Eddington Luminosity

$$\vec{g} = -\frac{GM_r}{r^2}\frac{\vec{r}}{r} \quad , \quad \vec{g}_{rad} = -\frac{1}{\rho}\frac{dP_{rad}}{dr}\frac{\vec{r}}{r}$$

with $\frac{dP_{rad}}{dr} < 0$

Here we assume that the only pressure present is radiation, which approximates the surface of the star.

Using $\frac{dP_{rad}}{dr} = -\frac{\kappa \rho F}{c} = -\frac{\kappa \rho}{c}\frac{L_r}{4\pi r^2}$

$$\Rightarrow \vec{g} + \vec{g}_{rad} = -\left(\frac{GM_r}{r^2} - \frac{1}{\rho}\frac{\kappa\rho}{c}\frac{L_r}{4\pi r^2}\right)$$

$$= -\frac{GM}{R^2}\left(1 - \frac{\kappa L}{4\pi c GM}\right) \quad \text{for } r = R$$

We define the Eddington Luminosity:

$$L_{EDD} = \frac{4\pi c GM}{\kappa}$$

Numerically: $\frac{L}{L_\odot} = 1.3 \cdot 10^4 \frac{1}{\kappa}\frac{M}{M_\odot}$