Homework 3 Due April 4   there are a total of 140 points – we are 2 weeks behind because of the snow and the spring break so this is homework is longer than usual and covers some stuff 3 weeks old.

The FMC refers to the text and the problems are on pg 210-211 and pg 273

1. FMC Q7.10 – there are 2 parts each 10 pts (see pg 195 of text). For the second part a 2-3 sentence answer is sufficient.

2 Michelson–Morley experiment 2 parts each 10 points
(a) Describe the Michaelson-Morley experiment, explaining its goal and how the apparatus was set up to make the needed measurements. Explain in what sense the original experiment was a "failure" and how this "failure" was important to the development of new hypotheses concerning light and motion.
 (b) The M-M experiment shows that the time it takes the photon to go along the two arms of the interferometer are equal at all times How can this be ?
Show that the result of the experiment is consistent with a contraction of the arm aligned with the direction of the earth motion by a factor
$\gamma = 1/\mathrm{sqrt}(1 - v^2/c^2)$ (this means that the length after contraction is
$L = L_0/\gamma < L_0$) if one uses Galilean relativity to calculate the velocities with respect to the 'ether'.
To solve this problem you need to know the time it takes for the photon to go back and forth on the arm perpendicular to the earths motion . Use the text on pg 187 eqs 7.2-7.4 where it shows that it takes a time $t_B = 2\gamma L_0/c$. (e.g $\Delta t_b = 2L/c$)

3 Special Relativity 35 points parts a-c 5 points each c and d 10 points
Answer concisely the following questions:
(a) What are the two postulates of special relativity?
(b) What are the basic consequences of special relativity regarding space and time?
(c) Why the speed of light regarded as the maximum speed that any object can reach?
(d) How can a muon created in the upper atmosphere, that has 1.5 microseconds lifetime in its own frame of reference, can reach the ground? Answer considering the point of view
of an observer on earth.
(e) Answer question (d) considering the point of view of the muon. (very similar to one of the questions on the mid-term)

4. FMC Q7.11 10 points – give examples of the expected effects on ordinary activities.
5. FMC Q7.3   15 points
6. Black holes [40pts]
    a. FMC Q9.1 [20pts]
    b. FMC Q9.3 [10 pts]
    c. Describe the difference between a Schwarzschild and a Kerr black hole [10pts]