Name_____

1. Absorption in the atmospheric window region between 8 and 13 μm is represented by an absorption coefficient of the form $k_2 e$ where e is the water vapor pressure (in kPa), $k_2 \approx 10^{-1}$ (g cm^{-2})$^{-1}$ kPa^{-1}. If the temperature is 298 K and the relative humidity is 31.6% calculate (1) the transmission of a horizontal path 1 km long at the surface, and (2) the transmission of a vertical path of atmosphere assuming that the distribution of water vapor pressure is proportional to pressure to the fourth power.

2. The absorption coefficient in the continuum has the form

$$k_\nu \approx k_{2,\nu} e$$

where e is the water vapor partial pressure in units of atmospheres. Assuming a hydrostatic atmosphere

$$p = p_S \, e^{-z/H}$$

where p_s=1013.13 mb, and assuming that the mixing ratio profile of water vapor is similarly exponential with

$$H_v = H/3$$

where H_v is the scale height of the vapor. Derive an expression for the optical mass *u* for the vertical path from $\bar{p}$=0 to $\bar{p}$ where $\bar{p} = p/p_S$ is the pressure in atmospheres. Express your answer in terms of r_s, the surface mixing ratio of water vapor and $\bar{p}$.