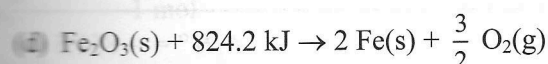
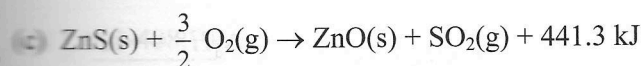
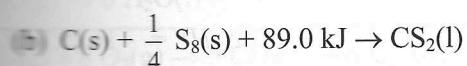
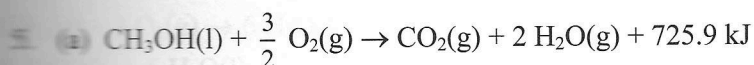


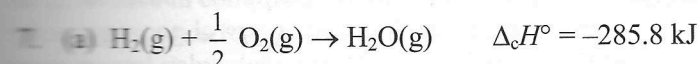
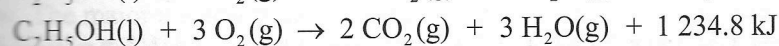
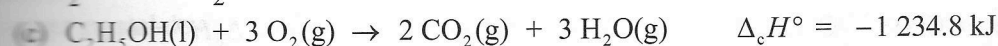
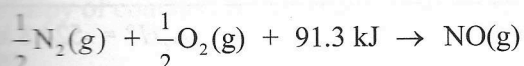
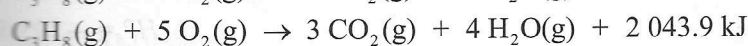
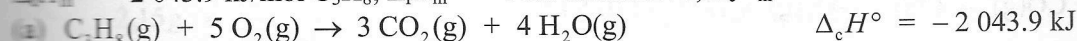
$$(d) \Delta_c H_m^{\circ} = \frac{-114 \text{ kJ}}{2 \text{ mol}} = -57 \text{ kJ/mol}$$



[Note the advantage of writing the chemical equation using one mole of the substance whose molar enthalpy is given. All of these chemical equations could be written with integer coefficients and appropriate enthalpy changes.]

6. [Note that the standard molar enthalpies of reaction should have been provided because the Alberta Education Data Booklet and the Appendices no longer list molar enthalpies of combustion.]

$$\Delta_c H_m^{\circ} = -2043.9 \text{ kJ/mol } \text{C}_3\text{H}_8; \Delta_f H_m^{\circ} = +91.3 \text{ kJ/mol } \text{NO}; \Delta_c H_m^{\circ} = -1234.8 \text{ kJ/mol } \text{C}_2\text{H}_5\text{OH}$$



- (b) The enthalpy changes are of the same magnitude, and differ only in that one is negative (exothermic) and the other positive (endothermic). Reactions that are exactly the reverse of each other have the same magnitude for the enthalpy change, but are of opposite sign.

$$\text{In general, } \Delta_r H_{(\text{reverse})} = -\Delta_r H_{(\text{forward})}$$

8. Combustion reactions often produce greenhouse gases like  $\text{CO}_2(\text{g})$  (and  $\text{H}_2\text{O}(\text{g})$ ). Further, combustion of fossil fuels often produces toxic or harmful nitrogen and sulfur oxides.

Drawbacks	Possible solutions
greenhouse gas emissions, contributing to climate change	<ul style="list-style-type: none"> <li>trap <math>\text{CO}_2(\text{g})</math> emissions to, for example, inject underground to increase the percentage of crude oil obtained from oil wells</li> <li>use alternative technologies that do not produce <math>\text{CO}_2(\text{g})</math>, such as hydrogen fuel cells, electric cars, and windmills</li> </ul>
harmful or toxic nitrogen and sulfur oxides	<ul style="list-style-type: none"> <li>use scrubbers or other technologies to remove harmful oxides, e.g., less sulfur in gasoline and diesel fuel</li> <li>use catalytic converters for cars and trucks to, for example, change nitrogen oxides back to nitrogen</li> </ul>