UNIVERSITY OF KANSAS
Department of Physics and Astronomy
Astrophysics I (ASTR 691) — Prof. Crossfield — Fall 2026

In-Class Problems 6

You may use your OoMA Sheet, your handwritten notes, and a scientific or graphing calculator – and you may work in a group. As always, be sure to: show your work, circle or highlight your final answer, list units, use the appropriate number of significant figures, and write your name.

1. **Equation of Radiative Transfer [21 pts]**.

   (a) Write the general form of the Equation of Radiative Transfer (not the *solution* to the Eqn. of Radiative Transfer; also, ignore terms of directionality such as μ or θ, which we haven't discussed in lecture yet). Thoroughly explain the meaning of all terms, and the meaning of the overall equation. [5 pts]

   (b) Show that if emission is negligible, that the solution to the equation of radiative transfer is

   $$I(\tau) = I_0 e^{-\tau}. \tag{1}$$

   Explain what this expression means, in words. [3 pts]

   (c) Show that if the source function is constant and absorption is negligible, then another solution is:

   $$I(\tau) = I_0 + \tau S. \tag{2}$$

   Explain what this expression means, in words. [3 pts]

   (d) Show that if the source function is constant and neither absorption nor emission can be ignored, the general solution is

   $$I(\tau) = I_0 e^{-\tau} + S\left(1 - e^{-\tau}\right). \tag{3}$$

   Explain what each term in this expression means, in words. [5 pts]

   (e) In Eq. 3, what is the emergent intensity $I(\tau)$: (i) if $\tau = 0$? (ii) if $\tau \gg 1$? (iii) if $0 < \tau \ll 1$? [5 pts]