Consider the product of the speed of light and the proper time: $c\,d\tau$.

Is this quantity invariant?

A. Yes
B. No
C. I don't know how to tell

Is this "4-velocity" a contravariant 4-vector?

$$\eta^\mu \equiv \frac{dx^\mu}{d\tau}$$

A. Yes

B. No

C. I don't know how to tell

What is $\dfrac{dt}{d\tau}$?

A. γ
B. $1/\gamma$
C. γ^2
D. $1/\gamma^2$
E. Something else

With $\eta^0 = c\gamma$ and $\vec{\eta} = \gamma\vec{u}$, what is the square of η?

$$\eta^2 \equiv \eta \cdot \eta = \eta_\mu \eta^\mu$$

A. c^2
B. u^2
C. -c^2
D. -u^2
E. Something else

The momentum vector $\vec{p}$ is given by,

$$\vec{p} = \frac{m\vec{u}}{\sqrt{1 - u^2/c^2}}$$

What is $|\vec{p}|$ as u approaches zero?

A. zero
B. $m\,u$
C. $m\,c$
D. Something else

Are energy and rest mass Lorentz invariants?

A. Both energy and mass are invariants
B. Only energy is an invariant
C. Only rest mass is an invariant
D. Neither energy or mass are invariants

$$E - E_{rest} = (\gamma - 1)mc^2$$

What happens to the difference in the total and rest energies when the particle speed (u) is much smaller than c?

A. It goes to zero
B. It goes to $m\,c^2$
C. It goes to $1/2\,m\,u^2$
D. It depends

What's $p_\mu p^\mu$?

A. γmc^2

B. $-\gamma mc^2$

C. mc^2

D. $-mc^2$

E. Something else

E_{tot} is conserved but not invariant. What does that mean?

A. It's the same at any time in every reference frame.
B. It's the same at a given time in every reference frame.
C. It's the same at any time in a given reference frame.
D. Something else

m is invariant but not conserved. What does that mean?

A. It's the same at any time in every reference frame.
B. It's the same at a given time in every reference frame.
C. It's the same at any time in a given reference frame.
D. Something else

Charge is invariant and conserved. What does that mean?

A. It's the same at any time in every reference frame.
B. It's the same at a given time in every reference frame.
C. It's the same at any time in a given reference frame.
D. Something else