1. Carbon-based fuels are not only important for energy production, but are also important as feedstock (raw materials) for chemical industries. Consequently, use for energy results in less available for chemical industries.
   The use of biofuels for energy production may free up more fossil fuels as feedstock for chemical industries.

2. Carbon (soot), carbon monoxide, unburnt hydrocarbons. Soot can create visual pollution, restrict light to leaves, damage the respiratory system, etc. Carbon monoxide pollution can deprive the body of oxygen leading to adverse health effects. Unburnt hydrocarbons react with other molecules in the atmosphere and produce secondary pollutants.

3.
   (a) heptane: $C_7H_{16} + 11O_2 \rightarrow 7CO_2 + 8H_2O$
   (b) ethane: $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$
   (c) glucose: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
   (d) methanol: $2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$
   (e) propanol: $2C_3H_7OH + 9O_2 \rightarrow 6CO_2 + 8H_2O$

4.
   (a) $C_3H_{8\,(g)} + 5O_{2\,(g)} \rightarrow 3CO_{2\,(g)} + 4H_2O_{\,(l)}$ $\Delta H = -2220$ kJ mol^{-1}
   (b) $C_4H_{10\,(g)} + \frac{13}{2}O_{2\,(g)} \rightarrow 4CO_{2\,(g)} + 5H_2O_{\,(l)}$ $\Delta H = -2886$ kJ mol^{-1}
   (c) $NH_4NO_{3\,(s)} \rightarrow NH_4^{+}{}_{(aq)} + NO_3^{-}{}_{(aq)}$ $\Delta H = +25$ kJ mol^{-1}
   (d) $NaOH_{(aq)} + HNO_{3\,(aq)} \rightarrow NaNO_{3\,(aq)} + H_2O_{\,(l)}$ $\Delta H = -57.1$ kJ mol^{-1}

5.
   (a) 890 kJ
   (b) M = 16.04 g mol^{-1} so one gram is $1 \div 16.04 = 0.0623$ mol, so $890 \times 0.0623 = 55.5$ kJ
   (c) 55.5 GJ (5.55×10^7 kJ or 5.55×10^{10} J)

6. (a) $m = 500.0$ g $\quad \Delta T = 33.5 - 22.6 = 10.9$ °K
   $E = mc\Delta T = 500.0\times4.18\times10.9 = 22.8$ kJ
   (b) $m = 151.2 - 149.6 = 1.6$ g
   $n = \frac{m}{M} = \frac{1.6}{284} = 5.63\times10^{-3}$ mol
   $\frac{22.8}{5.63\times10^{-3}} = 4.04\times10^3$ kJ or 4.04 MJ $\quad$ (accept "per mole" variants)

7. (a) $m = 1.00\times10^6$ g $\quad M = 12.01 + (4\times1.008) = 16.042$ g mol^{-1}
   $n = \frac{m}{M} = \frac{1.00\times10^6}{16.042} = 6.23\times10^4$ mol
   $6.23\times10^4 \times 890 = 5.55\times10^7$ kJ = 5.55×10^4 MJ = 55.5 GJ
   (b) $E = 5.55\times10^{10}$ J $\quad \Delta T = 70.0 - 20.0 = 50.0$ °K
   $m = \frac{E}{c\Delta T} = \frac{5.55\times10^{10}}{4.18\times50.0} = 2.66\times10^8$ g $\quad \therefore 266$ kL