Ques2. $\boxed{E=mc^2}$

einstien mass energy equation.

→ Suppose a force 'f' is acting on a body of 'm' in the same directio as its velocity 'v'.

$F \longrightarrow \bullet\, m \longrightarrow v$

The Gain in Kinetic energy in the Body is in the form of workdon

→ ~~If a force (F)~~ $dW = dK = F \cdot ds$ —(1)

Acc. to newton's law of motion

$$f = \frac{dp}{dt} = \frac{d(mv)}{dt}$$

$$f = \cancel{d(mv)}\ \frac{m\,dv}{dt} + \frac{v\,dm}{dt}$$

Multiply ds on Both sides

$$f \cdot ds = \frac{m\,ds}{dt} \cdot dv + v\frac{ds}{dt} \cdot dm$$

from eq (1) —

$$dK = mv\,dv + v^2 dm \quad \text{— (2)}$$

$$(ds/dt = v)$$

→ from Lorentz. Transformation

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

differentiating -

$$dm = m_0 \left(\frac{-1}{2}\right)\left(1 - \frac{v^2}{c^2}\right)^{-3/2}\left(\frac{-2v}{c^2}\right)dv$$

$$= \frac{m_0 v\,dv}{c^2\left(1 - \frac{v^2}{c^2}\right)^{3/2}} \Rightarrow dm = \frac{mv\,dv}{c^2\left(1 - \frac{v^2}{c^2}\right)}$$

$$\boxed{dm(c^2 - v^2) = mv\,dv} \quad \text{— (3)}$$

Put in eq (2)

$$dK = (c^2 - v^2)dm + v^2 dm = c^2 dm$$

$$\int_0^K dK = \int_0^{\infty} c^2 dm$$

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$K = c^2 (m - m_0) = c^2 (\Delta m)$

$E = (m - m_0) c^2 + m_0 c^2 = mc^2.$

$$\boxed{E = mc^2}$$