1 Reference Constants

This chapter summarizes all reference constants needed for evaluating the equations given in Chaps. 2 and 3.

The specific gas constant of ordinary water,

$$R = 0.461\,526 \text{ kJ kg}^{-1} \text{ K}^{-1}, \tag{1.1}$$

results from the value of the molar gas constant [2],

$$R_\text{m} = 8.314\,51 \text{ kJ kmol}^{-1} \text{ K}^{-1}, \tag{1.2}$$

and from the molar mass of ordinary water,

$$M = 18.015\,257 \text{ kg kmol}^{-1}. \tag{1.3}$$

The value of the molar mass of ordinary water results from the molar masses of hydrogen, M_H, and oxygen, M_O, based on the molar masses of H and O [3] and the concentration of the corresponding isotopes [4]. The values of R_m and M are not the current values for these quantities[2] and thus not for the specific gas constant R as given in Eq. (1.1). However, this value of R must be used in all equations in Chap. 2, which contain the specific gas constant, because the equations were developed based on the value of R according to Eq. (1.1).

The values of the critical parameters

$$T_\text{c} = 647.096 \text{ K}, \tag{1.4}$$
$$p_\text{c} = 22.064 \text{ MPa}, \tag{1.5}$$
$$\rho_\text{c} = 322 \text{ kg m}^{-3} \tag{1.6}$$

are from the corresponding IAPWS release [5]. The triple-point temperature is

$$T_\text{t} = 273.16 \text{ K} \tag{1.7}$$

according to the International Temperature Scale of 1990 (ITS-90) [6] and the triple-point pressure

$$p_\text{t} = 611.657 \text{ Pa} \tag{1.8}$$

was determined by Guildner et al. [7]. According to the scientific standard for the thermodynamic properties of ordinary water, the IAPWS-95 formulation [8, 9], the temperature of the normal boiling point (at a pressure of 0.101 325 MPa (1 atm)) amounts to

$$T_\text{b} = 373.1243 \text{ K}. \tag{1.9}$$

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[2] The current value of the molar gas constant is $R_\text{m} = 8.314\,459\,8$ kJ kmol^{-1} K^{-1} [10]. The current value of the molar mass of ordinary water is that of VSMOW (Vienna Standard Mean Ocean Water) [11]. Its value is $M = 18.015\,268$ kg kmol^{-1} [12]. This value is based on combining the isotopic composition of VSMOW with the accepted atomic mass of each isotope. According to these values for R_m and M the current value for the specific gas constant of ordinary water is $R = 0.461\,523\,1$ kJ kg^{-1} K^{-1}.