Table 9-1: Properties of mixture in the ideal-gas state. All properties (mixture or pure component) are understood to be in the ideal-gas state. The superscripts $^{\text{ig}}$ and $^{\text{igm}}$ have been omitted for simplicity.

Property of ideal-gas mixture	Property of mixing	Partial molar
$V = \sum x_i V_i$	$\Delta V_{\text{mix}} = 0$	$\overline{V}_i = V_i$
$H = \sum x_i H_i$	$\Delta H_{\text{mix}} = 0$	$\overline{H}_i = H_i$
$S = \sum x_i S_i - R \sum x_i \ln x_i$	$\Delta S_{\text{mix}} = -R \sum x_i \ln x_i$	$\bar{S}_i = S_i - R x_i \ln x_i$
$U = \sum x_i U_i$	$\Delta U_{\text{mix}} = 0$	$\overline{U}_i = U_i$
$G = \sum x_i G_i + RT \sum x_i \ln x_i$	$\Delta G_{\text{mix}} = RT \sum x_i \ln x_i$	$\overline{G}_i = G_i + RT x_i \ln x_i$

Other Properties

Other properties of the ideal-gas mixture can be obtained easily. For example, for the internal energy we write

$$U^{\text{igm}} = H^{\text{igm}} - PV^{\text{igm}} = \sum_i x_i \left(H_i^{\text{ig}} - PV_i^{\text{ig}} \right),$$

where we used eqs. (9.26) and (9.25) for the enthalpy and volume of the ideal-gas mixture. The quantity in parenthesis on the right-hand side in the above equation is the ideal-gas internal energy. Therefore, the final result for internal energy is

$$U^{\text{igm}} = \sum_i x_i U_i^{\text{ig}}. \tag{9.32}$$

From this result it also follows that the internal energy of mixing is zero, and the partial molar internal energy is equal to the internal energy of the pure component:

$$\Delta U_{\text{mix}}^{\text{igm}} = 0, \tag{9.33}$$

$$\overline{U}_i = U_i. \tag{9.34}$$

The corresponding results for the Gibbs free energy are

$$G^{\text{igm}} = \sum_i x_i G_i^{\text{ig}} + RT \sum_i x_i \ln x_i, \tag{9.35}$$

$$\Delta G_{\text{mix}}^{\text{igm}} = RT \sum_i x_i \ln x_i, \tag{9.36}$$

Right hand side missing xi before ln xi -- table 9-1 has the right expression

$$\overline{G}_i = G_i + RT \ln x_i. \tag{9.37}$$

These are obtained from the relationship between G, H, and S and their derivation is left as an exercise.