End of Convection Lecture, Oct 31
\( \dot{\lambda} \) - total energy loss rate

\[ \dot{\lambda} = 5 \ell \]

\[ f = \frac{4a_0 T^3}{3k} \frac{\partial T}{\partial n} \]

\( n \) is normal to surface element

\[ \frac{\partial T}{\partial n} = -2\frac{\partial T}{\partial \tau} \]

\( \dot{\lambda} = 5 \ell = \frac{8a_0 T^3}{3k} \frac{\partial T}{\partial S} \frac{\partial S}{\partial \tau} \]

\( \rho V c_p \frac{\partial T}{\partial \tau} = -\dot{\lambda} \) \text{ Luminosity of star}
Temp decrease per unit length traversed
(blood moves with velocity \( v \))

\[ \frac{dT}{dT} = \frac{\frac{dI}{dv}}{\rho v c_p v} \]

Multiply by \( \frac{\rho v c_p v}{\lambda} \) and get

\[ \frac{\rho v c_p v}{\lambda} \Delta T = \frac{\lambda}{\rho v c_p v} \]

Now \( \Delta T \) can be replaced by the average DT given in (2) and the term factor

\[ \frac{2}{VAD} = \left( \frac{\text{ft}}{\text{m}^3} \right) \text{ for aspirin at diameter} \]
In literature

\[ \frac{\lambda_m}{\sqrt{d}} \sim \frac{\alpha}{\lambda_m} \]

Which we adopt.

Then (5) becomes

\[ \nabla e - \nabla \rho d = \frac{6a c T^3}{\nabla \cdot \nabla e} \frac{K p^2 c p \lambda_m v}{K p^2 c p \lambda_m v} \]

\[ \lambda_m = \alpha H p \]

\[ 1 < \lambda < 2 \]
Summary:

\[ F_{\text{rad}} + F_{\text{con}} = \frac{4\pi c G}{3} \frac{T^4 m}{K r^2} \nabla \cdot \nabla \]

\[ F_{\text{rad}} = \frac{4\pi c G}{3} \frac{T^4 m}{K r^2} \nabla \cdot \nabla \]

\[ \nu^2 = g \delta (\nabla - \nabla_c) \frac{L_m^2}{\delta H_p} \]

\[ F_{\text{con}} = \rho c_p T \sqrt{g \delta} \frac{L_m^2}{4 \sqrt{2}} H_p^{-3/2} (\nabla - \nabla_c)^{3/2} \]

\[ \frac{\nabla_c - \nabla}{\nabla - \nabla_c} = \frac{6ac T^3}{K \rho c_p L_m N} \]
Solve for

\[ F_{rad} + F_{con} = \nabla x, \nabla \]

given

\[ P, T, \beta, \mu, \gamma, \mu_{rad}, \nabla \text{rad}, g \]