

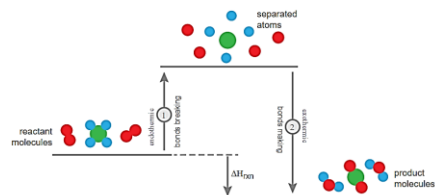
Calculate the energy released when 135g of aluminum are reacted in the below equation.  
 $2\text{Al} + \text{Fe}_2\text{O}_3 \rightarrow 2\text{Fe} + \text{Al}_2\text{O}_3 \quad \Delta H_{\text{rxn}} = -851.5\text{kJ}$

Calculate  $\Delta H$  for combustion of methane,  $\text{CH}_4$   
 $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$

Substance	$\Delta H_f^\circ$ (kJ)
$\text{CH}_4$	-74.80
$\text{O}_2$	0
$\text{CO}_2$	-393.50
$\text{H}_2\text{O}$	-285.83

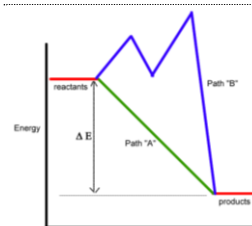
What is  $\Delta H_{\text{rxn}}^\circ$  (kJ) for combustion of ethanol?  
 $2\text{C}_2\text{H}_5\text{OH}(\text{l}) + 6\text{O}_2(\text{g}) \rightarrow 4\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{l})$

Formula	$\Delta H_f^\circ$
$\text{C}_2\text{H}_5\text{OH}(\text{l})$	-277.6
$\text{CO}_2(\text{g})$	-393.5
$\text{H}_2\text{O}(\text{g})$	-241.8
$\text{H}_2\text{O}(\text{l})$	-285.8



Action	Algebraic Sign	How to Remember
Break a Bond	+	Takes to Break
Form a Bond	-	Free to Form

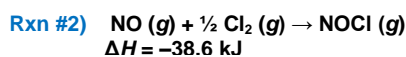
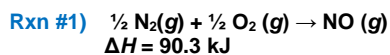
Single Bond Enthalpies (kJ/mol. of bonds)										
H	C	N	O	S	F	Cl	Br	I		
H	436									
C	413	346								
N	391	305	163							
O	463	358	201	146						
S	347	272			226					
F	465	485	283	160	294	156				
Cl	432	339	192	218	255	253	242			
Br	366	285		201	217	249	216	136		
I	299	213		201		278	202	175	151	
Multiple Bond Enthalpies (kJ/mol. of bonds)										
C=C	602	C≡N	815	C=O	799					
C≡C	835	C≡N	887	C=O	1072					
N=N	418	N=O	607							
N≡N	945	O=O	498							



Calculate  $\Delta H$  for combustion of  $\text{CH}_4$ :  
 $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$

#	Reaction	$\Delta H^\circ$
1	$\text{C} + 2\text{H}_2 \rightarrow \text{CH}_4$	-74.80 kJ
2	$\text{C} + \text{O}_2 \rightarrow \text{CO}_2$	-393.50 kJ
3	$\text{H}_2 + \frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{O}$	-285.83 kJ

$2\text{NOCl}(\text{g}) \rightarrow \text{N}_2(\text{g}) + \text{O}_2(\text{g}) + \text{Cl}_2(\text{g}) \quad \Delta H = ?$



**N-38**

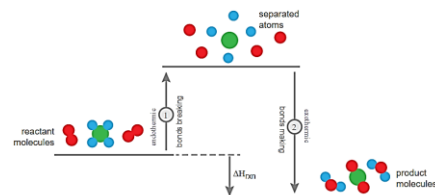
Calculate the energy released when 135g of aluminum are reacted in the below equation.  
 $2\text{Al} + \text{Fe}_2\text{O}_3 \rightarrow 2\text{Fe} + \text{Al}_2\text{O}_3 \quad \Delta H_{\text{rxn}} = -851.5\text{kJ}$

Calculate  $\Delta H$  for combustion of methane,  $\text{CH}_4$   
 $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$

Substance	$\Delta H_f^\circ$ (kJ)
$\text{CH}_4$	-74.80
$\text{O}_2$	0
$\text{CO}_2$	-393.50
$\text{H}_2\text{O}$	-285.83

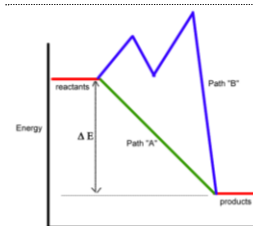
What is  $\Delta H_{\text{rxn}}^\circ$  (kJ) for combustion of ethanol?  
 $2\text{C}_2\text{H}_5\text{OH}(\text{l}) + 6\text{O}_2(\text{g}) \rightarrow 4\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{l})$

Formula	$\Delta H_f^\circ$
$\text{C}_2\text{H}_5\text{OH}(\text{l})$	-277.6
$\text{CO}_2(\text{g})$	-393.5
$\text{H}_2\text{O}(\text{g})$	-241.8
$\text{H}_2\text{O}(\text{l})$	-285.8



Action	Algebraic Sign	How to Remember
Break a Bond	+	Takes to Break
Form a Bond	-	Free to Form

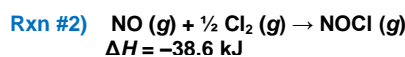
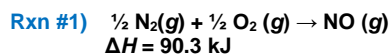
Single Bond Enthalpies (kJ/mol. of bonds)										
H	C	N	O	S	F	Cl	Br	I		
H	436									
C	413	346								
N	391	305	163							
O	463	358	201	146						
S	347	272			226					
F	465	485	283	160	294	156				
Cl	432	339	192	218	255	253	242			
Br	366	285		201	217	249	216	136		
I	299	213		201		278	202	175	151	
Multiple Bond Enthalpies (kJ/mol. of bonds)										
C=C	602	C≡N	815	C=O	799					
C≡C	835	C≡N	887	C=O	1072					
N=N	418	N=O	607							
N≡N	945	O=O	498							



Calculate  $\Delta H$  for combustion of  $\text{CH}_4$ :  
 $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$

#	Reaction	$\Delta H^\circ$
1	$\text{C} + 2\text{H}_2 \rightarrow \text{CH}_4$	-74.80 kJ
2	$\text{C} + \text{O}_2 \rightarrow \text{CO}_2$	-393.50 kJ
3	$\text{H}_2 + \frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{O}$	-285.83 kJ

$2\text{NOCl}(\text{g}) \rightarrow \text{N}_2(\text{g}) + \text{O}_2(\text{g}) + \text{Cl}_2(\text{g}) \quad \Delta H = ?$



**N-38**

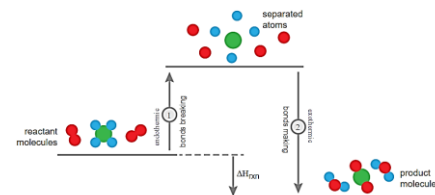
Calculate the energy released when 135g of aluminum are reacted in the below equation.  
 $2\text{Al} + \text{Fe}_2\text{O}_3 \rightarrow 2\text{Fe} + \text{Al}_2\text{O}_3 \quad \Delta H_{\text{rxn}} = -851.5\text{kJ}$

Calculate  $\Delta H$  for combustion of methane,  $\text{CH}_4$   
 $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$

Substance	$\Delta H_f^\circ$ (kJ)
$\text{CH}_4$	-74.80
$\text{O}_2$	0
$\text{CO}_2$	-393.50
$\text{H}_2\text{O}$	-285.83

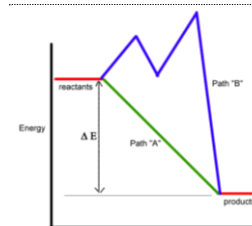
What is  $\Delta H_{\text{rxn}}^\circ$  (kJ) for combustion of ethanol?  
 $2\text{C}_2\text{H}_5\text{OH}(\text{l}) + 6\text{O}_2(\text{g}) \rightarrow 4\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{l})$

Formula	$\Delta H_f^\circ$
$\text{C}_2\text{H}_5\text{OH}(\text{l})$	-277.6
$\text{CO}_2(\text{g})$	-393.5
$\text{H}_2\text{O}(\text{g})$	-241.8
$\text{H}_2\text{O}(\text{l})$	-285.8



Action	Algebraic Sign	How to Remember
Break a Bond	+	Takes to Break
Form a Bond	-	Free to Form

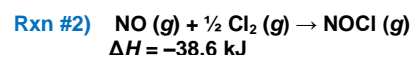
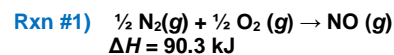
Single Bond Enthalpies (kJ/mol. of bonds)										
H	C	N	O	S	F	Cl	Br	I		
H	436									
C	413	346								
N	391	305	163							
O	463	358	201	146						
S	347	272			226					
F	465	485	283	160	294	156				
Cl	432	339	192	218	255	253	242			
Br	366	285		201	217	249	216	136		
I	299	213		201		278	202	175	151	
Multiple Bond Enthalpies (kJ/mol. of bonds)										
C=C	602	C≡N	815	C=O	799					
C≡C	835	C≡N	887	C=O	1072					
N=N	418	N=O	607							
N≡N	945	O=O	498							



Calculate  $\Delta H$  for combustion of  $\text{CH}_4$ :  
 $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$

#	Reaction	$\Delta H^\circ$
1	$\text{C} + 2\text{H}_2 \rightarrow \text{CH}_4$	-74.80 kJ
2	$\text{C} + \text{O}_2 \rightarrow \text{CO}_2$	-393.50 kJ
3	$\text{H}_2 + \frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{O}$	-285.83 kJ

$2\text{NOCl}(\text{g}) \rightarrow \text{N}_2(\text{g}) + \text{O}_2(\text{g}) + \text{Cl}_2(\text{g}) \quad \Delta H = ?$



**N-38**