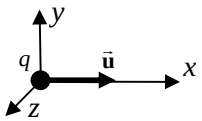
PHYS2100 Tutorial 2

Problem 2.1 Follow the way in which the transformation for B_2, B_3, and E_1 have been derived (see Lecture notes) and obtain transformations for B_1, E_2, E_3

Problem 2.2 Calculate the field created by an electrical charge moving with a constant velocity u (as shown in figure).



the

Problem 2.3.1. Prove that for any particle $\mathbf{P}^2 = m^2c^2$. This relation also holds for photons.

Problem 2.3.2. Elastic collisions preserve the rest masses of all involved particles. Prove that for elastic collisions $\mathbf{P}_b{}^2 = \mathbf{P}_a{}^2$, where *a* and *b* refer to "before collision" and "after collision", holds for any involved particle.

Problem 2.3.3. Prove that if two particles collide elastically then $\mathbf{P}_{b1} \cdot \mathbf{P}_{b2} = \mathbf{P}_{a1} \cdot \mathbf{P}_{a2}$.

Problem 2.3.4. Prove that the relative velocity of two elastically colliding particles does not change after collision.

Problem 2.4. A particle of mass M_b splits at rest in two parts one of which is a light article of mass $m \ll M_b$ and the second part is a heavy particle of mass M_a. The light particle moves with a relativistic velocity υ. The massive part moves with velocity $u \ll c$ and $u \ll \upsilon$. All velocities are in the reference frame where the original particle was at rest.

Prove that the classical momentum conservation law in the form $\Delta M \upsilon + M_a u = 0$, $\Delta M = M_b - M_a$ holds for any value of υ (even for $\upsilon \approx c$).