

ASTR367 - HW5

October 9, 2023, Due October 13, 2023

Weighted 2/3 as much as the others

1) Estimate the Eddington limit for  $\eta$  Car and compare your answer with the luminosity of that star (e.g., from Wikipedia). Is your answer consistent with a star that is losing a significant amount of its mass?

2) During the Great Eruption of  $\eta$  Car, the apparent visual magnitude reached a characteristic value of  $m_V \simeq 0$ .

(a) Estimate the luminosity of  $\eta$  Car during the Great Eruption. Look up values as needed (except the luminosity!).

(b) Determine the total amount of photon energy liberated (in J or erg) during the twenty years of the Great Eruption.

(c) If  $3 M_\odot$  of material was ejected at a speed of  $650 \text{ km s}^{-1}$ , how much energy went into the kinetic energy of the ejecta?

3) Supernovae!

a) In a supernova, essentially all the pressure in the core is removed at once. Estimate how long it takes for a supernova to happen from the free-fall time. Assume only the interior iron core collapses at the free-fall rate.

b) Assume there are 1000 detectable supernova remnants in our Galaxy and that 1 in  $10^6$  stars is massive enough to go supernova. How long are supernova remnants detectable?