sig. figs count

Enthalpy #4 **Worksheet on bond energies & Hess' law** **Name:** _____

Due Jan 13th (01)/ Jan 14th (02/03)

1. Calculate ΔH for the reaction C_2H_4 (g) + H_2 (g) → C_2H_6 (g), from the following data.

same C_2H_4 (g) + 3 O_2 (g) → 2 CO_2 (g) + 2 H_2O (l) ΔH = -1411 kJ

flip C_2H_6 (g) + 7/2 O_2 (g) → 2 CO_2 (g) + 3 H_2O (l) ΔH = -1560 kJ

same H_2 (g) + 1/2 O_2 (g) → H_2O (l) ΔH = -285.8 kJ

Rewrite & solve:

$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ −1411

$2CO_2 + 3H_2O \rightarrow C_2H_6 + 3.5O_2$ +1560

$H_2 + 0.5O_2 \rightarrow H_2O$ −285.8

$C_2H_4 + H_2 \rightarrow C_2H_6$ −136.8 kJ

Answer: The ΔH for this reaction is −137 kJ/mol of C_2H_6.

2. Calculate ΔH for the reaction 4 NH_3 (g) + 5 O_2 (g) → 4 NO (g) + 6 H_2O (g), from the following data.

same x 2 N_2 (g) + O_2 (g) → 2 NO (g) ΔH = -180.5 kJ x 2 = −361 4 sig figs

flip x 2 N_2 (g) + 3 H_2 (g) → 2 NH_3 (g) ΔH = -91.8 kJ x 2 = +183.6 3 sig figs

x 3 2 H_2 (g) + O_2 (g) → 2 H_2O (g) ΔH = -483.6 kJ x 3 = −1450.8 4 sig figs.

Rewrite & solve:

$2N_2 + 2O_2 \rightarrow 4NO$ −361.0

$4NH_3 \rightarrow 2N_2 + 6H_2$ +183.6

$6H_2 + 3O_2 \rightarrow 6H_2O$ −1450.8 (not significant)

$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$ −1628.2 kJ

Answer: The ΔH for this reaction is −1628 kJ total or −407.1 kJ/mol of NO.

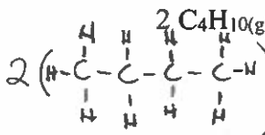
(−1628/4 = −407.05)

3. Using the table of bond energies find the enthalpy change of the following reactions. Rewrite the reaction including the value of ΔH as part of the equation.

(You may need to make a Lewis-dot structure to determine the bonding)

Bond	Energy
H-H	436 kJ/mol
H-O	460 kJ/mol
H-F	570 kJ/mol
H-Cl	432 kJ/mol
C-H	413 kJ/mol
C-C	347 kJ/mol
C=C	607 kJ/mol
C≡C	839 kJ/mol
C-O	358 kJ/mol
O=O	498 kJ/mol
C=O	745 kJ/mol
Cl-Cl	243 kJ/mol
N=N	418 kJ/mol
N=O	631 kJ/mol

$2C_4H_{10(g)} + 13O_{2(g)} \rightarrow 8CO_{2(g)} + 10H_2O_{(g)}$



ΔH = broken − formed

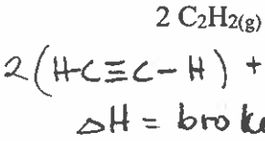
= (20(413) + 13(498)) − (16(745) + 20(460))

= 14734 − 21120

ΔH = −6386 kJ

$2C_4H_{10(g)} + 13O_{2(g)} \rightarrow 8CO_{2(g)} + 10H_2O_{(g)} + 6386\ kJ$

$2C_2H_{2(g)} + 5O_{2(g)} \rightarrow 4CO_{2(g)} + 2H_2O_{(g)}$



ΔH = broken − formed

= (4(413) + 2(839) + 5(498)) − (8(745) + 4(460))

= 5820 − 7800

ΔH = −1980 kJ

$2C_2H_{2(g)} + 5O_{2(g)} \rightarrow 4CO_2 + 2H_2O + 1980\ kJ$