Figure 17.1 Corotating coordinates for a binary star system.

Figure 17.2 The effective gravitational potential $\Phi$ for two stars of mass $M_1 = 0.85 \, M_\odot$, $M_2 = 0.17 \, M_\odot$ on the $x$-axis. The stars are separated by a distance $a = 5 \times 10^{10} \, \text{cm} = 0.718 \, R_\odot$, with their center of mass located at the origin. The $x$-axis is in units of $a$, and $\Phi$ is expressed in units of $G(M_1 + M_2)/a = 2.71 \times 10^{15} \, \text{ergs g}^{-1}$. (In fact, the figure is the same for any $M_2/M_1 = 0.2$.) The dashed line is the value of $\Phi$ at the inner Lagrangian point. If the total energy per gram of a particle exceeds this value of $\Phi$, it can flow through the inner Lagrangian point between the two stars.

Figure 17.3 Equipotentials for $M_1 = 0.85 \, M_\odot$, $M_2 = 0.17 \, M_\odot$, and $a = 5 \times 10^{10} \, \text{cm} = 0.718 \, R_\odot$. The axes are in units of $a$, with the system’s center of mass (the “x”) at the origin. Starting at the top of the figure and moving down toward the center of mass, the values of $\Phi$ (in units of $G(M_1 + M_2)/a = 2.71 \times 10^{15} \, \text{ergs g}^{-1}$) for the equipotential curves are $\Phi = -1.875, -1.768, -1.583, -1.583, -1.768$ (the “dumbbell”), $-1.875$ (the Roche lobe), and $-3$ (the spheres). $L_4$ and $L_5$ are local maxima, with $\Phi = -1.431$.

Figure 17.4 The classification of binary star systems. (a) Shows a detached system, (b) shows a semidetached system in which the secondary star has expanded to fill its Roche lobe, and (c) shows a contact binary.