Problem Set 1

(due: in-class on Monday, April 24, 2006)

Do the following problems from *Introduction to Cosmology*, Barbara Ryden, Addison-Wesley:

Chapter 2: Problems 2.2, 2.4, 2.5

Chapter 3: Problems 3.2, 3.3, 3.4, 3.5

Chapter 4: Problems 4.1, 4.2, 4.3, 4.5

Extra Credit Problem:
Consider the following problem in Special Relativity:

Let observer O' move with speed v in the x-direction relative to observer O. Let a photon have frequency v (energy $E = hv$) in frame O and move at an angle θ with respect to the x axis of O.

(a) Show that its frequency in O' is
$$v' / v = (1 - v/c \cos\theta) / \sqrt{(1 - (v/c)^2)}.$$

(b) Even when the motion of the photon is perpendicular to the x axis ($\theta = \pi/2$) there is a frequency shift. This is the *transverse Doppler shift*, and arises because of the time dilation. At what angle θ does the photon have to move so that there is no Doppler shift between O and O'?