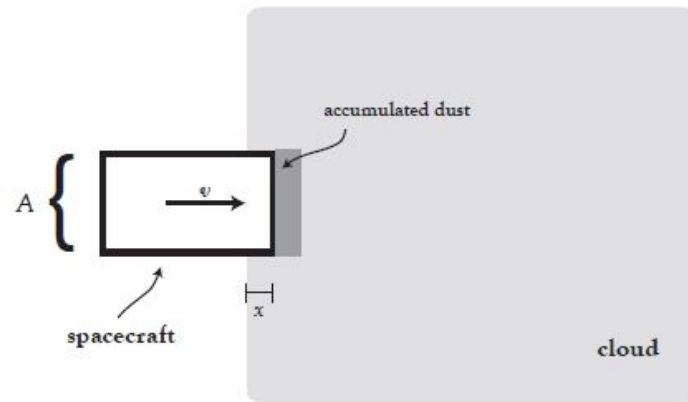**QP39**

A spacecraft of mass m_0 and cross sectional area A is moving at a constant velocity v_0 when it encounters a stationary cloud of dust of density ρ. Assume the dust sticks to the surface of the spacecraft and that A is constant over time.

a) (1 point) Will the total mechanical energy be conserved as the spacecraft moves through the cloud? Will the momentum? Explain why.

b) (1 point) Find an expression for the time rate $\frac{dm}{dt}$ at which the duct-covered spacecraft gains mass. Express your answer in terms of A, ρ and the velocity v of the spacecraft.

c) (2 point) Write down a first-order differential equation for $v(x)$. Solve it by integration.