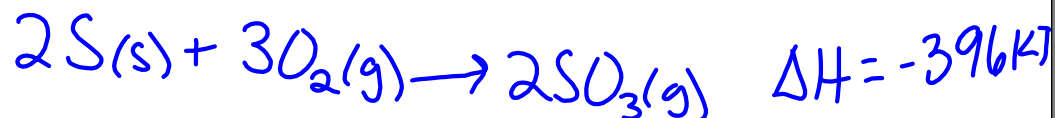
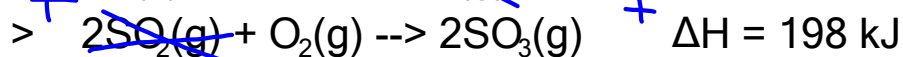


# HESS'S LAW

- Hess's Law the overall enthalpy change in a reaction is equal to the sum of the enthalpy changes of the individual steps.

- Example



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# STANDARD HEAT OF FORMATION

$\Delta H_f$ : the amount of energy released when a compound is formed from its elements.

- The standard heat of formation for water  $\Delta H_f = -285.83 \text{ kJ/mol}$
- Page 975 in your book has a table of standard heats of formation
- We use this information to determine the heat of formation for any reaction.

$$\Delta H_{\text{rxn}}^{\circ} = \overset{\text{sum}}{\Sigma} \Delta H_f(\text{products}) - \overset{\text{sum}}{\Sigma} \Delta H_f(\text{reactants})$$

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# HEAT OF FORMATION (PG. 975)

$$\Delta H^{\circ}_{\text{rxn}} = \Sigma \Delta H_f(\text{products}) - \Sigma \Delta H_f(\text{reactants})$$

Table R-11 Heat of Formation Values

$\Delta H_f^{\circ}$ (kJ/mol) (concentration of aqueous solutions is 1M)							
Substance	$\Delta H_f^{\circ}$	Substance	$\Delta H_f^{\circ}$	Substance	$\Delta H_f^{\circ}$	Substance	$\Delta H_f^{\circ}$
Ag(s)	0	CsCl(s)	-443.0	H <sub>3</sub> PO <sub>4</sub> (aq)	-1271.7	NaBr(s)	-361.1
AgCl(s)	-127.0	Cs <sub>2</sub> SO <sub>4</sub> (s)	-1443.0	H <sub>2</sub> S(g)	-20.6	NaCl(s)	-411.2
AgCN(s)	146.0	CuI(s)	-67.8	H <sub>2</sub> SO <sub>3</sub> (aq)	-608.8	NaHCO <sub>3</sub> (s)	-950.8
Al <sub>2</sub> O <sub>3</sub>	-1675.7	CuS(s)	-53.1	H <sub>2</sub> SO <sub>4</sub> (aq)	-814.0	NaNO <sub>3</sub> (s)	-467.9
BaCl <sub>2</sub> (aq)	-855.0	Cu <sub>2</sub> S(s)	-79.5	HgCl <sub>2</sub> (s)	-224.3	NaOH(s)	-425.8
BaSO <sub>4</sub>	-1473.2	CuSO <sub>4</sub> (s)	-771.4	Hg <sub>2</sub> Cl <sub>2</sub> (s)	-265.4	Na <sub>2</sub> CO <sub>3</sub> (s)	-1130.7
BeO(s)	-609.4	F <sub>2</sub> (g)	0	Hg <sub>2</sub> SO <sub>4</sub> (s)	-743.1	Na <sub>2</sub> S(s)	-364.8
BiCl <sub>3</sub> (s)	-379.1	FeCl <sub>3</sub> (s)	-399.49	I <sub>2</sub> (s)	0	Na <sub>2</sub> SO <sub>4</sub> (s)	-1387.1
Bi <sub>2</sub> S <sub>3</sub> (s)	-143.1	FeO(s)	-272.0	K(s)	0	NH <sub>4</sub> Cl(s)	-314.4
Br <sub>2</sub>	0	FeS(s)	-100.0	KBr(s)	-393.8	O <sub>2</sub> (g)	0
CCl <sub>4</sub> (l)	-128.2	Fe <sub>2</sub> O <sub>3</sub> (s)	-824.2	KMnO <sub>4</sub> (s)	-837.2	P <sub>4</sub> O <sub>6</sub> (s)	-1640.1
CH <sub>4</sub> (g)	-74.6	Fe <sub>3</sub> O <sub>4</sub> (s)	-1118.4	KOH	-424.6	P <sub>4</sub> O <sub>10</sub> (s)	-2984.0
C <sub>2</sub> H <sub>2</sub> (g)	227.4	H(g)	218.0	LiBr(s)	-351.2	PbBr <sub>2</sub> (s)	-278.7
C <sub>2</sub> H <sub>4</sub> (g)	52.4	H <sub>2</sub> (g)	0	LiOH(s)	-487.5	PbCl <sub>2</sub> (s)	-359.4
C <sub>2</sub> H <sub>6</sub> (g)	-84.0	HBr(g)	-36.3	Mn(s)	0	SF <sub>6</sub> (g)	-1220.5
CO(g)	-110.5	HCl(g)	-92.3	MnCl <sub>2</sub> (aq)	-555.0	SO <sub>2</sub> (g)	-296.8
CO <sub>2</sub> (g)	-393.5	HCl(aq)	-167.159	Mn(NO <sub>2</sub> ) <sub>2</sub> (aq)	-635.5	SO <sub>3</sub> (g)	-395.7
CS <sub>2</sub> (l)	89.0	HCN(aq)	108.9	MnO <sub>2</sub> (s)	-520.0	SrO(s)	-592.0
Ca(s)	0	HCHO	-108.6	MnS(s)	-214.2	TiO <sub>2</sub> (s)	-944.0
CaCO <sub>3</sub> (s)	-1206.9	HCOOH	-425.0	N <sub>2</sub> (g)	0	TiI <sub>3</sub> (s)	-123.8
CaO(s)	-634.9	HF(g)	-273.3	NH <sub>3</sub> (g)	-45.9	UCl <sub>4</sub> (s)	-1019.2
Ca(OH) <sub>2</sub> (s)	-985.2	HI(g)	26.5	NH <sub>4</sub> Br(s)	-270.8	UCl <sub>6</sub> (s)	-1092.0
Cl <sub>2</sub> (g)	0	H <sub>2</sub> O(l)	-285.8	NO(g)	91.3	Zn(s)	0
Co <sub>3</sub> O <sub>4</sub> (s)	-891.0	H <sub>2</sub> O(g)	-241.8	NO <sub>2</sub> (g)	33.2	ZnCl <sub>2</sub> (aq)	-415.1
CoO(s)	-237.9	H <sub>2</sub> O <sub>2</sub> (l)	-187.8	N <sub>2</sub> O(g)	81.6	ZnO(s)	-350.5
Cr <sub>2</sub> O <sub>3</sub> (s)	-1139.7	H <sub>3</sub> PO <sub>2</sub> (l)	-595.4	Na(s)	0	ZnSO <sub>4</sub> (s)	-982.8

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# STANDARD HEAT OF FORMATION

$$\Delta H^{\circ}_{\text{rxn}} = \Sigma \Delta H_f(\text{products}) - \Sigma \Delta H_f(\text{reactants})$$

- Page 975 in Textbook

\* All elements in their standard states (example: oxygen gas, solid copper, liquid mercury) will have an Enthalpy of formation of zero.

Practice:

$$= -2436. \text{KJ}$$

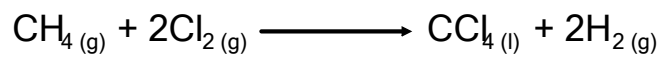


$$[2(-824.2 \text{KJ}) + 4(-296.8 \text{KJ})] - [4(100 \text{KJ}) + 7(0)]$$

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**PRACTICE**

Calculate the  $\Delta H_{\text{rxn}}$  for the following using the heats of formation on pg. 975 in your book.



$$[-128.2\text{kJ} + 2(0)] - [-74.6\text{kJ} + 2(0)]$$

$$= -53.6\text{kJ}$$

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