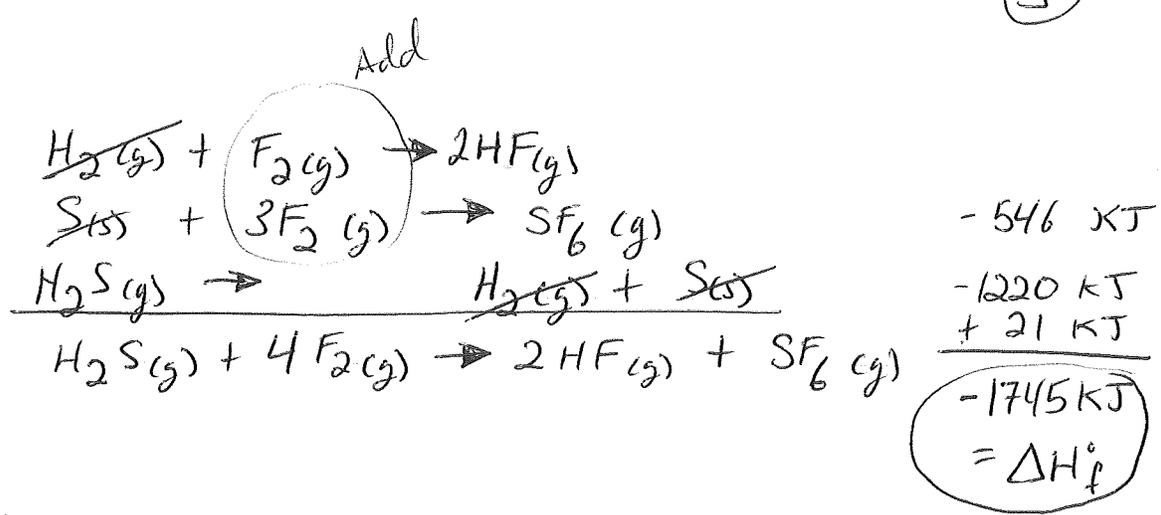
- we need 2 mol of HF, so multiply eqn by 2



\* combine all eqns. & cross out redundancies on both side

See  $\Delta H_f^\circ$   
 values on  
 pg. 975  
 Table R-11

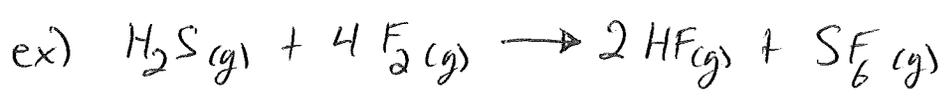
3



You could also use the summation Equ<sup>n</sup>

$$\Sigma = \text{sum} \quad \boxed{\Delta H_{\text{rxn}}^\circ = \Sigma \Delta H_f^\circ (\text{prod.}) - \Sigma \Delta H_f^\circ (\text{react})}$$

- must include moles in sum



$$\begin{aligned}
 \Delta H_{\text{rxn}}^\circ &= [(2 \times -273) + (-1220)] - [(-21) + (4 \times 0.0)] \\
 &= [-1766] - [-21] \\
 &= \boxed{-1745 \text{ kJ}}
 \end{aligned}$$

