Example

0.2 kg/s of hot oil (c_p = 2200 J/kg-°C) is to be cooled by water (c_p = 4180 J/kg-°C) in a 2-12 shell and tube HXR. The water flows through thin-walled tubes with a diameter of 1.8 cm at a rate of 0.1 kg/s. The length of each tube pass is 3 m and the overall heat transfer coefficient is 340 W/m²-°C. (Tube side or shell side? Does it matter?) The inlet temperatures of the oil and water are 160°C and 18°C, respectively.

(a) Find the rate of heat transfer in the exchanger and
(b) the exit temperatures of both fluids.