3. Moonshine

a. The Moon-Sun distance ~ Earth-Sun

$\therefore$ from sun, $E^{moon}_{sun} = S_0 = 1380\ W\,m^{-2}$

from Earth, we must calculate total thermal radiant flux $(\sigma T_E^4 \cdot 4\pi R_E^2)$, divided by $4\pi r_{E-m}^2$, r_{EM}: Earth-moon

$$\therefore E^{moon}_{Earth} = \frac{5.67\times10^{-8}\cdot(255)^4\cdot 4\pi\cdot(6.4\times10^6)^2}{4\pi\cdot(3.84\times10^8)^2} = 0.07\ W\,m^{-2}$$

$$E^{moon}_{Earth}/E^{moon}_{Sun} = \frac{0.7}{1380} = 5\times10^{-5}$$ very small

b. $$T_{moon} = \left(\frac{1380\times(1-0.06)}{4\cdot5.67\times10^{-8}}\right)^{1/4} = 275\ K$$

4.

a. $E/E_0 = \exp(-k\rho z)$ for $k\rho = 0.01\ m^{-1}, 0.1\ m^{-1}, 1\ m^{-1}$

See next plot

b. $$E/E_0 = \exp\left\{-\int_{100}^{z} k\rho_0 \exp\left(-\frac{z'}{H}\right)dz'\right\}$$

do integral: $$\int_{100}^{z}\exp\left(-\frac{z'}{H}\right)dz' = -H\left(\exp\left(-\frac{z'}{H}\right)\right)\Big|_{100}^{z}$$

$$= H\left(\exp\left(-\frac{z}{H}\right) - \exp\left(-\frac{100}{H}\right)\right) \sim H\exp\left(-\frac{z}{H}\right)$$

$\frac{100}{H}$: ≈ 7

$\therefore$

$$E/E_0 = \exp\left(-0.01\cdot1.2\cdot7\times10^3\cdot\exp\left(-\frac{z}{H}\right)\right)$$

$$= \exp\left(-84\exp\left(-z/H\right)\right)$$

see attached plot.