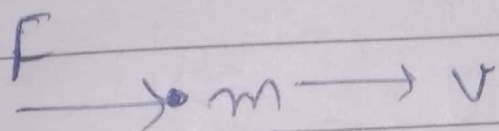


Ques 2.

$$E = mc^2$$

Einstein mass energy equation

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



The gain in kinetic energy in the body is in the form of work done

→ ~~if a force~~ $dw = dk = f \cdot ds$ — (1)

Acc. to Newton's law of motion

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

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

Multiply ds on Both sides

$$F \cdot ds = \frac{m ds}{dt} \cdot dt + v \frac{ds}{dt} \cdot dm$$

from eq (1) -

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

$$\left(\frac{ds}{dt} = v \right)$$

→ from Lorentz Transformation

$$m = m_0$$

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

differentiating -

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

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

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

$$\boxed{dm(c^2 - v^2) = m_0 v dv}$$

Put in eq (2) --- (3)

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

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

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

$$E = (m - m_0)c^2 + m_0c^2 = mc^2.$$

$$E = mc^2$$