ADVANCED DYNAMICS — PHY–4241/5227

HOMEWORK 7

(February 16, 2004)

Due Monday, February 23, 2004 (late afternoon)

PROBLEM 17

Let (in unspecified units)

$$(a)\ \ ct = 5,\ x^1 = 1,\ x^2 = 2,\ x^3 = 3$$

$$(b)\ \ ct = 5,\ x_1 = 1,\ x^2 = 2,\ x^3 = 3$$

$$(c)\ \ ct = 5,\ x^1 = 1,\ x^2 = 2,\ x^3 = -3$$

$$(d)\ \ ct = 5,\ x^1 = 0,\ x^2 = 3,\ x^3 = 4$$

$$(e)\ \ ct = 5,\ x_1 = 0,\ x_2 = 3,\ x_3 = 4$$

$$(f)\ \ ct = 5,\ x^1 = 2,\ x^2 = 3,\ x^3 = 4$$

$$(g)\ \ ct = 5,\ x^1 = 0,\ x^2 = 3,\ x^3 = -4$$

and calculate $x^\alpha\, x_\alpha$ for each case.

PROBLEM 18

Assume that a rocket ship leaves the earth in the year 2020. One of a set of twins born in 2000 remains on earth; the other rides in the rocket. The rocket ship is so constructed that it has an acceleration g in its own frame (to make the occupants feel comfortable). It accelerates on a straight-line path for 5 years (by its own clocks), decelerates at the same rate for 5 more years, turns around, accelerates for 5 years, decelerates for 5 years, and lands on earth. The twin in the rocket is 40 years old. What year is on earth?

Use $g = 9.81\ [m/s^2]$, one year $= 365 \times 24 \times 3600\ [s]$, and the speed of light c as given in the script. (Hint: Find first $\zeta(\tau)$, where τ is the proper time of twin # 2 in the rocket and ζ is the rapidity of the spaceship with respect to our solar system.)