2023-2학기 전자기파와 광학 HW8, Due: 11:59 pm Dec. 6 (eTL upload)

Fine name: NAME_ID_HW#, e.g. 홍길동_20230101_HW#

1. **Griffiths example 12.6. 예제 아래에 Einstein velocity addition rule 이 있습니다 (아래 수식). 본 예제를 풀고, 아래 수식을 유도해 보세요.**

$$v_{AC} = \frac{v_{AB} + v_{BC}}{1 + (v_{AB}v_{BC}/c^2)}.$$

2. **Griffiths problem 12.18**

Problem 12.18

(a) Write out the matrix that describes a *Galilean* transformation (Eq. 12.12).

(b) Write out the matrix describing a Lorentz transformation along the y axis.

(c) Find the matrix describing a Lorentz transformation with velocity v along the x axis followed by a Lorentz transformation with velocity $\bar{v}$ along the y axis. Does it matter in what order the transformations are carried out?

3. **Griffiths problem 12.23**

Problem 12.23 Inertial system $\bar{\mathcal{S}}$ moves in the x direction at speed $\frac{3}{5}c$ relative to system $\mathcal{S}$. (The $\bar{x}$ axis slides long the x axis, and the origins coincide at $t = \bar{t} = 0$, as usual.)

(a) On graph paper set up a Cartesian coordinate system with axes ct and x. Carefully draw in lines representing $\bar{x} = -3, -2, -1, 0, 1, 2,$ and 3. Also draw in the lines corresponding to $c\bar{t} = -3, -2, -1, 0, 1, 2,$ and 3. Label your lines clearly.

(b) In $\bar{\mathcal{S}}$, a free particle is observed to travel from the point $\bar{x} = -2$ at time $c\bar{t} = -2$ to the point $\bar{x} = 2$ at $c\bar{t} = +3$. Indicate this displacement on your graph. From the slope of this line, determine the particle's speed in $\mathcal{S}$.

(c) Use the velocity addition rule to determine the velocity in $\mathcal{S}$ algebraically, and check that your answer is consistent with the graphical solution in (b).

4. **Griffiths example 12.9. Compton scattering. 본 문제는 수업시간에 미처 다루지 못한 예제입니다. 상세한 수식전개를 하여 문제를 다시 풀어보세요. 유도과정을 상세히 보이시기 바랍니다.**

5. **Griffiths example 12.13. 본 문제는 수업시간에 미처 다루지 못한 예제입니다. 상세한 수식전개를 하여 문제를 다시 풀어보세요. 유도과정을 상세히 보이시기 바랍니다.**

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6. **Griffiths Chap. 12.3.1 Magnetism as a relativistic phenomenon (pp.550-552)를 읽고 eq. 12.86 을 유도해 보세요. 유도과정을 상세히 보이기시 바랍니다.**

$$F = -qu\left(\frac{\mu_0 I}{2\pi s}\right). \qquad (12.86)$$

7. **Griffiths example 12.14. 본 문제는 수업시간에 미처 다루지 못한 예제입니다. 상세한 수식 전개를 하여 문제를 다시 풀어보세요. 유도과정을 상세히 보이시기 바랍니다.**

8. **In class, we learned how to calculate $F^{\mu\nu}, F_{\mu\nu}, G^{\mu\nu}, G_{\mu\nu}$ in a tensor form. Fill out all the components. You need to do explicit calculations.**