ASTRONOMY 8300 – FALL 2024
Homework Set 2, Due 10/7/24 at 9:30 AM

1.a. (5 pts) Suppose that the interstellar medium contains dust grains with uniform number density of 10^{-12} cm^{-3}, all with the same radius of 10^{-5} cm, and extinction efficiency $Q_E = 0.5$ at the wavelength of the V band (5500 Å). If a star is at a distance of 1 kpc, what is the optical depth of the dust between the star and the Earth at 5500 Å?

b. (5 pts) What is the extinction in magnitudes at 5500 Å as seen from the Earth? If the dust were removed, how much brighter would the star's flux at 5500 Å be as measured from the Earth?

c. (5 pts) Assuming the standard Galactic extinction curve, what is the extinction at 1200 Å? If the dust were removed, how much brighter would the star be at 1200 Å?

2.a. (20 pts) Derive an expression for the temperature of dust (T_D) at a distance d from a star with radius $R*$ and temperature $T*$, assuming constant absorption and emission efficiencies Q_A and Q_{Emis}.

b. (15 pts) Given an isolated O star with a temperature of 50,000 K and radius of 12.0 $R\odot$, and assuming that $Q_A = 1$ and $Q_{Emis} = 1$, what is the distance from the star at which the dust sublimates (at a temperature of 1500 K). What is the distance at which the dust temperature reaches 20 K?

3. Suppose that you have two stars at the same distance with identical intrinsic continuum fluxes as a function of wavelength, but one star is reddened and the other is not. The following table gives the wavelength (λ in Å), intrinsic flux from the undreddened star (F_0 in 10^{-14} ergs s^{-1} cm^{-2} Å^{-1}), and the flux from the reddened star (F_λ in 10^{-14} ergs s^{-1} cm^{-2} Å^{-1}).

λ	1100	1650	2200	2750	3300	3850	4400	4950	5500	6050	6600
F_0	3.779	2.443	1.788	1.361	1.049	0.831	0.689	0.590	0.524	0.486	0.463
F_λ	0.743	0.622	0.555	0.507	0.468	0.434	0.401	0.371	0.348	0.336	0.320

a. (10 pts) What is E (B-V) for the reddened star?
b. (10 pts) What is the approximate H I column to the reddened star?
c. (10 pts) What is R_V?
d. (10 pts) Plot R_λ (the reddening curve) as a function of wavelength.
e. (10 pts) How does the reddening curve compare to those for the Galaxy, LMC, and SMC?