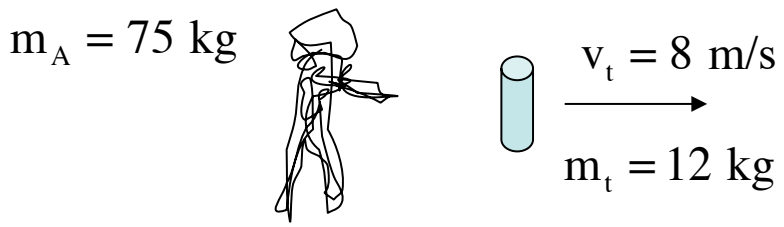
Problem 6.25

Astronaut carries 87 kg of total weight. She throws her 12 kg tank away with speed of 8 m/s.



a.) Determine the maximum distance she can be from space craft if she has to return in 2 minutes.

b.) Explain via Newton's laws.

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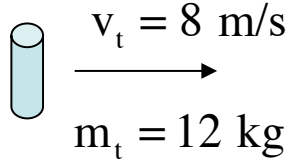


a.) Determine the maximum distance she can be from space craft if she has to return in 2 minutes.

The total momentum in the system to start with is zero, so that has to be the net, total momentum of the system throughout time (there are no external impulses acting to change the total momentum). As such, we can write:

$$\sum p_o + \sum F_{ext}\Delta t = \sum p_f$$

$$0 + 0 = -m_A v_{A,f} + m_t v_{t,f}$$

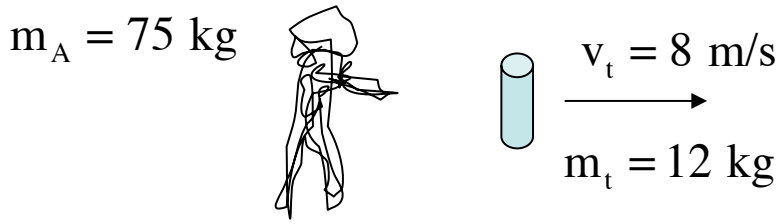
$$\Rightarrow \quad 0 = -(75\text{ kg})(v_{A,f}) + (12\text{ kg})(+8\text{ m/s})$$

$$\Rightarrow \quad v_{A,f} = 1.28\text{ m/s}$$

Traveling at 1.28 m/s for 120 seconds (2 minutes) means she can travel a distance of:

$$d = vt = (1.28\text{ m/s})(120\text{ sec}) = 153.6\text{ meters.}$$

b.) Explain via Newton's laws.



She applies a force to the tank that accelerates it to the right while it applies an equal and opposite force on her that accelerates her to the left. The forces are the same, but as the masses are different, the accelerations will be different and will be governed by F=ma.