

Evaluation

- (h) (i) If heat was lost to the surroundings, the ΔT and ΔH values would be low.
(ii) If MgO was on the surface of the magnesium, less Mg would be present and again the ΔT and ΔH values would be low.
- (i) Temperature and mass measurements may be inaccurate, and heat may be lost to the surroundings.
- (j) % difference = $\frac{|\text{accepted value} - \text{experimental value}|}{\text{accepted value}} \times 100\%$
- $$= \frac{|2601.6 \text{ kJ/mol} - (-508 \text{ kJ/mol})|}{2601.6 \text{ kJ/mol}} \times 100\%$$
- % difference = 15.5%

Synthesis

- (k) (Answers will vary.) The accuracy of this method depends on the sophistication of the apparatus. If bomb calorimetry had been used, the values would have been more accurate.

LAB EXERCISE 5.5.1 TESTING ENTHALPIES OF FORMATION

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Prediction

- (a) $\text{CH}_3\text{OH}_{(l)} + 3/2 \text{O}_{2(g)} \rightarrow 1 \text{CO}_{2(g)} + 2 \text{H}_2\text{O}_{(l)}$
- $$\Delta H_{\text{comb (methanol)}} = 1 \Delta H^\circ_{\text{f}(\text{CO}_{2(g)})} + 2 \Delta H^\circ_{\text{f}(\text{H}_2\text{O}_{(l)})} - 1 \Delta H^\circ_{\text{f}(\text{CH}_3\text{OH}_{(l)})} - \frac{3}{2} \Delta H^\circ_{\text{f}(\text{O}_{2(g)})}$$
- $$= 1(-393.5) + 2(-285.8) - 1(-239.1) - \frac{3}{2}(0)$$
- $$\Delta H_{\text{comb (methanol)}} = -726 \text{ kJ}$$
- The molar enthalpy of combustion of methanol is -726 kJ .

Analysis

- (b) $q_{\text{water}} = c \times \Delta T$
- $$= 10.9 \text{ kJ}/(^{\circ}\text{C}) \times (27.9^{\circ}\text{C} - 20.4^{\circ}\text{C})$$
- $$q_{\text{water}} = 81.7(5) \text{ kJ}$$
- $$n_{\text{methanol}} = 4.38 \text{ g} \times \frac{1 \text{ mol}}{32.0 \text{ g}}$$
- $$n_{\text{methanol}} = 0.137 \text{ mol}$$
- $$\Delta H_{\text{comb (methanol)}} = \frac{q_{\text{water}}}{n}$$
- $$= \frac{81.7(5) \text{ kJ}}{0.137 \text{ mol}}$$
- $$\Delta H_{\text{comb (methanol)}} = 597 \text{ kJ/mol}$$

Because the reaction is exothermic, the molar heat of combustion of methanol is -597 kJ/mol .

Evaluation

- (c) % difference = $\frac{|\text{accepted value} - \text{experimental value}|}{\text{accepted value}} \times 100\%$
- $$= \frac{|726 \text{ kJ/mol} - (-597 \text{ kJ/mol})|}{726 \text{ kJ/mol}} \times 100\%$$
- % difference = 18%

This is a reasonable result, given relatively simple apparatus.