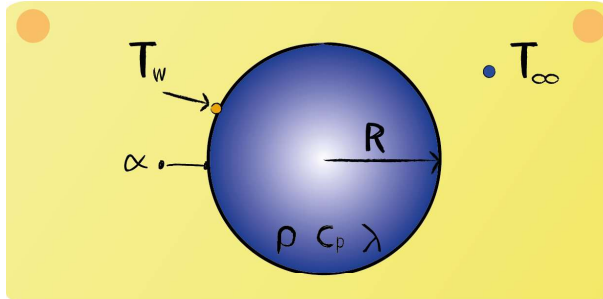# Lecture 14 - Question 12

Specify the energy balance to obtain the differential equation that expresses the change in temperature T_w of the cylinder over the course of time. Assume the process to be isobaric and the temperature to be homogeneous.

Energy balance:

$$\frac{dU}{dt} = -\dot{Q}_{out}$$

The heat transfer can be classified as transient, for that reason the change of internal energy over time equals the sum of the in and outgoing fluxes.

Change of internal energy over time:

$$\frac{dU}{dt} = \rho \cdot c_p \cdot \frac{4}{3} \cdot \pi \cdot R^3 \cdot \frac{dT_w}{dt}$$

The internal energy of the control volume can be described as: $U = m \cdot c_p \cdot T$.

Heat fluxes:

$$\dot{Q}_{out} = \alpha \cdot 4 \cdot \pi \cdot R^2 \cdot (T_w - T_\infty)$$