Chap. 5
CN
Fet. 5

Slide #2

$T = 100°C$
$= 373K$

(3)

$H_2O(\ell) \rightarrow H_2O(g)$

$\Delta_{vap}H° = 40.7\ kJ/mol$

$\Delta H = 40.7\ kJ$

$\Delta PV = PV_g - \cancel{PV_\ell}^{\approx 0}$

$= nRT = 1\,mol\left(8.31\ \frac{J}{mol\,K}\right)(373K)$

$= 3100\ \cancel{J} \times \frac{1\,kJ}{1000\ \cancel{J}} = 3.1\,kJ$

$\Delta U = \Delta H - \Delta(PV) = 40.7\,kJ - (3.1\,kJ) = 37.6\,kJ$

$\Delta H_{cond} = -\Delta H_{vap} = -40.7\ kJ/mol$

CN
Ch. 4
ch 5

Decane Combustion

(4)

$T = 25°C = 298K$

$C_{10}H_{22}(l) + O_2(g) \rightarrow 10CO_2(g) + 11H_2O(l)$

$31/2 = 15.5$

(A) $\Delta U = q = -95 kJ$

$n = \frac{2g}{142 g/mol} = 0.0141 mol$

$\Delta_{comb} U^0 = \frac{q}{n} = \frac{-95 kJ}{0.0141 mol}$

$= -6745 kJ/mol$

(B) $\Delta_{comb} H = \Delta_{comb} U + \Delta(PV)$

$= -6745 kJ/mol + (-13.6) = -6759 kJ/mol$

$\Delta PV = PV_{prod} - PV_{react} = [PV_{CO_2} + PV_{H_2O}]$ (0)

$- [PV_{C_{10}H_{22}} + PV_{O_2}]$ (0)

$= n_{CO_2} RT - n_{O_2} RT = RT[10 - 15.5]$

$= 8.31 (8.31)(298K) = -13,680 J \times \frac{1 kJ}{1000 J}$

$= -13.6 kJ$

Chap. 3
Feb 7

Example: Condensation of Water Vapor

$n = \frac{100\,g}{18\,g/mol} = 5.56\,mol$

383 K

Example: Calculate q, w, ΔU, and ΔH when 100 g of H_2O gas is condensed to the liquid at 1 bar and 100 °C.

$\Delta H = n\,\Delta_{cond}H = 5.5\,mol\,(-40.7\,kJ/mol)$

$q = = -226\,kJ$

~~$\Delta_{vap}H^\circ = 40.7$ kJ/mol~~

M = 18

$\Delta_{cond}H^\circ = -40.7\,kJ/mol$

$H_2O(g) \rightarrow H_2O(l)$

$w = -P[V_{liq} - V_{gas}]$

$= +PV_{gas} = nRT$

$= 5.5\,mol\,(0.31\,L\,bar/K\,mol)(383\,K)$

$= 817.20\,L\,bar = 82.2\,kJ = 17\,kJ$

$\Delta U = q + w = -226\,kJ + (17)$

$= -209\,kJ$

Chap. 3 Hess's Law Review Example #1 (Slide #30)
Feb. 7

$2C + H_2 \rightarrow C_2H_2$

Determine the enthalpy change for the formation of acetylene,

$2C(s) + H_2(g) \rightarrow C_2H_2(g)$ $\Delta H^\circ = ???$

from the thermochemical equations below.

(1) $C_2H_2(g) + (5/2)O_2(g) \rightarrow 2CO_2(g) + H_2O(l)$ $\Delta H_1 = -1299.6$ kJ

(2) $C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H_2 = -393.5$ kJ

(3) $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$ $\Delta H = -571.6$ kJ

1') $2CO_2 + H_2O \rightarrow C_2H_2 + \frac{5}{2}O_2$ $\Delta H_1' = -(-1299.6)$

$= +1299.6$ kJ

2') $2C + 2O_2 \rightarrow 2CO_2$ $\Delta H_2' = 2(-393.5)$

$= -787.0$ kJ

3') $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$ $\Delta H_3' = \frac{1}{2}(-571.6)$

$= -285.8$ kJ

$2CO_2 + H_2O + 2C + 2O_2 + H_2 + O_2 \rightarrow C_2H_2 + 5O_2 + 2CO_2 + H_2O$

$\Delta H = +1299.6 + (-787.0) + (-285.8)$

$= +226.8$ kJ

Chap. 3
Feb 7

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Chap. 3
Feb 7

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Feb. 7

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$2CO_2 + H_2O + 2C + 2O_2 + H_2 + O_2 \rightarrow C_2H_2 + 5O_2 + 2CO_2 + H_2O$

$\Delta H = +1299.6 + (-787.0) + (-285.8)$

$= +226.8$ kJ

Chap. 3 Hess's Law Review Example #2 (Slide #31)
Feb. 12

Determine the enthalpy of combustion of propene,
$C_3H_6(g) + (9/2)\ O_2(g) \rightarrow 3CO_2(g) + 3H_2O(l)$ $\Delta_{comb}H^\circ$ = ???
from the thermochemical equations below

(1) $2C_3H_6(g) + 2H_2(g) \rightarrow 2C_3H_8(g)$ $\Delta H = -248$ kJ

(2) $3CO_2(g) + 4\ H_2O(l) \rightarrow C_3H_8(g) + 5\ O_2(g)$ $\Delta H = +2220$ kJ

(3) $H_2(g) + (1/2)\ O_2(g) \rightarrow H_2O(l)$ $\Delta H = -286$ kJ

$C_3H_6 + \frac{9}{2}O_2 \rightarrow 3CO_2 + 3H_2O$

1') $C_3H_6 + H_2 \rightarrow C_3H_8$

2') $C_3H_8 + 5O_2 \leftarrow 3CO_2 + 4H_2O$

3') $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$

$\Delta H_1' = \frac{1}{2}(-248)$

$\Delta H_2' = -(+2220) = -2220$

$\Delta H_3' = +286$

$\Delta H = \frac{1}{2}(-248) - (2220) + 286$

$= -2058$ kJ

Q.3/
Fall 12

Ex 8 (36)

(L)

$$\Delta H = [2\Delta_f H^\circ(C_2H_5OH) + 2\Delta_f H^\circ(CO_2)] - [1\Delta_f H^\circ(C_6H_{12}O_6)]$$

$$= 2(-277.0) + 2(-393.5) - (-1268)$$

$$= -73.0\ kJ$$

Ex 8 (37)

$$\Delta H = 6\Delta_f H^\circ(CO_2) + 6\Delta_f H^\circ(H_2O) - [\Delta_f H^\circ(C_6H_{12}O_6) + 6(0)]$$

$$= -2808\ kJ$$

Ch 3
Sch 12

Ex - 51 38

$\Delta H = -3236 = [6(-393.5) + 7(-285.8)] - [2X + 0]$

$-3236 = -2X - 4361.6$

$2X = -4361.6 - (-3236)$

$2X = -1125.6$

$X = \frac{-1125.6}{2}$

$= -562.8 \text{ kJ/l}.$

$X = C_3H_7O_2N$