W05

Consider a circular terrace heater, which are used to warm persons sitting around it with the help of radiation, illustrated in figure 7. The heater hangs above the floor at a distance of 2 m, with a radius of 50 cm. The

Figure 7: Terrace heater

packaging states that it can radiate a surface area with a diameter of 4 m. Both the heater as the radiated surface can be considered as parallel planes. It is assumed that the heater has a surface temperature of 200 ^{o}C and transmits all of its energy as radiation. The surface on the ground is assumed to behave as a opaque surface, with an absorptivity of 0.7. The surrounding temperature is 12 ^{o}C.

a) Give a sketch of the two surfaces, their dimensions and their properties as stated in the introduction

b) Give values for the emissivity (ϵ), transmissivity (τ) and reflectivity (ρ) of surfaces 1 and 2

c) Determine the wavelength that holds the maximum power coming off of the heater, using Wien's displacement law.

d) Compute the **net** rate of heat transfer by radiation from the heater to the surface at the given temperatures

e) Based on the answer found in question d), how long will it take the bricks on the floor, which have a thickness of 3 cm and a specific heat of 840 [J/kgK] to heat up 1 ^{o}C?

f) Reflect on your given answer in question e). Is it realistic? What would change if instead of bricks we look at the persons sitting on the terrace?