11.8 The idea is to pick a gas with the weakest intermolecular forces, so that when it gets cold, the gas doesn't liquify. CH₄, C₂H₆, and C₄H₁₀ are all nonpolar, so the intermolecular forces are induced-dipole/induced dipole (London or dispersion forces). London forces increase with larger numbers of electrons, so C₄H₁₀ will be most likely to liquify, while CH₄ will not, so choose CH₄ as your fuel.

11.10 (a) nonpolar, dispersion forces
(b) polar, dipole-dipole forces
(c) polar, dipole-dipole forces
(d) ionic compound, ion-ion forces
(e) nonpolar, dispersion forces

11.12 There must be a bond between either N, O, F and H

(a) no (d) no
(b) no (e) yes
(c) no

11.16 (a) Xe because more electrons and therefore more polarizable which means greater dispersion forces
(b) CS₂ because same reasons
(c) Cl₂  "   "
(d) LiF because ionic bonds are strongest
(e) NH₃ even though fewer electrons, etc. NH₃ hydrogen bonds
11.32 Ethylene glycol has two -OH groups, allowing hydrogen bonding like ethanol (one -OH group \( \text{CH}_3\text{CH}_2\text{-OH} \)) and glycerol (three -OH groups).

11.77 \( \Delta H_{\text{vap}} = 40.79 \text{ kJ/mol} \) (Table 11.6, p. 447)

\[
\text{moles} = \frac{74.68 \text{ g}}{18.02 \text{ g/mol}} = 4.14 \text{ mol}
\]

\[
q = 4.14 \text{ mol} \times 40.79 \text{ kJ/mol} = 169 \text{ kJ}
\]

11.80 \( \Delta H_{\text{sub}} = \Delta H_{\text{fus}} + \Delta H_{\text{vap}} \)

\[
\Delta H_{\text{vap}} = \Delta H_{\text{sub}} - \Delta H_{\text{fus}}
\]

\[
= 62.30 - 15.27 \text{ kJ/mol}
\]

\[
= 47.03 \text{ kJ/mol}
\]

11.81 The substance with the lowest boiling point will have the highest vapor pressure at a given temperature. So butane will have the highest vapor pressure at \(-10^\circ\text{C}\) and toluene the lowest.
11.86 Use the Clausius-Clapeyron equation:

\[
\ln \left( \frac{P_1}{P_2} \right) = -\frac{\Delta H_{\text{vap}}}{R} \left( \frac{1}{T_1} - \frac{1}{T_2} \right)
\]

\[
R = 8.314 \text{ J/mol} \cdot \text{K}
\]

\[
P_1 = 40.1 \text{ mm Hg}
\]

\[
P_2 = ?
\]

\[
T_1 = 7.6^\circ \text{C} + 273.15 = 280.75 \text{ K}
\]

\[
T_2 = 60.6^\circ \text{C} + 273.15 = 333.75 \text{ K}
\]

\[
\Delta H_{\text{vap}} = 31.0 \text{ kJ/mol}
\]

\[
\ln \left( \frac{40.1 \text{ mm Hg}}{P_2} \right) = -\frac{31.0 \text{ kJ/mol}}{8.314 \times 10^{-3} \text{ kJ/mol} \cdot \text{K}} \left[ \frac{1}{280.75 \text{ K}} - \frac{1}{333.75 \text{ K}} \right]
\]

\[
\ln \left( \frac{40.1}{P_2} \right) = -3728.65 \text{ K} \left[ 5.656 \times 10^{-4} \text{ K}^{-1} \right]
\]

\[
\ln \left( \frac{40.1}{P_2} \right) = -2.109
\]

\[
\frac{40.1}{P_2} = e^{-2.109}
\]

\[
\frac{40.1}{P_2} = 0.1214
\]

\[
P_2 = \frac{40.1 \text{ mm Hg}}{0.1214} = 330. \text{ mm Hg}
\]
11.93

Graph showing phases of a substance at different pressures and temperatures. Key points include:
- Normal freezing point: $-72.7^\circ C$
- Normal boiling point: $-10^\circ C$
- Triple point: $P = 1.65 \times 10^{-3}$ atm, $T = -75.5^\circ C$

11.94
(a) solid $\rightarrow$ liquid $\rightarrow$ gas (melting followed by boiling)
(b) gas $\rightarrow$ solid (reverse of sublimation = deposition)
(c) liquid $\rightarrow$ gas (boiling as reduce pressure)

11.104 The critical point has been reached