Stellar Evolution – Hints to exercises – Chapter 12

12.1 Mass loss of massive stars during the main sequence

(a) $\Delta M/M_i = 10^{-4.02}(M_i/M_\odot)^{2.93}$. Answer: 5, 12, 26, 51 and 98 %.

(b) $\Delta t = 0.17 M_i/\dot{M} = 9.5 \times 10^5$ yrs.

(c) Because of the mass loss deeper and deeper layers of the star are revealed, i.e.: WNL → WNE → WC. The star in (b) becomes a WNL star.

12.2 Maximum mass loss rate for a radiation driven wind

(a) The rate at which momentum is carried away in the wind is $\dot{M}v_\infty$. The momentum of a photon is $E_{\rm ph}/c$, so the momentum carried by all photons per second is L/c.

(b) $\dfrac{v_\infty}{2c} \ll 1$

12.3 Burning stages

(a) Due to the strong neutrino losses, $L_\nu \gg L$ (see Sec. 12.3.1).

(b) Oxygen is a very strongly bound nucleus ('double magic' ⇒ $N = Z = 8$, see Sec. 6.4.3).