

## SPECIAL RELATIVITY HOMEWORK – WEEK 7

**Exercise 1.** *A particle starts out with an initial velocity in the  $x$  direction,  $\mathbf{v}_0 = (v_0, 0, 0)$ . The particle then undergoes a constant proper acceleration along the  $y$  axis, i.e. the 4-acceleration  $\alpha^\mu$  is in the  $(ty)$  plane, with constant magnitude  $\sqrt{\alpha_\mu \alpha^\mu} \equiv \alpha$ . Find the shape  $y(x)$  of the particle's trajectory through space.*

**Exercise 2.** *A particle at rest with mass  $M$  decays into two particles with masses  $m_1, m_2$ . Find the energy of each outgoing particle.*

**Exercise 3.** *A particle at rest with mass  $M$  decays into three particles with masses  $m_1, m_2, m_3$ . The distribution of energy-momentum among the outgoing particles is now no longer uniquely determined. In fact, different outcomes will occur probabilistically through quantum mechanics. Find the smallest possible energy and the largest possible energy of the particle with mass  $m_1$ .*