PH-105 Assignment Sheet - 1

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15. **A particle of rest mass m_0 has energy $4m_0c^2$. Find the momentum in the units of m_0c. What is the energy of the particle in a frame in which its momentum is $2m_0c$?**

Solution :
We have the relation :

$$E^2 = p^2c^2 + m_0^2c^4$$

where E = energy of particle as observed in given frame,
p = momentum of particle as observed in same frame

Putting $E = 4m_0c^2$, we get $16m_0^2c^4 = p^2c^2 + m_0^2c^4$, solving which we obtain $p = \sqrt{15}m_0c$.

In a frame where observed momentum is $2m_0c$, we get

$E^2 = 4m_0^2c^4 + m_0^2c^4 = 5m_0^2c^4$
Hence, $E = \sqrt{5}m_0c^2$.