In the figure, the height of the water level, $h(t)$, in the cylinder starts at h_0 at time $t = 0$, and is recorded as a function of time as the water discharges through the artificial core sample. Show that the relationship between h and t is given by

$$\ln \frac{h_0 - h_b}{h - h_b} = \frac{k}{\mu} \frac{A}{A_r} \frac{\rho g t}{\Delta l} \frac{1}{1.01325 \cdot 10^6}, \qquad \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots (1)$$

where Δl is the length of the core. The expression is in Darcy units with the density ρ in g/cm^3 and 1 atmosphere is 101325 Pascal. How can this expression be used to measure the permeability k?