and the amount of heat is

$$Q = \Delta H_{ab} = z_1(H_{V1} - H_{L1}) + z_2(H_{V2} - H_{L2}),$$

where $H_{Vi} - H_{Li}$ is the enthalpy change of pure component i from 1 bar, 25 °C, to 1 bar, 150 °C. These enthalpies may be calculated by any acceptable method. Using tabulated values from the NIST Chemistry WebBook:

P (bar)	T (°C)	H_1 (kJ/mol)	H_2 (kJ/mol)
1	25	−7.6978	−14.572
1	150	38.547	38.903

$$Q = (0.23)(38.547 - (-7.6978)) + (0.77)(38.903 - (-14.572)) = 51.81 \text{ kJ/mol}.$$

Comments When no hypothetical states are ~~involve,~~ the calculation of energy balances is straightforward.

involved

11.5 Noncondensable Gases

When only a single component is present (pure fluid), below the boiling temperature the system is liquid, and above it vapor. When two liquids are mixed to form a solution, then a component produces a vapor over a range of temperatures, from the bubble point to the dew point. This range is expanded even further if the second component is a gas above its critical temperature. We refer to such a gas as *noncondensable* to emphasize the fact that it does not undergo a vapor-liquid transition as long as temperature remains above the critical point. For example, pure water[6] at 1 atm cannot exist as vapor below 100 °C but in the presence of air it produces vapor even at room temperature. The presence of an noncondensable gas alters the phase behavior of a system, even when the gas itself has negligible solubility in the liquid. In reality, gases have a finite solubility in the liquid and they participate in phase equilibrium by partitioning between both phases. This problem will be discussed in Chapter 13. However, under pressures at temperatures near ambient, the solubility of most gases in liquids is low and it is an acceptable approximation to assume that the liquid phase contains only the condensable species. a

Suppose that an ideal solution of two components ($i = 1, 2$) is in the presence of a noncondensable gas (subscript g). Neglecting the solubility of the gas in the liquid, the liquid contains only the liquid components while the gas contains the

6. By "pure water" we mean a system that contains only water but no other substance. We may visualize such experiment by placing liquid water in a cylinder with a piston and moving the piston to touch the free surface of the liquid so that no gas is present.