① $P_{4(s)} + 5O_{2(g)} \rightarrow P_4O_{10(s)}$

8.90g $\quad \Delta H = -216.3\ kJ$ released ∴ −

$\Delta H_{comb} = ?$

Soln: $\left(8.90g\ P_4\right)\left(\frac{1\ mole\ P_4}{123.88g\ P_4}\right) = 0.0718\ mol\ P_4$

$$\Delta H_{comb} = \frac{-216.3\ kJ}{0.0718\ mol} = \boxed{-3010\ kJ/mol}$$

② Given: $Mg + 2HCl \rightarrow MgCl_2 + H_2$

$\Delta H = ?\ kJ/mol$ $\quad 0.7500g$ $\quad 150.00g$ $\quad 1.0M$

$C_{p\,water} = 4.184\ J/g°C$

$C_{p\,calor} = 2.90\ J/g°C$

$m_{cap} = 4.4g$

$T_1 = 22.2°C$ $\quad \Delta T = 44.8 - 22.2$

$T_2 = 44.8°C$ $\quad = 22.6°C$

Soln: $q = m_s C_{ps} \Delta T + m_{cal} C_{p\,cal} \Delta T$

$= (150.75g)(4.184\ J/g°C)(22.6°C)$

$+ (4.4g)(2.90\ J/g°C)(22.6°C)$

$= 14300J + 290J$

$= 14590J = 14.6\ kJ$

$\left(0.7500g\ Mg\right)\left(\frac{1\ mole\ Mg}{24.30g\ Mg}\right) = 0.0309\ mole\ Mg$

$\Delta H = -q$

$$\frac{14.6\ kJ}{0.0309\ mol} = \boxed{-472\ kJ}$$

③ A) $2N_2H_{4(g)} + N_2O_{4(g)} \rightarrow 3N_{2(g)} + 4H_2O_{(l)}$

Given: ΔH_f° 51 KJ 10. KJ -286 KJ

B) ΔH°_{Rxn} per mole N_2H_4

$$\Delta H^\circ_{Rxn} = \Sigma H^\circ_{fp} - \Sigma H^\circ_{fR}$$
$$= 4(-286\,KJ) - [2(51\,KJ) + (10.\,KJ)]$$
$$= -1144\,KJ - [-112\,KJ)$$
$$\Delta H^\circ_{Rxn} = -1256\,KJ$$

But per mole Eqn has coeff 2

$$\frac{-1256\,KJ}{2\,mol}$$

$$\Delta H^\circ_{Rxn\ N_2H_4} = -628\,KJ/mol$$

④ $2N_2H_{4(l)} + 2O_{2(g)} \rightarrow 2N_{2(g)} + 4H_2O_{(l)}$

51 KJ 0 -286 KJ

Less Heat of ⊕ formation since O_2 is Ø KJ while N_2O_4 had been 10 KJ

⑤
$$\Delta H^\circ_{Rxn} = \Sigma H^\circ_{fp} - \Sigma H^\circ_{fR}$$
$$= 4(-286\,KJ) - [2(51\,KJ)]$$
$$= -1246\,KJ$$

Per mole ∴ ÷2

$$\Delta H^\circ_{Rxn} = \frac{-1246\,KJ}{2}$$

$$\Delta H^\circ_{Rxn\ N_2H_4} = -623\,KJ/mol$$

(4) (A) $C_3H_8 + 5O_{2(g)} \longrightarrow 4H_2O_{(g)} + 3CO_{2(g)}$

10.0g 30. °C = 303°K 1.00 Atm ? V_{Air}

$V_{O_2} = 21.0\% V_{Air}$

(B) $\left(\frac{10.0\text{g } C_3H_8}{1}\right)\left(\frac{1\text{ mole } C_3H_8}{44.08\text{g } C_3H_8}\right)\left(\frac{5\text{ mole } O_2}{1\text{ mole } C_3H_8}\right) = 1.13\text{ mole } O_2$ needed to Burn 10.0g

$PV = nRT$

$V_{O_2} = \frac{nRT}{P} = \frac{(1.13\text{mole } O_2)(.08206\ \frac{L\,Atm}{mol\,K})(303\,K)}{1.00\text{ Atm}}$

$V_{O_2} = 28.1\text{ L}$

$V_{O_2} = 21.0\% V_{Air}$

$V_{Air} = \frac{V_{O_2}}{21.0\%} = \frac{28.1\text{ L}}{.210} = \boxed{134\text{ L}}$

(C) $C_3H_8 + 5O_{2(g)} \longrightarrow 4H_2O_{(g)} + 3CO_{2(g)}$

ΔH°_{comb} $-2220.1\ \frac{kJ}{mole}$ $-285.3\ \frac{kJ}{mol}$ $-393.5\ \frac{kJ}{mol}$

$\Delta H^\circ_f\ C_3H_8 = ?$

$H^\circ_{comb} = \Sigma H^\circ_{fp} - \Sigma H^\circ_{fR}$

$H^\circ_{f\,C_3H_8} = \Sigma H^\circ_{fp} - H^\circ_{comb}$

$H^\circ_{f\,C_3H_8} = \left[4(-285.3\ \frac{kJ}{mol}) + 3(-393.5\ \frac{kJ}{mole})\right] - (-2220.1\ \frac{kJ}{mol}$

$= -2321.7\ \frac{kJ}{mol} + 2220.1\ \frac{kJ}{mol}$

$\boxed{H^\circ_{f\,C_3H_8} = -101.6\ \frac{kJ}{mol}}$

(4)

(5) $C_3H_8 + 5O_2 \longrightarrow 4H_2O + CO_2$

30.0g 8.0kg = 8.0×10^3 g

$\Delta H^\circ_{comb} = -2220.1 \text{ kJ/mole}$ $C_p = 4.184 \text{ J/gK}$ $\Delta T = ?$ K

$$\left(\frac{30.0\text{ g } C_3H_8}{1}\right)\left(\frac{1\text{ mole } C_3H_8}{44.09\text{ g } C_3H_8}\right) = .680 \text{ mole } C_3H_8$$

$$\left(\frac{-2220.1\text{ kJ}}{\text{mole}}\right)(.680\text{ mol } C_3H_8) = -1510 \text{ kJ}$$

$$= -1.51 \times 10^6 \text{ J}$$

$q = m C_p \Delta T$

* $\Delta H = -q$

$$\Delta T = \frac{q}{mC_p} = \frac{+1.51 \times 10^6 \text{ J}}{(8.00 \times 10^3 \text{ g})\left(4.184 \frac{\text{J}}{\text{gK}}\right)}$$

$\Delta T = 45.1$ K°

(5)

A) goggles
Graduated cylinders
Coffee Cup Calorimeters
Thermometers
Balance/scale

B) Volume of Acid used
Volume of Base used
MASS of final soln in coffee Cup Calorimeter
MASS of empty & dry coffee Cup Calorimeter
Initial temp of Acid soln
Initial Temp of BASE soln
Final Temp of the final soln

C) Use the volume of Acid & Base used to determine the Limiting Rxn & then the moles of Reaction

(2) find $q = m\,c_p\,\Delta T$
q = MASS of Final soln
Δ = Δ in temp of Acid/BASE soln to its initial temp

(3) divide q By the moles of Reaction to obtain final ANSWER

d) Since the students obtained an Avg value LESS than the expected, Indicates that some heat was not accounted for in the Experiment.

(1) heat could have been lost to the Surroundings Resulting in a lower than correct temp change

(2) The other reason could Be the heat lost to the Calorimeter & Temperature probe would Also result in a lower correct temp change