**1. Boat** ***(9 points)*** Consider a boat of effective mass $m$, which moves along the (horizontal) $x$-axes, and for which the friction force of the water is given by $F_f = -\alpha v$, where $v$ is the velocity of the boat. (Effective mass is somewhat larger than the real mass, because any change of the boat's velocity incurs a velocity change of those regions of water, which are close to the boat; hence, the boat's inertia is complemented by the inertia of the surrounding water.)

**i)** Prove that during this motion,

$$v + kx = \text{Const},$$

and find the factor $k$.

**ii)** Now, a boy of mass $M$ moves inside the boat, back and forth, with velocity $u(t)$ (also, along the $x$-axis). What term must be added to the conservation law $v + kx = \text{Const}$, to describe this situation?

**iii)** Now, let the boat rest initially close to the coast and ready to depart. The boy jumps from the coast into the boat, turns around and jumps back to the coast. The horizontal component of the boy's velocity during the first jump was $u_1$, and during the second jump $-u_2$. What is the maximum distance $s$ travelled by the boat? Neglect the effect of a vertical motion on the horizontal friction force of the water.