Answer on Question #39567 – Physics – Other

Let M and m be the masses of Luke and c-3po respectively, v and w – velocities of Luke and c-3po after collision.

Darth Vader pushes Luke with 17N. According to the Newton's Second law:

$$F = Ma$$

$$M = \frac{F}{a} = \frac{17N}{\frac{11m}{s^2}} = \frac{17}{11}kg$$

According to the law of conservation of momentum:

$$Mv_0 = Mv + mw$$

where v_0 is the initial velocity of Luke.

Using the law of conservation of momentum:

$$\frac{Mv_0^2}{2} = \frac{Mv^2}{2} + \frac{mw^2}{2}$$

From the first equation we have

$$v = v_0 - \frac{m}{M}w$$

Supstitute it into the second equation:

$$\frac{Mv_0^2}{2} = \frac{M(v_0 - \frac{m}{M}w)^2}{2} + \frac{mw^2}{2}$$

$$\frac{Mv_0^2}{2} = \frac{Mv_0^2}{2} - \frac{2Mv_0\frac{m}{M}w}{2} + \frac{M\frac{m^2}{M^2}w^2}{2} + \frac{mw^2}{2}$$

$$0 = -v_0mw + \frac{m^2w^2}{2M} + \frac{mw^2}{2}$$

Divide the equation by m:

$$0 = -v_0w + \frac{mw^2}{2M} + \frac{w^2}{2}$$

$$m = \frac{2M}{w^2}\left(v_0w - \frac{w^2}{2}\right)$$

Substitute $M = \frac{17}{11}kg$, $w = 8m/s$ and $v_0 = v_0(t) = at = 11t$:

$$m = \frac{2 \cdot \frac{17}{11}}{64}\left(11t \cdot 8 - \frac{64}{2}\right) = \frac{17}{11 \cdot 32}(88t - 32) = 4.25t - \frac{17}{32}$$

So the mass of c-3po is $4.25t - \frac{17}{32}$. It depends how long (in seconds) Dart Vader applied his force.