a) $U = 2\frac{m_0 c^2}{\sqrt{1-\frac{v^2}{c^2}}} = 2mc^2 \overset{!}{=} M_0 c^2$

$\Rightarrow M_0 = 2m(v)$

b) erwarten: $\dot{v}_{sp} = \frac{2qE}{M_0} = \underline{\frac{q}{m_0} E \cdot \sqrt{1-\frac{v^2}{c^2}}}$ ✓

c) $\dot{v}_{sp} = \frac{d}{dt}\left(\frac{m_1 v_1 + m_2 v_2}{m_1 + m_2}\right) =$

$$= \frac{(m_1+m_2)\cdot(\dot{m}_1 v_1 + \dot{m}_2 v_2 + m_1 \dot{v}_1 + m_2 \dot{v}_2) - (m_1 v_1 + m_2 v_2)(\dot{m}_1 + \dot{m}_2)}{(m_1+m_2)^2}$$

$$= \underbrace{\frac{m_1 \dot{v}_1 + m_2 \dot{v}_2}{m_1+m_2}}_{\text{bei } t=0,\ m_1=m_2=m_0 \Rightarrow \frac{\dot{v}_2+\dot{v}_1}{2}} + \underbrace{\frac{\dot{m}_1 v_1 + \dot{m}_2 v_2}{m_1+m_2}}_{\circledast} - \underbrace{\frac{m_1 v_1 + m_2 v_2}{(m_1+m_2)^2}(\dot{m}_1+\dot{m}_2)}_{\text{bei } t=0 \to 0}$$

$\circledast$ bei $t=0$ mit $\dot{m}_1 = \frac{m_0}{\left(\sqrt{1-\frac{v^2}{c^2}}\right)^3}\frac{1}{c^2} v_1 \dot{v}_1$, m_2 = analog

$$\Rightarrow \frac{\dot{m}_1 v_1 + \dot{m}_2 v_2}{m_1+m_2} = \ldots = \frac{1}{2}\left(\frac{v_1^2}{c^2}\dot{v}_1 + \frac{v_2^2}{c^2}\dot{v}_2\right)\frac{1}{1-\frac{v^2}{c^2}}$$

$$\Longrightarrow \dot{v}_{sp} = \frac{\dot{v}_1+\dot{v}_2}{2} + \frac{1}{2}\left\{\frac{v_1^2}{c^2}\dot{v}_1 + \frac{v_2^2}{c^2}\dot{v}_2\right\}\frac{1}{1-\frac{v^2}{c^2}}$$

Es gilt: $v_1(t=0) = -v$; $v_2(t=0) = +v$; $\dot{v}_1(t=0) = \dot{v}_2(t=0) = \left(1-\frac{v^2}{c^2}\right)^{3/2}\frac{q}{m_0}E$

$$\Rightarrow \dot{v}_{sp} = \left(\frac{q}{m_0}E\right)\underbrace{\left(1+\frac{v^2/c^2}{1-v^2/c^2}\right)}_{1/1-\frac{v^2}{c^2}}\left(1-\frac{v^2}{c^2}\right)^{3/2} = \underline{\left(\frac{q}{m_0}E\right)\sqrt{1-\frac{v^2}{c^2}}}$$ ✓

d) nun spielt Veränderung von $m(v)$ keine Rolle mehr! Verwende:

$\left(\frac{d\vec{v}}{dt}\right)_\perp = \sqrt{1-\frac{v^2}{c^2}}\frac{q}{m_0}\vec{E}_\perp \Rightarrow \dot{v}_{sp} = \dot{v}_{1x} = \dot{v}_{2x} = \underline{\sqrt{1-\frac{v^2}{c^2}}\frac{q}{m_0}E}$ ✓