Set #9 - for Tuesday June 3

Read

	RHK	Ch. 20	Ohanian	Ch. 2
	K&K	Ch. 13, 14	Feynman Vol. I,	Ch. 16, 17

Solve

From K&K	**Ch. 12**	Problem 12.7
	Ch. 13	Problems 13.2, 13.4, 13.5, 13.7
	Ch. 14	Problems 14.1, 14.2, 14.4
From Ohanian	**Ch. 2**	Problem 36

Problem 1. A particle of mass m whose total energy is twice its rest energy collides with an identical particle at rest. If they stick together, what is the mass of the resulting composite particle? What is its velocity?

Problem 2. A spaceman with 50 years to live wants to visit the large Magellanic cloud, which is $160{,}000$ light-years away. If his mass is M, what kinetic energy does he need assuming he travels at constant speed u ? What is his speed?

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Problem 3. A physics student is arrested for going through a red light. In court, he pleads that he approached the light at such a speed that the red light appeared green to him. The judge changes the accused crime to speeding and fines the student one dollar for every kilometer per hour by which he exceeded the speed limit of $50\ \mathrm{km/h}$. What is the fine? The wavelength of green light is $5.3 \times 10^{-7}\ \mathrm{m}$, while that of red light is $6.5 \times 10^{-7}\ \mathrm{m}$ (Read pages 477, 478 in K&K.)

Extra Credit 1. Use expression for 4-velcoty w^μ you obtained in Homework #8 to show that 4-acceleration a^μ is orthogonal to the 4-vlocity $w^\mu a_\mu$. The vector of 4-acceleration is defined as $a^\mu = \mathrm{d}w^\mu/\mathrm{d}\tau$, where τ is the proper time.

Extra Credit 2. Show that components of 4-acceleration are:

$$a^\mu = \gamma\left(c\frac{d\gamma}{dt}, \frac{d\gamma}{dt}\vec{v} + \gamma\frac{d\vec{v}}{dt}\right),$$

where $\vec{v}$ is the physical velocity. Show that in the instantaneous rest frame of the particle $a^\mu = (0, a_x, a_y, a_z)$, where (a_x, a_y, a_z) is the physical acceleration. Explain why could you conclude that a^μ is a spacelike 4-vector in all frames.

Good Luck, Dr. B