(a) EOM:

$$C_1\dot{T}_1 = A_1\sigma\varepsilon\left(T_R^4 - T_1^4\right) - h_1\left(A_s + A_1\right)\left(T_1 - T_a\right) - \frac{\left(T_1 - T_2\right)}{R_{12}}$$

$$C_2\dot{T}_2 = \frac{\left(T_1 - T_2\right)}{R_{12}} - h_2 A_s\left(T_2 - T_a\right)$$

(c) There are many correct answers. One possible solution:

a = 20 cm
b = 10 cm

Compute Biot number for this case:

Bi = 0.08.

Since Bi $\leq$ 0.10, the lumped capacitance assumption is justified.