Problem Set #4 Meteo 300 Spring 2001

① Your radiance

a. $E = \epsilon \sigma T^4$ $\quad T = 98.6°F = 37°C = 310K$

$\sigma = 5.7 \times 10^{-8}\ W m^{-2} K^{-4}$

$\therefore E_{me} = 0.1 \cdot 5.7 \times 10^{-8} \cdot (310)^4$

$E_{me} = 53\ W m^{-2}$

b. $\lambda_m = \frac{2897}{T} = \frac{2897}{310} = 9.3\ \mu m$ infrared

c. Total radiant energy = E · Surface area

Surface area (cylinder) = 2m · (1.00 m around) = $2\ m^2$

$\therefore$ R.E. = 2 · 53 = 106 W

d. #people · R.E. · Δtime = $c_{pd} V \rho_{air} \Delta T$

$$\Delta T = \frac{\#people \cdot R.E. \cdot \Delta time}{c_{pd} V \rho_{air}}$$

= 150; RE = 110W Δtime = 3600 sec

$c_{pd} = 720\ J K^{-1} kg^{-1}$ $\rho_{air} \sim 1.2\ kg m^{-3}$

$V = 12 \times 8 \times 3 = 290\ m^3$

$$\therefore \Delta T = \frac{150 \cdot 106 \cdot 3600}{720 \cdot 290 \cdot 1.2} = 220 K\ !$$

What's going on?

- We neglected the walls, floor, and ceiling, which have greater heat capacities.
- Air & walls radiate back, thus reducing their T and increasing the people's.
- Other thermal exchange, like convection & conduction.