Class Test

(STR-Mass Energy Equivalence & Four Vectors)

Q1. According to the special theory of relativity, the speed v of a free particle of mass m and total energy $E = 2mc^2$ is:

(a) $\frac{\sqrt{3}}{2}c$ (b) $\frac{1}{2}c$ (c) $\frac{\sqrt{5}}{4}c$ (d) $\frac{1}{4}c$

Q2. The muon has rest mass $105MeV/c^2$ and mean life time $2\mu s$ in its rest frame. The mean time traversed by a muon of energy $210MeV$ before decaying is approximately:

(a) $2\mu s$ (b) $3\mu s$ (c) $4\mu s$ (d) $6\mu s$

Q3. A particle of mass M decays at rest into a massless particle and another particle of mass $\frac{M}{2}$. The magnitude of the momentum of each of these relativistic particles is:

(a) $\frac{\sqrt{3}}{2}Mc$ (b) $\frac{\sqrt{3}}{4}Mc$ (c) $\frac{\sqrt{3}}{8}Mc$ (d) $\sqrt{3}Mc$

Q4 A particle of rest mass m_0 whose total energy is twice the rest mass energy collide with identical particle at rest. If the stick together and make a composite mass. Find the rest mass of composite mass .

(a) $2m_0$ (b) $4m_0$ (c) $\sqrt{3}m_0$ (d) $\sqrt{6}m_0$

Q5. From the S frame total energy and momentum is given by E and $\vec{p} = (p_x, p_y, p_z)$ respectively. If another frame S' is moving with velocity $v\hat{j}$ then Total energy from S' frame is

(a) $E' = \frac{E - vp_x}{\sqrt{1 - \frac{v^2}{c^2}}}$ (b) $E' = \frac{E + vp_x}{\sqrt{1 - \frac{v^2}{c^2}}}$ (c) $E' = \frac{E - vp_y}{\sqrt{1 - \frac{v^2}{c^2}}}$ (d) $E' = \frac{E + vp_y}{\sqrt{1 - \frac{v^2}{c^2}}}$

Q6. A relativistic particle of mass m and charge e is moving in a uniform electric field of strength ε. Starting from rest at $t = 0$, how much time will it take to reach the speed $\frac{c}{2}$?

(a) $\frac{1}{\sqrt{3}}\frac{mc}{e\varepsilon}$ (b) $\frac{mc}{e\varepsilon}$ (c) $\sqrt{2}\frac{mc}{e\varepsilon}$ (d) $\sqrt{\frac{3}{2}}\frac{mc}{e\varepsilon}$

Q7. The light source is moving towards observer with velocity $\frac{\sqrt{3}}{2}c$ at angle $\theta = 30^0$. If ν_0 is frequency at rest frame of source. The frequency measured by observer is

(a) ν_0 (b) $1.5\nu_0$ (c) $2\nu_0$ (d) $3\nu_0$

Q8. If x', t' is position and time measured from S' frame and x, t are measured from S frame if origin of S' moving with respect to S frame . if $\beta = \frac{v}{c}$ Then $\frac{\text{one } x' \text{ unit}}{\text{one } x \text{ unit}}$ given by

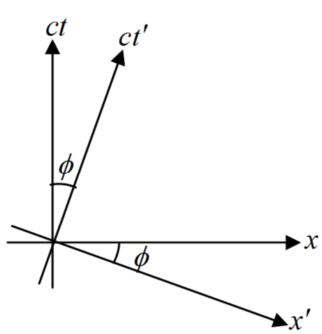
(a) 1 (b) β (c) $\sqrt{\frac{1+\beta^2}{1-\beta^2}}$ (c) $\sqrt{\frac{1-\beta^2}{1+\beta^2}}$

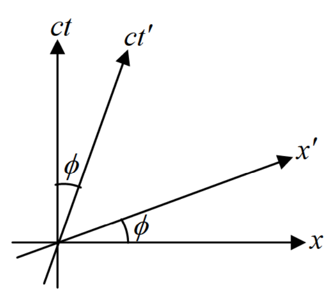
Q9. If $\vec{A} = (A_0, A_1, A_2, A_3), \vec{B} = (B_0, B_1, B_2, B_3)$ are four vectors the inner product $\vec{A}.\vec{B}$ is defined as

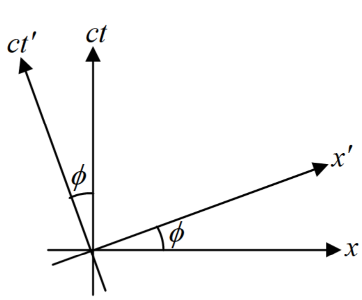
(a) $\vec{A}.\vec{B} = A_0B_0 + A_1B_1 + A_2B_2 + A_3B_3$ (b) $\vec{A}.\vec{B} = A_0B_0 - A_1B_1 - A_2B_2 - A_3B_3$

(c) $\vec{A}.\vec{B} = -A_0B_0 - A_1B_1 - A_2B_2 - A_3B_3$ (d) $\vec{A}.\vec{B} = -A_0B_0 + A_1B_1 - A_2B_2 + A_3B_3$

Q10. An inertial frame K' moves with a constant speed v with respect to another inertial frame K along their common x - direction. Let (x, ct) and (x', ct') denote the space-time coordinates in the frames K and K', respectively. Which of the following space-time diagrams correctly describes the t' - axis $(x' = 0 \text{ line})$ and the x' - axis $(t' = 0 \text{ line})$ in the x-ct plane? (In the following figures $\tan\phi = v/c$)

(a)


(c)


(c)


(d)