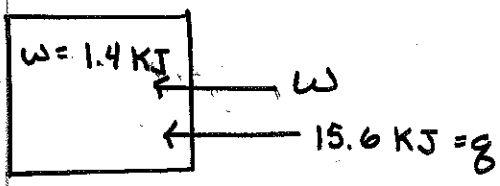
① Given:

$\Delta E = ?$



Endo
$+w$
$+q$

Soln:

$\Delta E = w + q$

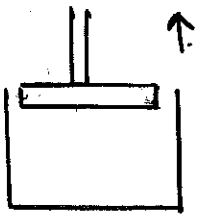
$= 1.4\,KJ + 15.6\,KJ$

$\boxed{\Delta E = 17.0\,KJ}$

②

Given:

$w = ?$



↑ Expansion ↑ V ∴ +V
· work done By system
∴ $-w$

$V_1 = 46L$

$V_2 = 64L$

$P = 15\,Atm$

Soln:

$w = -P\Delta V$

$= -P(V_f - V_i)$

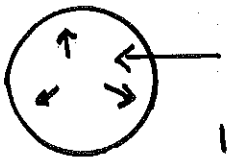
$= +(15Atm)(64L - 46L)$

$\boxed{w = -270\,L \cdot Atm}$

③ Given:

Ballon inflated → Expansion

$\Delta E = ?$



$V_1 = 4.00 \times 10^6 L$

$V_2 = 4.50 \times 10^6 L$

$P = 1.0\,Atm$

Soln:

$\Delta E = \overset{?}{w} + q$

$w = -P\Delta V$

$= -(1.0\,Atm)(4.50 \times 10^6 L - 4.00 \times 10^6 L)$

$w = -5.0 \times 10^5\ L \cdot Atm$

$\Delta E = \left(-5.00 \times 10^5\ L \cdot Atm\right)\left(\frac{101.3\,J}{Atm}\right) + 1.3 \times 10^8\,J$

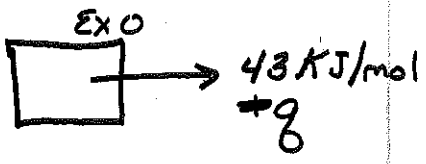
$= -5.1 \times 10^7\,J + 1.3 \times 10^8\,J$

$13 \times 10^7\,J$
$- 5.1 \times 10^7\,J$
$8 \times 10^7\,J$

$\boxed{\Delta E = 8 \times 10^7\,J}$

④ Given: $KOH_{(s)} \rightarrow KOH_{(aq)} + 43\ KJ/mol$

14.0g



Soln.: Beaker gets warmer ∴ Exo

-43 KJ/mol is for 1 mole $\Delta H = -43\ KJ/mol$

14.0g is how much of 1 mole?

$$\left(\frac{14.0\text{g KOH}}{1}\right)\left(\frac{1\text{ mole KOH}}{56.11\text{g KOH}}\right) = 0.250\text{ mole KOH}$$

$$\left(\frac{-.250\text{ mole KOH}}{1}\right)\left(-43\ KJ/\text{mole}\right) = \boxed{-11\ KJ/\text{mol Rxn}}$$

⑤ Given: In Calorimeter

$NaOH_{(aq)} + HCl_{(aq)} \rightarrow H_2O_{(e)} + NaCl_{(aq)} + ?$

1.0M 1.0M

100.0mL 100.0mL

Exo

$T_R = 24.6°C$ $T_P = 31.3°C$

All soln.

$d = 1.0\ g/cm^3$

$C_p = 4.184\ J/g°C$

$\Delta H = ?$

Soln.: Heat given off By Rxn = Heat Absorbed By Soln

$\Delta H = q$ @ constant p

$q = m C_p \Delta T$

$$m = \left(\frac{200.0\text{ ml}}{1}\right)\left(\frac{1.0\text{g}}{\text{cm}^3}\right)\left(\frac{1\text{cm}^3}{1\text{ml}}\right) = 200\text{g soln}$$

$$q = (200\text{g})\left(\frac{4.184\text{ J}}{\text{g C°}}\right)(31.3°C - 24.6°C)$$

$q = 5600\text{ J}$

$\boxed{\Delta H = -5.6\ KJ/\text{mole Rxn}}$ Exo, Heat Lost

⑥ Given: $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_2 + 2H_2O + 890\ KJ/mole$

$\Delta H = ?$ 1 mole, 5.8 g — EXO

Soln:

$$\left(\frac{5.8\ g\ CH_4}{1}\right)\left(\frac{1\ mole\ CH_4}{16.04\ g\ CH_4}\right) = 0.36\ mole\ CH_4$$

$$\left(\frac{0.36\ mole}{1}\right)\left(-890\ KJ/mole\right) = \boxed{-320\ KJ/mole\ Rxn}$$

heat flows

⑦ Given:

Constant Pressure Calorimetry

$Ba(NO_3)_{2(aq)} + Na_2SO_{4(aq)} \rightarrow BaSO_{4(s)} + 2NaNO_3 + q$

$Ba(NO_3)_2$: 1.00 L, 1.00 M, 25.0°C

Na_2SO_4: 1.00 L, 1.00 M, 25.0°C

28.1°C ∴ EXO

$c_p = 4.18\ J/°C\,g$

$D = 1.0\ g/mL$

$\Delta H = ? = q$ @ constant P

$\Delta T = 28.1° - 25.0°C = 3.1°C$

Soln:

mass of soln? $q = mc_p\Delta T$

$$\left(\frac{2.00\ L}{1}\right)\left(\frac{1.0\ g}{mL}\right)\left(\frac{1000\ mL}{L}\right) = 2000\ g$$

Total Volume

$$q = (2000\ g)(4.18\ J/°C\,g)(3.1°C)$$

$= -26000\ J$ EXO ∴ $-q$

$\Delta H = q$ $\boxed{= -26\ KJ/mol\ Rxn}$

(8) Given:

$$3Al_{(s)} + 3NH_4ClO_{4(s)} \rightarrow Al_2O_{3(s)} + AlCl_{3(s)} + 3NO_{(g)} + 6H_2O$$

ΔH_f° KJ/mol	0	-295	-1676	-704	90.0	-242

$\Delta H^\circ_{Rxn} = ?$

Soln:

$$\Delta H^\circ_{Rxn} = \Sigma \Delta H_{products} - \Sigma \Delta H_{Reactants}$$

$$\Sigma \Delta H_R = \Delta H_f^\circ Al_2O_3 + \Delta H_f^\circ AlCl_3 + 3\Delta H_f NO + 6\Delta H_f^\circ H_2O$$

$$= (-1676 + -704 + 3(90.0) + 6(-242)) \text{ KJ/mol}$$

$$= -3562 \text{ KJ/mol}$$

$$\Sigma \Delta H_P = 3\Delta H_f^\circ NH_4ClO_4$$

$$= 3(-295) \text{ KJ/mol}$$

$$= -885 \text{ KJ/mol}$$

$$\Delta H^\circ_{Rxn} = -3562 \text{ KJ/mol} - -885 \text{ KJ/mol}$$

$$\boxed{\Delta H^\circ_{Rxn} = -2677 \text{ KJ/mol Rxn}}$$

(9) Given:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + 2800 \text{ KJ}$$

$?H_f^\circ$ $\quad -393.5$ KJ $\quad -285.8$ KJ $= \Delta H_f^\circ$

Soln:

$$\Delta H_f^\circ = \Sigma \Delta H_P - \Sigma \Delta H_R$$

$$-2800 \text{ KJ (exo)} = (6\Delta H_f CO_2 + 6\Delta H_f H_2O) - \Delta H_f^\circ C_6H_{12}O_6$$

$$\Delta H_{f\,C_6H_{12}O_6}^\circ = [6(-393.5) + 6(-285.8)] \text{ KJ} + 2800 \text{ KJ}$$

$$= -2361 \text{ KJ} - 1715 \text{ KJ} + 2800 \text{ KJ}$$

$$\boxed{\Delta H_{f\,C_6H_{12}O_6}^\circ = -1276 \text{ KJ/mol}}$$

(10) Given: $2\,Al_{(s)} + Fe_2O_{3(s)} \rightarrow Al_2O_{3(s)} + 2\,Fe_{(s)} + ?$

Soln:

From Bodl P. 231 $\quad \phi \qquad -826\ KJ/mol \qquad -1676\ KJ/mol$

$$\Delta H^\circ_{f\,Rxn} = \Sigma \Delta H^\circ_{f\,P} - \Sigma \Delta H^\circ_{f\,R}$$

$$= -1676\ KJ/mol - (-826\ KJ/mol)$$

$$\boxed{\Delta H^\circ_{f\,Rxn} = -850.\ KJ/mol}$$

Exothermic

(11) Given: $2\,H_3BO_{3(aq)} \rightarrow B_2O_{3(g)} + 3\,H_2O_{(g)}$

$\Delta H = ?$

$2\times$	$H_3BO_{3(aq)} \rightarrow HBO_{2(aq)} + H_2O_{(l)}$	$-0.02\ KJ/mol$
$\frac{1}{2}\times R$	$H_2B_4O_{7(aq)} + H_2O_{(l)} \rightarrow 4\,HBO_{2(aq)}$	$-11.3\ KJ/mol$
$\frac{1}{2}X$	$H_2B_4O_{7(aq)} \rightarrow 2\,B_2O_{3(s)} + H_2O_{(l)}$	$8.75\ KJ/mol$

$2\,H_3BO_{3(aq)} \rightarrow 2\,HBO_{2(aq)} + 2\,H_2O_{(l)} \qquad -0.04\ KJ/mol$

$2\,HBO_{2(aq)} \rightarrow \frac{1}{2}\,H_2B_4O_{7(aq)} + \frac{1}{2}\,H_2O_{(l)} \qquad 5.65\ KJ/mol$

$\frac{1}{2}\,H_2B_4O_{7(aq)} \rightarrow B_2O_{3(s)} + \frac{1}{2}\,H_2O_{(l)} \qquad 8.75\ KJ/mol$

$2\,H_3BO_{3(aq)} \rightarrow B_2O_{3(s)} + 3\,H_2O_{(l)} \qquad 14.36\ KJ/mol$

+ ∴ Endothermic

(12) Given: $H_2 + F_2 \rightarrow 2\,HF$

$\Delta H = ?$ $\quad 432 \quad 154 \quad 565\ KJ/mol$

Soln:

$$\Delta H = \Sigma\,Bond\,E_{Broken} - \Sigma\,Bond\,E_{formed}$$

$$= H_2 + F_2 - 2\,HF$$

$$= 432\ KJ/mol + 154\ KJ/mol - 2(565)\ KJ/mol$$

$$\boxed{\Delta H = -544\ KJ/mole_{Rxn}}$$