7.6

A thin layer of Masonite (wood veneer) is attached to an insulating layer of glass wool. The Masonite is 2 mm thick and has the following properties.

$kw := 0.14 \qquad rho := 640\ \frac{kg}{m^3} \qquad cp := 2850\ \frac{J}{kgK} \qquad Tig := 300 + 273 \qquad dw := 0.002$

$Te := 25 + 273 \qquad qrad := 5 \cdot 10^4 \qquad he := 30 \qquad sig := 5.67 \cdot 10^{-8}$

a ) calculate the time to ignition for Masonite subject to a radiant flux of 50 kW/m^2.

invert eqn 7.27 in terms of tig

$$tig := \frac{(-rho \cdot cp \cdot dw) \cdot \ln\left[1 - \frac{he \cdot (Tig - Te)}{qrad}\right]}{he} \qquad tig = 21.927 \quad \text{seconds}$$

b ) calculate the minimum heat flux for ignition

eqn 7.29b

$$qcrit := he \cdot (Tig - Te) + sig \cdot \left(Tig^4 - Te^4\right) \qquad qcrit = 1.392 \times 10^4\ \frac{W}{m^2}$$

c ) after ignition, what is the initial upward spread rate if the flame heat flux is uniform at 30 kW/m^2 and the flame extends 0.2 m beyond the ignited region of 0.1 m?

really requires chp 8 knowledge and we use 8.6 $\qquad qf := 3 \cdot 10^4$

$$Vp := \frac{qf \cdot 0.2}{rho \cdot cp \cdot dw \cdot (Tig - Te)} \qquad Vp = 5.981 \times 10^{-3}\ \frac{m}{s}$$

the flame initially spreads at about 6 mm/s

$$qf \cdot 0.2 = 6 \times 10^3$$

$$rho \cdot cp \cdot dw \cdot (Tig - Te) = 1.003 \times 10^6$$