

ADVANCED DYNAMICS — PHY 4241/5227

HOME AND CLASS WORK – SET 10

(April 11, 2011)

(31) The matrix  $L$  is defined by

$$L = \begin{pmatrix} l^0_0 & l^0_1 & l^0_2 & l^0_3 \\ l^1_0 & l^1_1 & l^1_2 & l^1_3 \\ l^2_0 & l^2_1 & l^2_2 & l^2_3 \\ l^3_0 & l^3_1 & l^3_2 & l^3_3 \end{pmatrix}$$

1. Calculate  $-g L$  (2 points).
2. Write down the transpose matrix  $\tilde{L}$  (2 points).
3. Calculate  $\tilde{L} g$  (2 points).
4. Compare 1. and 3. to find the general form of  $L$  (*i.e.* after using  $\tilde{L} g = -g L$ , 4 points).
5. Obtain the same result by discussing the elements of the equation  $g^{\alpha\beta} \tilde{l}_\beta^\gamma g_{\gamma\delta} = -l^\alpha_\delta$  (4 extra points. Hint: Do the contractions first.)

Due Wednesday, April 13, before class.

(32) In the following  $K_1$  and  $S_3$  are generators as defined in class.

1. Calculate  $\exp(-\zeta K_1)$  and explain its physical meaning (3 points).
2. Calculate  $\exp(-\phi S_3)$  and explain its physical meaning (3 points).

Due in class.

(33) Consider the spaceship journey again and plot versus the proper time  $\tau$  the following quantities (NOT required solution posted):

1. The time on earth at which the spaceship, seen from earth, is at its position at time  $\tau$ .
2. The distance from earth as seen from earth.
3. The date of news received from earth, which is transmitted at the speed of light.