Physics
Theory Part 13

Topics: Quantum Physics/ Special Theory Of Relativity

Course: B.Sc/ Physics

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MCQ on Special Theory of Relativity (STR)

40) What does Faraday's Law of EM Induction describe?

a) A steady current producing a magnetic field

b) A changing B field producing an E field ☑ → $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$ & $\mathcal{E} = -\frac{\partial \phi_B}{\partial t}$

c) " " E " " a B "

41) Maxwell's Hypothesis contributed which of the following points

a) A steady electric current produces a magnetic field

b) A changing B field produces an E field ☑ $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$

c) A " E " " " B "

42) The amplitude of the E field oscillations in an EM wave travelling in air is 40 N/C. What is the amplitude of B field.

Ans. We know that velocity of light (EM) wave is, $C = |E_0|/|B_0|$

or, $|B_0| = \frac{|E_0|}{C} = \frac{40\ N/C}{3 \times 10^8\ m/s} = \boxed{13.33 \times 10^{-8}\ T}$

43) Which of the following are basic postulates of Special Relativity Theory (more than one correct choice possible)

a) Nothing can travel faster than the speed of light. ☑

b) No material object can be accelerated to the " " " ☑

c) The speed of light is the same for all observers ☑

d) The laws of physics are the " " " reference frames.

e) " " " " " " in " inertial ref. frames. ☑

45) You are moving at a speed 2/3 c towards Randy when he shines a light toward you. At what speed do you see the light approaching you?

a) 1/3 c | b) 2/3 c | c) 4/3 c | d) c ☑ since velocity of light is same for all observer. It can't change.

44) A spaceship travelling at constant velocity passes by Earth and later passes by Mars. In which ref. frame, the amount of time separating these two events the proper time?

a) the Earth frame of reference

b) " Mars " " "

c) " spaceship " " " ☑

d) any inertial " " "

e) any frame of reference, inertial or not.

Since proper time between two events is measured in the reference frame that the two events occur at the same location (same coordinates in the ref. frame) the space-ship is the correct answer.

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$\vec{L}$ & $\vec{S}$ coupling

$\vec{J} = \vec{L} + \vec{S}$ where $\vec{J} = \sum_i \vec{j}_i$

$\vec{L} = \sum_i \vec{l}_i$

$\vec{S} = \sum_i \vec{s}_i$

or, $J^2 = L^2 + S^2 + 2\vec{L}\cdot\vec{S}$

or, $\vec{L}\cdot\vec{S} = \dfrac{J^2 - L^2 - S^2}{2}$

Given term $\boxed{{}^2D_{3/2}}$: ~~$l = D = 2$~~, ~~$j = 3/2$~~, ~~$s = \frac{1}{2}$~~

${}^{2S+1}L_J$ $\therefore$ $S = \frac{1}{2}$

$L = 2$

$J = 3/2$

$$\therefore \vec{L}\cdot\vec{S} = \frac{\left(\frac{3}{2}\right)^2 - 2^2 - \left(\frac{1}{2}\right)^2}{2} = \frac{\frac{9}{4} - \frac{1}{4} - 4}{2}$$

$$= \frac{2-4}{2} = -2\hbar$$

$$\therefore \boxed{\vec{L}\cdot\vec{S} = -2\hbar}$$

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