$$= \frac{d}{dt}(mv)\,v\,dt = v\,d(mv)$$

$$= v(v\,dm + m\,dv)$$

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

Using equation (1)

$$= c^2 dm$$

or

$$dm = \frac{dk}{c^2} \;, \quad dk = c^2 dm \qquad \text{———— (3)}$$

Suppose the particle is initially at rest and that time its mass m_0, After the application of force F, its mass become say, m, Then total Kinetic Energy is given by

$$K = \int dk = \int_{m_0}^{m} c^2 dm = (m - m_0)c^2$$

$$K = mc^2 - m_0c^2$$

$$K + m_0c^2 = mc^2 \qquad \text{———— (4)}$$

Let E be the total Energy, that is the Sum of kinetic Energy and rest mass Energy

$$E = K + m_0c^2$$

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

③ Look back at eqn, and rewrite eqn:

$$m_m = m_r\left(1 + \frac{v^2}{2c^2}\right)$$

$$= m_r + m_r\frac{v^2}{2c^2}$$

m_m = total mass
= rest mass + relative mass.
m_r = rest mass.

Subtract M_r from both sides, and let relative mass = m

∴ Since $M_m - M_r = m$

$$m = m_r\frac{v^2}{2c^2}$$

$$= \frac{\left(\frac{1}{2}m_r v^2\right)}{c^2}$$

④ Remember kinetic energy = $\frac{1}{2}mv^2$, where $m = m_r$ in this case ?

$$\therefore m = \frac{e}{c^2}$$

⑤ Rearrange to give: $\underline{\underline{e = mc^2}}$//

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