



Initially the momentum of the system is zero. When air escapes through the opening in the balloon, it has some finite momentum. Conservation of momentum implies that the balloon must have some equal and opposite momentum so that the vector sum of the two momentums remains zero. Thus the balloon scoots across the fishing line.

The velocity of the balloon can be found as follows:

Since there is no external force on the balloon/air system the equation of motion is:

$$F = dP/dt = m(dv/dt) + v(dm/dt) = 0.$$

Considering dm/dt equal to a constant, α , then

$$dv/dt + (\alpha/m)v = 0.$$

Thus,

$$v = v_0 e^{-(\alpha/m)x}.$$